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Frequency coordination requirements between microwave fixed point-to-point links and earth stations

RALI: MS45

DATE OF EFFECT: 12TH SEPTEMBER 2025

Amendment history

Date	Comments
11 January 2019	IFC 1/2019 Consultation draft
2 August 2019	Initial release covering 6 GHz and 6.7 GHz finalised
22 July 2022	Update released for public consultation (IFC 26/2022) to include coordination requirements between earth station transmitters communicating with geostationary satellites in the fixed satellite services and fixed point-to-point fixed link receivers in the frequency bands: • 8 GHz (7725–8275 MHz) • 13 GHz (12.75–13.25 GHz) • 15 GHz (14.5–15.35 GHz) • 18 GHz (17.7–19.7 GHz) Additional guidance on application of minimum earth station elevation angle requirement (section 4.1). Inclusion of Appendices B & C providing information on how distance culls are calculated.
September 2025	Update to introduce coordination requirements for earth receive stations and fixed point-to-point link transmitters in the following bands: • 7.5 GHz (7425–7725 MHz) • 8 GHz (7725–8275 MHz) • 11 GHz (10.7–11.7 GHz) • 18 GHz (17.7–19.7 GHz) • 75 GHz (71–76 GHz) Update to introduce coordination requirements for earth transmit stations and fixed point-to-point link receivers in the 85 GHz (81–86 GHz) band.

Suggestions for improvements to Radiocommunications Assignment and Licensing Instruction MS45 may be addressed to:

The Manager, Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

or by email to: freqplan@acma.gov.au.

Please notify the ACMA of any inaccuracy or ambiguity found in this RALI so that it can be investigated, and appropriate action taken.

Contents

1 Introduction

1.1 Purpose

The purpose of this Radiocommunications Assignment and Licensing Instruction (RALI) is to describe procedures for the frequency coordination between apparatus licensed earth and earth receive stations and microwave fixed point-to-point (PTP) links operating in accordance with arrangements in RALI FX3 and RALI FX20. The procedures are for use when considering new fixed PTP links or earth/earth receive stations within the specified frequency ranges.[1]

This RALI currently covers specific frequency bands that are shared between fixed and satellite services as listed in Table 1. The intention is to increase its scope in the future to include additional frequency bands, as required.

This RALI covers coordination between earth/earth receive stations and PTP links operating in accordance with the following bands:

Table 1: PTP fixed link bands covered by this RALI

Frequency bands	Station type(s) being coordinated with PTP links
6 GHz (5925–6425 MHz)	earth stations
6.7 GHz (6425–7110 MHz)	earth stations
7.5 GHz (7425–7725 MHz)	earth receive stations
8 GHz (7725–8275 MHz)	earth and earth receive stations
11 GHz (10.7–11.7 GHz)	earth receive stations
13 GHz (12.75–13.25 GHz	earth stations
15 GHz (14.5–15.35 GHz)	earth stations
18 GHz (17.7–19.7 GHz)	earth and earth receive stations
75 GHz (71–76 GHz)	earth receive stations
85 GHz (81–86 GHz)	earth stations

Note: Under the Australian Radiofrequency Spectrum Plan the frequency range 7975–8025 MHz is subject to Australian Footnote AUS100 (This band is designated for use by the Australian Defence Force and Department of Defence. The Department of Defence is to be consulted in considering non-defence use of this band). FSS (Earth-to-space) in the frequency ranges 7375–7750 MHz, 7900–7975 MHz and 8025–8400 MHz is subject to

[1] This RALI uses the terminology of 'earth stations' being transmitters and 'earth receive stations' being receivers, noting that in most cases the same physical station would include both a transmitter and receiver.

AUS100A (This service is designated for use by the Australian Defence Force and Department of Defence. The Department of Defence is to be consulted in considering non-defence use of this service).

The information in this document reflects the ACMA's statement of current policy in relation to the frequency coordination of earth and earth receive stations with fixed PTP links. In making decisions, accredited frequency assigners and the ACMA's officers should take all relevant factors into account and decide each case on its merits. Issues relating to this document that appear to fall outside the enunciated policy should be referred to:

The Manager, Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

or by email to: freqplan@acma.gov.au.

1.2 Scope

The scope of the RALI is limited to coordination between earth/earth receive stations and fixed PTP links operating in accordance with the RALI FX3 and RALI FX20 arrangements in the frequency bands identified in Table 1.

