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Recommendation ITU-R M.2159-0

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Technical and regulatory measures to provide compatibility between international mobile telecommunications and mobile-satellite services with respect to mobile-satellite services operations in the frequency band 1 518-1 525 MHz for administrations wishing to implement international mobile telecommunications in the frequency band 1 492-1 518 MHz

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Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R M.2159-0*

Technical and regulatory measures to provide compatibility between international mobile telecommunications and mobile-satellite services with respect to mobile-satellite services operations in the frequency band 1 518-1 525 MHz for administrations wishing to implement international mobile telecommunications in the frequency band 1 492-1 518 MHz[1]

(2023)

Scope

This Recommendation provides technical and regulatory measures for adjacent band compatibility between satellite systems in the mobile-satellite service (MSS) operating in the band 1 518-1 525 MHz and terrestrial international mobile telecommunications (IMT) systems operating in the band 1 492-1 518 MHz as invited by Resolution **223 (Rev.WRC-19)**. See also footnote 1.

Keywords

IMT, MES, adjacent band compatibility

Abbreviations/Glossary

BS	Base station
e.i.r.p.	Equivalent isotropically radiated power
FDD	Frequency division duplex
IMT	International mobile telecommunications
MES	Mobile earth station
MSS	Mobile-satellite service
pfd	Power flux-density
SDL	Supplemental downlink
TDD	Time division duplex
UE	User equipment

Related ITU-R Recommendations/Reports

Recommendation ITU-R M.1036 – Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications in the bands identified for IMT in the Radio Regulations

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* This Recommendation should be brought to the attention of the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO), and the International Mobile Satellite Organization (IMSO).

[1] While the Recommendation is based on studies requested by Resolution **223 (Rev.WRC-19)** relating to coexistence between IMT in the band 1 492-1 518 MHz and MSS in the band 1 518-1 525 MHz, the technical requirements and regulatory measures recommended are also effective and may be applicable to mobile Earth stations operating in the band 1 525-1 559 MHz.

Report ITU-R M.2529 – Adjacent band compatibility studies of IMT systems in the mobile service in the band 1 492-1 518 MHz with respect to systems in the mobile-satellite service in the frequency band 1 518-1 525 MHz

The ITU Radiocommunication Assembly,

considering

a) that the frequency band 1 492-1 525 MHz is allocated to the mobile service in Regions 2 and 3 and to the mobile, except aeronautical mobile, service in Region 1 on a primary basis;

b) that WRC-15 identified the frequency band 1 427-1 518 MHz globally for use by administrations wishing to implement terrestrial IMT systems;

c) that the frequency band 1 518-1 559 MHz is allocated in all three Regions to the mobile-satellite service (MSS) on a primary basis;

d) that the frequency band 1 518-1 559 MHz may be used for land MSS, maritime MSS and aeronautical MSS applications;

e) that there is a need to ensure the continued operations of the MSS in the frequency band 1 518-1 525 MHz, in accordance with Resolution **223 (Rev.WRC-19)**;

f) that there may be a need to ensure compatibility between terrestrial IMT systems and MESs at ports and airports, and land MESs. This is particularly the case for some legacy MESs without adequate blocking protection;

g) that new mobile earth stations (MES) are being developed, providing better protection against blocking interference from the adjacent band,

recognizing

a) that Resolution **223 (Rev.WRC-19)** invites the ITU-R to conduct compatibility studies in order to provide technical measures to ensure coexistence between MSS in the frequency band 1 518-1 525 MHz and IMT in the frequency band 1 492-1 518 MHz, including guidance on the implementation of frequency arrangements for IMT deployment in the frequency band 1 427-1 518 MHz, taking into account the results of these studies;

b) that Report ITU-R M.2529 contains the technical measures to ensure coexistence between MSS in the frequency band 1 518-1 525 MHz and IMT in the frequency band 1 492-1 518 MHz;

c) that guidance on frequency arrangements for the implementation of terrestrial IMT is contained in Recommendation ITU-R M.1036-6,

noting

that, whilst the recommendations for IMT and MES equipment may provide a certain level of compatibility, there may be areas within a country where additional measures may be applied to facilitate compatibility,

recommends

1 that administrations should consider the emission levels from IMT equipment operating in the band 1 492-1 518 MHz as provided in Annex 1;

