

Coordination of terrestrial stations operating in the bands shared with space service

1 Provisions of the Radio Regulations (RR) for coordination in the shared bands

Article 9 provides in its Section II the procedure for effecting coordination. Coordination of terrestrial services in the shared bands shall be effected with other administrations for the cases described in the following provisions:

- No. **9.16**: for a transmitting station of a terrestrial service for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to No. **9.11A** and which is located within the coordination area of an earth station in a non-geostationary-satellite network;
- No. **9.18**: for any transmitting station of a terrestrial service in frequency bands above 100 MHz allocated with equal rights to space and terrestrial services within the coordination area of an earth station, in respect of this earth station, with the exception of the coordination under Nos. **9.16** and **9.19**;
- No. **9.19**: for any transmitting station of a terrestrial service in a frequency band shared on an equal primary basis with the broadcasting-satellite service, with respect to typical earth stations included in the service area of a space station in the broadcasting-satellite service;
- No. **9.21**: for any station of a service for which the requirement to seek the agreement of other administrations is included in a footnote to the Table of Frequency Allocations referring to No. **9.21** (such as footnotes Nos. **5.410** and **5.447**).

Furthermore, the Rules of Procedure¹ (RoP) define how the provisions Nos. **9.16**, **9.18**, **9.19** and **9.21** shall be applied.

The frequency bands, which are subject to the application of No. **9.16**, are summarized in Table 9.11A-2 of the Rules of Procedure.

The coordination procedure of No. **9.18** is to be applied only in frequency bands allocated to a space service in the direction space-to-Earth, i.e. when transmitting terrestrial stations are inside the coordination area of a receiving earth station for which coordination under No. **9.17** has already been initiated and in the case where both services have the same category of allocation. The coordination between receiving terrestrial stations and transmitting earth stations is done only when the transmitting earth station is coordinated in application of No. **9.17**. Once that coordination is initiated an administration wishing to operate terrestrial stations within the coordination area of the transmitting earth station can evaluate the level of interference that its station may receive and decide by itself whether to proceed or not with the implementation of its terrestrial stations.

The provision No. **9.19** relates to the requirements of coordination between transmitting terrestrial stations and BSS earth stations. For terrestrial assignments in the frequency bands shared with planned BSS, i.e. for the frequency band 11.7-12.7 GHz, the necessary criteria and procedures are defined in Appendix **30**.

¹ [Rules of Procedure](#), approved by the Radio Regulations Board, for the application by the Radiocommunication Bureau of the provisions of the Radio Regulations, Regional Agreements, Resolutions and Recommendations of World and Regional Radiocommunication Conference

However, for the non-planned BSS frequency bands to date, there is no ITU-R Recommendation defining the power flux-density level produced by the terrestrial stations at the edge of the service area of non-planned BSS to be used for triggering the coordination. Until such time that a calculation method and technical criteria are included in the relevant ITU-R Recommendations, in applying this provision, for the identification of the affected administration, the Bureau, in addition to the frequency overlap examination, also uses, the distance from the location of the terrestrial station to the national border of any country included in the service area of the BSS assignment less than 1 200 km, as well as for transmitting IMT stations notified with nature of service “IM” in the frequency band 1 452-1 492 MHz, in Regions 1 and 3, the power flux-density of $-154 \text{ dB(W/(m}^2 \cdot 4 \text{ kHz))}$ at the edge of the service area of non-planned BSS (see Rule of Procedure Part A1 with respect to provision No **9.19**).

It is necessary to state that coordination referred in Nos. **9.16**, **9.18** and **9.19** is to be used in coordination between administrations. The coordination referred in Nos. **9.21** is to be effected by the application of the procedure described in Article **9**, which includes the identification of potentially affected administrations, publication of Special Sections RR9.21/C and RR9.21/D and provision of assistance by the Bureau, when requested. After completion of coordination the administration can notify the Bureau of the terrestrial station, with indication of administrations with which the coordination has been effected.

The frequency assignments to be taken into account in effecting coordination are identified using the principles of Appendix **5** to the RR.

