

RECOMMENDATION ITU-R S.1341*

SHARING BETWEEN FEEDER LINKS FOR THE MOBILE-SATELLITE SERVICE AND THE AERONAUTICAL RADIONAVIGATION SERVICE IN THE SPACE-TO-EARTH DIRECTION IN THE BAND 15.4-15.7 GHz AND THE PROTECTION OF THE RADIO ASTRONOMY SERVICE IN THE BAND 15.35-15.4 GHz

(Question ITU-R 242/4)

(1997)

The ITU Radiocommunication Assembly,

considering

- a) that Resolution 116 (WRC-95) of the World Radiocommunication Conference (Geneva, 1995) calls for studies by the ITU-R of the sharing situation between feeder links (space-to-Earth) for the mobile-satellite service (MSS) and the aeronautical radionavigation service in the band 15.4-15.7 GHz;
- b) that the band 15.4-15.7 GHz is allocated to the aeronautical radionavigation service on a primary basis and that No. 953 (S4.10) of the Radio Regulations (RR) applies;
- c) that the WRC-95 has added an allocation to the fixed-satellite service in this band for feeder links of non-geostationary (non-GSO) networks in the MSS in the space-to-Earth direction;
- d) that the requirements for feeder links (space-to-Earth) of non-GSO satellite systems need to be accommodated in this band;
- e) that emissions from satellites can cause harmful interference to stations in the aeronautical radionavigation service;
- f) that power flux-density (pfd) limitations have been placed on the emissions from non-geostationary space stations to protect the aeronautical radionavigation service in accordance with No. S5.511A of the RR, which are subject to review by the ITU-R;
- g) that the coordination of satellite emissions with aeronautical radionavigation stations is not considered practical;
- h) that emissions from aeronautical radionavigation stations propagated along the Earth's surface can cause unacceptable interference to feeder-link earth stations;
- j) that methods are needed to determine the coordination and separation distances required between feeder-link earth stations and aeronautical radionavigation stations in order to protect the feeder-link earth stations;
- k) that aircraft stations are not permitted to transmit in the band 15.45-15.65 GHz in accordance with No. S5.511B of the RR;
- l) that there is fairly extensive use of this band by the aeronautical radionavigation service for airborne, land and ocean based stations;
- m) that the technical and operational characteristics of the aeronautical radionavigation stations are reasonable well defined;
- n) that the technical and operational characteristics of feeder links are not well defined;
- o) that satellite systems in this frequency range usually do not operate with low earth station antenna elevation angles;
- p) that studies have been made with respect to § o;

* This Recommendation should be brought to the attention of Radiocommunication Study Groups 7 and 8.

- q) that the adjacent band 15.35-15.4 GHz is allocated to the radio astronomy service and other passive services and that protection from harmful interference due to emissions from space stations is needed (see No. S5.511A of the RR);
- r) that all emissions are prohibited in the band 15.35-15.4 GHz in accordance with No. S5.340 except those provided for in No. S5.341;
- s) that Recommendation ITU-R RA.769 provides threshold levels of detrimental interference for the radio astronomy service,

recommends

- 1 that feeder links for the MSS should be limited to the band 15.43-15.63 GHz (Note 1);
- 2 that provisionally the pfd at the Earth's surface produced by emissions from the feeder links of a space system of non-GSO satellites for all conditions and for all methods of modulation should not exceed the values given in 2.1 under the condition given in § 2.2 (Note 2);
- 2.1 in the frequency band 15.43-15.63 GHz, where φ is the angle of arrival (degrees) above the local horizontal plane:
- | | | | |
|----------------------------------|--------------------------------|-----|---------------------------|
| -127 | dB(W/m ²) in 1 MHz | for | $0 \leq \varphi < 20$ |
| $-127 + 0.56(\varphi - 20)^2$ | dB(W/m ²) in 1 MHz | for | $20 \leq \varphi < 25$ |
| -113 | dB(W/m ²) in 1 MHz | for | $25 \leq \varphi < 29$ |
| $-136.9 + 25 \log(\varphi - 20)$ | dB(W/m ²) in 1 MHz | for | $29 \leq \varphi < 31$ |
| -111 | dB(W/m ²) in 1 MHz | for | $31 \leq \varphi \leq 90$ |
- 2.2 that these limits relate to the pfd which would be obtained under assumed free-space propagation conditions;
- 3 that with the pfd limits given in *recommends* 2 coordination of satellite emissions with receiving stations in the aeronautical radionavigation service is not required;
- 4 that surface based radars as described in Annex 1 should not operate in the band 15.43-15.63 GHz;
- 5 that the threshold distance for the coordination of emissions from stations in the aeronautical radionavigation service with respect to feeder-link earth stations for the MSS based on an earth station antenna gain in the local horizontal plane of 11.5 dBi are:
- 150 km from the ground segment for aircraft landing system (ALS);
 - 600 km from aircraft using general purpose radars;
 - 60 km from the aircraft landing surface for radar sensing and measurement systems;
- 6 that feeder-link earth stations should limit their operation to angles above the local horizontal plane of at least 5°;
- 7 that emissions from the feeder links of a space system of non-GSO satellites for all conditions and all methods of modulation should take into account the threshold levels for the radio astronomy service given in Recommendation ITU-R RA.769 for the band 15.35-15.4 GHz (see Note 3);
- 8 that additional information is contained in Annexes 1, 2, and 3.

