Development of the 3.6 GHz spectrum licence technical framework

Technical Liaison Group Consultation Paper

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# Version Control

|  |  |
| --- | --- |
| **Version** | **Comments** |
| Version 1.0 | Initial release |
| Version 1.1 | 22/3/18  Updated timeline |

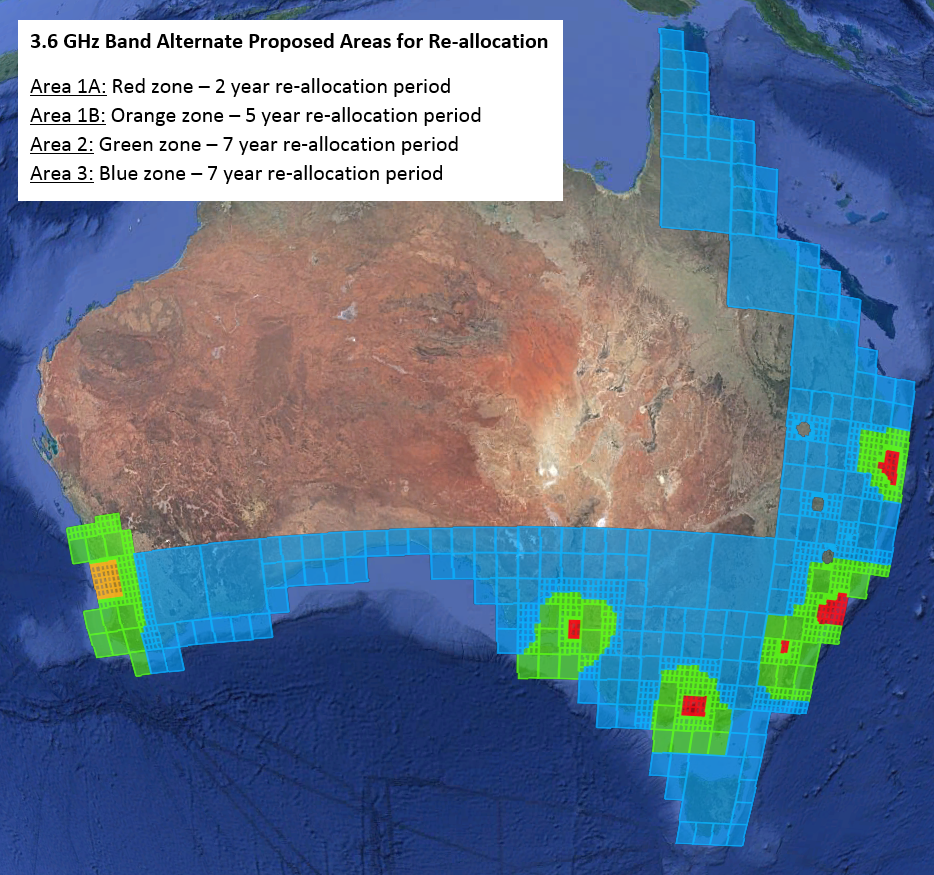
# Introduction

The Australian Communications and Media Authority (the ACMA) develops a technical framework for every band subject to spectrum licensing. Each framework is a collection of technical and regulatory conditions applicable to the use of radiocommunications devices in the spectrum-licensed band. The purpose of the technical framework is to define the technical conditions and constraints under which a device may be deployed and operated within the specified geographic area and frequency band of the licence.

Although the technical framework is optimised for technologies, or services most likely to be deployed in the band, it is intended to be technology-flexible. This means licensees can operate any type of radiocommunications device for any purpose, provided they comply with the technical framework relevant to the licence.

The frequency range 3575-3700 MHz (the 3.6 GHz band) was recently re-allocated for the issue of spectrum licences in defined regional and metropolitan areas (refer to Figure 1)[[1]](#footnote-2). The purpose of this paper is to develop a technical framework for spectrum licences issued in the 3.6 GHz band. This paper provides information and seeks comment on the proposed technical framework for spectrum licences in the 3.6 GHz band.

1. Area in the 3.6 GHz band re-allocated for the issue of spectrum licences.



## Outline

This paper has been divided into discussion on the relevant instrument that form a spectrum licence technical framework:

* Spectrum Licence:
  + Unwanted emission limits;
  + Other conditions on the licence;
* The s.145(4) determination on unacceptable levels of interference:
  + The device boundary criteria (controlling emissions across geographical boundaries);
  + Deployment constraints;
* Advisory guidelines made under s.262:
  + Managing interference from spectrum licensed transmitters to the following:
    - Point-to-point services;
    - Fixed satellite service (FSS) Earth receive stations operating in the 3400-4200 MHz band;
    - Broadband wireless access (including point-to-multipoint (P-MP) and PTS) services operating in the 3400-3700 MHz band;
    - Radiolocation services operating in the 3300-3400 MHz and 3400-3600 MHz bands;
    - Class licensed services;
    - Earth station protection zones (ESPZ);
    - Earth stations operating at the Lockheed Martin facility near Uralla, NSW
  + Managing interference to spectrum licensed receivers.

Draft versions of the spectrum licence, s.145(4) determination and advisory guidelines are provided at Appendix C-F. Where appropriate, new or draft updates to any RALIs will also be provided to the TLG for consideration. At this stage this includes:

* RALI FX19: Updates to define interference management requirements from devices deployed under a spectrum licence with apparatus licensed P-MP services operating in the 3.6 GHz band; and
* RALI [ESPZ]: Proposed new RALI managing interference to ESPZs and earth stations operating at the Lockheed Martin facility near Uralla, NSW.

## Scope

This paper is focused on developing a technical framework for the areas and frequencies covered in the Minister’s 3.6 GHz band re-allocation declarations[[2]](#footnote-3)while also taking into account existing 3.4 GHz band spectrum licences. It will not consider:

* Allocation issues (e.g. lot sizes, auction format): This will be covered in a separate consultation process.
* Defragging of the broader 3400-3700 MHz band: This would need to be considered as a separate process and could possibly be implemented by licensees via the use of trading mechanisms. However, technical conditions that would facilitate a future defragmentation of the 3400-3700 MHz band could be considered for implementation in the technical framework.

## Spectrum reform

The government is reforming the spectrum management framework within Australia. These reforms will simplify the regulatory framework and support new and innovative technologies and services. The reforms include implementing the recommendations of the government’s Spectrum Review report to:

1. Replace the current legislative arrangements with new legislation that removes prescriptive processes and streamlines licensing for a simpler and more flexible framework.
2. Better integrate the management of public sector and broadcasting spectrum to improve the consistency and integrity of the framework.
3. Review spectrum pricing to ensure consistent and transparent arrangements to support the efficient use of spectrum and secondary markets.

On 18 May 2017, the government released a [consultation package](https://www.communications.gov.au/have-your-say/consultation-new-spectrum-legislation) on reforms to modernise and simplify Australia’s spectrum management framework. The comprehensive consultation package included an Exposure Draft of the Radiocommunications Bill and related consultation papers, including approaches for broadcasting spectrum and transitional arrangements. Consultation papers on government spectrum holdings and spectrum pricing were also released. Consultation closed on 28 July 2017.

Currently, the Radiocommunications Bill and draft transitional and consequential legislation is being finalised before introduction into parliament. The Department of Communications and the Arts (DoCA) stated in the recent consultation package that transition to a new framework would take place over a number of years. In addition, the commencement of the new legislation would occur approximately 12 months after passage of the Bill through parliament.

Given the timeframes associated with the 3.6 GHz band review, the ACMA is proposing to develop new arrangements in this band assuming the existing regulatory regime will apply. It is acknowledged that any new arrangements for the 3.6 GHz band may need to be accommodated under the new legislative framework, once it commences. The ACMA will take into account relevant opportunities offered by the implementation of the new legislative framework, if and when applicable.

Further information on spectrum reform is available from DoCA at [spectrumreform@communications.gov.au](mailto:spectrumreform@communications.gov.au).

