RECOMMENDATION ITU-R M.1185-1

METHOD FOR DETERMINING COORDINATION DISTANCE BETWEEN GROUND BASED MOBILE EARTH STATIONS AND TERRESTRIAL STATIONS OPERATING IN THE 148.0-149.9 MHz BAND

(Question ITU-R 201/8)

(1995-1997)

Summary

This Recommendation provides the calculation method of coordination distances used for procedures in Resolution 46 (Rev.WRC-95) of the World Radio Conference (Geneva, 1995). This method is based on the troposcatter propagation model in Recommendation ITU-R P.452.

The ITU Radiocommunication Assembly,

considering

a) that the use of the 148.0-149.9 MHz frequency band is subject to Radio Regulations No. S5.219;

b) that mobile earth stations (MESs) in the mobile-satellite service (MSS) operating below 1 GHz will, typically, operate with e.i.r.p.s of 10 dBW or less;

c) that the MESs may typically be located anywhere within an administration implementing such a service;

d) that the land earth stations in the MSS operating below 1 GHz will use high-gain steerable antennas at fixed locations which may sometimes radiate nearly continuous signals in any azimuth and various, sometimes low elevations at e.i.r.p.s higher than that of the MES;

e) that some administrations may choose to implement only MESs;

f) that coordination of MESs is inherently different from the coordination of land earth stations;

g) that in the case of MESs transmitting short duration bursts with low duty cycle, coordination with terrestrial stations may be limited inside auxiliary contours based upon more favourable assumptions than the ones used to determine the coordination contours,

recommends

1 that the method described in Annex 1 be used to calculate a coordination distance identifying administrations that may be affected;

2 that the method take account of the actual parameters of terrestrial stations;

3 that the method be used in conjunction with procedures of Resolution 46 (Rev.WRC-95) relating to coordination between grounded based MESs and terrestrial stations;

4 that the method described in Annex 2 be used in order to facilitate the coordination with terrestrial analogue voice services in the case of MESs transmitting short duration bursts with low duty cycle.

ANNEX 1

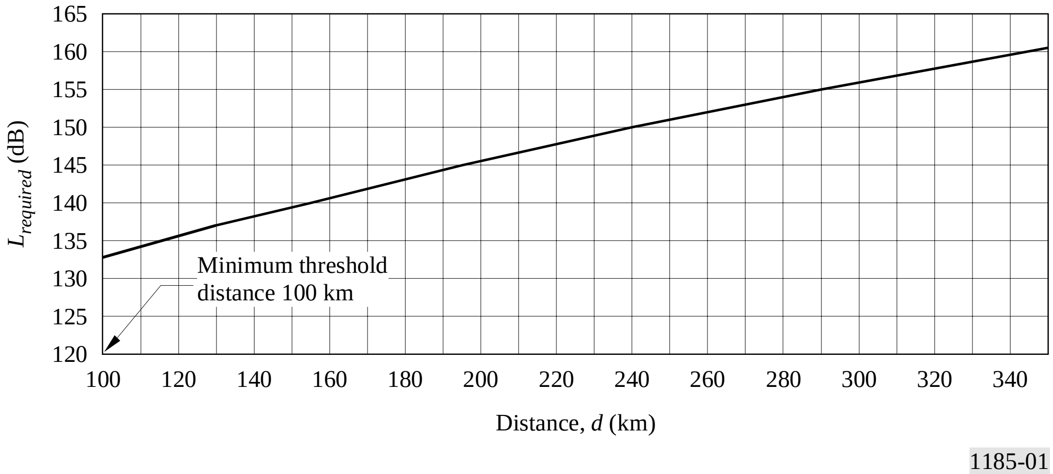
Method for determining the coordination distance between ground based MESs and terrestrial stations

The method of calculation of a coordination distance between a MES and a terrestrial station is based on determining the distance, on the surface of the Earth, that will provide sufficient isolation between MES transmitter and the terrestrial receiver such that a terrestrial receiver lying beyond the coordination distance will have a very low probability of receiving interference from the MES. The coordination distance calculation is based on a troposcatter propagation model which is slightly more conservative to the one used in the propagation section of Recommendation ITU-R P.452, "Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above about 0.7 GHz". The troposcatter propagation mechanism provides a relatively large distance in comparison to other propagation mechanisms and, therefore, can be used as a conservative estimate of the coordination distance between the two systems. Specifically, the propagation loss in Fig. 1 is based on an equation 10 dB more conservative than equation (10a) of Recommendation ITU-R P.452. Among the simplifying assumptions used to derive Fig. 1 are:

– the frequency is 148 MHz;
– no site shields exist for either transmitter or receiver;
– the propagation loss will be exceeded for 99.9% of the time.