2 that, administrations should consider the MES blocking levels as provided in Annex 2;

3 that administrations should consider further regulatory measures for IMT BSs, to provide for compatibility with ship earth stations and aircraft earth stations in selected areas, as described in Annex 3;

4 that where this Recommendation is used for compatibility with land MESs, administrations should consider further regulatory measures to IMT, as described in Annex 4.

Annex 1

Emission levels from IMT equipment operating in the band 1 492-1 518 MHz

This Annex provides the technical requirements for the unwanted emissions from IMT equipment. Unwanted emissions from IMT base stations and user equipment operating in the band 1 492-1 518 MHz could cause interference to MSS operations above 1 518 MHz. Administrations should consider application of the unwanted emission limits for IMT base stations and user equipment from the options provided in this Annex.

The following Tables contain different options based on the different results of the studies in Report ITU-R M.2529. It should be noted that the requirements expressed in the different options below are based on results of compatibility studies related to interference from unwanted emissions. Potential interference due to MES receiver blocking is addressed separately, however the unwanted emissions for IMT base stations will be affected by the required reduction of the IMT in-band signal to meet the pfd level related to blocking requirements.

Options for IMT base stations are defined in Table 1. In this Table, those options employing the lower unwanted emission limits for IMT base stations would lower the risk of harmful interference to MSS operations in the frequency band above 1 518 MHz. However, in order for IMT base stations to meet the unwanted emission limits in this table, technical or operational measures (e.g. filtering, reduction of in-band power or guard band) are required, in particular for those base stations using channels above 1 502 MHz or 1 507 MHz depending on the individual manufacturers equipment characteristics.

TABLE 1

Options for IMT base stations unwanted emission limits

Option	MSS operations in the band 1 518-1 525 MHz (Y/N)	Maximum unwanted emissions (e.i.r.p.) (Δf is the frequency relative to and above 1 518 MHz)
1 (1)	Y	−0.8 dBm/MHz (0 MHz ≤ Δf ≤ 2 MHz), −30 dBm/MHz (2 MHz < Δf ≤ 41 MHz)
2	N	No additional requirement (0 ≤ Δf ≤ 7 MHz), −30 dBm/MHz (7 MHz < Δf ≤ 41 MHz)
3	Y	−41 dBm/MHz (0 MHz < Δf ≤ 41 MHz)
4	N	No additional requirement (0 ≤ Δf ≤ 7 MHz), −41 dBm/MHz (7 MHz < Δf ≤ 41 MHz)
5	Y	−30 dBm/MHz (0 MHz ≤ Δf ≤ 2 MHz), −41 dBm/MHz (2 MHz < Δf ≤ 7 MHz), −52 dBm/MHz (7 MHz < Δf ≤ 41 MHz)

TABLE 1 (*end*)

Option	MSS operations in the band 1 518-1 525 MHz (Y/N)	Maximum unwanted emissions (e.i.r.p.) (Δf is the frequency relative to and above 1 518 MHz)
6	N	No additional requirement ($0 \leq \Delta f \leq 7$ MHz), −52 dBm/MHz (7 MHz < $\Delta f \leq 41$ MHz)

(1) This option assumes an upper edge of the IMT frequency block at 1 517 MHz with a maximum of 58 dBm/5 MHz in-band e.i.r.p. for the band 1 512-1 517 MHz. The result of applying the unwanted emission level of −0.8 dBm/MHz is that in 1 518-1 520 MHz, MSS will not be able to operate in this portion of the band in the same geographical area as IMT.