## Timeline

The ACMA is working towards allocating the 3.6 GHz band in Q4 2018. To do this the following timeframe for the TLG is:

| Key steps | Proposed Date |
| --- | --- |
| TLG process   * Initial release of TLG paper * Deadline for submissions/comments on initial TLG paper * Revision to TLG paper * Deadline for submissions/comments on revised TLG paper * Second (final) revision to TLG paper | March-April 2018  9th March 2018  29th March 2018  4th April 2018  16th April 2018  27th April 2018 |
| Public consultation on the draft updates to the following technical framework instruments (the consultation will also include a draft 3.6 GHz band marketing plan):   * Draft spectrum licence; * Draft update to *Radiocommunications (Unacceptable Levels of Interference – [3.4/3.6] GHz Band) Determination 2015;* * Draft update to *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — [3.4/3.6] GHz Band) 2015;* * Draft update to *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band) 2015* * Draft update to *Radiocommunications (Trading Rules for Spectrum Licences) Determination 2012* * Draft updates to relevant RALIs\* | May-June 2018 |

*\* Consultation on the draft updates to the relevant RALIs may occur at a later point depending on when discussion on them is finalised within the TLG.*

It is noted that the TLG is just the first step in the process of developing a technical framework. While the aim is to complete the work in the timeframe defined this will ultimately depend on the complexity of the issues identified. It is intended that the ACMA will use the outcomes of the TLG to publicly consult on the relevant instruments that will form the 3.6 GHz band technical framework. This means TLG members will be able to provide comments on the technical framework both as part of the informal TLG and subsequent formal public consultation processes.

## Legal Review

It is noted that the draft instruments at appendices A-F have not undergone legal review. It is possible there could be changes to the text in the draft instruments after such a review has been conducted.

Under the currently proposed timeline, a legal review of the draft instruments will be performed after the 16th April and finalised in time for public consultation of the draft technical framework in May 2018.

# Discussion on proposed technical framework

A technical framework consists of three interlocking regulatory elements provided for under the Act:

* The conditions specified on the spectrum licence—in particular, the core conditions that define the spectrum space (both frequency and geographical area) and the level of emissions permitted inside and across the frequency boundaries of the licence (section 66 of the Act).
* A determination of unacceptable interference for the purpose of device registration in each band (section 145 of the Act). This defines permissible levels of emissions across geographical licence boundaries and can also define various deployment constraints.
* Radiocommunications advisory guidelines (RAG) that provide assistance and advice for coordination with stations in other services when and where required (section 262 of the Act). This includes detailing interference management criteria with incumbent apparatus and other spectrum licences.

A more comprehensive explanation of spectrum licence technical frameworks is provided in the document [*Know your obligations—Spectrum licensees*](http://www.acma.gov.au/theACMA/Library/Industry-library/Spectrum/know-your-obligationshelp-for-spectrum-licensees).

This section of the paper considers the development of each of these components along with the standard trading unit and minimum contiguous bandwidth.

## 3.4 GHz Band Spectrum Licence Technical Framework

It is noted that the 3.4 GHz spectrum licence band is directly adjacent the 3.6 GHz band. Since the same equipment is likely to be deployed in both bands and it is possible the same licensees could hold licences in both bands, there could be benefit in having the same or a similar technical framework in place in both the 3.4 GHz and 3.6 GHz bands. Such a move could also facilitate a future defragging of the broader 3400-3700 MHz band. However, any changes to the technical framework for the 3.4 GHz band licences would require the agreement of affected 3.4 GHz band licensees to implement in that band.

It is also noted that Time Division Duplex (TDD) technologies are expected to be predominantly used in the band.

1. **The ACMA proposes to combine the technical frameworks for the 3.4 GHz and 3.6 GHz bands. This includes optimising use of the band for TDD technologies.**

The relevant 3.4 GHz band technical framework instruments are:

* Spectrum Licence ([Current licence holders and copies of licences](http://web.acma.gov.au/rrl/browse_licences.licence_list?pSV_ID=85&pSS_ID=861));
* [*Radiocommunications (Unacceptable Levels of Interference - 3.4 GHz Band) Determination 2015*](https://www.legislation.gov.au/Details/F2015L00727)*;*
* [*Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*](http://www.comlaw.gov.au/Details/F2015L00728)*;*
* [*Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band) 2015*](http://www.comlaw.gov.au/Details/F2015L00729)*.*

Details of the TLG process (including relevant papers) that developed the current 3.4 GHz band technical framework are available on the [ACMA website](https://www.acma.gov.au/-/media/Spectrum-Transformation-and-Government/Information/zip-file/2014--34-GHz-TLG-Package-zip.ZIP?la=en).

## Standard Trading Unit and Minimum Contiguous Bandwidth

A spectrum licence may be traded in whole, or in part, by geographic area or frequency or both. Under section 88 of the Act, the ACMA may determine the rules that apply to trades under spectrum licensing. These rules are contained in the [*Radiocommunications (Trading Rules for Spectrum Licences) Determination 2012*](https://www.legislation.gov.au/Details/F2015C00469)(trading determination).

The trading determination specifies (a) the smallest parcel of spectrum space that can be traded (the standard trading unit) and (b) the minimum contiguous holding of spectrum space required by a licensee after the completion of a trade. This minimum holding is a combination of frequency and geographic requirements. Where:

1. the frequency requirement is equal to the minimum contiguous bandwidth (MCB)
2. the geographical requirement is equal to the geographical component of the standard trading unit (STU)

The minimum quotas of frequency and area that can be traded are defined by the STU. The definition of an STU is contained in the trading determination.

The STU that applies to the 3.4 GHz band (and every other spectrum licence band) is defined as a parcel of spectrum space that consists of:

1. a geographic area equal to a Level 1 HCIS cell of the 2012 Australian Spectrum Map Grid (ASMG)[[3]](#footnote-4)– approximately a 9×9 kilometre in size
2. a frequency band where the lower and upper frequency limits of each segment are integers when described in Hertz

This means the frequency component of the STU is defined as 1 Hz for the 3.4 GHz band and all other spectrum licence bands. This provides licensees with flexibility in the quantum of spectrum that may be traded, subject to the value of the MCB. The minimum area is referenced to the ASMG mapped consistently in five-minute increments by latitude and longitude.

It is noted that changing the STU would affect every spectrum licensees in every band. It would therefore require consultation with all affected licensees. Given the current flexibility in the STU (coupled with the MCB) and the broader effect any change would have, the ACMA does not propose making any changes to it as part of the 3.6 GHz band TLG process.

1. **There is no proposed change to the STU.**

The current MCB for the 3.4 GHz band is 10 MHz. This means that any 3.4 GHz SL band trades must not result in a licensee holding a contiguous bandwidth less than the 10 MHz in any area. The same MCB is proposed for adoption in the 3.6 GHz band.

1. **Is a 10 MHz MCB appropriate for both the 3.4 GHz and 3.6 GHz spectrum licence bands?**

## Conditions on the spectrum licence

Each spectrum licence includes both core conditions and statutory conditions specified under relevant sections of the Act. The Act also provides that other specific conditions may be included by the ACMA.

* **Core conditions**—required under section 66, these conditions define the spectrum space within which the licensee is authorised to operate radiocommunications devices under the licence, and the maximum permitted level of radio emissions inside and outside the band. These conditions are included in all spectrum licences.
* **Statutory conditions**—required under sections 67 to 69A, these conditions include information about payment of charges, use by third parties, residency, registration of transmitters and devices exempt from registration. These conditions are included in all spectrum licences.
* **Other conditions**—conditions placed on licences under section 71 generally provide for the efficient management of the spectrum and administration of the Act. These conditions may vary from one band or licence to another.

The core conditions of a spectrum licence form the fundamental building blocks for operation of a spectrum-licensed device, and for managing interference with adjacent frequency bands and geographic areas. Section 66 of the Act states spectrum licences must specify the following core conditions:

* the part or parts of the spectrum in which operation of radiocommunications devices is authorised under the licence (frequency range of operation)
* the maximum permitted level of radio emission, in parts of the spectrum outside the frequency range specified on the licence, that may be caused by operation of radiocommunications devices under the licence (outside-the-band emission)
* the area within which operation of radiocommunications devices is authorised under the licence (geographic area of operation)
* the maximum permitted level of radio emission that may be caused by the operation of radiocommunications devices under the licence (outside-the-area emission).

When developing conditions on the spectrum licence it is proposed to use those on the 3.4 GHz spectrum licence as a starting point. The 3.4 GHz band spectrum licence technical framework was updated in 2015. It was optimised for the deployment of TDD LTE services.

### In-band emission limits

***Current 3.4 GHz band limits***

The current in-band emission limits for 3.4 GHz band spectrum licences are:

* 25 dBm/5 MHz EIRP in upper 5 MHz that is adjacent to another spectrum licence (referred to as the ‘restricted use block’);
* Otherwise 68 dBm/5 MHz EIRP.

Note: Adjacent band licensees are free to negotiate relaxation of the 25 dBm/5 MHz EIRP limit to a maximum of 68 dBm/5 MHz.

***Proposed limits***

It is proposed to apply the current 3.4 GHz band in-band emission limits to the 3.6 GHz band.

