World Radiocommunication Seminar 2016

Avoiding unrealistic data

BR Space Services Department
International Telecommunication Union

Unrealistic data

- **Submitted frequency assignments of satellite networks may present a combinations of parameters leading to unlikely link budgets that are:**
  - creating unrealistic levels of interference
  - either over-sensitive to interference or triggering coordination at very low power levels
  - far from the actual operation of the satellite network frequency assignments.
  - very sensitive links have also the capability of requiring excessive coordination requirements with satellite networks with a later date of submission of coordination information.

Earth station antenna gain

Potentially unrealistic antenna gains of earth stations having non-directional antenna patterns and associated number of beams in MIFR

Type or Service	Criteria for maximum gain considered to be excessive dBi
RNSS	>7 dBi
MSS below 3 GHz	>6 dBi
MSS above 3 GHz	>15 dBi
Other (BSS, MetSAT, SO)	>6 dBi

Earth station antenna patterns

- Use most recent radiation antenna patterns for FSS/BSS/MSS as defined in ITU-R Recommendations (S.465-5, S.580-6, S. 1855) .
- Unrealistic data such as a very low antenna gain for directional antenna pattern would result in defaulting antenna pattern to Appendix 8 antenna pattern during examination. The use of Appendix 8 antenna pattern increase coordination requirements.
- Consult Antenna Patterns resource (http://www.itu.int/en/ITU-R/software/Pages/ant-pattern.aspx) to verify whether submitted earth station pattern corresponds to intended off-axis gain.
- Please observe limitations of certain recommendations. Do not use ITU-R Recommendation S.580-6 for smaller antenna diameters ($D/\lambda<50$)

