Recommendation SFCG 32-1

METHODOLOGY FOR THE COMPUTATION OF AGGREGATE INTERFERENCE FROM THE HIGH DENSITY FIXED SERVICE (HDFS) TO A DEEP-SPACE EARTH STATION IN 37-38 GHZ BAND

The SFCG

CONSIDERING

a) that there are only a limited number of deep space earth stations in operation worldwide;

b) that large number of HDFS transmitters around a deep space earth station make the computation of the interference from the HDFS transmitters to the earth station extremely difficult;

c) that HDFS transmitters close to each other have highly correlated propagation path losses in the direction of a deep space earth station and HDFS transmitters far away from each other have independent propagation statistics in the direction of the earth station;

d) that the use of aggregate EIRP (AEIRP), which groups HDFS transmitters in a geographical area, with highly correlated propagation statistic, as a single transmitter greatly simplifies the computation of the HDFS interference to deep space earth stations;

NOTING

a) that the Radio Regulations have allocated the 37-38 GHz band to space research service (SRS) as primary;

b) that the Radio Regulations have also allocated the 37-38 GHz band to fixed service (FS), as primary, making the band available for HDFS deployment;

c) that Rec. ITU-R SA.1396 specifies the deep space protection criterion in the 37-38 GHz band for non-line-of-sight propagation weather statistics as 0.001% of the time for manned missions and 0.1% of the time for unmanned missions;

d) that Rec. ITU-R P.452 specifies methodologies for computing non-line-of-sight propagation losses as functions of the terrain and atmospheric condition, as well as the distance between a transmitter and a receiver;

RECOMMENDS

1. that AEIRP is used to represent the total transmit power from a group of HDFS transmitters in an area with highly correlated propagation statistics in the direction of a deep space earth station;

2. that HDFS transmitters around a deep space earth station be divided into azimuth sectors using the earth station as the center, with the assumption that the propagation statistics are independent for HDFS transmitters in different azimuth sectors;

3. that within each azimuth sector, the HDFS transmitters be further divided into zones in radial direction from the deep space station and the HDFS transmitters in each zone be represented by a single transmitter with the AEIRP of all the transmitters in that zone;

4. that some zones within an azimuth sector can then be organized into a zone group depending on geographic factors with the assumption that the propagation statistics within each zone group are highly correlated and the propagation statistics among different zone groups are independent;

5. that the Monte Carlo simulation method described in the Annex is used to determine whether the interference from HDFS transmitters meets the deep space protection criterion.

Annex

Computing the total interference power spectral density for a deep-space earth station from the HDFS transmitters is a difficult problem due to the large number of HDFS transmitters. To simplify the problem, the area surrounding the earth station is partitioned into sectors, zones, and zone groups as shown in Figure A.1. The HDFS transmitters in a zone is represented by a single transmitter at the center of the zone with EIRP that is equivalent to the aggregate EIRP of all the HDFS transmitters in that zone in the direction of the deep space earth station.

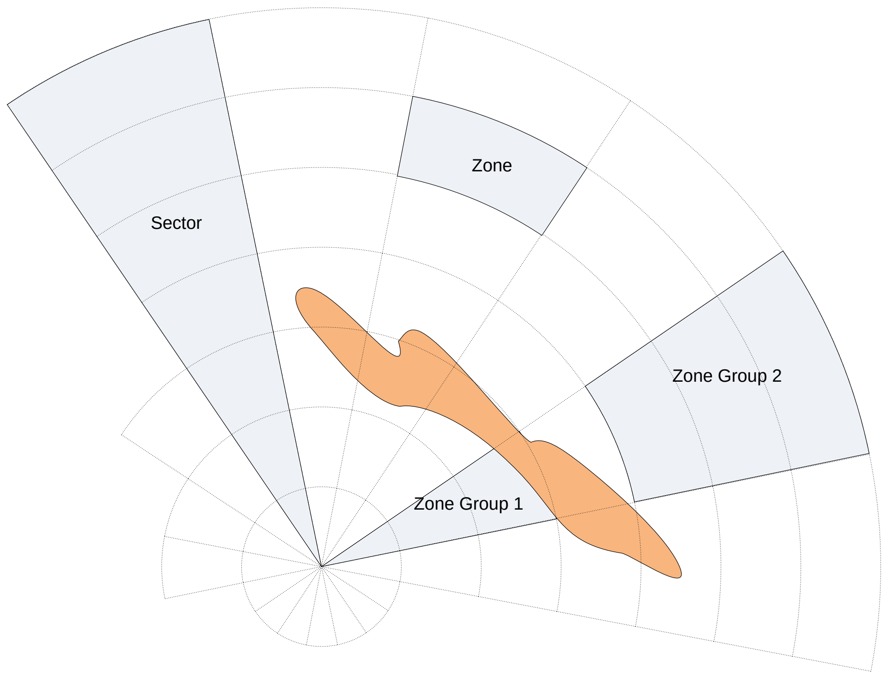

Figure A.1, Partitioning the area surrounding a deep space earth station into sectors, zones, and zone groups. The brown object denotes a mountain range that divides a sector into different zone groups due to distinct terrain profiles.

The aggregate interference from the HDFS transmitters around a deep space earth station antenna is expressed as

$$S = \sum_{n=1}^{K} G_n \sum_{m=1}^{M_n} A_{nm} \cdot \frac{1}{L_{nm}(p_n)} \qquad (1)$$

where K is the number of zone groups, G_n is the deep space earth station antenna gain toward the n-th zone group, M_n is the number of zones in the n-th zone group, A_{nm} is the AEIRP spectral density of the zone[n,m] (i.e. zone-m in the n-th zone group) toward the deep-space earth station receiver (W/Hz), $L_{nm}(p_n)$ is the p_n-th percentile of the propagation loss of the zone[n,m] due to intervening terrain and atmospheric conditions. $L_{nm}(p_n)$ should be computed using Rec. ITU-R P.452, including the clear-air (diffraction, tropospheric scatter, and ducting) and hydrometeor-scatter methods. In a zone group, all zones have the same weather statistics, hence, the same p_n. The weather statistics for the propagation losses is assumed to be independent for different zone groups.

Rec. ITU-R SA. 1396 specifies that non-line-of-sight interference density should be no more than -217 dBW/Hz for 0.001% weather statistics for manned missions and for 0.1% for unmanned missions operating in the 37-38 GHz band. Monte Carlo simulations should be used to determine whether the aggregate interference power spectral density from the HDFS transmitters meets the deep space earth station protection criterion for a given azimuth pointing. The lowest possible elevation angle of the earth station should be used in the simulations as the dominant interference would most likely come from such elevation angle. Monte Carlo simulations should be repeated such that the deep space protection criterion is satisfied for all azimuth sectors around the earth station.