1. **Are these in-band limits appropriate?**
2. **Noting that adjacent band licensees can negotiate to relax the stricter emission limits defined for the restricted block, is a restricted use block required to assist in the management of interference between unsynchronised or semi-synchronised networks (including 4G and 5G networks)? Is this something licensees could manage without specific restrictions on the licence?**

### Unwanted emission limits

Existing unwanted emission limits that apply to 3.4 GHz band spectrum licences have been reproduced at Appendix B.

When defining unwanted emission limits (both out-of-band and spurious), consideration has been given to the following list of 3GPP defined operating bands for TDD services that cover the 3400-3700 MHz:

* E42 (E-UTRA operating band 42): 3400-3600 MHz
* E43: 3600-3800 MHz
* E48: 3550-3700 MHz
* N77 (New radio operating band 77): 3300-4200 MHz
* N78: 3300-3800 MHz

***Registered devices***

*Current 3.4 GHz band limits*

The current out-of-band emission limits defined for 3.4 GHz spectrum licences are reproduced at Appendix B. A summary of how they were developed follows:

* While stricter out-of-band emission limits would ensure greater compatibility with adjacent band apparatus and spectrum licence services, less stringent limits were adopted. The reasons for this were to:
  + avoid unnecessary costs and burdens on licensees to implement strict unwanted emission limits that are only required to enable compatibility in specific situations;
  + minimise costs and complexity of retuning services as part of any future defragmentation of licence holdings across the broader 3400-3575 MHz frequency range.

It was also expected that, irrespective of who was first-in-time, spectrum licensees would work with relevant adjacent band apparatus licensees (in particular PTS and point-to-multipoint licensees) and spectrum licensees to manage interference. This includes reducing out-of-band emissions down to a specified level when appropriate (taking advantage of the restricted block for emission roll-off) and accepting a higher level of interference for in-band blocking as defined by the notional receiver. These expectations are specified in the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 3.4 GHz Band)* and *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band)*;

* Within the 3390-3610 MHz frequency range, the out-of-band emission limit for devices that are required to be registered are based on the E-UTRA category B masks for base stations[[4]](#footnote-5). An assumed 17 dBi gain antenna was used to convert this to a radiated power limit;
* Within the 3390-3610 MHz frequency range, the out-of-band emission limit for devices that are not required to be registered are based on the highest level for E-UTRA UE 5 and 20 MHz channel emission masks[[5]](#footnote-6). A 0 dBi gain antenna was assumed to convert this to a radiated power limit;
* Outside the 3390-3610 MHz frequency range, the same radiated spurious emission limits apply to all devices. These limits are more stringent than the standard conducted spurious emission limits defined in standards for those frequencies outside of 3390-3610 MHz when the gain of a device’s antenna is greater than 0 dBi.

Further details on the development of unwanted emissions for 3.4 GHz band spectrum licences is contained in the 3.4 GHz band TLG document. This document is available on the [ACMA website](https://www.acma.gov.au/-/media/Spectrum-Transformation-and-Government/Information/zip-file/2014--34-GHz-TLG-Package-zip.ZIP?la=en).

It is proposed to adopt unwanted emission limits for the 3.6 GHz band based on the current 3.4 GHz band spectrum licences for devices with a few amendments. The aim of these amendments are to:

* ensure existing devices deployed under the current 3.4 GHz band framework can either continue operating unaffected;
* enable new devices to be deployed (or existing ones to be retuned if possible) anywhere in the 3425-3492.5 MHz and 3542.5-3700 MHz frequency bands;
* support multicarrier aggregation and larger channel bandwidths for UEs;
* avoid unnecessary costs and burdens on licensees to implement strict unwanted emission limits that are only required to enable compatibility in specific situations;
* minimise costs and complexity of retuning services as part of any future defragmentation of licence holdings across the broader 3400-3700 MHz frequency range;

To adopt these arrangements, it would be expected that, when required, spectrum licensees will work with relevant adjacent band apparatus (in particular PTS and point-to-multipoint licensees) and spectrum licensees in good faith to manage interference, as defined in the current 3.4 GHz band spectrum licence technical framework. This would be irrespective of who was first-in-time.

An alternative approach would be to define more stringent unwanted emission limits from the onset. Under this approach licensees would be free to negotiate a relaxation of these levels on a case-by-case basis. An example of more stringent levels are those being considered by ECC PT1 for unsynchronised and semi-synchronised systems, where a total radiated power level of -43 dBm/5MHz is currently proposed. Of course, a potential problem with this approach is it may affect the ability of a licensee to re-tune systems as part of a defragmentation of spectrum holdings in the broader 3400-3700 MHz band. It is also unlikely to be required in all deployment scenarios.

*Proposed out-of-band emission limits for registered devices*

The proposed out-of-band emission limits for registered devices are based on E-UTRA and draft NR Category B unwanted emission limits, as defined in the relevant 3GPP standards[[6]](#footnote-7). Since these limits are the same for both E-UTRA and NR, the proposed limits are based on the current the 3.4 GHz spectrum licence limits. The only change proposed is to the frequency range the limits apply.

3GPP E-UTRA standards state that, for base stations, the out-of-band emission limits do not apply ±10 MHz outside of a defined operating band. For this reason the current frequency range out-of-band emissions apply, as specified on 3.4 GHz band spectrum licences and assuming band E42 compliant equipment, is 3390-3610 MHz.

However, draft 3GPP NR standards state that, for base stations, the out-of-band emission limits do not apply ±40 MHz outside of a defined operating band. The two currently defined NR profile bands cover the 3300-3800 MHz and 3300-4200 MHz bands respectively. This would suggest that the out-of-band emission limits should apply over either the 3260-3840 MHz or 3260-4240 MHz frequency range.

Due to coexistence requirements with adjacent band radiolocation and fixed satellite services, this is not considered appropriate. Therefore a smaller frequency range is proposed, specifically 3380-3720 MHz. As discussed in the next section, more stringent emissions are proposed for the 3100-3380 MHz and 3720-4200 MHz bands. The application of a ±20 MHz buffer to the 3400-3700 MHz band is based on work conducted by ECC PT1 that indicates more stringent emissions can be achieved over a 20 MHz frequency range.

As a result of this discussion, the resulting out-of-band emission limits proposed are shown in Table 1.

1. Transmitter unwanted emission limits within the 3380-3720 MHz frequency band – registered devices.

|  |  |  |
| --- | --- | --- |
| **Frequency Range (foffset)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 0 kHz ≤ foffset ≤ 5 MHz | 10 – (7/5).foffset(MHz) | 100 kHz |
| 5 MHz≤ foffset ≤ 10 MHz | 3 | 100 kHz |
| foffset ≥ 10 MHz | 2 | 1 MHz |

Regarding the management of interference, the limits above work well when adjacent band systems are using the same technology and have synchronised operation. However, they may not be sufficient when adjacent band services have unsynchronised (or semi-synchronised) operation or employ different technologies that are incapable of being synchronised. Therefore, if these limits are adopted, in the event interference occurs between adjacent band services, it would be expected that spectrum licensees work in good faith with relevant apparatus (in particular PTS and point-to-multipoint licensees) and spectrum licensees operating in the 3400-3700 MHz band to manage interference, irrespective of who was first-in-time. This could include reducing out-of-band emissions down to the levels specified in Table 2. This expectation would be (and currently is for the 3.4 GHz band spectrum licences) specified in the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 3.4 GHz Band)* and *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band)*.

The only change to the limits in Table 2 is the alignment of emissions from 0-5 MHz with those defined in Table 1.

1. Additional transmitter unwanted emission limits within the 3400-3700 MHz frequency band, if required, to manage adjacent band interference – registered devices.

|  |  |  |
| --- | --- | --- |
| **Frequency Range**  **(foffset)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 0 kHz ≤ foffset ≤ 5 MHz | 10 – (7/5).foffset(MHz) | 100 kHz |
| 5 MHz≤ foffset ≤ 10 MHz | 3 | 100 kHz |
| foffset ≥ 5 MHz | -25 | 1 MHz |

*Proposed additional unwanted and spurious emission limits for registered devices*

For registered devices, it is proposed to maintain the existing 3.4 GHz band unwanted emission limits that apply outside the 3380-3720 MHz frequency range. This resulting unwanted emission limits are shown in Tables 3 and 4. In these tables the upper frequency limit is also set to 19 GHz. This is in line with relevant standards and represents the fifth harmonic of the frequency 3.8 GHz.