This RALI does not cover all matters relevant to coordination and licensing for earth/earth receive stations and PTP links. It should be read in conjunction with other applicable documentation including earth station licensing procedures as outlined the ACMA Business Operating Procedure Submission and processing of applications for earth and earth receive apparatus licenses for fixed earth stations; and dependent on the frequency band RALI FX3 Microwave fixed services frequency coordination or RALI FX20: Millimetre wave point-to-point (self-coordinated) stations.

In addition, ITU requirements to facilitate sharing between earth/earth receive stations and microwave fixed point-to-point links are applicable. These include requirements from ITU RR Article **21** and earth/earth receive station elevation restrictions.

Additional coordination requirements may apply if the coordination area affects the territory of neighbouring countries (mainly applicable for sites in northern Australia due to proximity to Papua New Guinea).

2 Frequency coordination procedures for earth/earth receive stations and fixed point-to-point links

Coordination procedures for earth/earth receive stations and fixed PTP links are set out in this section. Coordination is based on a first-in-time process, where the proposed station is to be coordinated with existing stations using the arrangements in this RALI.

2.1 Identification of potentially affected services

Stations in existing services within the following frequency and distance from the proposed station of the new service are to be considered.

2.1.1 Distance cull

Distance culls (distances beyond which detailed coordination is not normally required) are as outlined in Table 2 (for earth stations and PTP link receivers) and Table 3 (for earth receive stations and PTP link transmitters). The methodology and assumptions used to derive the cull distance values are provided in Appendix B. The distance cull values in Table 2 and Table 3 are applicable for services operating within the parameters described in Appendix B. Distances calculated using modelling are in Appendix C for a station at 33 degrees south latitude. Each calculation was rounded up to the neared 25 km to derive the distance cull values. Distance cull values should be reassessed for earth/earth receive stations or terrestrial stations operating outside of the parameters used in this modelling. As an upper bound, ITU Appendix 7 propagation mode 1 radio-climatic zones maximum coordination culls are 500 km for coastal land (zone A1) and 375 km for all other land (zone A2).

Table 2: Cull distances for earth stations and PTP link receivers

Proposed Station	Existing Station	Frequency Bands	Cull distance
Earth station transmitter	PTP link receiver	6 GHz (5925–6425 MHz) 6.7 GHz (6425–7110 MHz) 8 GHz (7725–8275 MHz)	250 km
PTP link receiver	Earth station transmitter		
Earth station transmitter	PTP link receiver	13 GHz (12.75–13.25 GHz)	200 km
PTP link receiver	Earth station transmitter		
Earth station transmitter	PTP link receiver	15 GHz (14.5–15.35 GHz)	175 km
PTP link receiver	Earth station transmitter		
Earth station transmitter	PTP link receiver	18 GHz (17.7–19.7 GHz)	150 km
PTP link receiver	Earth station transmitter		
Earth station transmitter	PTP link receiver	85 GHz (81–86 GHz)	50 km
PTP link receiver	Earth station transmitter		

Table 3: Cull distances for earth receive stations and PTP link transmitters

Proposed Station	Existing Station	Frequency Bands	Cull distance
Earth receive station	PTP link transmitter	7.5 GHz (7425–7750 MHz)[2]	150 km
PTP link transmitter	Earth receive station		
Earth receive station	PTP link transmitter	8GHz (7750–7900 MHz, 8025–8400 MHz)[3]	125 km (GSO)
PTP link transmitter	Earth receive station		100 km (NGSO)
Earth receive station	PTP link transmitter	11 GHz (10.7–11.7 GHz)	125 km
PTP link transmitter	Earth receive station		
Earth receive station	PTP link transmitter	18 GHz (17.7–19.7 GHz)	100 km
PTP link transmitter	Earth receive station		
Earth receive station	PTP link transmitter	75 GHz (71–76 GHz)	50 km
PTP link transmitter	Earth receive station		

2.1.2 Frequency cull range

[2] This frequency range is the overlap between PTP transmitters and Earth receivers within 7.5 GHz band.

[3] This frequency range is the overlap between PTP transmitters and Earth receivers within the 8 GHz band.

2.1.2.1 Frequency cull ranges for earth stations and PTP link receivers

Frequency cull ranges are provided in Table 4 (for the coordination of earth stations and fixed PTP link receivers).