Options for IMT user equipment are defined in Table 2.

TABLE 2

Options for IMT user equipment unwanted emission limits

Option	Application	Maximum unwanted emissions (Δf is the frequency relative to and greater than 1 518 MHz)
1 (1), (2)	IMT TDD	−70 dBm/MHz (0 MHz < $\Delta f \leq 41$ MHz)
2 (3)	IMT TDD	−20 dBm/MHz (2 MHz < $\Delta f \leq 41$ MHz)
3	IMT SDL or FDD	None, noting that there are no UE transmitting in the band 1 492-1 518 MHz

(1) This option is to be applied with an additional regulatory requirement that the UE should not be used within 10 m of a ship earth station.

(2) The option employing the lower unwanted emission limit for IMT user equipment would lower the risk of harmful interference to MSS operations in the frequency band above 1 518 MHz. However, complying with the lower unwanted emission limit would make it more difficult to implement IMT user equipment.

(3) Employing the higher unwanted emission limits for IMT user equipment would increase the risk of harmful interference to MSS operations in the frequency band above 1 518 MHz, while complying with the higher unwanted emission limit is easier to implement in IMT user equipment. Therefore, this option would make it more difficult to operate MSS systems. In addition, this option does not provide any unwanted emission level for MSS band in the range of 1 518-1 520 MHz.

Annex 2

MES receiver blocking resilience levels

This Annex provides the receiver blocking levels in MES equipment. The pfd and e.i.r.p. measures to ensure the continued operations of the MSS defined in Annexes 3 and 4 include measures based on the anticipated improvements in the receiver blocking performance of mobile earth stations. The Phase 2 limits in particular, are applied at a time when MESs could tolerate a higher level of emissions from IMT. Consequently, the timing of the transition from Phase 1 limits to Phase 2 limits is dependent on the deployment of MESs with improved receiver performance.

Administrations may wish to plan for the transition from Phase 1 to Phase 2 limits for land, maritime, and aeronautical MES terminals, considering different equipment replacement cycles for those categories. Administrations may consult with international and national aeronautical and maritime agencies, the airlines, the mobile industry, and other relevant organisations to establish conditions and time schedules as appropriate.

TABLE 3

MES receiver blocking level

Blocking signal level	IMT signal	MES operating condition
–30 dBm (1)	5 MHz bandwidth IMT signal operating below 1 517 MHz	Wanted signal is above 1 518 MHz (2)

(1) MES blocking level of −40 dBm or lower may be applied to small terminals, without changing the coexistence measures defined elsewhere in this Recommendation.

(2) For the purpose of testing, the MESs wanted signal is above 1 520 MHz

Annex 3

Additional measures for IMT base stations to provide for compatibility with ship earth stations and aircraft earth stations in selected areas[2]

The compatibility measures contained in this Annex are in addition to the technical requirements for MESs and IMT set out in (Annexes 1, 2 and 4) and are based on maximum pfd levels applied as a regulatory condition within geographic areas selected by administrations. The effect of the pfd limits is to reduce the risk of interference to maritime MESs and would be applied at the boundary of selected geographical areas where ships use MES terminals, i.e. ports, and may also include coastal areas, and some inland waterways. The effect of the pfd limits is to reduce the risk of interference to aeronautical MESs and would be applied to the boundary of the area where aircraft operate on the ground, i.e. airports and may include some maintenance facilities. IMT BSs would be deployed taking account of the selected areas to avoid exceeding the pfd limits within. In addition to any national requirements for ship earth stations and aircraft earth stations, there may also be obligations for visiting foreign ships and aircraft at these locations.

Where an administration has decided to use the compatibility measures of this Annex, a geographical separation is typically required between the IMT base station and the boundary of the geographical areas. The geographical separation depends on a number of factors including IMT base station e.i.r.p., local clutter, and the applicable pfd limits (Phase 1 or Phase 2). For some of the pfd values, this geographical separation may be up to several tens of kms.