1. Transmitter unwanted emission limits outside the 3380-3720 MHz frequency band – registered devices.

|  |  |  |
| --- | --- | --- |
| **Frequency Range**  **(f)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 9 kHz ≤ f ≤ 150 kHz | -36 | 1 kHz |
| 150 kHz ≤ f ≤ 30 MHz | -36 | 10 kHz |
| 30 MHz ≤ f ≤ 1 GHz | -36 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -30 | 1 MHz |

1. Receiver unwanted emission limits outside the 3380-3720 MHz frequency band – registered devices.

|  |  |  |
| --- | --- | --- |
| **Frequency Range**  **(f)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 30 MHz ≤ f ≤ 1 GHz | -57 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -47 | 1 MHz |

Specific questions to consider in relation to the development of unwanted emission limits are:

1. **Are the unwanted emission limits proposed in the paper appropriate?**
2. **Should there be separate emission limits for registered active antenna systems (that can make use of beamforming) and non-active antenna systems?**
3. **Is it suitable to only provide text in the Advisory Guidelines stating spectrum licensees need to work with other affected licensees in good faith to manage adjacent band interference? Or should this be defined as a condition on the licence?**
4. **Is such a requirement practical when managing interference to/from devices with active antenna systems given their integrated architecture and potential difficulty in reducing unwanted emissions post-manufacture? Would more stringent unwanted emission limits or other approach be more appropriate under these circumstances?**
5. **Are stricter limits required to facilitate coexistence with adjacent band radiolocation and earth station receiver services?**

***Devices exempt from registration***

*Proposed out-of-band emission limits for devices exempt from registration*

Devices exempt from registration, as defined on the current 3.4 GHz spectrum licences, fall into two categories:

1. Devices operating with an EIRP less than 25 dBm per occupied bandwidth (typically mobile and nomadic devices)
2. Ubiquitously deployed fixed terminals with high gain antennas placed lower than 10m above ground level (typically wall or roof mounted on the outside of homes or businesses)

The out-of-band emission limits for these cases were originally based on the limits defined for E-UTRA UEs. It is proposed that the revised limits be developed by considering both E-UTRA and NR UE out-of-band emission limits.

E-UTRA and draft NR UE standards[[7]](#footnote-8) state that the out-of-band emission limits do not apply:

* ±10 MHz and ±25 MHz from the edge of a 5 MHz and 20 MHz operating bandwidth for an E-UTRA UE;
* ±45 MHz and ±65 MHz from the edge of the aggregated bandwidth of an E-UTRA UE utilising 2x20 MHz and 3x20 MHz carrier aggregation respectively;
* ±105 MHz outside of a 100 MHz operating bandwidth for an NR UE.

Based on the above dot points, the general rule of thumb is that for UEs the out-of-band emission limits do not apply ±(aggregated bandwidth + 5 MHz) from the lower or upper edge of the channel used (or outer most channel in the case of carrier aggregation).

It is noted that the out-of-band emission limits for devices exempt from registration defined on current 3.4 GHz band spectrum licences are more stringent than those defined for LTE carrier aggregation and larger NR bandwidths. Taking this into account and the fact that only the 3400-3700 MHz band is being considered, it is proposed that the frequency range that the out-of-band limit applies be 3295-3805 MHz (i.e. 3400-105=3295 MHz and 3700+105=3805 MHz). This ensures that E-UTRA carrier aggregation and larger NR channels are accommodated.

The actual out-of-band limits proposed are then based on the combined maximum emission limits defined for UEs operating in the three different scenarios listed previously (i.e. considering 5 MHz and 20 MHz channels, multiple carrier aggregation and NR bandwidths up to 100 MHz). The resulting out-of-band emission limits are shown in Table 5.

1. Transmitter unwanted emission limits within the 3295-3805 MHz frequency band – devices exempt from registration.

|  |  |  |
| --- | --- | --- |
| **Frequency Range (foffset)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 0 kHz ≤ foffset ≤ 1 MHz | -15 | 30 kHz |
| 1 MHz≤ foffset ≤ 5 MHz | -10 | 1 MHz |
| 5 MHz≤ foffset ≤ 100 MHz | -13 | 1 MHz |
| foffset ≥ 100 MHz | -25 | 1 MHz |

*Proposed spurious emission limits for devices exempt from registration*

For devices exempt from registration, it is proposed to maintain the existing 3.4 GHz band unwanted emission limits that apply outside the 3295-3805 MHz frequency range. This resulting unwanted emission limits are shown in Tables 6 and 7. In these tables the upper frequency limit is also set to 19 GHz. This is in line with relevant standards and represents the fifth harmonic of the frequency 3.8 GHz.

1. Transmitter unwanted emission limits outside the 3295-3805 MHz frequency band – devices exempt from registration.

|  |  |  |
| --- | --- | --- |
| **Frequency Range**  **(f)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 9 kHz ≤ f ≤ 150 kHz | -36 | 1 kHz |
| 150 kHz ≤ f ≤ 30 MHz | -36 | 10 kHz |
| 30 MHz ≤ f ≤ 1 GHz | -36 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -30 | 1 MHz |

1. Receiver unwanted emission limits outside the 3295-3805 MHz frequency band – devices exempt from registration.

|  |  |  |
| --- | --- | --- |
| **Frequency Range**  **(f)** | **Radiated Mean Power (dBm EIRP)** | **Measurement Bandwidth** |
| 30 MHz ≤ f ≤ 1 GHz | -57 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -47 | 1 MHz |

### Other conditions on the licence

It is proposed to maintain all of the ‘other conditions’ (i.e. those other than core and statutory conditions) that are currently contained in 3.4 GHz band spectrum licences (refer to the PDF image of current 3.4 GHz band spectrum licences available on the [RRL](https://web.acma.gov.au/rrl/browse_licences.licence_list?pSV_ID=85&pSS_ID=861) for more details).

In addition to these, it is also proposed to include the following:

* A condition that licensees do not cause unacceptable levels of interference to earth stations operated by Lockheed Martin at Uralla, NSW
* A condition that licensees protect the currently identified earth station protection zones (ESPZ) defined in:
  + [Embargo 49](https://www.acma.gov.au/-/media/Spectrum-Engineering/Regulation/pdf/Embargo-No-49.pdf?la=en) – the west Australian ESPZ centred around Mingenew, WA; and
  + [Embargo 72](https://www.acma.gov.au/-/media/Spectrum-Engineering/Regulation/pdf/Embargo-No-72-pdf.pdf?la=en) – the three proposed east Australian ESPZs around the towns of Quirindi, Moree and Roma.

The proposed wording of the second and third conditions follow:

**Managing interference with Uralla Earth station facility**

1. The licensee must not cause interference to Earth stations operated within HCIS identifier NU7K4 in accordance with the criteria specified in *RALI[ESPZ]*

**Coordination with Earth station protection zones**

1. Before seeking to register a radiocommunications transmitter, the licensee must follow the procedures set out in *RALI[ESPZ]* for the protection of the defined Earth station protection zones.

RALI[ESPZ] is a proposed new RALI that will developed as part of the TLG process. Refer to the *Managing interference from spectrum licensed transmitter* section of this paper for more detail.

It is also recognised that a decision is yet to be made regarding which (if any) of the locations in east Australia may be a viable ESPZ. Therefore by defining procedures for the general protection of these areas in a new RALI (i.e. RALI[ESPZ]), in the event one or more of them is found to be unsuitable, it can be removed at short notice and allow greater utility of spectrum licences in the adjacent areas.

1. **Do stakeholders have any concerns or alternative proposals for the proposed additional conditions?**
2. **Are there any other conditions stakeholders propose to include?**

## Unacceptable levels of interference

Spectrum licensees are required to register a radiocommunications transmitter in the Register of Radiocommunications Licences before they may be operated under the licence. The only exception to this is if there is a condition on licences that exempts certain types of transmitter.

Subsection 145(1) of the Act gives the ACMA the power to refuse to register a radiocommunications transmitter if it is satisfied that the operation of the transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices. Under subsection 145(4) of the Act, the ACMA can make a determination (referred to as a section 145 determination) that sets out what is considered unacceptable levels of interference for each spectrum-licensed band.

A section 145 determination sets out the circumstances in which devices are deemed to cause unacceptable levels of interference. These circumstances typically include:

* if the levels of emissions from a device at the geographical boundary of a licence exceed a defined level;
* if the operation of the transmitter will cause a breach of a core condition of the licence; and
* if the deployment of the device is outside any deployment constraints defined for the band.

### 3.4 GHz band section 145 determination

The current section 145 determination for the 3.4 GHz band is the *[Radiocommunications (Unacceptable Levels of Interference - 3.4 GHz Band) Determination 2015](https://www.legislation.gov.au/Details/F2015L00727" \t "_self)*. Details on the development of this s.145 determination are contained in the [3.4 GHz band TLG papers](https://www.acma.gov.au/-/media/Spectrum-Transformation-and-Government/Information/zip-file/2014--34-GHz-TLG-Package-zip.ZIP?la=en).