2 Identification of administrations with which coordination is to be effected

For the purpose of effecting coordination of a transmitting terrestrial station under Nos. **9.16**, **9.18** and **9.19** of Article **9** of the RR and for identifying the administrations with which coordination is to be effected, the frequency assignments to be taken into account are those in the same frequency band as the terrestrial station, pertaining to a space service to which the band is allocated with equal rights or a higher category of service, which might affect or be affected and which are identified using the method described in Appendix **5** to the RR.

For the application of No. **9.21**, the agreement of an administration may be required with respect to the frequency assignments in the same frequency band as the planned terrestrial assignment, pertaining to the same service or to another service to which the band is allocated with equal rights or a higher category of service, which may affect or be affected, as appropriate, and which are identified using the method described in Appendix **5** to the RR.

For each of the frequency assignments to a station of a terrestrial or space radiocommunication service referred to above, the level of interference shall be determined using the method referred to in Table **5-1** of Appendix **5** to the RR and the relevant RoP which is appropriate to the particular case.

No coordination of a terrestrial assignment is required in cases such as:

- when the use of a new frequency assignment will not cause or suffer, as appropriate, in respect of any service of another administration, an increase in the level of interference above the threshold calculated in accordance with the method referred to in Table **5-1**; or
- when the characteristics of a new or modified frequency assignment are within the limits of those of a frequency assignment that has previously been coordinated; or
- to change the characteristics of an existing assignment in such a way as not to increase the interference to or from, as appropriate, the assignments of other administrations; or

- to bring into use an assignment to a terrestrial station which is located, in relation to an earth station, outside the coordination area of that earth station; or
- to bring into use an assignment to a terrestrial station within the coordination area of an earth station, provided that the proposed assignment to a terrestrial station is outside any part of a frequency band coordinated for reception by that earth station.

Parts of Table 5-1 and some provisions of RoP applicable to the coordination of terrestrial services are presented below.

Methods for identifying the level of interference

	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.16 Terrestrial/ non-GSO	A transmitting station in a terrestrial service within the coordination area of an earth station in a non-GSO satellite network in frequency bands for which a footnote refers to No. 9.11A	Frequency bands for which a footnote refers to No. 9.11A	Transmitting terrestrial station is situated within the coordination area of a receiving earth station		The coordination area of the affected earth station has already been determined using the method of Appendix 7
No. 9.18 Terrestrial/ GSO, non-GSO	Any transmitting station of a terrestrial service in the bands referred to in No. 9.17 within the coordination area of an earth station, in respect of this earth station, with the exception of the coordination under Nos. 9.16 and 9.19	Any frequency band allocated to a space service	Transmitting terrestrial station is situated within the coordination area of a receiving earth station	See Remarks column	Reference of Article 9
No. 9.19 Terrestrial GSO, non-GSO/ GSO, non-GSO	Any transmitting station of a terrestrial service or a transmitting earth station in the FSS (Earth-to-space) in a frequency band shared on an equal primary basis with the BSS, with respect to typical earth stations included in the service area of a space station in the BSS	1 452-1 492 MHz 2 310-2 360 MHz (terrestrial services in all three Regions in respect of BSS allocation in No. 5.393) 2 520-2 670 MHz (see No. 5.416) 11.7-12.7 GHz (see Article 6 of Appendix 30) 12.5-12.7 GHz (terrestrial services in Nos. 5.494 and 5.496 as well as in Regions 2 and 3, or transmitting earth	i) Necessary bandwidths overlap; ii) the pfd of the interfering station at the edge of the BSS service area exceeds the permissible level; or iii) Transmitting terrestrial station is situated	Check by using the assigned frequencies and bandwidths; and Check the pfd of the interfering station at the edge of the BSS service area exceeds the permissible level or the	See also Article 6 of Appendix 30 and RoP on No. 9.19