As an example, one administration has authorised IMT systems in the band 1 492-1 517 MHz and has provided an indication that the IMT base station around airports needs to be at distances up to around 3 km to 12 km to meet the recommended pfd limits in this Recommendation.

[2] Regarding the application of this Annex to countries with MSS operations in different parts of 1.5 GHz range, see also the footnote to the title of this Recommendation.

This Annex has not considered the use of IMT BSs located at sea or on aerial platforms in the band 1 492-1 518 MHz.

The pfd limits are applied in two phases, which are consecutive in time. The Phase 1 limits are based on the characteristics of currently operating MESs and the Phase 2 limits are based on the characteristics of terminals which meet the technical blocking levels of this Recommendation, which are expected to be more resilient to blocking, and hence would lead to less demanding pfd values.

For the specific pfd values for Phase 1, two options are presented, based on different assumptions regarding the blocking performance of currently operating MES terminals which are described below. For the Phase 2 pfd values, both options determine pfd limits based on blocking performance of MES terminals which meet the technical blocking levels of this Recommendation.

MES terminals are more susceptible to interference from multiple IMT channels within the band 1 492-1 517 MHz. Measurements were performed to assess blocking due to intermodulation from a base station transmitting multiple IMT channels. Under the first option (A), pfd limits are provided in two tables, Table 4 for an IMT BS that transmits a single channel in this band and Table 5 for an IMT BS that transmits on multiple channels in this band, where the signals from the channels experience the same propagation condition and are received at the same relative signal levels at the MES terminal. Under the second option (B), pfd limits are provided in a single table (see Table 6) applicable for single and multiple channels. This is based on the assumption that when IMT BS signals from multiple channels are received at the MES terminal, due to the propagation characteristics, only one channel is dominant and hence the effect of multiple channels is considered negligible.

Option A

– For Phase 1, the pfd values are based on the blocking measurements of the currently operating terminals performed by some manufacturers. Those measurements determined that, with respect to IMT emissions in the band 1 512-1 517 MHz, blocking occurs at a level of −76 dBm for currently operating maritime terminals and −50.3 dBm for currently operating aeronautical terminals. For IMT emissions in the band 1 502-1 512 MHz, blocking occurs at levels of −68 dBm and −35 dBm for maritime and aeronautical terminals respectively. For IMT emissions in the band 1 492-1 502 MHz, blocking occurs at levels of −53 dBm and −21 dBm for maritime and aeronautical terminals respectively.

– The pfd limits applied during Phase 2 are based on assumed blocking performance for next generation MESs. For Phase 2, the pfd limits in Table 4 are based on −20 dBm and −30 dBm blocking levels resulting from the band 1 502-1 512 MHz and the band 1 512-1 517 MHz respectively; and the pfd values in Table 5 are based on −23 dBm and −33 dBm blocking levels resulting from the band 1 492-1 512 MHz and the band 1 512-1 517 MHz respectively.

TABLE 4

Pfd limits for IMT BS transmitting a single channel

Phase		Phase 1			Phase 2		
	MES terminal antenna gain (dBi)	**pfd limit for BS emissions in the band 1 492-1 502 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 502-1 512 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 492-1 502 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 502-1 512 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m²)**
Ports and inland waterways	3	−60.9	−75.9	−83.9	No limit required provided that the BS e.i.r.p. does not exceed 68 dBm	−27.9	−37.9
	3-19 (1)	−60.9 to −76.9	−75.9 to −91.9	−83.9 to −99.9	No limit required provided that the BS e.i.r.p. does not exceed 68 dBm	−27.9 to −43.9	−37.9 to −53.9
Airports	3	−28.9	−42.9	−58.2	No limit required provided that the BS e.i.r.p. does not exceed 68 dBm	−27.9	−37.9
	3-17 (1)	−28.9 to −42.9	−42.9 to −56.9	−58.2 to −72.2	No limit required provided that the BS e.i.r.p. does not exceed 68 dBm	−27.9 to −41.9	−37.9 to −51.9

(1) The pfd values based on 3 dBi MES antenna gain apply in most situations, but there are locations in the world where the antenna gain towards the horizon can exceed 3 dBi (up to 19 dBi or 17 dBi). This is where there is a low elevation angle for the MES and where an IMT BS could be deployed in the direction of the MSS satellite as seen from the MES. For these cases, the actual angles to the satellite and the IMT deployment should be taken into consideration and the pfd adjusted to a value within the ranges shown.