Some of the key details of the 3.4 GHz band section 145 determination are:

* It is optimised for TDD use;
* The only deployment constraint is clause s.7(8) which prevents devices being registered on an airship or balloon (note this does not prevent the use of devices exempt from registration on an airship or balloon);
* The device boundary criteria (DBC) is based on the following:
* A defined level of protection of -111 dBm/MHz to a receiver with a gain of 0 dBi at a height of 5m above the ground;
* Use of Recommendation ITU-R P.526-13 as the propagation model; and
* A calculation procedure similar to that implemented in other spectrum licence bands.

### Options for consideration

The current 3.4 GHz band section 145 determination was developed in 2015 and may be suitable for the 3.6 GHz band. The main questions to consider here are:

* whether or not it adequately caters for active antenna systems capable of beamforming or if a different approach to manage the level of emissions across geographical boundaries would be more appropriate;
* whether, with the benefit of 2 years implementation of the current 3.4 GHz section 145 determination, any of the parameters associated with the DBC should be adjusted (e.g. level of protection).

Considering the above points, the ACMA has identified the following options with regards to development of a section 145 determination for the 3.6 GHz band:

* use the current 3.4 GHz band section 145 determination; or
* use the current 3.4 GHz band section 145 determination but modify one or more of the parameters of the current DBC

While changes to deployment constraints could be considered, the ACMA does not currently propose any changes to those currently defined in the 3.4 GHz band section 145 determination.

At this stage the ACMA proposes to adopt the current 3.4 GHz band section 145 determination for the 3.6 GHz band. This would require a change to the definition of the 3.4 GHz band to include the 3575-3700 MHz frequency range.

The following additional changes are also proposed:

* Exempt spectrum licensees from having to meet the device boundary criteria around the areas excised for consideration as earth station protection zones and the earth s station facility operating at Uralla;
* Include the following note to provide guidance on how to cater for devices with active antenna systems capable of beamforming:

*Note: RP[[8]](#footnote-9) for a device that is capable of beamforming is defined as the maximum intended EIRP in the horizontal plane for azimuth from 0-360 degrees.*

A draft update to the *Radiocommunications (Unacceptable Levels of Interference - 3.4 GHz Band) Determination 2015* is at Appendix C.

1. **Should the current 3.4 GHz band section 145 determination be adopted for the 3.6 GHz band with the additional changes proposed? If not, Why? Is a specific modification proposed?**

For any TLG members proposing changes to the current 3.4 GHz band section 145 determination, please keep the following in mind:

* Development of a DBC is a balance between providing protection to adjacent area services/spectrum licences and increasing the usability of a spectrum licence. For example, the greater the restriction on emissions leaving the area (equivalently: the greater the level of protection provided to adjacent area services) the less coordination is required between licensees to manage interference but the greater the ‘dead-zones’ near licence boundaries[[9]](#footnote-10).
* If a single spectrum licence technical framework is to be adopted across the broader 3400-3700 MHz band, then the effect of any deviation to the current 3.4 GHz technical framework on any existing devices deployed will need to be considered. This includes whether any measures are required to ensure existing devices can continue operating (e.g. through the inclusion of a grandfather clause).

## Radiocommunications advisory guidelines

Further guidance on interference management with other licensed services is provided in Radiocommunications Advisory Guidelines (RAGs) made under section 262 of the Act. RAGs can refer to any aspect of radiocommunications or radio emissions.

Generally, RAGs include provisions to help assess the possible interference between spectrum-licensed devices and services operating under spectrum, apparatus or class licences. Potentially affected services are identified in the RAGs to enable licensees to assess and mitigate the risk of interference between these services.

It is important to note that where a case of interference arises between a spectrum-licensed device and another licensed device, the ACMA will refer to the provisions of the RAGs in resolving the matter. In general, affected licensees also have the ability to negotiate their own arrangements in order to manage interference. Such arrangements will also be taken into account when resolving any interference disputes.

Currently, there are two section 262 guidelines relevant to the deployment of services under 3.4 GHz band spectrum licences:

* *[Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015](http://www.comlaw.gov.au/Details/F2015L00728" \t "_self);*
* [*Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band) 2015*](http://www.comlaw.gov.au/Details/F2015L00729)*.*

### Managing interference from spectrum-licensed transmitters

The [*Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*](http://www.comlaw.gov.au/Details/F2015L00728) (RAG Tx) provide guidance on the protection of adjacent band apparatus and class-licensed receivers from interference from spectrum-licensed transmitters. The existing guidelines identify the types of apparatus-licensed services potentially affected by transmitters operated under a spectrum licence in the 3.4 GHz band. They also explain the protection criteria and coordination arrangements that apply to these services, sometimes by reference to various RALIs[[10]](#footnote-11) or international standards.

It is proposed that the existing 3.4 GHz RAG Tx be updated to include the 3.6 GHz band and protection requirements of relevant services be updated to account for this. Some of the key differences between the existing RAG Tx and the proposed updated RAG Tx are[[11]](#footnote-12):

* Section 1.4(1) - Include 3.6 GHz band definition.
* Sections 2.3 & 3.1 – indicate fixed links operate ‘in and adjacent to the 3.4 GHz band’.
* Section 4.3 – update to include co-channel coordination with Fixed Satellite Service (FSS) earth stations as well as a requirement to notify affected earth station licensees of any new systems to ensure they have suitable RF filters installed.
* Section 5.2(2) – update note to cover 3400-3700 MHz frequency band. Note: this also requires an update to RALI FX19 to manage interference to P-MP apparatus licences.
* Section 7.1(1) – update frequency range to encompass 3400-3700 MHz frequency band.
* A new section providing guidance on how to manage interference with the east and west coast ESPZ.
* A new section dealing with how to coordinate with the earth station facility operated by Lockheed Martin near Uralla (NSW).

Other than the update to clause 4.3, the changes to RALI FX19 required to manage interference with P-MP licences, the new ESPZ section and protection of earth stations operating at Uralla, the proposed changes are relatively minor and self-explanatory in nature. For this reason, they are not discussed in detail in this TLG paper. However, the other proposed changes are discussed in turn below.

A draft update to the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*is at Appendix D.

1. **Should the current 3.4 GHz band RAG Tx be adopted with the changes proposed for the 3.6 GHz band? If not, why? Are any other modifications proposed?**
2. **Is further guidance required in the RAG Tx (and/or the RAG Rx) on how to coordinate with devices with active antenna systems?**

***FSS protection criteria***

In the *Australian Radiofrequency Spectrum Plan 2013* (ARSP 2013), the FSS(s-E) is a primary service in the 3600-4200 MHz band. This means apparatus licensed FSS earth station receivers or transmitters registered for use under a spectrum licence need to be coordinated against each other on a first-in-time basis.

The RAG Tx currently contains adjacent channel coordination criteria between an earth station and a transmitter registered for use under a spectrum licence. Details on the development of this criteria is available in the [3.4 GHz band TLG paper](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum-licence-technical-liaison-groups-1). With the re-allocation of the 3.6 GHz band for spectrum licensing there is a need to include co-channel coordination criteria. It is also proposed to revise the current adjacent band coordination criteria to facilitate better coexistence with earth stations.

*Co-channel protection criteria*

When managing co-channel interference to Earth station receivers operating on a primary basis, the following co-channel interference management criteria is proposed:

* Coordination is performed on a first-in-time basis (i.e. a proposed new spectrum/apparatus licensed service must manage interference with all pre-existing apparatus/spectrum licensed services);
* Coordination is only required with those Earth stations that have their details recorded in the Register of Radiocommunications Licences (RRL). Earth station will only be offered co-channel protection over their licensed bandwidth.
* Any Earth stations and proposed transmitters operated under a spectrum licence within 200 km of each other should be assessed to see if the relevant protection criteria is met.
* Earth stations are to be protected to a level of -128.6 dBm/MHz (corresponding to a noise temperature of 100 K and an I/N of -10 dB – as calculated using ITU-R Recommendation SF.1006) for 20% of the time. This criteria must be met for every 1 MHz bandwidth of a licensed earth station receiver, meaning the 1 MHz bandwidth with the highest level of out-of-band emissions should be considered in calculations.
* The propagation model defined in ITU-R Recommendation P.452 should be used when modelling interference.
* In the event actual antenna patterns are not available for an Earth station, ITU-R Recommendation S.465 can be used.