	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/ condition	Calcula- tion method	Remarks
		<p>station in the FSS (Earth-to-space) in Region 1, in respect of BSS allocation in Region 3)</p> <p>12.7-12.75 GHz (terrestrial services in Nos. 5.494 and 5.496 as well as in Regions 2 and 3, or transmitting earth station in the FSS (Earth-to-space) in Regions 1 and 2, in respect of BSS allocation in Region 3)</p> <p>17.7-17.8 GHz (terrestrial services in all three Regions in respect of BSS allocation in Region 2)</p> <p>17.3-17.8 GHz (transmitting earth stations in the FSS (Earth-to-space) in respect of BSS allocation in Region 2) (see Article 4 of Appendix 30A)</p> <p>40.5-42.5 GHz</p> <p>74-76 GHz</p>	within the coordination distance set in RoP on No.9.19.	distance from the location of the terrestrial station to the national border of any country included in the service area of the BSS earth station.	

	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.21 Terrestrial, GSO, non-GSO/terrestrial, GSO, non-GSO	A station of a service for which the requirement to obtain the agreement of other administrations is included in a footnote to the Table of Frequency Allocations referring to No. 9.21	Band(s) indicated in the relevant footnote	Incompatibility established by the use of Appendices 7, 8 , technical Annexes of Appendices 30, 30A , pfd values specified in some of the footnotes, other technical provisions of the RR or ITU-R Recommendations, as appropriate	Methods specified in, or adapted from, Appendices 7, 8, 30, 30A , other technical provisions of the RR or ITU-R Recommendations	See also RoP on Nos. 5.312A, 5.316B, 5.341A, 5.346 and 9.21 and Sections B4, B5 and B6 of Part B of the RoP.

	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.16 Terrestrial/ non-GSO	A transmitting station in a terrestrial service within the coordination area of an earth station in a non-GSO satellite network in frequency bands for which a footnote refers to No. 9.11A	Frequency bands for which a footnote refers to No. 9.11A	Transmitting terrestrial station is situated within the coordination area of a receiving earth station		The coordination area of the affected earth station has already been determined using the method of Appendix 7
No. 9.18 Terrestrial/ GSO, non-GSO	Any transmitting station of a terrestrial service in the bands referred to in No. 9.17 within the coordination area of an earth station, in respect of this earth station, with the exception of the coordination under Nos. 9.16 and 9.19	Any frequency band allocated to a space service	Transmitting terrestrial station is situated within the coordination area of a receiving earth station	See Remarks column	Reference of Article 9
No. 9.19 Terrestrial GSO, non-GSO/ GSO, non-GSO	Any transmitting station of a terrestrial service or a transmitting earth station in the FSS (Earth-to-space) in a frequency band shared on an equal primary basis with the BSS, with respect to typical earth stations included in the service area of a space station in the BSS	1 452-1 492 MHz 2 310-2 360 MHz (terrestrial services in all three Regions in respect of BSS allocation in No. 5.393) 2 520-2 670 MHz (see No. 5.416) 11.7-12.7 GHz (see Article 6 of Appendix 30) 12.5-12.7 GHz (terrestrial services in Nos. 5.494 and 5.496 as well as in Regions 2 and 3, or transmitting earth station in the FSS (Earth-to-space) in Region 1, in respect of BSS allocation in Region 3) 12.7-12.75 GHz (terrestrial services in Nos. 5.494 and 5.496 as well as in Regions 2 and 3, or	i) Necessary bandwidths overlap; ii) the pfd of the interfering station at the edge of the BSS service area exceeds the permissible level; or iii) Transmitting terrestrial station is situated within the coordination distance set in RoP on No. 9.19 .	Check by using the assigned frequencies and bandwidths; and Check the pfd of the interfering station at the edge of the BSS service area exceeds the permissible level or the distance from the location of the terrestrial station to the national border of any country	See also Article 6 of Appendix 30 and RoP on No. 9.19

	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/ condition	Calcula- tion method	Remarks
		transmitting earth station in the FSS (Earth-to-space) in Regions 1 and 2, in respect of BSS allocation in Region 3) 17.7-17.8 GHz (terrestrial services in all three Regions in respect of BSS allocation in Region 2) 17.3-17.8 GHz (transmitting earth stations in the FSS (Earth-to-space) in respect of BSS allocation in Region 2) (see Article 4 of Appendix 30A) 40.5-42.5 GHz 74-76 GHz		included in the service area of the BSS earth station.	

