

RECOMMENDATION ITU-R SF.1650-1

The minimum distance from the baseline beyond which in-motion earth stations located on board vessels would not cause unacceptable interference to the terrestrial service in the bands 5925-6425 MHz and 14-14.5 GHz^{*,**}

(Questions ITU-R 226/9 and ITU-R 251/4)

(2003-2005)

Scope

This Recommendation provides the offshore distance beyond which earth stations on board vessels (ESVs) will not interfere with fixed service systems. The Annex provides the assumptions and methodology used in determining these distances in the frequency bands 5 925-6 425 MHz and 14-14.5 GHz.

The ITU Radiocommunication Assembly,

considering

- a) that the technology exists which permits the use of FSS networks by earth stations on board vessels (ESVs) in the bands 5 925-6 425 MHz and 14-14.5 GHz (Earth-to-space);
- b) that ESVs have the potential to cause unacceptable interference to FS systems in these bands;
- c) that ESV operations require considerably less than the full bandwidth in this FSS allocation and only a portion of the visible GSO arc;
- d) that in order to ensure the protection and future growth of the FS, the ESV must operate with certain operational constraints;
- e) that a minimum distance from the low-water mark as officially recognized by the coastal State could be determined beyond which the ESV will not cause unacceptable interference to the FS in these bands;
- f) that the minimum distance in *considering* e) may be based on administrative and technical considerations,

noting

- a) that some administrations have been operating ESVs for several years under No. 4.4 of the Radio Regulations (RR),

* With respect to the impact to other terrestrial services other than the fixed service (FS), this will be the subject of further study.

** The Administrations of Saudi Arabia, Djibouti, Egypt, United Arab Emirates, Jordan, Kuwait, Morocco, Mauritania, Syrian Arab Republic, Tunisia and Yemen objected to the approval of this Recommendation for the reasons that can be found in the Radiocommunication Assembly (Geneva, 2003) (RA-03) Report to the WRC-03.

The Administrations of Germany, Australia, Canada and Israel reserve their opinion on this Recommendation for the reasons that can be found in the RA-03 Report to the WRC-03. The Administrations of Gabon and Senegal reserve their opinion on this Recommendation.

recommends

1 that, in the band 5 925-6 425 MHz, the minimum distance from the low-water mark as officially recognized by the coastal State, beyond which in-motion ESVs would not cause unacceptable interference to the terrestrial services is 300 km for an antenna of 2.4 m diameter (based on the parameters of Table 1);

2 that, in the band 14-14.5 GHz, the minimum distance from the low-water mark as officially recognized by the coastal State, beyond which in-motion ESVs would not cause unacceptable interference to the terrestrial services is 125 km for an antenna of 1.2 m diameter in bands shared with the terrestrial services (based on the parameters of Table 2).

NOTE 1 – The purpose of this Recommendation is to protect terrestrial services to which the frequency bands are allocated. As for the protection of the space services in the same frequency bands the matter is dealt with in Recommendation ITU-R S.1587¹.

Annex 1

Method to use in development of a minimum distance for the 5 925-6 425 MHz and 14-14.5 GHz bands

1 Method to determine the distance

The maximum permissible interference power is

$$I_{max} = \left(\frac{I}{N} \right)_{th} + 10 \log_{10}(k T_{FSR} B_{FSR}) \quad \text{dBW} \quad (1)$$

where:

$\left(\frac{I}{N} \right)_{th}$: interference to thermal noise power ratio defined in interference criterion (dB)

k : Boltzman's constant (W/(K · Hz))

T_{FSR} : system noise temperature of the fixed service receiver (FSR) (K)

B_{FSR} : bandwidth of FSR (Hz).

Once the short-term interference criterion has been defined, the minimum permissible transmission loss is given by subtracting the FSR's permissible interference power level from the sum of the ESV's e.i.r.p. in the direction of the FSR and the FSR's average antenna gain in its –10 dB beamwidth. The minimum permissible transmission loss is therefore given by:

$$L_{b,min}(p_s) = P_{t,max} + G_t + G_{r,AVE} - I_{max} - F \quad (2)$$

¹ The characteristics of the ESVs need to be within the envelope of those initially published in the BR IFIC relating to the corresponding FSS network. Otherwise, the earth stations need to be coordinated in accordance with the current provisions of the RR and the relevant Rules of Procedure (i.e. § 2 of the Rules of Procedure relating to RR No. 11.32).

where:

- $L_{b, min}$: minimum required basic transmission loss (dB)
- $P_{t, max}$: maximum transmit power at the ESV antenna input flange (dBW)
- G_t : ESV antenna gain in the direction of the FSR (dBi)
- $G_{r, AVE}$: average gain of the FSR antenna within its -10 dB beamwidth (dBi)
- I_{max} : maximum permissible interference power (dBW)
- F : loss in the feed from the FSR antenna to the low-noise amplifier (dB).