1. **Is the co-channel FSS protection criteria proposed adequate?**

*Adjacent band protection criteria*

The RAG Tx currently defines the adjacent band protection requirements for licensed FSS Earth receive stations operating in the 3600-4200 MHz band as:

* FSS Earth station receivers are to be protected from unwanted emissions (out-of-band and spurious) to a level of -128.6 dBm/MHz, assuming a receiver noise temperature of 100K, not to be exceeded for more than 20% of the time;
* A radiocommunications transmitter operated under a spectrum licence in the 3.4 GHz band is not considered to overload the receiver of an FSS Earth station if the total power received from the interfering service at the input of an FSS Earth station receiver (i.e. after considering Antenna gain, RF filtering and other losses) does not exceed -65 dBm.

When assessing interference using the above criteria, the RAG Tx states that the minimum RF filter performance described in Table 8, can be assumed at the front end of the Earth station receiver.

1. Characteristics of Earth station receivers RF filter in the RAG Tx

|  |  |
| --- | --- |
| **Frequency offset from the edge of the Earth station receiver licence (MHz)** | **Rejection (dB)** |
| < 25 | 0 |
| < 50 | 15 |
| < 150 | 45 |
| < 200 | 50 |
| ≥ 200 | 70 |

Details on the development of the current adjacent band protection criteria are provided in the [3.4 GHz band TLG paper](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum-licence-technical-liaison-groups-1). While it is not proposed to amend these, it may be worth reviewing the assumed RF filter characteristics. Figure 2 compares the current levels assumed in the RAG Tx with those defined by the FCC in [rule 96.17](https://www.gpo.gov/fdsys/search/pagedetails.action?collectionCode=CFR&browsePath=Title+47%2FChapter+I%2FSubchapter+D%2FPart+96%2FSubpart+B%2FSection+%26sect%3B+96.17&granuleId=CFR-2016-title47-vol5-sec96-17&packageId=CFR-2016-title47-vol5&collapse=true&fromBrowse=true). While the two masks are similar, there are noticeable points of difference. These include:

* The RAG Tx filter mask has a stepped response whereas the FCC mask is linear;
* The FCC filter mask assumes higher levels of attenuation from 0-50 MHz; and
* The RAG Tx filter mask assumes a noticeably higher attenuation from 50-100 MHz and from 200 MHz onwards.

1. Comparison of FCC (blue) and RAG Tx (red) assumed Earth station RF filter performance

The RAG Tx filter mask was based on the technical performance of RF filters published by various manufacturers. This information was typically only defined for a set of frequency offsets (e.g. 0 MHz, 25 MHz, 50 MHz, 150 MHz etc). Consequently the RAG Tx filter mask appears stepped in nature. It is noted that this may underestimate the level of rejection at some frequency offsets, in particular from 0-50 MHz. It also suggests a higher level of rejection from 50-100 MHz offsets than the FCC filter mask.

1. **Is the current RAG Tx RF filter mask for ES suitable or should the FCC filter mask be adopted?**
2. **Is the current adjacent band protection criteria for earth stations appropriate? If not, what changes are proposed?**

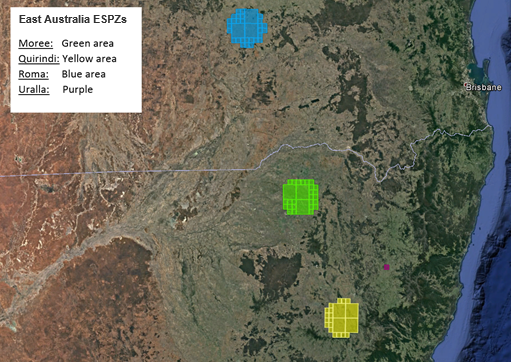
***Earth station protection zones***

The ACMA is interested in working with industry to identify and develop (ESPZs) in eastern and western Australia. The purposes of these ESPZs is to have defined areas outside of reasonably sized population centres that provide long-term certainty and flexibility for the investment in and operation of commercial space communications teleport facilities in Australia.

An ESPZ has already been identified near Mingenew in Western Australia. The area is currently protected by [Embargo 49](https://www.acma.gov.au/-/media/Spectrum-Engineering/Regulation/pdf/Embargo-No-49.pdf?la=en) (a kml file of the area viewable in Google Earth is also available on the [ACMA website](http://channelfinder.acma.gov.au/interforms/placemarks/embargo/embargo_49.kmz)).

As part of the outcomes announced in the paper *Future use of the 3.6 GHz band: Decisions and preliminary views* (3.6 GHz decision paper), the ACMA also identified three potential locations for an ESPZ in eastern Australia. These areas are currently protected by [Embargo 72](https://www.acma.gov.au/-/media/Spectrum-Engineering/Regulation/pdf/Embargo-No-72-pdf.pdf?la=en) and defined by Area 3, Area 4 and Area 5 in the embargo (a kml file of these areas viewable in Google Earth is also available on the [ACMA website](http://channelfinder.acma.gov.au/interforms/placemarks/embargo/embargo_72.kmz)). The relevant areas are reproduced in Figure 4.

1. East Australia ESPZs



The ACMA intends to work with industry to investigate the suitability each of the three eastern Australia ESPZs. Should it become apparent that one or more of these zones is not viable, the ACMA will remove any protection requirements in place and investigate mechanisms to make the area available for wide-area broadband services.

It is noted that another outcome of the 3.6 GHz decision paper was that the ACMA was open to working with stakeholders to:

* Identify a second ESPZ on the west coast of Australia. Though it is expected that any location considered would be outside of those areas re-allocated for the issue of spectrum licences in the 3.6 GHz band; and
* Determine the viability and location of an ESPZ located at latitudes above 15°.

However, work on these issues is outside the scope of the 3.6 GHz band TLG and will be considered under a separate process.

*Protection of ESPZs*

The existing embargoes, while an effective tool, are considered too conservative for the protection of the ESPZs. The ACMA believes the same level of protection can be provided while also allowing greater utilisation of the areas surrounding the ESPZs.

A summary of the proposed coordination procedure for ESPZs follows:

* No transmitters will be allowed within the designated ESPZ area (refer to Appendix G for area definitions);
* Spectrum licensees wishing to deploy a transmitter within 200 km of the ESPZ will be required to coordinate with a notional earth station receiver at each of several ‘defined’ locations within each ESPZ;
* The currently proposed locations for coordination at each ESPZ are at Appendix H. Each of these locations was chosen so as not to be located on top of a hill and as far as possible to take advantage of local terrain shielding.
* The same co-channel protection criteria that was defined for the protection of FSS earth stations is proposed to apply to each notional earth station receiver.
* The characteristics of the notional earth station receiver are:

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Height | 10m |
| Feeder loss | 0 dB |
| Antenna pattern | ITU-R S.465 with a D/λ value of 100 |
| Maximum Antenna gain | 58 dBi |
| Minimum antenna elevation | Protection must be afforded for the antenna pointing anywhere at the geostationary arc, down to a minimum elevation of 15° |
| Interference threshold | -128.6 dBm/MHz, assuming a receiver noise temperature of 100K, not to be exceeded for more than 20% of the time |

* As described in the *FSS protection criteria* section of this paper, any proposed transmitters will also be required to coordinate with any apparatus licensed earth station receivers in the ESPZ. Such coordination will occur on a first-in-time basis.

It is further proposed that the coordination procedure for ESPZs be contained in a new RALI (with a working title of RALI[ESPZ]) which would then be incorporated by reference into the RAG Tx. This will allow a more timely removal of any criteria in the event one or more of the eastern Australia ESPZs is found unsuitable. A draft version of RALI[ESPZ] will also be made available to the TLG to consider in due course.

1. **Is the proposed coordination procedure for ESPZs suitable?**
2. **Are the proposed locations sufficient to provide nominal protection of each of the ESPZs?**
3. **Are the characteristics of the notional earth station receiver representative of gateway earth stations that could be deployed in each ESPZ?**
4. **Do stakeholders have any views on the viability of any of the proposed eastern Australia ESPZs?**

***Protection of Lockheed Martin facility near Uralla (NSW)***

Earth stations operating at the Lockheed Martin facility near Uralla, NSW (the Uralla facility), are used to provide services such as TT&C as well as temporary missions to support Transfer Orbit and In-orbit satellite testing. While some of these services are permanent, others are temporary (or intermittent) and can operate in any portion of the band depending on each satellite’s design.

As of 1st March 2018, there are 4 earth station receiver licences for the Uralla facility. These licences occupy four 1 MHz bandwidths across the 3400-3700 MHz frequency range. However, as indicated other licences are taken out on ad hoc basis to support different missions. Therefore there is a need to provide a notional level of protection for the site so such missions can continue to be conducted across the 3400-4200 MHz band. Unfortunately this also means that the use of RF filtering to manage adjacent band interference is not possible.

*Protection requirements*

Co-channel interference for existing licensed services at the Uralla facility (inside HCIS NU7K4) would be provided by the co-channel protection requirements for earth stations previously discussed[[12]](#footnote-13). The adjacent band protection criteria also applies, however, in this case, the use of RF filtering cannot be assumed.