	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. 9.21	A station of a service for which the requirement to obtain the agreement of other administrations is included in a footnote to the Table of Frequency Allocations referring to No. 9.21	Band(s) indicated in the relevant footnote	Incompatibility established by the use of Appendices 7, 8, technical Annexes of Appendices 30, 30A, pfd values specified in some of the footnotes, other technical provisions of the RR or ITU-R Recommendations, as appropriate	Methods specified in, or adapted from, Appendices 7, 8, 30, 30A, other technical provisions of the RR or ITU-R Recommendations	See also RoP on Nos. 5.312A, 5.316B, 5.341A, 5.346 and 9.21 and Sections B4, B5 and B6 of Part B of the RoP.

3 Methods for the determination of the coordination area

Appendix 7 to the RR contains procedures and system parameters for calculating an earth station's coordination area, including predetermined distances for the frequency bands between 100 MHz and 105 GHz.

The procedures allow the determination of a distance in all azimuthal directions around a transmitting or receiving earth station.

The basic concept is based on two propagation modes:

- *Propagation mode (1)*: propagation phenomena in clear air (tropospheric scatter, ducting, layer reflection/refraction, gaseous absorption and site shielding). These phenomena are confined to propagation along the great-circle path.
- *Propagation mode (2)*: hydrometeor scatter.

Tables 7 and 8 of Annex 7 to Appendix 7 to the RR specify the system parameters required for the determination of coordination distances for different frequency bands and different services.

The row in each table entitled "method to be used" directs the user to the appropriate section of the main body of Appendix 7 which describes the methods to be followed for the determination of the coordination area.

In addition, Appendix 7 in Table 10 provides information on predetermined coordination distances, which are applicable under certain sharing situations as follows:

Frequency sharing situation		Coordination distance (in sharing situations involving services allocated with equal rights) (km)
Type of earth station	Type of terrestrial station	
Ground-based in the bands below 1 GHz to which No. 9.11A applies. Ground-based mobile in the bands within the range 1-3 GHz to which No. 9.11A applies	Mobile (aircraft)	500
Aircraft (all bands)	Ground-based	500
Aircraft (all bands)	Mobile (aircraft)	1 000
Ground-based in the bands: 400.15-401 MHz 1 668.4-1 675 MHz	Station in the meteorological aids service (radiosonde)	580
Aircraft in the bands: 400.15-401 MHz 1 668.4-1 675 MHz	Station in the meteorological aids service (radiosonde)	1 080
Ground-based in the radiodetermination-satellite service (RDSS) in the bands: 1 610-1 626.5 MHz 2 483.5-2 500 MHz 2 500-2 516.5 MHz	Ground-based	100
Airborne earth station in the radiodetermination-satellite service (RDSS) in the bands: 1 610-1 626.5 MHz 2 483.5-2 500 MHz 2 500-2 516.5 MHz	Ground-based	400
Receiving earth stations in the meteorological-satellite service	Station in the meteorological aids service	The coordination distance is considered to be the visibility distance as a function of the earth station horizon elevation angle for a radiosonde at an altitude of 20 km above mean sea level, assuming 4/3 Earth radius (see Note 1 of AP7-Table 10). The minimum and maximum coordination distances are 100 km and 582 km, and correspond to physical horizon angles greater than 11° and less than 0°.
Non-GSO MSS feeder-link earth stations (all bands)	Mobile (aircraft)	500

Frequency sharing situation		Coordination distance (in sharing situations involving services allocated with equal rights) (km)
Type of earth station	Type of terrestrial station	
Non-GSO MSS feeder-link earth stations in the band 5 091-5 150 MHz	Station in the aeronautical radionavigation service	For the coordination distance in the frequency band 5 091-5 150 MHz vis-à-vis stations in the aeronautical radionavigation service, see No. 5.444A.
Receiving earth stations in the space research service in the band: 2 200-2 290 MHz	Mobile (aircraft)	880
Ground-based in the bands in which the frequency sharing situation is not covered in the rows above	Mobile (aircraft)	500

4 Some ITU-R references concerning coordination and sharing

There are several Resolutions and Recommendations contained in Volumes 3 and 4 of the RR and different ITU-R Recommendations dealing with particular coordination and sharing aspects. Many of them may serve as a supporting tool to administrations when considering the coordination of terrestrial stations in the shared frequency bands.

