

15 February 2019



**Mark Arkell**

Manager  
Spectrum Engineering & Space  
Spectrum Planning & Engineering Branch  
Communications Infrastructure Division  
Australian Communications and Media Authority  
Email: mark.arkell@acma.gov.au

Dear Mark,

**RE: Coordination between fixed-satellite service earth station transmitters and fixed point-to-point links in the 6 and 6.7 GHz bands**

The Communications Alliance Satellite Services Working Group (SSWG) would like to thank the ACMA for the opportunity to comment on consultation on the *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*.

The SSWG understands that this consultation concerns the coordination procedures for the 6 GHz (5,925 to 6,425 MHz) and 6.7 GHz (6,425 to 7,110 MHz) microwave fixed point-to-point bands and earth station transmitters communicating with geostationary satellite (GSO) systems in the fixed-satellite service (FSS). The SSWG notes that it is the ACMA's intention to expand over time the coordination arrangements to include other microwave fixed point-to-point bands, earth station receivers and earth stations communicating with non-geostationary satellite (NGSO) systems. The SSWG looks forward to being involved in future consultations with regards to NGSO systems.

The SSWG welcomes the proposed new method to supplant path length correction factors, as a useful advance, bringing greater certainty through protection ratios. In addition, the recognition of a dated RALI FX3 (1998) is helpfully overcome by direct reference to ITU Article 21.

The SSWG notes that in the *References to ITU Radio Regulations* in the Consultation Paper, geostationary orbit avoidance and other criteria that facilitate sharing between terrestrial and space services are referenced in RALI FX 3 and have not been updated or reviewed since 1998. On the other hand, the ITU (Article 21) has been kept up to date by the ITU. This suggests that a review of FX3 may be appropriate, which would assist in formalising acceptance of the ITU text (or a local derivative) for licensing purposes in Australia.

The SSWG is concerned that the specification of 15 degrees as a notional elevation angle can be constraining into the future. It also needs to be clearly stated whether this is relevant in a protection zone or not, with a cross reference to the draft RALI MS 44 *Frequency coordination procedures for the earth station protection zones*.

The SSWG has also taken the opportunity to provide a marked-up version of the draft RALI MS TBD *Frequency coordination requirements between microwave fixed point-to-point links and FSS earth stations (Initial release covering 6 and 6.7 GHz)*, accompanying this submission. It provides a few typographical suggestions to improve the presentation of the instrument.

Thank you for your consideration of this submission. If you have any questions with regards to this response, please contact Mike Johns on (02) 9959 9125.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'John Stanton'. The signature is fluid and cursive, with the first letter 'J' being particularly large and stylized.

John Stanton  
**Chief Executive Officer**

RALI : MS TBD

DATE OF EFFECT : TBD

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Radiocommunications Assignment and Licensing Instruction