Earth station antenna patterns

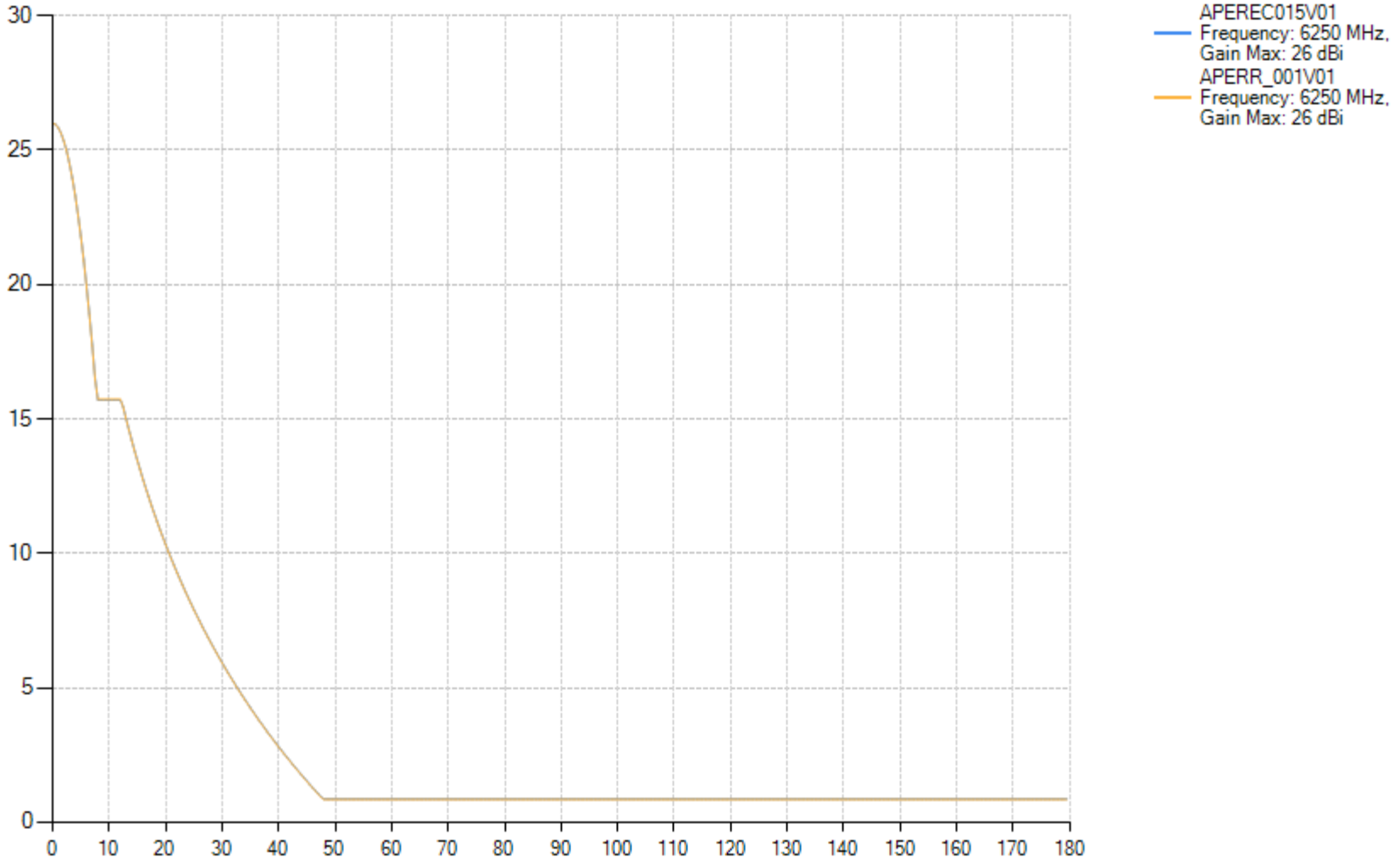
D/λ (Gain) table

Frequency, GHz / Diameter, m	4	6	11	14	17	20	27	30
0.6	8 (26)	12 (29)	22 (35)	28 (37)	34 (38)	40 (40)	54 (42)	60 (43)
1.2	16 (32)	24 (35)	44 (41)	56 (43)	68 (44)	80 (46)	108 (48)	120 (49)
2.4	32 (38)	48 (41)	88 (47)	112 (49)	136 (50)	160 (52)	216 (54)	240 (55)
4.5	60 (43)	90 (47)	165 (52)	210 (54)	255 (56)	300 (57)	405 (60)	450 (61)
6	80 (46)	120 (49)	220 (55)	280 (57)	340 (58)	400 (60)	540 (62)	600 (63)
9	120 (49)	180 (53)	330 (58)	420 (60)	510 (62)	600 (63)	810 (66)	900 (67)
12	160 (52)	240 (55)	440 (61)	560 (63)	680 (64)	800 (66)	1080 (68)	1200 (69)