Because the ESV is not always present, it is not appropriate to use the short-term interference objective time percentage, p_s , directly as the propagation model input parameter, p , which is the time percentage for which the required minimum transmission loss is not exceeded (e.g. in Recommendations ITU-R P.452 or ITU-R P.620). The appropriate p depends on how much time the ESV spends within the -10 dB beamwidth of the FSR. But as is clear in Fig. 1, this amount of time depends on the distance from the ESV to the FSR. Since p depends on this distance and vice versa, an iterative method for determining the minimum distance d_{xxx} , that satisfies the short-term interference criteria is unavoidable.

FIGURE 1
Geometry of modelled scenario

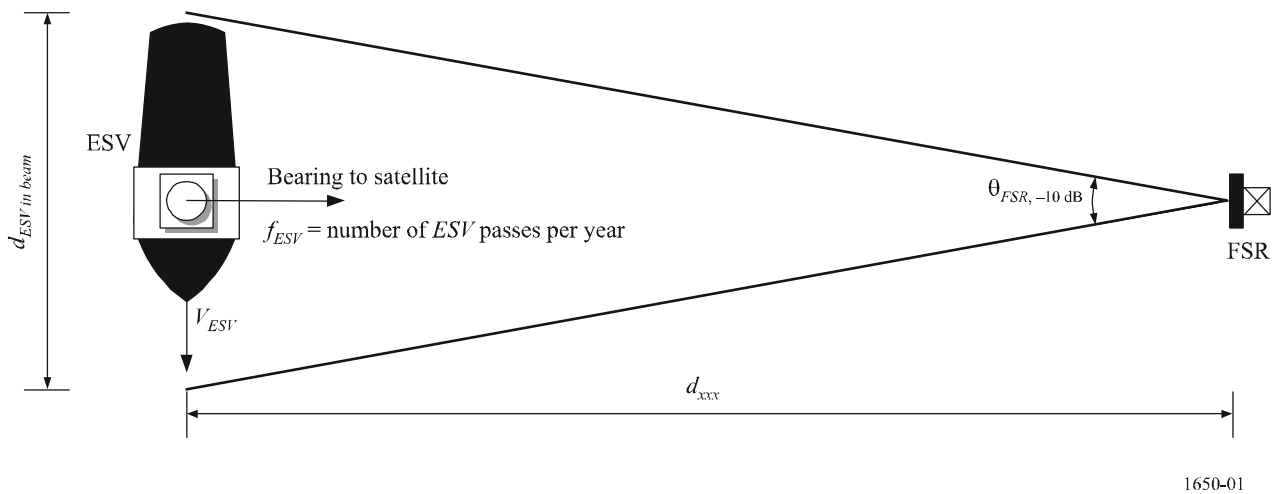
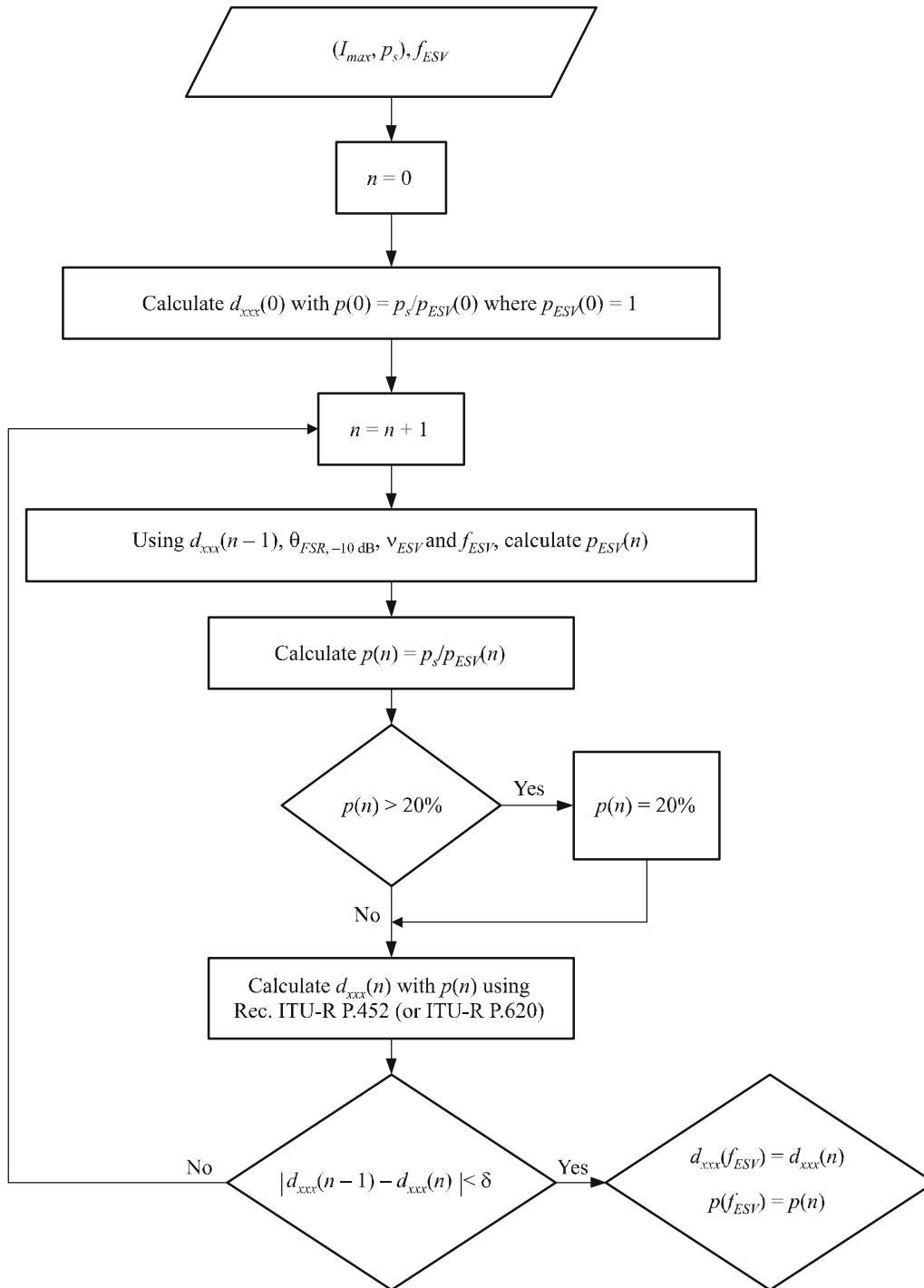