NOTE 1 – The bandwidth given in *recommends* 1 is smaller than that allocated by WRC-95 for non-GSO MSS feeder links. This difference is recommended to facilitate sharing between the non-GSO MSS feeder links and the aeronautical radionavigation service. *Recommends* 1 will be reviewed at a later date in accordance with the outcome of a future WRC.

NOTE 2 – The feasibility to design and operate feeder links in the space-to-Earth direction with the provisional pfd limits given in *recommends* 2.1 has not yet been studied. Further, the provisional pfd values given in *recommends* 2.1 should be reviewed to ensure protection to the ARNS.

NOTE 3 – Additional design and operational constraints may be placed on MSS space-to-Earth feeder links in order to take into account the threshold levels for the radio astronomy service given in ITU-R RA.769 per *recommends* 7.

ANNEX 1

Aeronautical radionavigation systems in the 15.4-15.7 GHz band**1 Surface based radars (SBR)**

The land and ship based SBR are used for the detection, location, and movement of aircraft and other vehicles on the surface of airports and other aircraft landing areas.

1.1 Antenna patterns

- Nominal 3 dB beamwidth: <3.5° vertical, inverted cosecant to –31°
0.35° horizontal;
- Frequency range: 15.65-16.7 GHz;
- Polarization: circular;
- Typical gain: 43 dBi;
- Maximum side-lobe level: 25 dB below peak gain;
- Maximum back-lobe level: 35 dB below peak gain;
- Vertical tilt range: ± 1.5°;
- Maximum horizontal scan range: 360°

1.1.1 Antenna elevation envelope pattern

Based on measured data and side-lobe level specifications and with the peak gain directed at +1.5°, an elevation envelope pattern is defined as follows where φ is the elevation angle (degrees):

$$G(\varphi) = \begin{cases} 43 & \text{dBi} & \text{for} & 0 \leq \varphi < 4 \\ 43 - 5(\varphi - 4) & \text{dBi} & \text{for} & 4 \leq \varphi < 9 \\ 18 & \text{dBi} & \text{for} & 9 \leq \varphi < 16 \\ 43.2 - 21 \log \varphi & \text{dBi} & \text{for} & 16 \leq \varphi < 48 \\ 8 & \text{dBi} & \text{for} & 48 \leq \varphi \leq 90 \end{cases}$$

1.1.2 Antenna azimuth envelope pattern

Based on measured data and side-lobe level specifications, the azimuth gain pattern is defined as follows where φ is the relative azimuth angle (degrees):

$$G(\varphi) = \begin{cases} 43 - 110 \varphi^2 & \text{dBi} & \text{for} & 0 \leq \varphi < 0.4767 \\ 18 & \text{dBi} & \text{for} & 0.4767 \leq \varphi < 0.72 \\ 17.07 - 6.5 \log \varphi & \text{dBi} & \text{for} & 0.72 \leq \varphi < 48 \\ 8 & \text{dBi} & \text{for} & 48 \leq \varphi \leq 180 \end{cases}$$

1.2 Other characteristics**1.2.1 Transmitting**

- Peak e.i.r.p.: 86 dBW
- Pulse repetition frequency: 8 192 Hz
- Pulse duration: 0.04 μ s
- Pulse 3.5 dB bandwidth: 25 MHz.

1.2.2 Receiving

- Typical antenna gain: 43 dBi
- Typical noise figure: 6.2-6.9 dB.

2 Aircraft landing systems (ALS)

These ALS are general purpose systems and are used on ships, as portable or permanent land based systems and for shuttle landings. The microwave scanning beam landing system (MSBLS) is one such system. Some of the characteristics vary with the particular applications.

2.1 Surface based station antenna patterns

The antenna patterns are similar for all applications including the MSBLS. The scanning ranges vary with application. The scanning ranges given below cover all applications.

The antenna complement of the ALS consists of an elevation antenna and an azimuth antenna.

The elevation antenna portion of the ALS is used to transmit vertical angle data to the aircraft.

- Nominal 3 dB beamwidths: 1.3° vertical
40° horizontal
- frequency range: 15.4-15.7 GHz
- polarization: horizontal and vertical
- typical gain: 28 dBi
- maximum side-lobe level: 17 dB below peak gain in both planes
- maximum vertical scan range: 0° to 30°.

The azimuth antenna portion of the ALS is used to transmit azimuth information to the aircraft:

- Nominal 3 dB beamwidths: 2.0° horizontal
6.5° vertical
- the vertical pattern is spoiled to achieve at least a 20 dBi gain at 20 degrees above the horizon
- frequency range: 15.4-15.7 GHz
- polarization: horizontal and vertical
- typical gain: 33 dBi
- maximum side-lobe level: 17 dB below peak gain in both planes
- maximum horizontal scan range: $\pm 35^\circ$.

2.1.1 Combined antenna elevation envelope pattern

A combined vertical envelope gain pattern based on measured data is defined as follows where φ is the elevation angle (degrees):

$$G(\varphi) = \begin{cases} 33 & \text{dBi} & \text{for} & 0 \leq \varphi < 8 \\ 33 - 0.833(\varphi - 8) & \text{dBi} & \text{for} & 8 \leq \varphi < 14 \\ 28 & \text{dBi} & \text{for} & 14 \leq \varphi < 32 \\ 28 - 9(\varphi - 32) & \text{dBi} & \text{for} & 32 \leq \varphi < 34 \\ 10 & \text{dBi} & \text{for} & 34 \leq \varphi < 40 \\ 10 - 0.2(\varphi - 40) & \text{dBi} & \text{for} & 40 \leq \varphi \leq 90 \end{cases}$$