$$20 \log \frac{D}{\lambda} \approx G_{amax} - 7.7$$

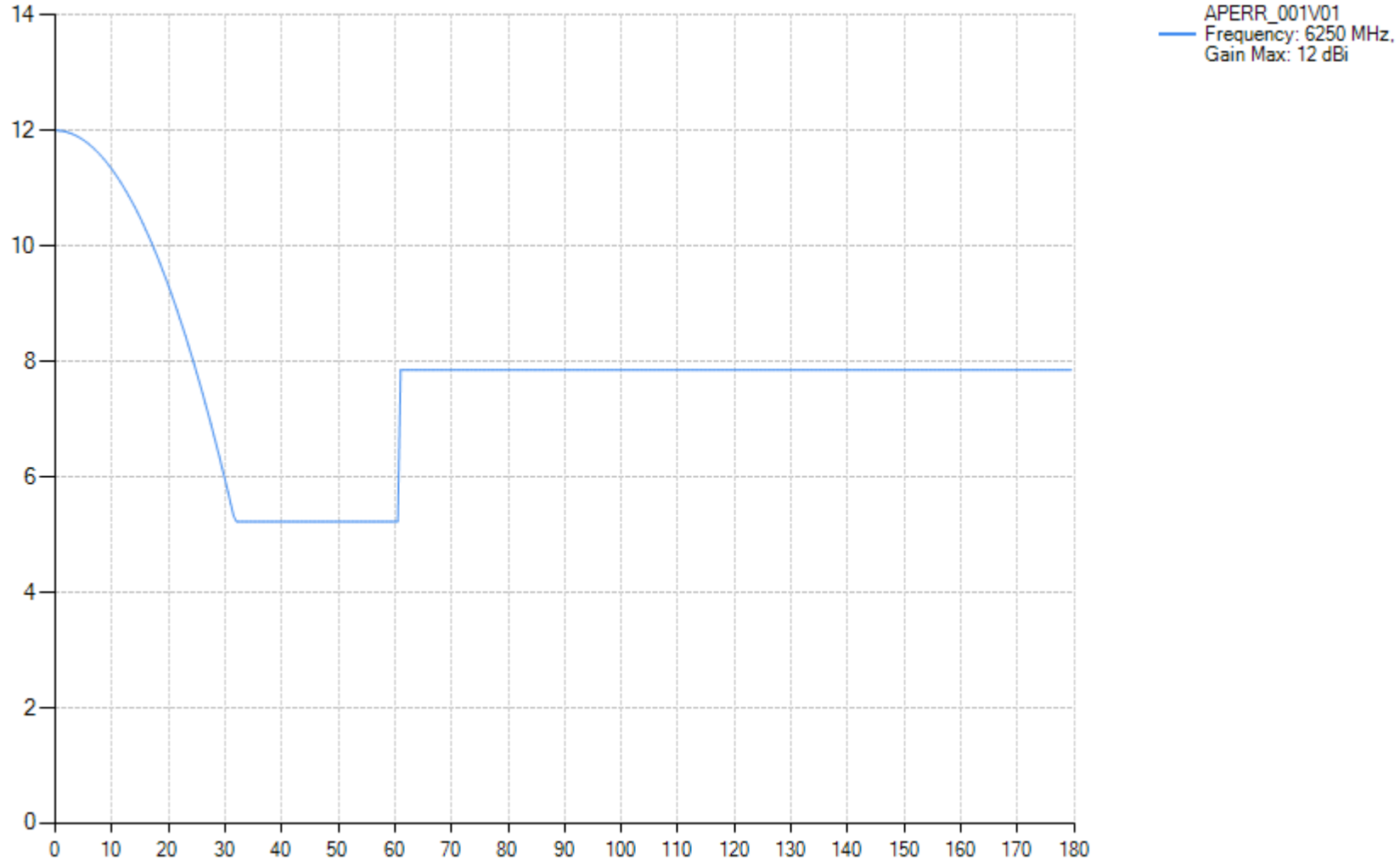
Earth station antenna patterns

- **Appendix 8 antenna pattern is used for D/λ<50 in REC-580-6**



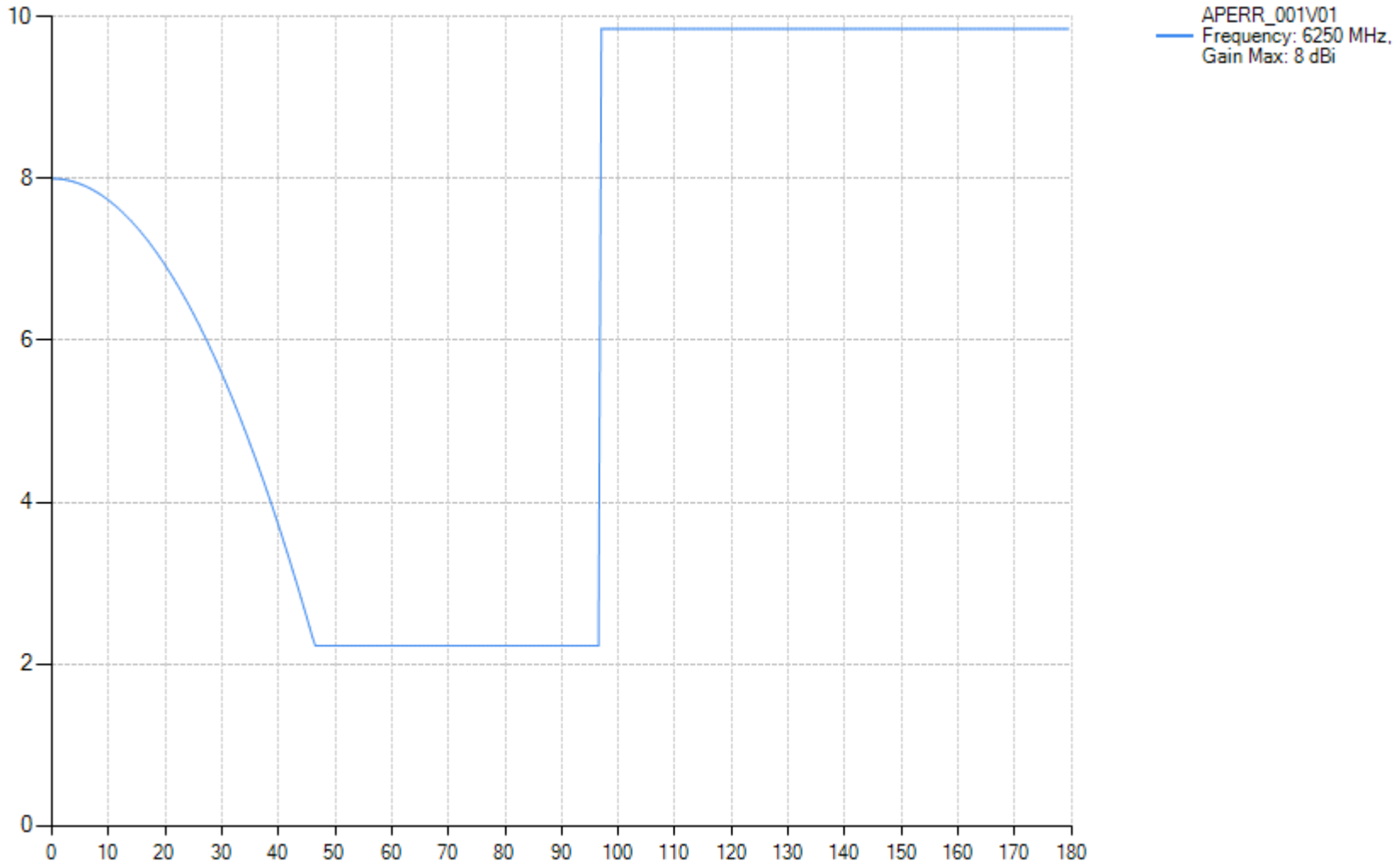
