Some FCC calculations for the Hiber Satellite

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1 Power flux density computations

A satellite is directly over the area where we want to compute the power flux density. We assume the following values:

- Distance R between the satellite and the Earth's surface is 600km.
- Transmitter P_{Tx}power measured at the antenna port is 10W.
- Antenna average gain G is 1.4 dBi (this value has also been used in the link budged calculations).
- Channel bandwidth BW_{ch} is 100kHz.
- Bandwidth of interest BW_i 4kHz

The power flux density is defined as:

$$P_{fd} = \frac{P_{Tx}G}{4\pi R^2} \ [W/m^2] \tag{1}$$

with the assumed values of the variables, we have:

$$P_{fd} = \frac{10 \times 10^{1.4/10}}{4\pi \times (600 \times 10^3)^2} = 3.051 \times 10^{-12} \ [W/m^2] \tag{2}$$

Power flux density in 1Hz bandwidth:

$$P_{df|1Hz} = \frac{P_{df}}{BW_{ch}} \ [W/m^2/Hz] \tag{3}$$

substituting proper values, the power flux density in 1Hz band:

$$P_{df|1Hz} = \frac{3.051 \times 10^{-12}}{100 \times 10^3} = 3.051 \times 10^{-17} \ [W/m^2/Hz] \tag{4}$$

The $P_{df|1Hz}$ expressed in the log scale is:

$$P^L_{df|1Hz} = 10\log(P_{df|1Hz}) = 10\log(3.051 \times 10^{-17}) = -165.16 \ \ [dBW/m^2/Hz] \quad (5)$$

The power flux density in 4kHz bandwidth is (in the log domain):

$$P^L_{df|4kHz} = P^L_{df|1Hz} + 10\log(BW_i) = -165.16 + 10\log(4000) = -129.14 \ [dBW/m^2/4kHz] \quad (6)$$

2 Power flux computation with antenna pattern included

The Schedule S document section "Transmitting Beam" lines 103 to 108, requires computation of the power flux densities for different angle of arrivals. Taking into account the antenna pattern described in the following document "Feasibility Report On Various 400 MHz RHCP Antenna Configurations". [1], the results of computations required by the Schedule S document are presented in Table(1). These are maximal theoretical values which will never be achieved in a real system. I have assumed that the boresight of the antenna (-Z direction in the antenna report is the nadir) is at 0 degrees (the Schedule S does not say anything about it)

Angle of arrival [deg]	Gain	$P_{df|4kH}[dBW/m^2/4kHz]$	Remarks
0-5	4.6	-125.93	(1)
5-10	4.6	-125.93	
10-15	4.5	-126.03	
15-20	4.5	-126.03	
20-25	4.4	-126.13	
25-90	4.4	-126.13	(2)

Table 1: Pfd computation as a function of an angle of arrival.

Remarks:

1. See antenna report section 2.4 for the antenna pattern used in the calculations.
2. Computed for the maximum value of the gain between 25-90 deg..

3 Transmitting beam

They could some differences in calculation results. During the development we use an average antenna gain and NOT the peak gain. For example the power

[1] The antenna deployed on the satellite will never be use with the maximum gain due to the reasons stated in the report(section 3.7, pp 11)

flux density uses an average value of the gain for computations but for different angles of arrival I have to use the data from the antenna pattern.

4 Receiver Beam

Computation of the C/T values assumes the maximal available gain from the antenna. The value was computed during evaluation of the link budget (Hiber's in-house tool). The C/T is -24.2 dB/K. For the real system the gain is 1.4dB, and C/T is -27.4 dB/K.