Table 4: Frequency cull ranges for earth stations and PTP link receivers

Proposed station		**Frequency cull range**
PTP link receiver	**Earth station transmitter**	
6 GHz (5925–6425 MHz)	5850–7075 MHz	5850–7110 MHz
6.7 GHz (6425–7110 MHz)		
8 GHz (7.725–8.275 MHz)	7900–8275 MHz	7725–8275 MHz
13 GHz (12.75–13.25 GHz)	12.75–13.25 GHz	12.75–13.25 GHz
15 GHz (14.5–15.35 GHz)	13.75–14.8 GHz	13.75–15.35 GHz
18 GHz (17.7–19.7 GHz)	17.3–18.4 GHz	17.3–19.7 GHz
85 GHz (81–86 GHz)	81–86 GHz	81–86 GHz

The frequency culls in Table 4 can be refined depending on whether considering a new earth station transmitter or new PTP link to identify co-channel, first adjacent channel and second adjacent channel services to consider all services within a frequency separation of:

$$\Delta f < [2 \times max(B_{ES}, B_{FS}) + (B_{ES} + B_{FS})/2]$$

where:

B_{FS}: is the channel bandwidth of the proposed new PTP receiver or maximum channel bandwidth for the frequency band in accordance with the RALI FX3 channel plan, as appropriate.

When considering a new PTP link receiver or earth station transmitter Δf and B_{ES} become:

<u>New earth station transmitter</u>:

Δf: the absolute value of the difference between the centre frequencies of the proposed new earth station transmitter and existing PTP receivers

B_{ES}: is the emission bandwidth of the proposed new earth station transmitter

New PTP link receiver:

Δf: the absolute value of the difference between the centre frequencies of the proposed new PTP receiver and existing earth station transmitters

B_{ES}: is the maximum emission bandwidth of existing earth station transmitters within the distance cull specified in Table 2 and the frequency cull specified in Table 4 of the proposed new service.

2.1.2.2 Frequency-based cull for earth receive stations and PTP link transmitters

A frequency-based cull is used to identify all PTP link or earth receive stations where the frequency separation between the edge of the respective transmitter and receiver channels is less than twice the bandwidth of the applicable PTP link transmitter, with the applicable bandwidth being:

- For a proposed fixed link transmitter – the bandwidth of the proposed transmitter.
- For a proposed earth receive station – the bandwidth of each existing fixed link transmitter within the cull distance. This means that the frequency cull range will need to be reassessed for each existing fixed link transmitter.

Coordination is not required when the frequency separation between the edge of the respective transmitter and receiver channels is greater than or equal to twice the bandwidth of the applicable fixed link transmitter.

2.2 Protection criteria

2.2.1 Fixed PTP link receivers

PTP receivers are to be protected to a maximum interference level specified in Table 5[4] or, for services other than in the 75/85 GHz bands, protection ratios can be applied as specified in RALI FX3.

Table 5: Fixed link receiver maximum interference thresholds

Frequency Bands	
6 GHz	–146.0 dBW/MHz
6.7 GHz	–146.0 dBW/MHz
8 GHz	–146.0 dBW/MHz
13 GHz	–145.0 dBW/MHz
15 GHz	–145.0 dBW/MHz
18 GHz	–145.0 dBW/MHz
85 GHz	–142.0 dBW/MHz

[4] See consultation IFC 1/2019 *Coordination between fixed-satellite service earth station transmitters and fixed point-to-point links in the 6 and 6.7 GHz bands* – Rationale and consultation paper

Where coordination is based on the limits shown in Table 5, coordination is to use the actual out-of-band emission levels from the earth station transmitter, if known. In the absence of information on the actual levels, the relevant emission mask (assuming the spurious limit is equivalent to 40 dB) in Annex 5 of Recommendation ITU-R SM.1541-7 should be used.

The values of protection ratios for co-channel[5], first adjacent channel and second adjacent channel are those listed in RALI FX3 for the PTP link channel bandwidth under consideration where:

Co-channel:

$$0 \leq \Delta f < (B_{ES} + B_{FS})/2$$

First adjacent-channel:

$$(B_{ES} + B_{FS})/2 \leq \Delta f < [max(B_{ES}, B_{FS}) + (B_{ES} + B_{FS})/2]$$

Second adjacent-channel:

$$[max(B_{ES}, B_{FS}) + (B_{ES} + B_{FS})/2] \leq \Delta f < [2 \times max(B_{ES}, B_{FS}) + (B_{ES} + B_{FS})/2]$$

where:

- Δf: is the frequency offset, the absolute value of the difference between the centre frequencies of the earth station transmitter and the PTP link receiver being coordinated
- B_{ES}: is the emission bandwidth of the proposed earth station transmitter
- B_{FS}: is the channel bandwidth of the PTP link receiver

The relevant protection ratios to use when coordinating with PTP links are defined in RALI FX3 for each frequency band. Note that protection ratio values have been normalised for a particular path length, rainfall rate and time percentage. Accordingly, appropriate corrections must be applied to the tabulated protection ratio values to account for the victim system's actual path length, geoclimatic zone and time availability in accordance with the relevant protection ratio correction factor detailed in RALI FX3.