Earth station antenna patterns

- **Using low antenna gain for directional antennas (Appendix 8)**



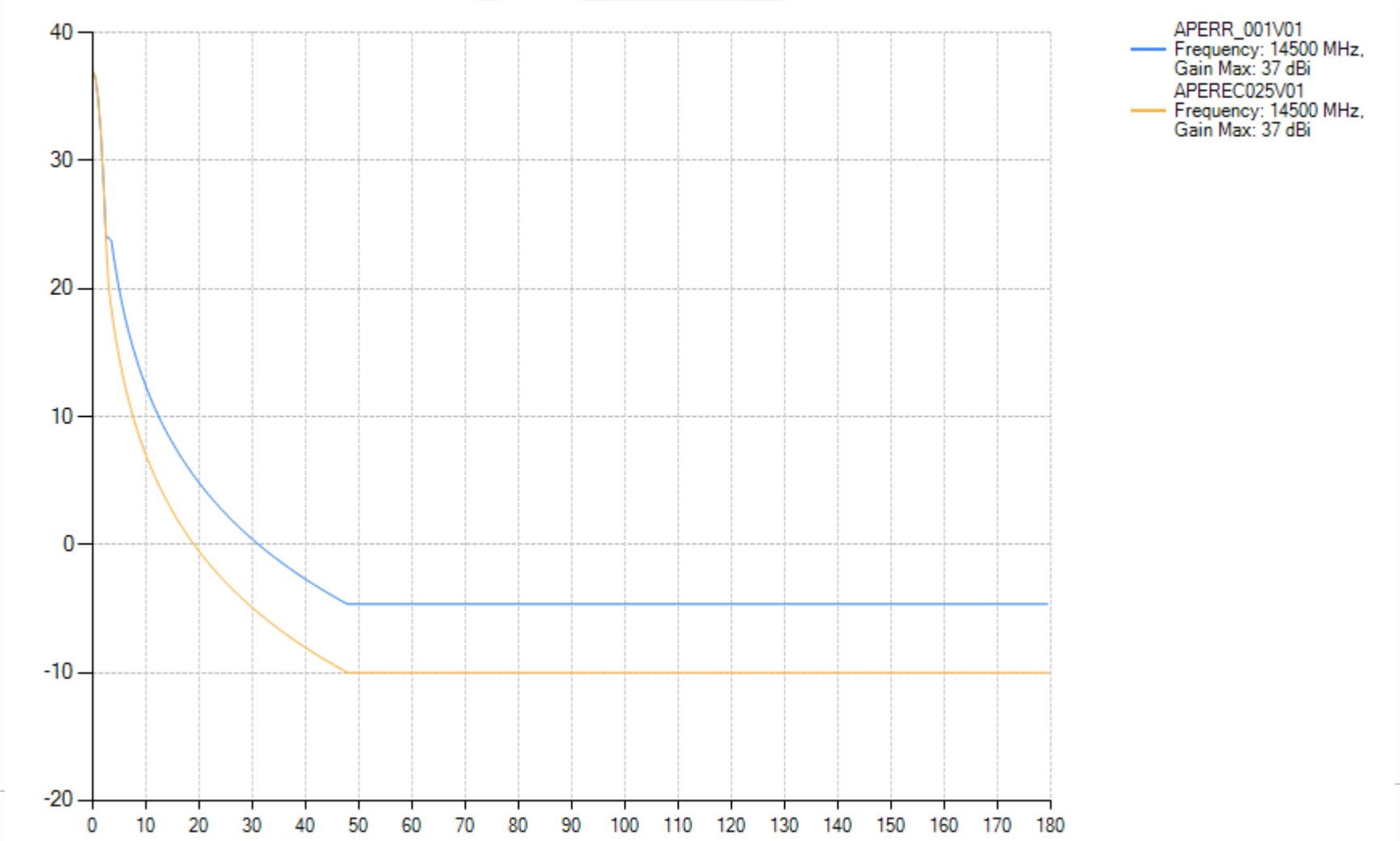
Earth station antenna patterns

- Using low antenna gain for directional antennas (Appendix 8)