Broader protection of the entire 3400-4200 MHz band cannot be provided due to existing spectrum licences that cover the Uralla facility in the 3.4 GHz band and the fact the earth stations are a secondary service in the 3400-3600 MHz frequency range. For this reason general protection can only be considered for the 3600-4200 MHz frequency ranges. This means earth stations operating in the 3400-3600 MHz band at the Uralla facility do so on a ‘no protection from interference’ basis.

In order to provide general protection of the broader 3600-4200 MHz band a coordination process similar to that developed for the ESPZs is proposed.

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Location | Latitude -30.6315°, Longitude 151.5661° (GDA94) |
| Height | 25m |
| Antenna pattern | ITU-R S.465 with a D/λ value of 100 |
| Maximum Antenna gain | 58 dBi |
| Minimum antenna elevation | 5° (any direction) |
| Interference threshold | -128.6 dBm/MHz, assuming a receiver noise temperature of 100K, not to be exceeded for more than 20% of the time |
| Receiver overload | -65 dBm (total received power) |

It is further proposed that the protection criteria for the Lockheed Martin facility also be contained in a new RALI (with a working title of RALI[ESPZ]) which would then be incorporated by reference into the RAG Tx. A draft version of RALI[ESPZ] will also be made available to the TLG to consider in due course.

Given some of the services operating at the Uralla facility are temporal in nature and/or may only track certain parts of the sky, there may be opportunity for detailed negotiations between licensees to manage interference while improving spectrum utilisation.

Please note that as indicated in the paper *Future use of the 3.6 GHz band—Decisions and preliminary views*, the long-term viability of the Uralla facility may be reviewed in the future. This is in light of the increasing demand for fixed and mobile broadband capacity, growing international interest in the 3700–4200 MHz band for use by fixed and mobile broadband services and the proximity of the site to major regional population centres. However, if it is shown that fixed and mobile broadband service deployments in nearby major towns are not unreasonably restricted (noting there is likely to be some restrictions), this would be taken into consideration when assessing the long term viability of the Uralla facility.

***Frequency assignment requirements for point-to-multipoint licences in the 3.6 GHz band***

Frequency assignment criteria for P-MP licences in the 3425-3700 MHz frequency range are contained in [RALI FX14](https://www.acma.gov.au/-/media/Spectrum-Engineering/Information/Word-Document/RALI-FX14-PMP.doc?la=en) (P-MP licences in the 3425-3442.5 MHz and 3475-3492.5 MHz bands) and [RALI FX19](https://www.acma.gov.au/theACMA/frequency-coordination-licensing-bwa-19001920-20102025-and-35753700-mhz-bands) (P-MP licences in the 3575-3700 MHz band). It is proposed to revise the criteria in RALI FX19 to account for the Minister’s 3.6 GHz band re-allocation declaration and updates to the 3.4 GHz band spectrum licence technical framework. No changes are proposed to RALI FX14.

An overview of the changes proposed to RALI FX19 include:

* The inclusion of co-channel protection criteria between P-MP licences issued before 9th March 2018 (the date the Minister’s 3.6 GHz band spectrum re-allocations take affect) and transmitters registered for operation under a spectrum licences;
* The inclusion of a device boundary requirement for new P-MP licences in remote areas to manage the strength of emissions into regional areas re-allocated for the issue of spectrum licences;
* Revision of the adjacent channel coordination requirements between P-MP licences and transmitters registered for operation under a spectrum licence, to reflect updates to the 3.4 GHz band spectrum licence technical framework;
* General editorial updates to reflect the Minister’s 3.6 GHz band re-allocation declaration and the changes made to the frequency assignment criteria.

A draft update to RALI FX19, which details all these changes, will be made available to the TLG to consider in due course.

1. **Do the changes proposed to RALI FX19 adequately account for the Ministers 3.6 GHz band re-allocation declaration and updates to the 3.4 GHz band spectrum licence technical framework?**
2. **Are any other changes to RALI FX19 proposed?**

### Managing interference to spectrum-licensed receivers

The [*Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band) 2015*](http://www.comlaw.gov.au/Details/F2015L00729) (RAG Rx) provides guidance on the management of interference to receivers operating under a 3.4 GHz band spectrum licence.

A key part of the management of this type of interference is the specification of a notional receiver performance level and a compatibility requirement. This provides a base for the operators of radiocommunications transmitters to coordinate their services against. While adherence to the notional receiver is optional, the ACMA will have regard to it when settling interference disputes. For this reason, it is recommended that all receivers operating under a spectrum licence have a performance level at least equal to the defined notional receiver.

It is proposed that the existing RAG Rx be updated to include the 3.6 GHz band and protection requirements of relevant services be updated to account for this. Some of the key differences between the existing RAG Tx and the proposed updated RAG Tx are[[13]](#footnote-14):

* Section 1.4(1) - Include 3.6 GHz into the frequency ranges covered by the RAG Rx. Also include a definition of unwanted emissions.
* Replace ‘out-of-band emission’ with ‘unwanted emission’ throughout out the document.
* Section 3.1(2) & (5) – Update clauses to include how in-band interference from apparatus licences is managed in the 3575-3700 MHz band.
* Schedule 3 – Minor change to the additional unwanted emission limits that apply to registered devices when managing adjacent band interference to (and from) apparatus (specifically PTS and P-MP) and spectrum licensed services operating in the 3400-3700 MHz. The proposed additional limits are defined in the *Unwanted emissions* section of this paper.

No changes are proposed to the definition of the notional receiver or the compatibility requirement in Schedules 2 and 3 respectively.

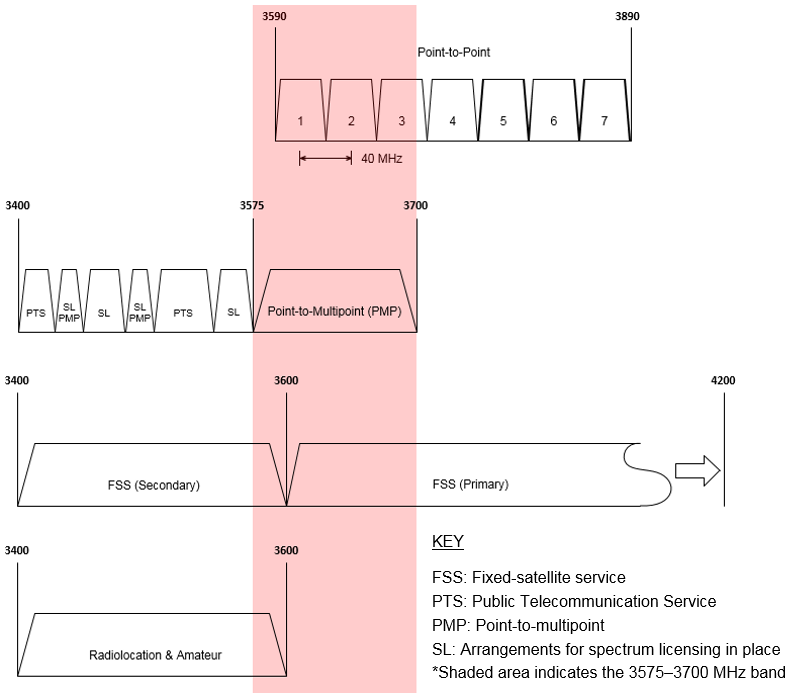
A draft update to the *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers— 3.4 GHz Band) 2015*is at Appendix E.

1. **Should the current 3.4 GHz band RAG Rx be adopted with the changes proposed for the 3.6 GHz band? If not, why? Are any other modifications proposed?**
2. **Is further guidance required in the RAG Rx (and/or the RAG Tx) on how to coordinate with devices with active antenna systems?**

# Appendix A – Current use of the 3.6 GHz and adjacent bands

Figure 4 provides the current arrangements in the 3.6 GHz band (shown by the shaded area) and adjacent bands. Table 9 and Figure 5 provide information on the number and location of existing apparatus-licensed services in the 3.6 GHz band.