FIGURE 1

MES/terrestrial station coordination distance



The method first calculates the required loss between the MES and a terrestrial receiver as shown in equation (1):

$$L_{required} = (P_t + G_t + 36.0) - (I_r - G_r + L_r) \quad (1)$$

where:

- $L_{required}$: required threshold loss between the transmitter and receiver (dB)
- I_r: terrestrial receiver permissible interference referenced to a 4 kHz bandwidth (dB(W/4 kHz))
- L_r: line losses between the terrestrial receiver and antenna (dB)
- G_r: maximum antenna gain of terrestrial receiver (dBi)
- P_t: maximum power density of the MES (dB(W/Hz))
- G_t: maximum antenna gain of the MES (dBi).

The values of P_t and G_t, for the MES, are available in the information supplied under Section II of Annex 1 to Resolution 46 (Rev.WRC-95). The values for I_r, G_r and L_r will be provided by the administration that may be affected.

Figure 1 is then used to determine the coordination distance by entering $L_{required}$ on the ordinate and reading the corresponding distance (d (km)) on the abscissa. A minimum coordination distance of 100 km should be used.

Examples of the application of this method are shown in Appendix 1.

The generating equation for Fig. 1 is:

$$L_{required}(d) = 86 + 20 \log d + 0.0674\, d \qquad \text{dB} \tag{2}$$

where:

d: distance (km) ($d \geq 100$ km)

$L_{required}$: intersystem loss required (dB) that can be expected to be exceeded for 99.9% of the time.

APPENDIX 1

TO ANNEX 1

Example of determination of coordination distance

Two examples of the use of the coordination distance calculation method are provided in this Appendix. Example 1 represents a narrow-band MSS system and example 2 a wide-band MSS system.

TABLE 1

Coordination distance examples

	Example 1	Example 2
	Narrow-band MSS	Wide-band MSS
MSS system information		
MSS maximum power density(1) (dB(W/Hz))	–27.0	–56.3
MSS maximum isotropic gain(1) (dBi)	2.0	0.0
Conversion to 4 kHz bandwidth (dB)	36.0	36.0
MSS e.i.r.p. density (dB(W/4 kHz))	11.0	–20.3
Mobile system information		
Example terrestrial receiver permissible interference level (dB(W/4 kHz))	–140.0	–140.0
Example terrestrial line losses (dB)	–1.0	–1.0
Example terrestrial antenna gain (dBi)	5.0	5.0
Terrestrial receiver permissible interference level at antenna (dB(W/4 kHz))	–144.0	–144.0
Required isolation, $L_{required}$ (dB)	155.0	123.7
Coordination distance from Fig. 1 (km)	290	100(2)

(1) Information supplied in accordance with Section II of Annex 1 to Resolution 46 (Rev.WRC-95).

(2) Minimum coordination distance is 100 km.

ANNEX 2

Coordination between MESs and terrestrial stations providing analogue voice in the case of MESs transmitting short duration bursts with low duty cycle

In order to reduce the probability of interference to terrestrial stations, MES operating in the 148-149.9 MHz frequency band may have a working mode consisting in transmitting short bursts with low duty cycle, so allowing to use the propagation model (average conditions) contained in Recommendation ITU-R P.529, provided that adequate limits are imposed on the burst duration and the duty cycle.

The use of this model is limited to systems having burst durations which even though short, would still represent interference if received for a percentage of time exceeding 0.1%, and duty cycles less than 0.5% of the time. The recommended use is for establishing auxiliary contour in order to facilitate the coordination with terrestrial stations.

When these conditions are satisfied, the auxiliary contour is computed as follows, using the protection criteria of the affected terrestrial system:

– the required threshold loss between the transmitter and receiver, $L_{required}$, is derived from formula (1) of Annex 1;

– the radius of the auxiliary contour is calculated with the following formula:

$$L_{required} = 100 + 40 \log d \qquad \text{dB} \qquad (3)$$

where d is the radius of the auxiliary contour (km).

Note that formula (3) has been established with the product of h_1 and h_2 being 10 m^2, where h_1 and h_2 are the equivalent heights of the transmitting and receiving antennas respectively. The product of h_1 and h_2 being 10 m^2 is considered to be realistic when concluding coordination between a MES and a mobile station. Generalization of formula (3) to different values of h_1 and h_2 leads to the following formula (4):

$$L_{required} = 100 + 40 \log d - 20 \log \left[(h_1 \, h_2) / 10 \right] \qquad \text{dB} \qquad (4)$$

where h_1 and h_2 are expressed in metres.

When an ensemble of MESs is present within the auxiliary contour as calculated above, consideration of the transmitting characteristics (i.e., burst length, duty cycle, probability of simultaneous transmission) must be taken into account to determine the total interfering probability to a terrestrial station.