2.2.2 Earth receive stations

Earth receive stations are to be protected to a maximum interference level specified in Table 6, which applies within the station's passband. When accessing compliance with the values in Table 6, coordination is to account for both in-band and out-of-band emissions from the PTP link transmitter that fall within the passband of the earth receive station. Emissions that are beyond

[5] That is where there is any frequency overlap of the licensed bandwidths of the proposed and existing service.

the second adjacent channel (i.e. in the spurious domain) do not need to be considered.

Coordination is to take account of the actual out-of-band emission levels from the PTP link transmitter, if known. In the absence of information on the actual levels, the following emission masks are to be used:

- For bands within the scope of RALI FX3: the relevant emission masks referenced in Table 2 of Spectrum Planning Report SPP 2014/07 are to be used are to be used.[6]

- For the 75 GHz band, the emission mask in ETSI EN 302 217-3 is to be used.

[6] Emission masks referenced in Table 2 of SPP 2014/07 were used to derive the protection ratios in RALI FX3 and are considered typical for PTP link transmitters in the frequency bands within this RALI.

Table 6: Earth receive station maximum interference thresholds

Earth receive station frequency range[7]	Maximum interference level (dBW/MHz)	Percentage time	Source
7425–7750 MHz	–158.6	20%	Rec. ITU-R SF.1006 (for digital emissions)
7750–7900 MHz	–154.0 (GSO)	20%	Appendix 7
	–142 (NGSO)	20%	
8025–8400 MHz	–154.0 (GSO)	20%	Appendix 7
	–142 (NGSO)	20%	
10.7–11.7 GHz	–154.1	20%	Rec. ITU-R SF.1006 (for digital emissions)
17.7–21.2 GHz	–150.8	20%	Rec. ITU-R SF.1006 (for digital emissions)
71–76 GHz	–148.2	20%	Based on: • I/N of –6dB[8] • receive noise level of –142.2 dBW/MHz[9] • receive noise temperature of 438 Kelvin[10]

Earth receive stations often utilise sensitive receivers and operate with a relatively low wanted signal level. This means that earth receive stations may be vulnerable to receiver overload caused by high level emissions outside the receiver passband, particularly when the transmitter is physically close and the transmitting antenna is pointed towards the earth receive station.

While this RALI does not contain any coordination arrangements to specifically manage receiver overload, accredited persons should consider the risks of receiver overload when planning for the deployment of new earth receive stations or PTP transmitters.

[7] The frequency ranges listed in this table align with current allocations in the ARSP for satellite services in the space to earth direction, noting that coordination is only required under this RALI for earth receive stations within the frequency cull detailed in section 2.2.2.

[8] Assumed, based on the default level of protection of 81 GHz band PTP links in RALI FX20. This value is also consistent with I/N values in Rec. ITU-R SF.1006 which increase with frequency, with an I/N of –7 dB specified for the highest frequency range (15–40 GHz) in the recommendation.

[9] Receiver noise = 10 × log(Boltzmann constant × noise temperature × bandwidth)

[10] Derived from the only Australian earth station filing in the 75 GHz band.

If receiver overload occurs, licensees are encouraged to consider potential mitigation measures, such as implementing additional filtering and/or reducing emissions from the transmitter. Negotiation between affected parties is encouraged. Where negotiation does not resolve the issue, the ACMA would consider the arrangements in this RALI and the order in which licences were issued when arbitrating on any interference disputes.

2.3 Propagation model

For interference path calculations: Recommendation ITU-R P.452 'Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 100 MHz' using 20% time percentage for calculating unwanted receive power.

For wanted path calculations: Recommendation ITU-R P.525 'Calculation of free-space attenuation' for calculating the wanted receive power of a PTP link.