Figure 2 presents a flow chart that details the iterative procedure. The procedure can be initiated under the assumption that the ESV is always present, yielding $d_{xxx}(0)$. The next iteration determines how much time the ESV would spend in the -10 dB beamwidth of the FSR at the distance $d_{xxx}(0)$ and then calculates $d_{xxx}(1)$ based on the resulting value of p . The procedure continues until the difference between d_{xxx} on successive iterations is less than a threshold, δ . It is recommended that $\delta = 3$ km.

FIGURE 2
Flow chart of iterative process



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- n : stage of the iteration, $n = 0, 1, 2, \dots$
 I_{max} : maximum permissible interference power (dBW)
 P_s : time percentage (annual) for which I_{max} be exceeded (%)
 P_{ESV} : time percentage (annual) for which ESV 's are present (%)
 v_{ESV} : ship's speed (km/h)
 p : time percentage (annual) for which minimum required transmission loss is not exceeded (%)
 δ : 3 km is recommended (distances < 3 km are not recommended due to the interaction between the iterations of the propagation model and the iterations of this method)

2 Parameter values

The parameter values below do not necessarily represent the worst case of each parameter. However, they are used to develop a representative set of characteristics which are considered to provide adequate protection to the FS from potential interference from ESVs.

2.1 Parameter values for the 6 GHz band

TABLE 1
Parameters used in calculating the minimum distance

ESV parameters		
Parameter	Value	Comment
Frequency of operation, f (MHz)	6 000	
Antenna height above sea level, h_{ts} (m)	40	
Elevation angle to satellite, ϕ (degrees)	>10	Lower elevation angles may be used provided that the e.i.r.p. towards the horizon is consistent with the 10° elevation angle operational limitation
Horizon gain angle, θ_h (degrees)	0	Equation (24) of Recommendation ITU-R SM.1448 = 0 in worst case
Maximum transmit power at input to antenna, $P_{t, max}$ (dBW)	16.7	
Minimum antenna diameter, D_{min} (m)	2.4	
Antenna gain in direction of FSR, $G_t = G_{ESV}(\phi)$ (dBi)	+4 to -10	Equation (33) of Recommendation ITU-R SM.1448
Maximum occupied bandwidth, B_{ESV} (MHz)	2.346	
Data rate, R_{ESV} (Mbit/s)	1.544	
Ship's speed, v_{ESV} (km/h)	18.3	Typical minimum value when out to sea (10 knots)
Frequency of passage, f_{ESV} (passes/year) which fall into FSR receiver channel bandwidth	Variable	See § 3.5
FSR parameters		
Frequency of operation, f (MHz)	6 000	Equal to ESV value
Antenna height above ground, h_{rg} (m)	70	