# **FREQUENCY COORDINATION REQUIREMENTS BETWEEN MICROWAVE FIXED POINT-TO-POINT LINKS AND FSS EARTH STATIONS**

**(Initial release covering 6 and 6.7 GHz)**

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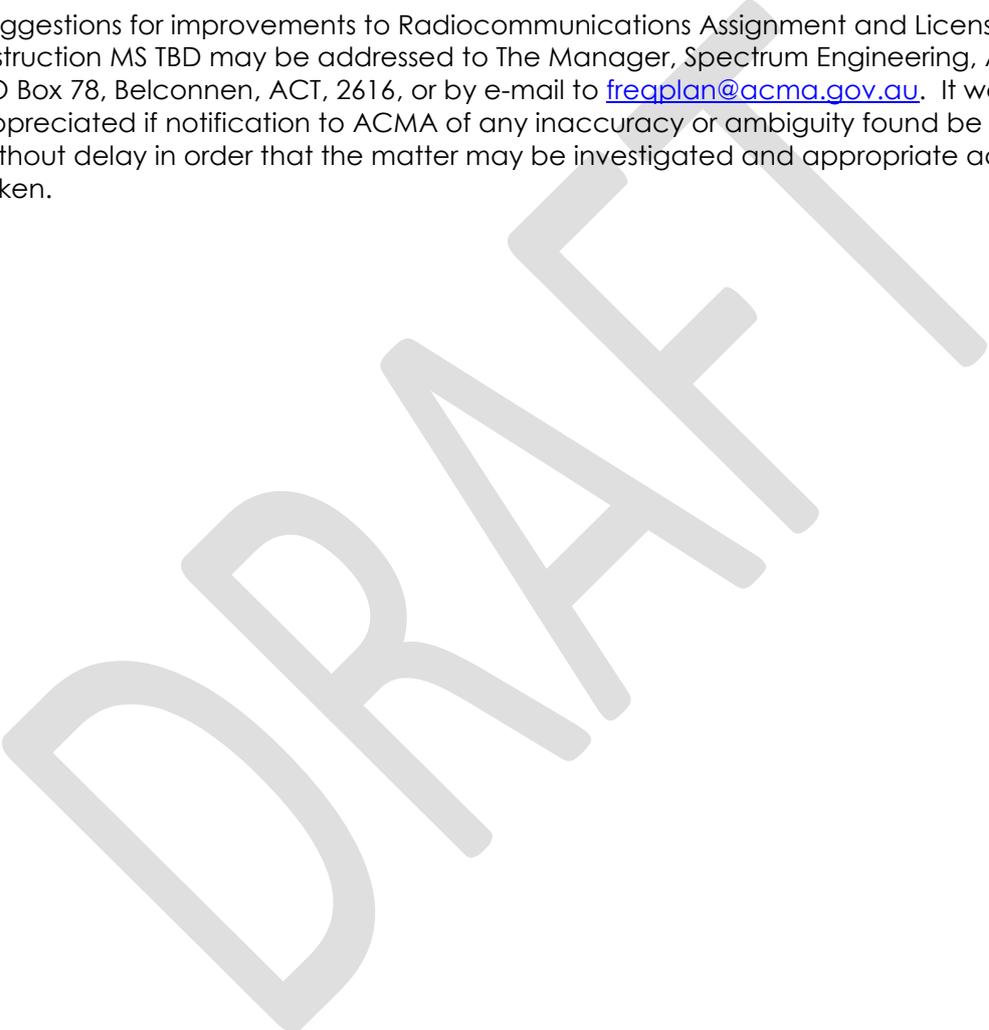
AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY

SPECTRUM PLANNING AND ENGINEERING BRANCH

# Amendment History

Date	Comments
January 2019	IFC 1/2019 Consultation draft

Suggestions for improvements to Radiocommunications Assignment and Licensing Instruction MS TBD may be addressed to The Manager, Spectrum Engineering, ACMA at PO Box 78, Belconnen, ACT, 2616, or by e-mail to [freqplan@acma.gov.au](mailto:freqplan@acma.gov.au). It would be appreciated if notification to ACMA of any inaccuracy or ambiguity found be made without delay in order that the matter may be investigated and appropriate action taken.



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# FREQUENCY COORDINATION REQUIREMENTS BETWEEN MICROWAVE FIXED POINT-TO-POINT LINKS AND FSS EARTH STATIONS

## 1 Introduction

### 1.1 Purpose

The purpose of this Radiocommunications Assignment and Licensing Instruction (RALI) is to describe procedures for the frequency coordination between earth stations operating in the fixed-satellite service (FSS) and microwave fixed point-to-point links operating in accordance with channel arrangements of RALI FX 3. The procedures are for use when considering new fixed point-to-point links or earth stations.

The initial draft covers coordination between earth station transmitters operating in the frequency range 5850-7025 MHz and fixed links operating in accordance with the 6 GHz (5925-6425 MHz) and 6.7 GHz (6425-7110 MHz) RALI FX 3 channel arrangements.

The information in this document reflects the Australian Communications and Media Authority's statement of current policy in relation to the frequency coordination of FSS earth stations with fixed point-to-point 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 Engineering Section, PO Box 78, Belconnen, ACT, 2616, or by e-mail to [freqplan@acma.gov.au](mailto:freqplan@acma.gov.au).

### 1.2 Scope

The scope of the RALI is limited to coordination between earth station transmitters operating in the frequency range 5850-7025 MHz and fixed links operating in accordance with the 6 GHz (5925-6425 MHz) and 6.7 GHz (6425-7110 MHz) RALI FX 3 channel arrangements.

