



Recommendation WG 3.93.040

EARTH STATION ANTENNA PATTERN

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RECOMMENDATION

Subject Area: Coordination Procedures

Title: Earth Station Antenna Pattern

Synopsis

This recommendation provides guidelines under which earth station antenna pattern data is employed in the frequency coordination process.

Background

The basic goal of frequency coordination is to enable the construction of new radio facilities with reasonable assurances of avoiding excessive interference, either suffered or caused by the new facility and involving other previously licensed or coordinated facilities. The prior coordination notification-and-response process represents an analytical attempt to control the predictable levels of interference.

Unfortunately the earth station antenna patterns do not have FCC numbers assigned to them. In addition the FCC files on this matter are less than adequate. NSMA Working Group 16 has found that inconsistent earth station antenna pattern data has been supplied by the antenna manufacturers and different interpretation and use of this data by frequency coordination's has occurred.

Antenna pattern data presently provided by the antenna manufacturers consists of the following:

- Radiation Pattern Envelope (RPE)
- Measured Antenna Patterns
- Antenna Specification Sheets
- Computer Generated Patterns

Sometimes the data supplied by the antenna manufacturer is not consistent when more than one of the above items is supplied.

A brief review of each information sheet follows:

- Radiation Pattern
- Envelope

A typical Radiation Pattern Envelope for earth station antennas consists of the compilation of measured data from the following 6 measurements (example for 4 GHz).

| Frequency MHz | Polarization |
|------------------|--------------|
| 3700 | Vertical |
| 3700 | Horizontal |
| 3950 | Vertical |
| 3950 | Horizontal |
| 4200 | Vertical |
| 4200 | Horizontal |

The antenna manufactures interpret Part 25.209(2) of the FCC rules and present the RPE which they guarantee that their antenna meets.

(2) In all other directions:

Outside the main beam, the gain of the antenna shall lie below the envelope defined by:

$$32-25 \log_{10}(\theta) \text{ dBi } 1^\circ < \theta < 48^\circ$$

$$-10 \text{ dBi } 48^\circ < \theta \leq 180^\circ$$

where θ is the angle in degrees from the axis of the main lobe, and dBi refers to dB relative to an isotropic radiator. For the purposes of this section, the peak gain of an individual sidelobe may be reduced by averaging its peak level with the peaks of the nearest sidelobes on either side, or with the peaks of two nearest sidelobes on either side, provided that the level of no individual sidelobe exceeds the gain envelope given above by more than 6 dB.

Although there may be differences in the actual averaging by the different manufacturers since they guarantee this RPE, this appears to be the best information available to the frequency coordinators.

Measured Antenna Pattern Data

The measured antenna data is supplied on some antenna 's. At times the measured data consists of the 6 radiation tests and on other occasions a manufacturer may only supply one measured pattern. How the different frequency coordinators handle this data may vary.

Antenna Specification Sheets

This data is supplied by the antenna manufacturer to present mechanical and electrical characteristics of the antenna system. On some occasions this data is more conservative than either the RPE or the measurement data. Since this is what the antenna manufacturer guarantees then the frequency coordinators should use this information which usually corresponds to the FCC rules stated in section 25.209(2).

Computer Generated Patterns

In previous meetings with the antenna manufacturers it was agreed that the computer generated pattern should not be used for the following reasons:

- The computer generated pattern is overly optimistic and could be used to the earth stations advantage to clear difficult cases. Measured data has been compared to computer generated patterns where computer generated data was as much as 20 dB better than the actual data.
- The use of the computer generated data severely penalizes the earth station owner in the 4 GHz frequency range when a pattern is coordinated with a -40 dBi gain at some discrimination angles where he

could be protected to a -10 dBi level. This also could hinder the earth station uplink if in the future a terrestrial path is engineered based on a -40 dBi gain when actually the antenna only has a -20 dBi gain in the direction of new terrestrial station.

- Some computer generated patterns state that the pattern is $29-25 \log \theta$ from 1 to 92 degrees without any apparent justification.

Recommendation

When analyzing or coordinating earth station locations, the antenna pattern used should be as follows:

1. The measured Radiation Pattern Envelope provided by the antenna manufacturer and on file with the FCC is the preferred pattern.
2. If the measured RPE is not on file with the FCC, the FCC reference pattern $32-25 \log \theta$ from 1 to 48° and -10 dB from 48° to 180° or the antenna manufacturer's specification sheet is to be used.
3. The actual measured antenna data supplied by the antenna manufacturer can be used when this data is satisfactory to all involved parties.
4. The computer generated pattern is not to be used in the frequency coordination process.

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