3 Default earth/earth receive station characteristics for coordination

For coordination with existing earth/earth receive stations in cases where information is not available or not specified on the licence the following characteristics can be assumed:

3.1 Antenna radiation pattern

To facilitate effective coexistence between terrestrial and space services, it is preferable that coordination makes use of the actual radiation pattern envelope (RPE) data for the proposed service. Making RPE data available for fixed links is already a requirement in RALI FX3 and FX20. Where possible, RPE data for proposed earth/earth receive station antennas should be supplied to the ACMA, however, it is acknowledged that recording this information is not always feasible due to various constraints. Further detail on supplying RPE data is available on the ACMA website.

Where RPE data for earth/earth receive stations is not available, Recommendation ITU-R S.465 'Reference radiation pattern of earth station antennas in the fixed-satellite service for use in coordination and interference assessment in the frequency range from 2 to 31 GHz' should be referred to for purposes of coordination.

3.2 Minimum earth/earth receive station antenna elevation

Where the minimum earth/earth receive station antenna elevation angles for existing stations are not available, the follow values are to be used:

- geostationary orbit (GSO): 15° (based on typical look angle)
- orbit unknown: as per ITU RR Nos. **21.14** and **21.15**, that is 3°, except for
    - Earth stations in the space research service (near Earth): 5°
    - Earth stations in the space research service (deep space): 10°.

Minimum elevation angles for new earth/earth receive stations are detailed in Section 4.

4 Facilitating coexistence between terrestrial and space services

The requirements listed below and in Appendix A are to be met by all new earth/earth receive stations and PTP links to facilitate spectrum sharing. In the main they reflect the requirements of Article **21** of the ITU Radio Regulations.

4.1 Minimum earth station elevation angle

The minimum angle for new earth/earth receive stations is specified in Table 7. For new earth receive stations, operation is permitted below the angles detailed in Table 7, however no additional interference protection will be afforded below these elevation angles. In these cases, the below special condition is to be attached to the licence:

Protection afforded to this earth receive station is to be based on a minimum antenna angle of X° above the horizontal plane, [where x is the applicable angle from Table 7].

While the ACMA is open to considering requests for earth/earth receive stations with antenna angles below the limits in Table 7, the ACMA would not be of a mind to support such requests in and around capital city areas. The ACMA preference is that earth/earth receive stations requiring low antenna elevation angles be located in earth station protection zones and in low and remote density apparatus licence areas so as to avoid areas of high spectrum usage.

Table 7: Minimum elevation angle for new earth/earth receive stations

	Earth / earth receive station location	
Orbit of the satellite that the earth/earth receive station is communicating with	**High and medium density areas**	**Other areas**
GSO	15°	15°
NGSO	15°	5°

Note 1: For existing services, the technical details specified on the licence, including any special conditions, are to be used when undertaking coordination.

Note 2: The requirements in Table 7 do not apply to services operated under AUS100 and AUS100A footnote.

4.2 Earth station site shielding

It is beneficial to choose an earth/earth receive station location that provides a degree of site shielding so as to provide additional diffraction propagation losses over the horizon. The ACMA does not support earth/earth receive stations being sited on elevated locations (for example at the top of a hill) as they increase spectrum denial. Coordination distances of this RALI assume an earth/earth receive station distance to horizon of 500 m and an angle to the horizon of 5°. Prospective earth/earth receive station licensees are encouraged to apply good engineering practices and choose locations that provide an equivalent or greater isolation.

4.3 Earth station pointing angles

While the ACMA preference is that antenna pointing information (azimuth, elevation/tilt) be recorded in the appropriate technical field on the station record, it is recognised that this is not always possible. With the caveat that the decision as to how many 'satellite networks' are recorded on one station record is made separately as part of the licensing processes (considering factors such ITU coordination status and whether the same satellite network operator applies in all cases), to ensure that earth/earth receive station licence records contain accurate antenna pointing information it is proposed that in addition to the information recorded in the antenna fields (azimuth, tilt) that:

- GSO – the orbit location should be recorded as a special condition. Where an earth station communicates with more than one GSO orbit location, all locations should be listed.
- NGSO – the minimum elevation angle and azimuth angle range should be recorded as a special condition (noting that this is a separate special condition to the one described in section 4.1).

5 Relationship to RALI MS44

RALI MS44 ‘Frequency coordination procedures for the earth station protection zones’ provides a framework for the management of interference to and from earth and earth receive stations communicating with satellites (or space stations) in specific defined areas known as protection zones. RALI MS44 provides notional criteria required for coordination between proposed terrestrial transmitters and receivers with notional earth/earth receive stations in the protection zones.