The intention is to increase the scope in the future to include the coordination of fixed point-to-point transmitters with FSS earth station receivers and expand the frequency ranges considered.

Note that this RALI does not cover all matters relevant to coordination and licensing for earth stations and fixed point-to-point links. It should be read in conjunction with other applicable documentation including earth station licensing procedures as outlined in the ACMA Business Operating Procedure [Submission and processing of applications for earth and earth receive apparatus licences for fixed earth stations](#); and [RALI FX 3 Microwave Fixed Services Frequency Coordination](#).

In addition ITU requirements to facilitate sharing between earth stations and microwave fixed point-to-point links are applicable. These include requirements from ITU RR Article **21** and earth station elevation restrictions. Refer section 6.1.2.

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

## 2 Coordination procedures: Earth station transmitters and fixed point-to-point receivers

### 2.1 Identification of potential affected services

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

**Distance cull:** Within 300 km of the proposed new station as outlined below:

Proposed station	Existing station	Distance cull
Earth station transmitter	Fixed link receiver	300 km
Fixed link receiver	Earth station transmitter	300 km

**Frequency cull:** The range 5870-7110 MHz is, reduced/defined depending on whether considering a new earth station transmitter or new fixed point-to-point link to identify co-channel, first adjacent channel and second adjacent channel services to consider all services within a frequency separation of:

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

Explicitly, when considering a new fixed link receiver or earth station transmitter this becomes:

New earth station transmitter:

All services within frequency separation of:

$$\Delta f < [2 * \max (B_{ES}, 80 \text{ MHz}) + (B_{ES} + 80 \text{ MHz}) / 2]$$

where:

$\Delta f$ : the absolute value of the difference between the centre frequencies of the proposed new earth station transmitter and the bandwidth of the existing fixed service receiver

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

New fixed link receiver:

All services within frequency separation of:

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

where:

$\Delta f$ : the absolute value of the difference between the centre frequencies of the proposed new fixed point-to-point receiver and existing earth station transmitters

$B_{ES}$ : is the maximum emission bandwidth of existing earth station transmitters within 300 km of the proposed new service

$B_{FS}$ : is the channel bandwidth of the proposed new fixed service receiver in accordance with 6 GHz or 6.7 GHz FX 3 channel plan as appropriate.

## 2.2 Protection criteria

Fixed service receivers are to be protected to a maximum interference level specified in Table 1 or protection ratios as specified in RALI FX 3:

<b>RALI FX 3 Band</b>	<b>Maximum interference level</b>
6 GHz	-146 dBW/MHz
6.7 GHz	-146 dBW/MHz

**Table 1: Fixed link receiver maximum interference thresholds**

The values of protection ratios for co-channel, first adjacent channel and second adjacent channel are those listed in RALI FX 3 for the fixed link channel bandwidth under consideration where:

Co-channel:<sup>1</sup>

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

First adjacent-channel:

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

Second adjacent-channel:

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

where:

$\Delta f$ : is the frequency offset, the absolute value of the difference between the centre frequencies of the FSS earth station transmitter and the fixed service receiver being coordinated

$B_{ES}$ : is the emission bandwidth of the earth station

$B_{FS}$ : is the channel bandwidth of the fixed service receiver

The relevant protection ratios to use when coordinating with 6 GHz and 6.7 GHz fixed links are defined in RALI FX 3 [1] and provided in Tables 2 and 3 respectively.

Frequency offset (MHz)	Fixed Link Bandwidth	
	$B_{FS}=29.65$ MHz	$B_{FS}=59.3$ MHz
Cochannel	60	68
1 <sup>st</sup> Adjacent	30	34
2 <sup>nd</sup> Adjacent	0	13

**Table 2: Protection ratios for the fixed point-to-point links operating in the 6 GHz band**

<sup>1</sup> That is where there is any frequency overlap of the licensed bandwidths of the proposed and existing service.