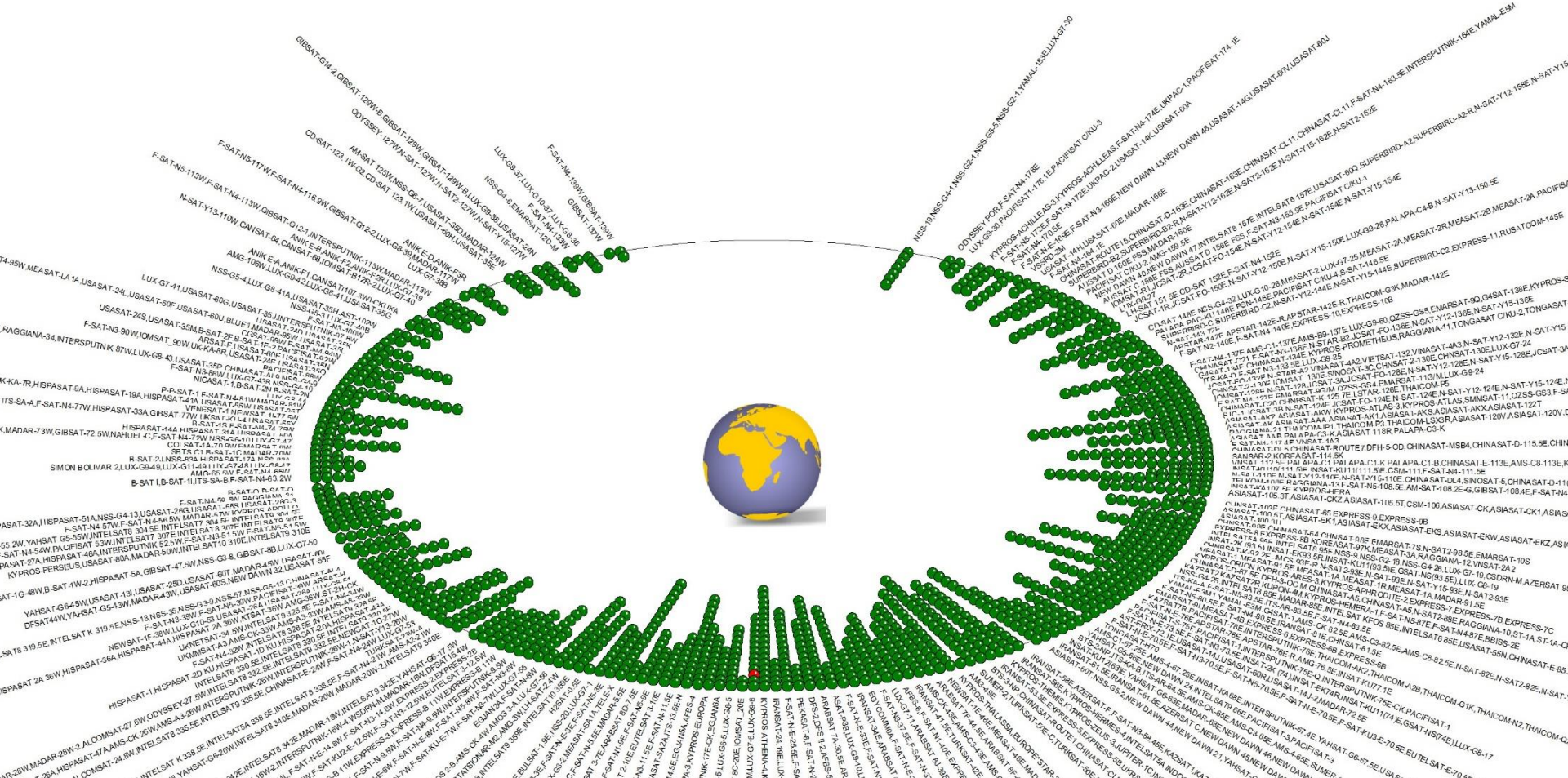
Earth station antenna patterns

- Consider using latest radiation patterns (REC-465-6, REC-1855)