When applying the procedures of RALI MS44 in the context of new fixed point-to-point links or earth/earth receive stations (in the earth station protection zones) the following should be considered:

- new PTP links: interference into a PTP link receiver or from a PTP link transmitter should be assessed using both the procedures of RALI MS44 (using the test points) and this RALI
- new earth/earth receive stations: only the procedures of this RALI need to be applied.

6 Exceptions

Exceptions to the requirements of this RALI for prospective assignments require case-by-case consideration by the Manager, Spectrum Planning Section.

A request for exemption from the requirements of this RALI would need to be accompanied by evidence to support the request.

All requests for exemptions should be submitted to freqplan@acma.gov.au.

7 RALI Authorisation

Approved 8th September 2025

Manager
Spectrum Planning Section
Spectrum Planning and Engineering Branch

Communications Infrastructure Division
Australian Communications and Media Authority

Appendix A: Extract from ITU RR Article 21

The following requirements are an extract of relevant parts of Article **21** '*Terrestrial and space services sharing frequency bands above 1 GHz'* of the ITU Radio Regulations. Where redactions have been made from the original version '…..' will appear. For the full version please see the ITU Radio Regulations.

Section I—Choice of sites and frequencies

…..

21.2 § 2 1) As far as practicable, sites for transmitting[11,12] stations, in the fixed or mobile service, employing maximum values of equivalent isotropic radiated power (e.i.r.p.) exceeding the values given in Table **21-1** in the frequency bands indicated, should be selected so that the direction of maximum radiation of any antenna will be separated from the geostationary-satellite orbit by at least the angle in degrees shown in the Table, taking into account the effect of atmospheric refraction[13]: (WRC-12)

[11] **21.2.1** For their own protection receiving stations in the fixed or mobile service operating in frequency bands shared with space radiocommunication services (space-to-Earth) should also avoid directing their antennas towards the geostationary-satellite orbit if their sensitivity is sufficiently high that interference from space station transmissions may be significant. In particular, in the frequency bands 13.4–13.65 GHz and 21.4–22 GHz, it is recommended to maintain a minimum separation angle of 1.5° with respect to the direction of the geostationary-satellite orbit. (WRC-15)

[12] **21.2.4** For frequency bands above 15 GHz (except 25.25–27.5 GHz), there is no restriction on the angular separation for transmitting stations of the fixed or mobile service. This matter is being studied in ITU-R.

[13] **21.2.2** Information on this subject is given in the most recent version of Recommendation ITU-R SF.765 (see Resolution **27 (Rev.WRC-03)***). * Note by the Secretariat: This Resolution was revised by WRC-07 and WRC-12.

21.2.3 Not used.

Table 21-1

Frequency band	e.i.r.p. value (see also Nos. 21.2 and 21.4)	Minimum separation angle with respect to geostationary-satellite orbit
1–10 GHz	+35 dBW	2°
10–15 GHz	+45 dBW	1.5°
25.25–27.5 GHz	+24 dBW (in any 1 MHz band)	1.5°
Other bands above 15 GHz	+55 dBW	No limit[14]

Section II—Power limits for terrestrial stations

21.3 § 3 1) The maximum equivalent isotropic radiated power (e.i.r.p.) of a station in the fixed or mobile service shall not exceed +55 dBW.

21.4 2) Where compliance with No. **21.2** for frequency bands between 1 GHz and 10 GHz is impracticable, the maximum equivalent isotropic radiated power (e.i.r.p.) of a station in the fixed or mobile service shall not exceed:

- +47 dBW in any direction within 0.5° of the geostationary-satellite orbit; or
- +47 dBW to +55 dBW, on a linear decibel scale (8 dB per degree), in any direction between 0.5° and 1.5° of the geostationary-satellite orbit, taking into account the effect of atmospheric refraction[15].

21.5 3) The power delivered by a transmitter to the antenna of a station in the fixed or mobile services shall not exceed +13 dBW in frequency bands between 1 GHz and 10 GHz, or +10 dBW in frequency bands above 10 GHz, except as cited in No. **21.5A**. (WRC-2000)

21.5A As an exception to the power levels given in No. **21.5**, the sharing environment within which the Earth exploration-satellite (passive) and space research (passive) services shall operate in the band 18.6–18.8 GHz is defined by the following limitations on the operation of the fixed service: the power of each RF carrier frequency delivered to the input of each antenna of a station in the fixed service in the band 18.6–18.8 GHz shall not exceed −3 dBW. (WRC-2000)

21.6 4) The limits given in Nos. **21.2**, **21.3**, **21.4**, **21.5** and **21.5A** apply, where applicable, to the services and frequency bands indicated in Table **21-2**

[14] **21.2.4** For frequency bands above 15 GHz (except 25.25-27.5 GHz), there is no restriction on the angular separation for transmitting stations of the fixed or mobile service. This matter is being studied in ITU-R.