TABLE 5

Pfd limits for IMT BS transmitting multiple channels

Phase	MES terminal antenna gain (dBi)	Phase 1		Phase 2	
		pfd limit for BS emissions in the band 1 492-1 512 MHz (dBW/m^2)	pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m^2)	pfd limit for BS emissions in the band 1 492-1 512 MHz (dBW/m^2)	pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m^2)
Ports and inland waterways	3	−74.9	−85.9	−30.9	−40.9
	3-19 (1)	−74.9 to −90.9	−85.9 to −101.9	−30.9 to −46.9	−40.9 to −56.9
Airports	3	−53.5	−63.4	−30.9	−40.9
	3-17 (1)	−53.5 to −67.5	−63.4 to −77.4	−30.9 to −44.9	−40.9 to −54.9

(1) The pfd values based on 3 dBi MES antenna gain apply in most situations, but there are locations in the world where the antenna gain towards the horizon can exceed 3 dBi (up to 19 dBi or 17 dBi). This is where there is a low elevation angle for the MES and where an IMT BS could be deployed in the direction of the MSS satellite as seen from the MES. For these cases, the actual angles to the satellite and the IMT deployment should be taken into consideration and the pfd adjusted to a value within the ranges shown.

Option B

The pfd limits for this option are provided in Table 6 and are derived with reference to measurements of MSS terminals conducted by the United States FCC in 2004. FCC document FCC 05-30[3] records testing based on CDMA-2000, GSM/TDMA 800 and GSM 1 800 mobile system architecture. It showed that CDMA-2000 corresponds to a −52 dBm blocking level for 1 to 2 MHz frequency separation. The blocking level used for this option is −50 dBm for IMT in the band 1 512-1 517 MHz and −35 dBm for the frequencies below. Currently used maritime and aeronautical terminals (e.g. Inmarsat-C and Inmarsat aeronautical terminals) were not included in the tests performed back in 2004. It is noted that IMT-2020 and IMT-Advanced signals could have wider bandwidth that the CDMA-2000 signal used.

[3] FCC 05-30: "Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands – Memorandum Opinion and Order and Second Order on Reconsideration", February 2005.

TABLE 6

Pfd limits for IMT BSs transmitting a single or multiple channels

Phase	Phase 1			Phase 2		
	pfd limits for BS emissions in the band 1 492-1 502 MHz (dBW/m²)	**pfd limit for BS emissions in the band 1 502-1 512 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 492-1 502 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 502-1 512 MHz (dBW/m²)**	**pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m²)**
Ports and maritime areas, to be determined by administrations	−42.9	−42.9	−57.9	No limit required provided that the BS e.i.r.p. does not exceed 68 dBm	−27.9	−37.9
Airports	−42.9	−42.9	−57.9	No limit required provided that the BS e.i.r.p. does not exceed 68 dBm	−27.9	−37.9

Note: The pfd values based on 3 dBi MES antenna gain apply in most situations, but there are locations in the world where the antenna gain towards the horizon can exceed 3 dBi (up to 19 dBi for maritime or 17 dBi for aeronautical MESs). This is where there is a low elevation angle for the MES and where an IMT BS could be deployed in the direction of the MSS satellite as seen from the MES. For these cases, the actual angles to the satellite and the IMT deployment should be taken into consideration and the pfd adjusted to a value that reflect this.