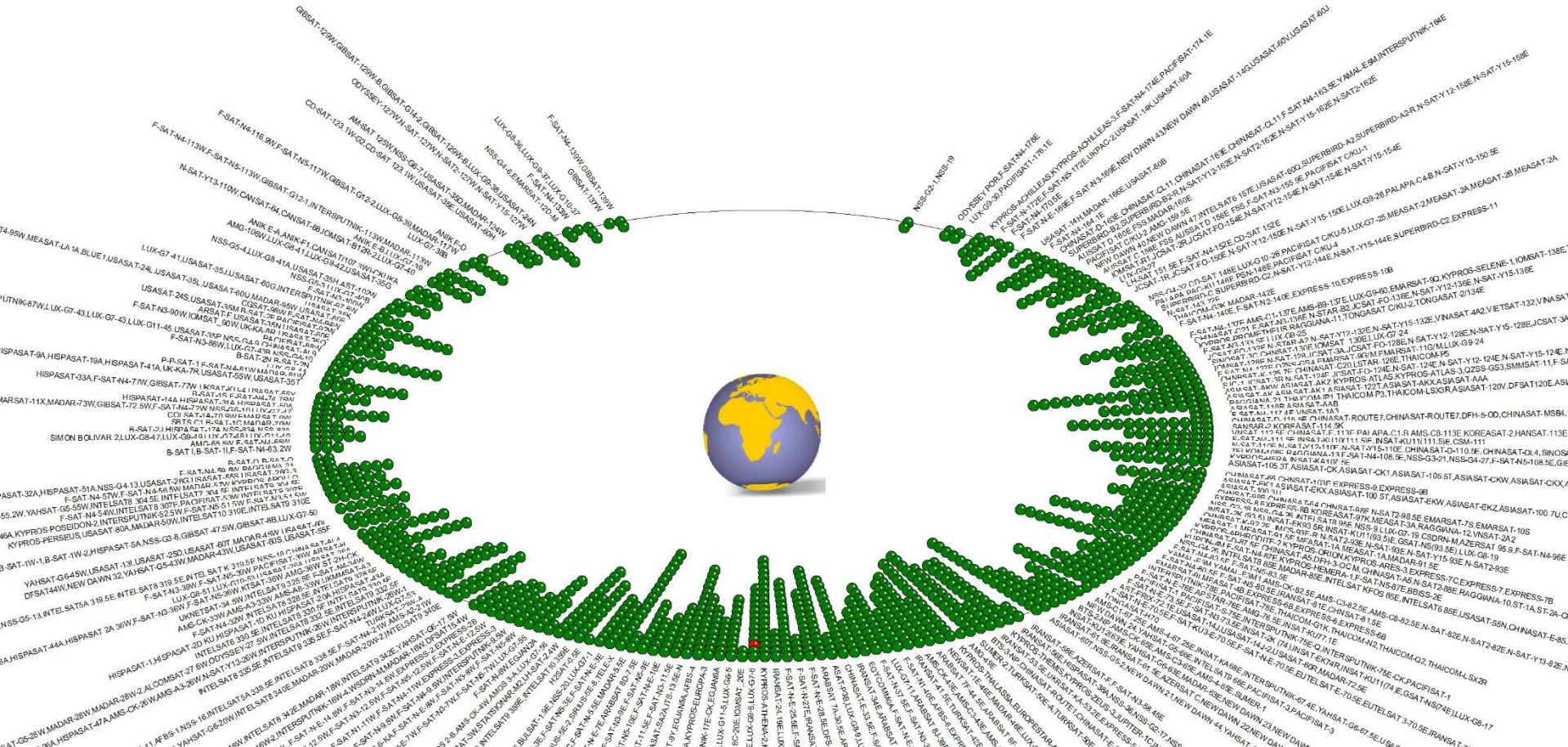
Earth station antenna patterns

- Initially AP8 antenna pattern



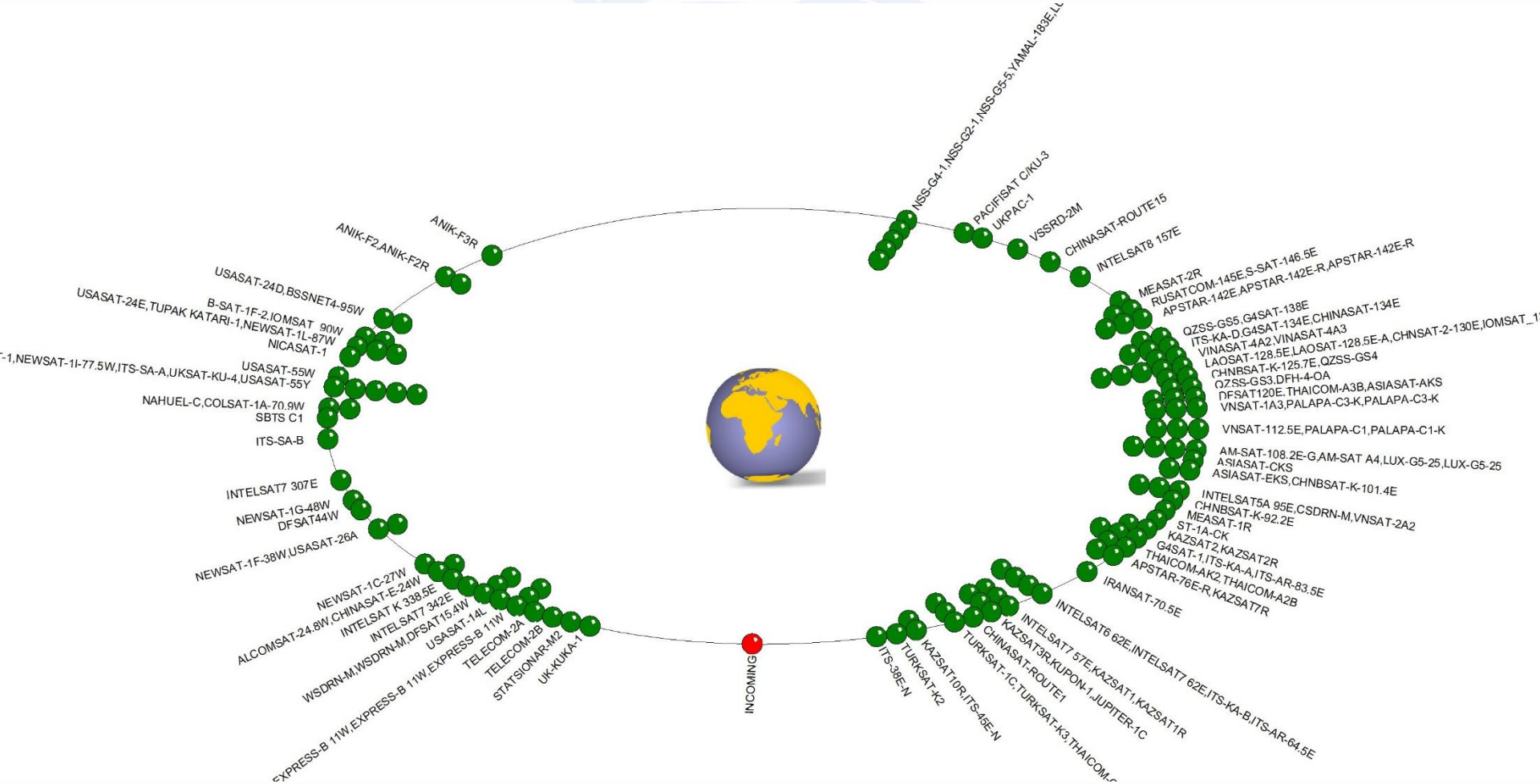
Earth station antenna patterns

Change to REC-465-6 antenna pattern



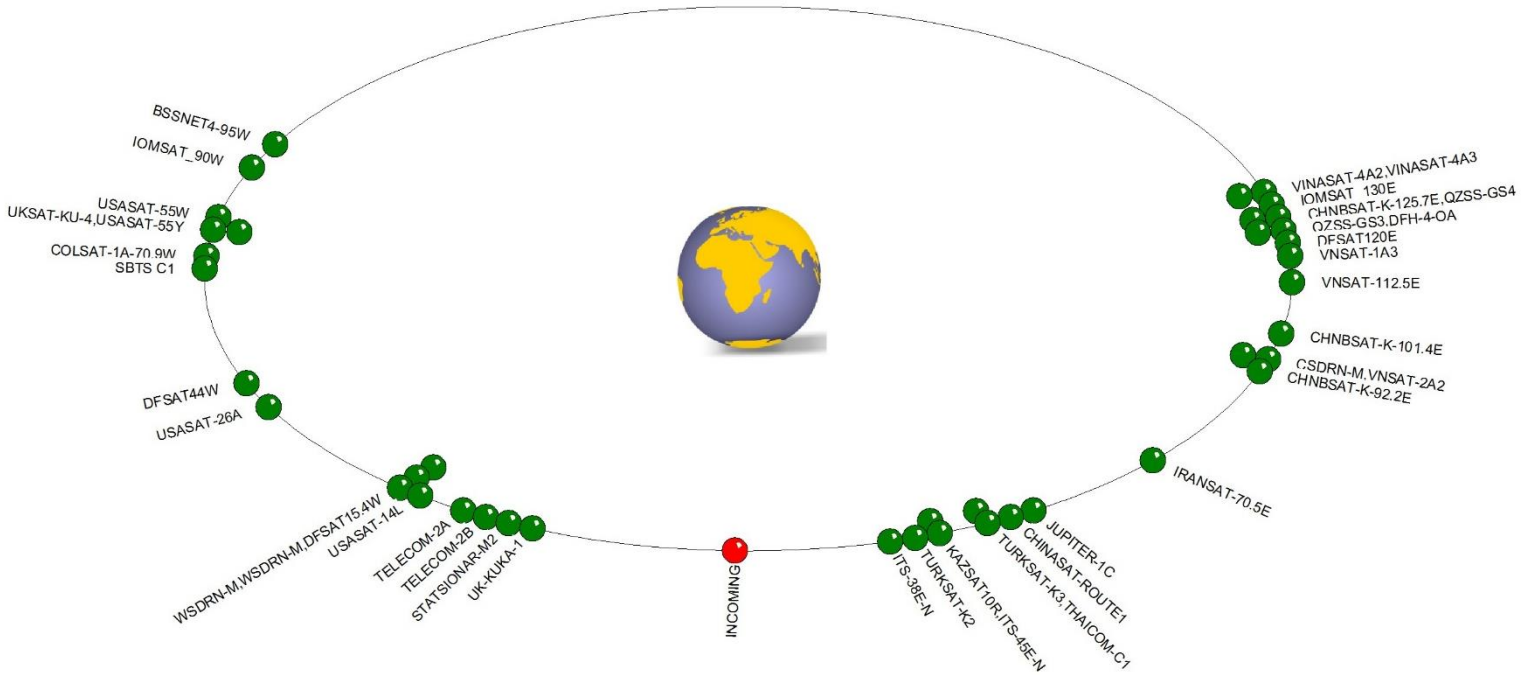
Earth station antenna patterns

Initially AP8 antenna pattern (causing interference)



Earth station antenna patterns

Change to REC-465-6 antenna pattern (causing)



Satellite receiving system noise temperature

- Space station receivers are susceptible to different interference sources coming from earth, space, sun etc.
- The brightness temperature of the earth and the brightness temperature of the atmosphere reflected from are taken to be 290 K.
- The noise temperature less than 290 K for Earth-to-space links for global coverage maybe considered unrealistic.

Earth station e.i.r.p.

Consider power spectral density not exceeding 0 dBW/4 kHz (except TT&C)

Maximum e.i.r.p. per transponder (36 MHz) derived from maximum power spectral density of 0 dBW/4 kHz

Antenna diameter, m Central frequency, MHz	1	4.5	9	13
6 700	74.2	87.3	93.3	96.5
14 000	80.6	93.7	99.7	102.9
19 000	83.3	96.3	102.4	105.6
29 000	86.9	100.0	106.0	109.2

Off-axis e.i.r.p.