[15] **21.4.1** Information on this subject is given in the most recent version of Recommendation ITU-R SF.765. (WRC-23)

for reception by space stations where the frequency bands are shared with equal rights with the fixed or mobile services: (WRC-2000)

Table 21-2 (Rev. WRC-23)

Frequency band	Service	Limit as specified in Nos.
….. 5850–7075 MHz 7900–8400 MHz …..	Fixed-satellite …..	**21.2**, **21.3**, **21.4** and **21.5**
….. 12.75–13.25 GHz ….. 14.5–14.8 GHz	Fixed-satellite	**21.2, 21.3 and 21.5**
17.7–18.4 GHz 19.3–19.7 GHz …..	Fixed-satellite …..	**21.2, 21.3, 21.5** and **21.5A**

…..

Section III—Power limits for earth stations

21.8 § 4 1) The equivalent isotropic radiated power (e.i.r.p.) transmitted in any direction towards the horizon by an earth station shall not exceed the following limits except as provided in No. **21.10** or **21.11**:

a) in frequency bands between 1 GHz and 15 GHz

+40 dBW in any 4 kHz band for $\theta \leq 0°$

+40 + 3 θ dBW in any 4 kHz band for $0° < \theta \leq 5°$; and

b) in frequency bands above 15 GHz

+64 dBW in any 1 MHz band for $\theta \leq 0°$

+64 + 3 θ dBW in any 1 MHz band for $0° < \theta \leq 5°$,

where θ is the angle of elevation of the horizon viewed from the centre of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.

21.9 2) For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropic radiated power (e.i.r.p.) transmitted by an earth station towards the horizon.

21.10 3) As an exception to the limits given in No. **21.8**, the equivalent isotropic radiated power (e.i.r.p.) towards the horizon for an earth station in the space research service (deep space) shall not exceed +55 dBW in any 4 kHz

band in frequency bands between 1 GHz and 15 GHz, or +79 dBW in any 1 MHz band in frequency bands above 15 GHz.

21.11 4) The limits given in Nos. **21.8** and **21.10**, as applicable, may be exceeded by not more than 10 dB. However, when the resulting coordination area extends into the territory of another country, such increase shall be subject to agreement by the administration of that country.

21.12 5) The limits given in No. **21.8** apply, where applicable, to the services and frequency bands indicated in Table 21-3 below for transmission by earth stations where the frequency bands are shared with equal rights with the fixed or mobile service:

Table 21-3 (Rev. WRC-19)

Frequency band	Service
…..	…..
5850–7075 MHz	Fixed-satellite
7190–7250 MHz	…..
7900–8400 MHz	
…..	
12.75–13.25 GHz	
…..	
14.4–14.8 GHz	
17.7–18.1 GHz	
…..	

…..

Appendix B: Distance cull derivation

The distance culls have been determined by use of International Telecommunication Union (ITU) Radio Regulations Appendix 7 'Methods for the determination of the coordination area around an earth station in frequency bands between 100 MHz and 105 GHz' for propagation mode (1).[16] Typical parameters for earth/earth receive stations and PTP links (based on an analysis of current assignments and derivation of protection ratios published in RALI FX3) are outlined below.

Radio climate zone:

Zone A1: Costal land/Zone A2: All land

Current aggregate land distance for Zone A1 and A2 is equal to the distance consideration ($d_t = d_i$ in equation (43) of Appendix 7).

The minimum distance values were calculated using Appendix 7 for an auxiliary contour. The frequency used for calculations was the value given by the band name. In Appendix 7, the calculation of minimum distances are based on the gain of the earth/earth receive station antenna (dBi) towards the horizon[17]. As a conservative approach[18] earth/earth receive station antenna gain values have been calculated under an assumed antenna discrimination between the relevant transmitter and receiver antennas of at least 2 degrees. At such antenna discrimination angles and using standard models, the earth station antenna gain is a fixed value, and a rounded value for earth/earth receive station antenna gain of 30 dBi was used.

[16] 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.