Attachment to Annex 3

Blocking performances assumptions of MES terminals considered in Tables 4 to 6

The blocking performance assumptions of aeronautical and maritime MES terminals are provided below in Tables 7 and 8 for the respective IMT signal frequency range. The sources for the values for Phase 1 are described in Annex 3. While the Phase 2 values for IMT in the band 1 512-1 517 MHz are based on the MESs which meet the technical blocking levels of this Recommendation provided in Annex 2, the values for the band 1 492-1 512 MHz are based on assumptions. Therefore, when the MES terminals which meet the technical blocking levels provided in Annex 2 are available, administrations may need to review their blocking performance for the 1 492-1 512 MHz band and the corresponding pfd values in Annex 3.

TABLE 7

Blocking performance (dBm) assumptions of aeronautical and maritime MES terminals in Option A

Phase		**Phase 1**			**Phase 2**	
Frequency range (MHz)		**1 492-1 502**	**1 502-1 512**	**1 512-1 517**	**1 492-1 512**	**1 512-1 517**
For Table 4	Maritime MESs	−53	−68	−76	−20	−30
	Aeronautical MESs	−21	−35	−50.3	−20	−30
For Table 5	Maritime MESs	−67		−78	−23	−33
	Aeronautical MESs	−45.6		−55.5	−23	−33

TABLE 8

Blocking performance (dBm) assumptions of aeronautical and maritime MES terminals in Option B

Phase		**Phase 1**			**Phase 2**	
Frequency range (MHz)		**1 492-1 502**	**1 502-1 512**	**1 512-1 517**	**1 492-1 512**	**1 512-1 517**
For Table 6	Maritime MESs	−35	−35	−50	−20	−30
	Aeronautical MESs	−35	−35	−50	−20	−30

Annex 4

Additional regulatory measures for compatibility with land MESs

A4-1 Introduction

The measures in this Annex address the situation where the administration decides to apply additional regulatory compatibility measures to reduce the risk of interference in specific geographical areas for land MESs. This may be local areas or countrywide. These measures may be used on their own or together in different areas of a country to complement each other. They include:

1) Application of pfd limits for selected area(s) used by land MESs.

2) Application of an e.i.r.p. in-band limit for IMT BSs.

In general, land MES are deployed in a ubiquitous manner and operate nationwide. Therefore, IMT operations may not be feasible in the band 1 512-1 518 MHz in such cases.

For the applicability of this Annex, see the footnote to the title. More detail of the definition and application of these measures is provided below.

A4-2 Measure 1 – pfd limits

Administrations should define the geographic areas (parts of the country or its entirety) where the pfd limits apply. These maximum pfd levels apply to the IMT base station's emissions arriving in the defined areas irrespective of where the IMT BSs are located. The maximum pfd levels are to be met at a defined height above ground (e.g. 1.5 m), at the boundary of and inside, the area. The pfd limits improve the compatibility with IMT emissions and are in addition to the technical requirements of Annex 1. Because the IMT UEs are only able to transmit when connected to the network, the geographical separation distance resulting from the pfd levels for the IMT BSs may also provide separation for the UEs with respect to MESs, along with additional attenuation resulting from the UE antenna height and surrounding clutter.

The pfd limits are applied in two phases. For Phase 1, the pfd values are based on the measured blocking performance of current land MESs. For Phase 2, the pfd values are based on MESs which meet the blocking resilience levels in Annex 1. The Phase 2 pfd values are less constraining for IMT deployment and should be used when this is required by the concerned administration at a time when the resilient MES terminals are considered more widely deployed. The pfd limits relate to the emissions from the IMT base stations within the band 1 502-1 517 MHz.

Land MSS operations are typically authorised throughout a country and in that case the pfd limits may be applied throughout the national territory. In this case IMT operations may not be feasible in the band 1 512-1 518 MHz.

The pfd limits provided in Table 9 are for the highest and lowest MES antenna gain values given in Report ITU-R M.2529.