Frequency offset (MHz)	Fixed Link Bandwidth	
	$B_{FS}=40$ MHz	$B_{FS}=80$ MHz
Cochannel	60	69
1 <sup>st</sup> Adjacent	30	46
2 <sup>nd</sup> Adjacent	0	15

**Table 3: Protection ratios for the fixed point-to-point links operating in the 6.7 GHz 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 FX 3.

## 2.3 Propagation model

Earth station transmitter: [Recommendation ITU-R P.452](#) 'Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz' using 20% time percentage

Fixed link transmitter: [Recommendation ITU-R P.525](#) 'Calculation of free-space attenuation'.

## 3 Default earth station characteristics for coordination

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

Antenna radiation pattern: [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'

Minimum earth station antenna elevation:

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

## 4 Facilitating sharing between terrestrial and space services

The requirements listed below and in Appendix A are to be met by all new earth station transmitters and microwave fixed point-to-point links to facilitate spectrum sharing. In the main they reflect the requirements of Article 21 of the ITU Radio Regulations.

### Minimum earth station elevation angle

Frequency range	Earth station	Antenna minimum angle
5850-7075 MHz	GSO earth station transmit	15°

### Earth station site shielding

It is beneficial to choose an earth 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 stations being site on elevated locations (for example at the top of a hill) as they increase spectrum denial. Coordination distances of this RALI assume an earth station distance to horizon of 500 m and an angle to the horizon of 5 degrees.

Prospective earth station licensees are encouraged to apply good engineering practices and choose earth station locations that provide an equivalent or greater isolation.

### 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, 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 as ITU coordination status and whether the same satellite network operator applies in all cases), to ensure that earth 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.

## 5 Relationship to RALI MS 44

[RALI MS 44 'Frequency coordination procedures for the earth station protection zones'](#) provides a provide a framework for the management of interference to and from earth stations communicating with satellites (or space stations) in the fixed-satellite service (FSS) in specific defined areas [known as protection zones](#). For terrestrial receivers the RALI provides notional criteria required for coordination between proposed receivers and FSS earth station transmitters [\(in the protection zones\)](#).

When applying the procedures of RALI MS 44 in the context of new fixed point-to-point links or earth station transmitters (in the earth station protection zones) the following should be considered:

***New fixed link receivers:***

Interference into a fixed link receiver should be assessed using both the procedures of RALI MS 44 (using the test points) and this RALI.

***New earth station transmitters:***

Only the procedures of this RALI need to be applied.

## **6 RALI Authorisation**

[not approved]      xx/xx/2019

Manager  
Spectrum Engineering and Space Section  
Spectrum Planning and Engineering Branch  
Communications Infrastructure Division  
Australian Communications and Media Authority

## APPENDIX A: Extract from ITU RR Article 21

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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 stations<sup>2,3</sup>, in the fixed or mobile service, employing maximum values of equivalent isotropically 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<sup>4</sup>: (WRC-12)

Table 21-1:

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

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<sup>2</sup> **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)

<sup>3</sup> **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.

<sup>4</sup> **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.

**Section II – Power limits for terrestrial stations**

**21.3** § 3 1) The maximum equivalent isotropically 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 isotropically 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<sup>5</sup>

**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** 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-15):**

Frequency band	Service	Limit as specified in Nos.
..... 5 850-7 075 MHz .....	Fixed-satellite .....	<b>21.2, 21.3, 21.4 and 21.5</b>
.....	.....	.....
.....	.....	.....

.....

<sup>5</sup> **21.4.1** 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.

**Section III – Power limits for earth stations**

**21.8** § 4 1) The equivalent isotropically 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  $\theta \leq 0^\circ$   
 +40 + 3  $\theta$  dBW in any 4 kHz band for  $0^\circ < \theta \leq 5^\circ$ ; and
- b) in frequency bands above 15 GHz  
 +64 dBW in any 1 MHz band for  $\theta \leq 0^\circ$   
 +64 + 3  $\theta$  dBW in any 1 MHz band for  $0^\circ < \theta \leq 5^\circ$ ,

where  $\theta$  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  $5^\circ$  there shall be no restriction as to the equivalent isotropically 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 isotropically 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-15):**

Frequency band	Service
.....	.....
5 850-7 075 MHz	Fixed-satellite
.....	.....

.....