[17] Refer Appendix 7, section 3.1.1 definition of G_t is the gain of the coordinating (transmitting) earth station antenna (dBi) towards the horizon at the horizon elevation angle and the azimuth under consideration

[18] Conservative as for other calculations have assumed an earth station antenna elevation angle to the horizon of 5 degrees.

Table B.1: Parameters used for calculating cull distances

PTP link station:	
Transmitter power	+3 dBW[19], for frequencies below 70 GHz 0 dBW[20], for frequencies above 70 GHz
Antenna gain[21]	+45dBi, for frequencies below 70 GHz +54 dBi, or frequencies above 70 GHz
Permissible interference level	As per Table 5 for each band
Earth/earth receive station:	
Antenna gain (towards the horizon)	30 dBi (antenna discrimination between earth/earth receive station and fixed link of at least 2 degrees)
Transmitter power	39 dBW (normalised to 1 MHz bandwidth)
Permissible interference level	As per Table 6 for each band
Common parameters:	
Distance to the horizon	0.5 km (ITU Appendix 7 default when no information available)
Distance to the coast	1 km
Angle to the horizon	5°
Maximum percentage of time for which the permissible interference power may be exceeded	20%
Latitude	33° S
Radio climate zone: Zone A1: Costal land/Zone A2: All land	

Using the parameters above and the methods described in Appendix 7 of the *ITU Radio Regulations*, the resulting distance culls for each band are given in Table 2 and 3. The distance cull values defined were calculated and rounded up to the nearest 25 km.

Note calculations are based on values given in Appendix 7 of the *ITU Radio Regulations*; detailed modelling with system-specific information may result in values differing to those specified in Table 2 and 3.

The distance cull values in Table 2 and 3 are applicable for services operating within the parameters assumed above. Distance cull values should be reassessed for transmitters and receivers operating outside of the above parameters.

[19]. Appendix 7 Table in1.2.2.2.1 (AP5-22) shows transmit power as 7 dBW for 64 kbit/s or 2 Mbit/s capacity which aligns with the maximum transmit power levels in the RRL database.

[20] Maximum transmit power level permitted under RALI FX20.

[21] Based on the maximum antenna gain for PTP links as per RRL database.

Appendix C: Cull distance calculations

Transmitting earth stations

Taking the approximate latitudes from the top of the Australian mainland (10° S), the bottom of Tasmania (44° S) and the average latitude of 27° S through the Australian mainland, the cull distance values (d) in Tables C1 and C2 were obtained for each frequency band (frequency band value used for simplicity). The approximate latitudes of the following north, south, east, west and central locations of Australia align with the latitudes used in the model:

- Cape York (north): 10.7 S
- Hobart (south): 42.9 S
- Brisbane (east): 27.5° S
- Perth (west): 32° S
- Alice Springs (central): 23.7° S

The results for latitude 33° S were used to derive the distance cull values in Tables 2 and 3, noting each calculation was rounded up to the nearest 25 km.

Table C1 Calculations to determine cull distances for earth stations and PTP link receivers

Frequency band	Latitude 10° d	Latitude 24° d	Latitude 27° d	Latitude 33° d	Latitude 44° d
6 GHz	306km	271km	263km	246km	214km
6.7 GHz	300km	264km	255km	239km	207km
8 GHz	290km	253km	244km	227km	194km
13 GHz	255km	214km	205km	187km	154km
15 GHz	242km	200km	191km	174km	142km
18 GHz	215km	175km	167km	150km	121km
85 GHz	46km	46km	46km	46km	46km

Table C2 Calculations to determine cull distances for earth receive stations and PTP link transmitters

Frequency band	Latitude 10° d)	Latitude 24° d	Latitude 27° d	Latitude 33° d	Latitude 44° d
7425–7750 MHz	220km	167km	156km	133km	103km
7750–7900 MHz – GSO	203km	148km	137km	115km	103km
7750–7900 MHz – NGSO	163km	108km	107km	105km	103km
8025–8400 MHz – GSO	200km	146km	134km	112km	102km
8025–8400 MHz - NGSO	160km	108km	107km	105km	102km
10.7–11.7 GHz (11 GHz)	183km	130km	120km	103km	101km
17.7–19.7 GHz (18 GHz)	135km	103km	102km	100km	97km
71–76 GHz (75 GHz)	40km	40km	40km	40km	40km

Generally speaking, Australia can be considered as being in ITU radio-climatic zones A1 (coastal land) and A2 (all other land).

Under Appendix 7 maximum coordination culls for these zones are 500 km (A1) and 375 km (A2).