TABLE 9

Pfd limits for IMT BS emissions

Phase		**Phase 1**			**Phase 2**		
	MES terminal antenna gain (dBi) in the direction of the IMT base station	**pfd limit for BS emissions in the band 1 502-1 507 MHz (dBW/m^2)**	**pfd limit for BS emissions in the band 1 507-1 512 MHz (dBW/m^2)**	**pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m^2)**	**pfd limit for BS emissions in the band 1 502-1 507 MHz (dBW/m^2)**	**pfd limit for BS emissions in the band 1 507-1 512 MHz (dBW/m^2)**	**pfd limit for BS emissions in the band 1 512-1 517 MHz (dBW/m^2)**
Land based MESs	1 (lowest)	−54.9	−61.9	−68.9	−19.9	−23.9	−38.9
	32 (highest)	−85.9	−92.9	−99.9	−50.9	−54.9	−69.9

Note: The pfd limits apply to the total power radiated by any base station in the indicated band of 5 MHz bandwidth.

Administrations may need to adjust the values according to the characteristics of the MESs expected to operate in their territory and taking account of any MES antenna discrimination that may be assumed. It may be noted that the majority of land-based MES antennas are low gain because they are small IoT or handheld devices. However, where high gain MES antennas are used, they provide a higher level of discrimination. There are locations in the world where the antenna gain towards the horizon or towards a base station can be close to the peak value. This is where there is a low elevation angle for the MES and where an IMT BSs are deployed in the vicinity and in the direction of the MSS satellite as seen from the MES. For these cases, the actual angles to the satellite and the direction and distance to the IMT deployment should be taken into consideration and the pfd adjusted to a value that reflect this.

A geographical separation may be required between the IMT base station and the boundary of the defined areas where the pfd limits apply. This is particularly the case for the Phase 1 values and for higher power IMT base stations using the uppermost IMT block (closest to 1 518 MHz). The geographical separation depends on a number of factors including IMT base station e.i.r.p., local clutter, and the applicable pfd values (Phase 1 or Phase 2). For some of the pfd values and MES antenna elevation angles (very low), this geographical separation may be up to several tens of km.

A4-3 Measure 2 – In-band e.i.r.p. limits

The e.i.r.p. limits shown in Table 10 are intended to apply to IMT base stations and UEs and may be used as a standalone measure throughout a given country or may be used to supplement where an administration has decided not to use pfd levels for aeronautical, maritime or land MESs.

The e.i.r.p. values are based on the blocking resilience of currently operating MESs and next generation MESs that meet the technical requirements of this Recommendation.

The e.i.r.p. limits may be applied in two phases. For Phase 1, the e.i.r.p. values are based on the measured blocking performance of current land MESs. For Phase 2, the e.i.r.p. values are based on MESs which meet the blocking resilience levels in Annex 3.

TABLE 10

IMT BS e.i.r.p. limits and UE transmit power for compatibility with land MESs (for IMT BS/UE transmitting signal in the band 1 512-1 517 MHz)

Option	Maximum e.i.r.p. from IMT base station (dBm) Rural deployment	Maximum e.i.r.p. from IMT base station (dBm) Suburban deployment	Maximum e.i.r.p. from IMT base station (dBm) Urban deployment	Maximum transmit power from IMT User equipment (dBm)
1 (Phase 1) [1), 2)]	19.5	7	5.5	Not defined
1 (Phase 2) [1), 3)]	52.5	40	38.5	23
2 (Phase 1)	Not defined	Not defined	Not defined	Not defined
2 (Phase 2) [4)]	58	58	58	23

[1)] e.i.r.p. limits are not consistent with standard IMT parameters, but may allow deployment of other applications.

[2)] Providing improved compatibility to currently operating MESs.

[3)] Providing improved compatibility to next generation standard of MESs compared to Option 2.

[4)] Providing compatibility with next generation standard of MESs, but with higher interference than Option 1.