- **Consider limiting off-axis EIRP to the levels defined:**
  - In Recommendation ITU-R S.524-9
  - RR Article **22** (RR Nos. **22.26** to **22.32**)
- **Calculate off-axis gain using antenna pattern to be submitted in the filing and maximum power spectral density**

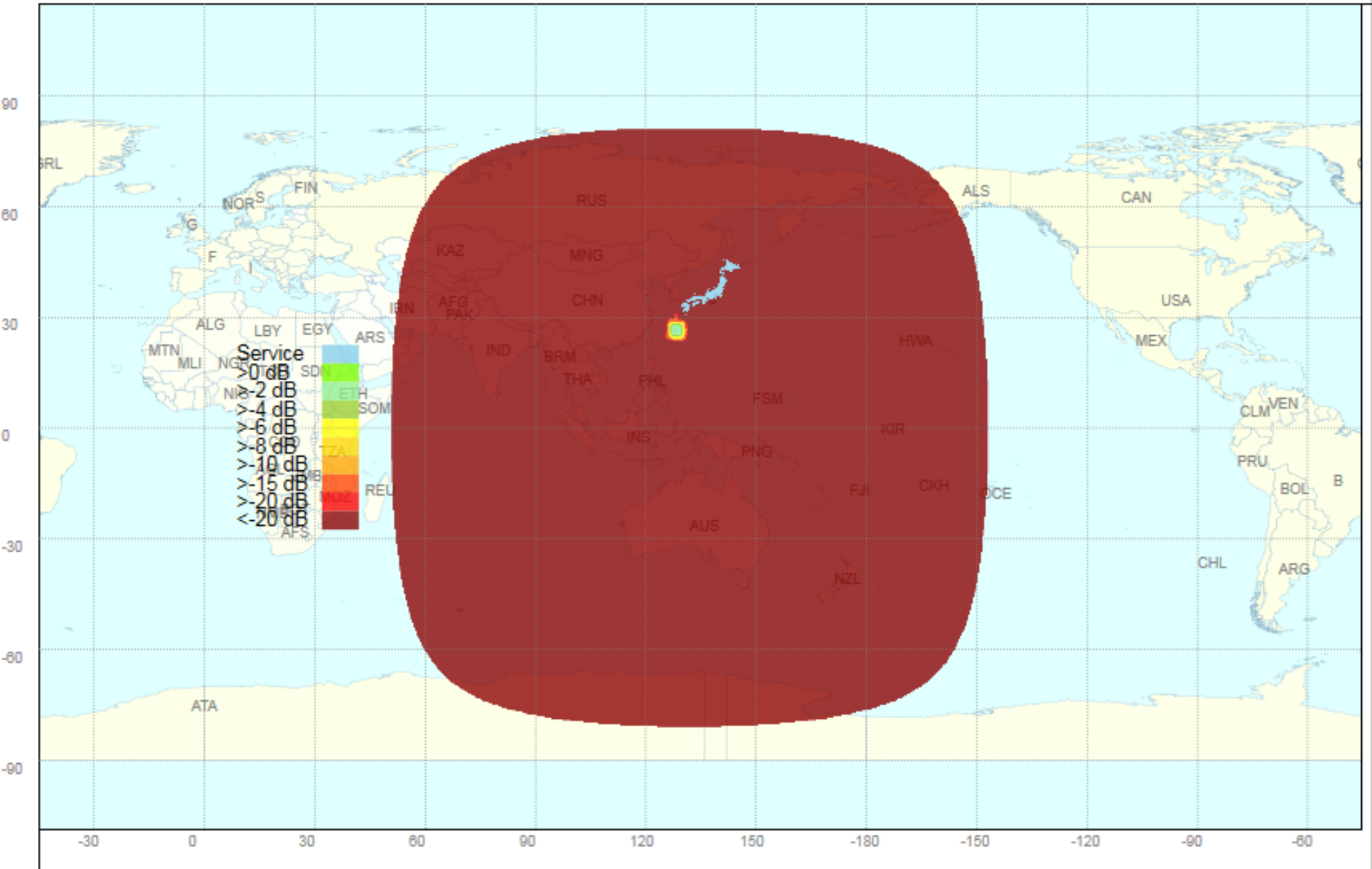
High level of submitted *C/N* ratio

- Submitted C/N affects results of RR No. 11.32A examination.
- When the network is submitted for RR No. 11.32A examination the Bureau will use submitted value of *C/N* objective to calculate a potential for harmful interference received by this network from incumbent networks.
- The greater the level of *C/N* of the assignment, the greater protection assignment will require.
- Use C/I exercise to calculate C/Nrequired and make sure that C/Nobjective indicated in filing is corresponding to calculated C/Nrequired.

Service area contours

- **GIMS data includes service area and gain contours**
- **To extent practicable align the gain contours to the service area:**
  - Avoid locating gain boresight outside service area
  - Avoid extending service area to region where satellite antenna gain is at minimum.
  - Make sure that submitted C/N objective is maintained across whole service area.

Service area contours



Service area contours