The most recent versions of the following Recommendations, for example, may be considered in the coordination of fixed service stations with mobile satellite service stations:

- Recommendation ITU-R [F.1245](#): Mathematical model of average and related radiation patterns for line-of-sight point-to-point fixed wireless system antennas for use in certain coordination studies and interference assessment in the frequency range from 1 GHz to about 70 GHz.
- Recommendation ITU-R [M.1141](#): Sharing in the 1-3 GHz frequency range between non-geostationary space stations operating in the mobile-satellite service and stations in the fixed service.
- Recommendation ITU-R [M.1142](#): Sharing in the 1-3 GHz frequency range between geostationary space stations operating in the mobile-satellite service and stations in the fixed service.
- Recommendation ITU-R [M.1143](#): System specific methodology for coordination of non-geostationary space stations (space-to-Earth) operating in the mobile-satellite service with the fixed service.
- Recommendation ITU-R [M.1319](#): The basis of a methodology to assess the impact of interference from a time division multiple access/frequency division multiple access (TDMA/FDMA) mobile-satellite service (MSS) space-to-Earth transmissions on the performance of line-of-sight fixed service receivers in the frequency range 1-3 GHz.
- Recommendation ITU-R [F.1108](#): Determination of the criteria to protect fixed service receivers from the emissions of space stations operating in non-geostationary orbits in shared frequency bands.

- Recommendation ITU-R [F.699](#): Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to 86 GHz.
- Recommendation ITU-R [M.1469](#): Methodology for evaluating potential for interference from time division multiple access/frequency division multiple access (TDMA/FDMA) mobile-satellite service (MSS) Earth-to-space transmissions into line-of-sight fixed service receivers in the frequency range 1-3 GHz.
- Recommendation ITU-R [M.1471](#): Guide to the application of the methodologies to facilitate coordination and use of frequency bands shared between the mobile-satellite service and the fixed service in the frequency range 1-3 GHz.
- Recommendation ITU-R [M.1472](#): Methodology to evaluate the impact of interference from time division multiple access/frequency division multiple access (TDMA/FDMA) mobile-satellite service (MSS) (space-to-Earth) transmissions on baseband performance in frequency division multiplexing-frequency modulation (FDM-FM) analogue line-of-sight fixed service receivers in the frequency range 1-3 GHz.
- Recommendation ITU-R [M.1473](#): Methodology to evaluate the impact of interference from time division multiple access/frequency division multiple access (TDMA/FDMA) mobile-satellite service (MSS) (space-to-Earth) transmissions on video baseband performance in TV-FM analogue line-of-sight fixed service receivers in the frequency range 1-3 GHz.
- Recommendation ITU-R [M.1474](#): Methodology to evaluate the impact of interference from time division multiple access/frequency division multiple access (TDMA/FDMA) mobile-satellite service (MSS) systems on baseband performance in digital line-of-sight fixed service receivers based on statistics of radio-frequency interference in the frequency range 1-3 GHz;
- Recommendation ITU-R [M.2082](#): Methodology and technical example to assist coordination of the mobile-satellite service and the radiodetermination-satellite service with the fixed service based on the power flux-density coordination trigger levels in the 2 483.5-2 500 MHz band.
- Recommendation ITU-R [SA.2142](#): Methodologies for calculating coordination areas around Earth exploration satellite and space research earth stations to avoid harmful interference from IMT-2020 systems in the frequency bands 25.5-27 GHz and 37-38 GHz.

Furthermore, technical guidance and a planning tool are provided in Recommendation ITU-R [F.1335](#) and could be considered when planning the transition of fixed service systems from the bands 1 980-2 010 MHz and 2 170-2 200 MHz in all three Regions, and 2 010-2 025 MHz and 2 160-2 170 MHz in Region 2.