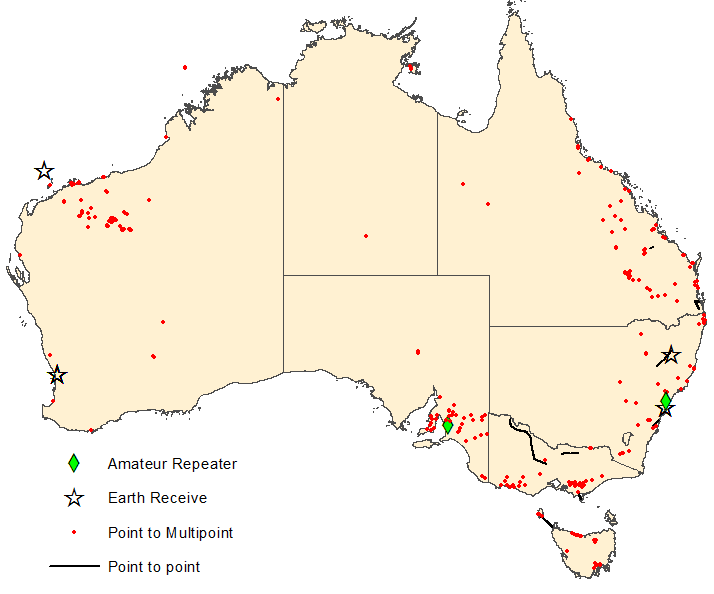
1. 3.6 GHz band arrangements



1. Breakdown of licences in the 3.6 GHz band (RRL extract, 1 February 2017)

| Licence type | No. of licences | No. of licensees | Major licensees (number of licences) |
| --- | --- | --- | --- |
| Earth receive | 19 | 5 | Telstra (9), Inmarsat (6), Lockheed Martin (2), Optus (1) |
| Point-to-multipoint | 443 | 62 | Pilbara Iron Company (63), BHP Billiton Iron Ore (46), Aus Pacific LNG (28), Aussie Broadband (28), Agile (25), Connectivity I.T. Pty Ltd (22), Dep Transport Qld (19), Tasmanet (18), QEStel (18) |
| Point-to-point | 46 | 5 | Digital Distributions Australia (37), Telstra (6) |
| Amateur repeater | 2 | 2 | Elizabeth Amateur Radio Club (1), Central Coast Amateur Radio Club (1) |

1. Location of embargoed areas and licensed services in the 3.6 GHz band (RRL extract, 1 February 2017)



# Appendix B – Current 3.4 GHz band unwanted emission limits

## Frequency band and geographic areas

1. This licence authorises the operation of radiocommunications devices in the frequency bands and within the geographic areas set out in Part 2 of Licence Schedule 1.

## Emission limits outside the frequency band

1. Core conditions 3 to 10 apply in relation to those frequencies that are outside the frequency bands set out in Part 2 of Licence Schedule 1.
2. Where a written agreement specifying the maximum permitted level of radio emission for frequencies described in core condition 2 exists between:
   1. the licensee; and
   2. all the affected licensees of frequency-adjacent spectrum licences and area-adjacent spectrum licences;

the licensee must comply with that specified maximum permitted level of radio emission.

1. Where there is no written agreement for the purposes of core condition 3 in force, the licensee must comply with core conditions 5 to 10.

## Non spurious emission limits

1. (1) The licensee must ensure that radiocommunications transmitters operated under this licence, other than a transmitter that is not exempt from the registration requirement under statutory condition 4 of Licence Schedule 3, does not exceed the non spurious emission limits in core condition 6.

(2) The licensee must ensure that radiocommunications transmitters operating under this licence that are exempt from the registration requirement under statutory condition 4 of Licence Schedule 3 do not exceed the non spurious emission limits described in core condition 7.

1. The non spurious emission limits in Table 3 apply:
   1. at frequencies outside the upper or lower frequency limits set out in Part 2 of Licence Schedule 1; and
   2. offset from the upper or lower frequency limits set out in Part 2 of Licence Schedule 1;

where:

**foffset:** is the frequency offset from the upper or lower frequency limits set out in Part 2 of Licence Schedule 1. The closest -3dB point of the specified bandwidth to the upper or lower frequency limits of the licence is placed at **foffset.**

## Licence Table 3: Radiated maximum true mean power non-spurious emission limits

|  |  |  |
| --- | --- | --- |
| **Frequency offset range**  **(foffset)** | **Radiated maximum true mean power (dBm EIRP)** | **Specified Bandwidth** |
| 0 kHz < foffset < 5 MHz | 10 - (7/5) x f offset (MHz) | 100 kHz |
| 5 MHz < foffset < 10 MHz | 3 | 100 kHz |
| foffset > 10 MHz | 2 | 1 MHz |

1. The non spurious emission limits in Table 4 apply:
   1. at frequencies outside the upper or lower frequency limits set out in Part 2 of Licence Schedule 1; and
   2. offset from the upper or lower frequency limits set out in Part 2 of Licence Schedule 1;

where:

**foffset:** is the frequency offset from the upper or lower frequency limits set out in Part 2 of Licence Schedule 1. The closest -3dB point of the specified bandwidth to the upper or lower frequency limits of the licence is placed at **foffset.**

## Licence Table 4: Radiated maximum true mean power non-spurious emission limits

|  |  |  |
| --- | --- | --- |
| **Frequency offset range**  **(foffset)** | **Radiated maximum true mean power (dBm EIRP)** | **Specified Bandwidth** |
| 0 kHz < foffset < 1 MHz | -15 | 30 kHz |
| 1 MHz < foffset < 20 MHz | -13 | 1 MHz |
| foffset > 20 MHz | -25 | 1 MHz |

**Spurious Emission Limits**

1. The licensee must ensure that radiocommunications devices operated under this licence do not exceed the spurious emission limits in core conditions 9 and 10.
2. For radiocommunications transmitters operated under this licence, the spurious emission limits in Table 5 apply at frequencies outside the 3390-3610 MHz frequency band, measured over the specified bandwidth for the relevant frequency range.

## Licence Table 5: Radiocommunications transmitter spurious emission limits

|  |  |  |
| --- | --- | --- |
| **Frequency range**  **(f)** | **Mean power**  **(dBm)** | **Specified**  **Bandwidth** |
| 9 kHz < f < 150 kHz | -36 | 1 kHz |
| 150 kHz < f < 30 MHz | -36 | 10 kHz |
| 30 MHz < f < 1 GHz | -36 | 100 kHz |
| 1 GHz < f < 12.75 GHz | -30 | 1 MHz |

1. For radiocommunications receivers operated under this licence, the spurious

emission limits in Table 6 apply at frequencies outside the 3390-3610 MHz frequency band, measured over the specified bandwidth for the relevant frequency range.

## Licence Table 6: Radiocommunications receiver spurious emission limits

|  |  |  |
| --- | --- | --- |
| **Frequency range**  **(f)** | **Radiated mean power**  **(dBm EIRP)** | **Specified**  **Bandwidth** |
| 30 MHz < f < 1 GHz | -57 | 100 kHz |
| 1 GHz < f < 12.75 GHz | -47 | 1 MHz |

# Appendix C – Draft Radiocommunications (Unacceptable Levels of Interference - 3.4 GHz Band) Determination

Refer to attachment on SharePoint

# Appendix D – Draft Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 3.4 GHz Band)

Refer to attachment on SharePoint

# Appendix E – Draft Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band)

Refer to attachment on SharePoint

# Appendix F – Draft spectrum licence

Refer to attachment on SharePoint

# Appendix G – ESPZ area definitions

The HCIS area definition of ESPZs is contained in Table 10.

The Australian Spectrum Map Grid (ASMG) is used to define geographical areas over which spectrum licences are issued. The Hierarchical Cell Identification Scheme (HCIS) is a naming convention developed by the ACMA that applies unique ‘names’ to each of the cells that make up the ASMG. The ASMG and HCIS are described in detail in the document [*The Australian spectrum map grid 2012*](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-3_4-ghz).

The HCIS coordinates in the table below can be converted into a Placemark file (viewable in Google Earth) through a facility on the ACMA website: [www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark](http://www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark)

1. ESPZ area definitions.

| Area name | HCIS |
| --- | --- |
| Moree | MU5G, MU5H, MU5L, MU5C8, MU5C9, MU5D7, MU5D8, MU5D9, MU5K1, MU5K2, MU5K3, MU5K4, MU5K5, MU5K6, MU5K8, MU5K9, MU6A7, MU6E1, MU6E2, MU6E4, MU6E5, MU6E7, MU6E8, MU6I1, MU6I2, MU6I4, MU6I5, MU6I7 |
| Quirindi | MV3G, MV3H, MV3K, MV3L, MV3C8, MV3C9, MV3D7, MV3F3, MV3F5, MV3F6, MV3F8, MV3F9, MV3J2, MV3J3, MV3J5, MV3J6, MV3J9, MV3O1, MV3O2, MV3O3, MV3P1 |
| Roma | MT4H, MT4K, MT4L, MT4F9, MT4G2, MT4G3, MT4G4, MT4G5, MT4G6, MT4G7, MT4G8, MT4G9, MT4J3, MT4J6, MT4O1, MT4O2, MT4O3, MT4O6, MT4P1, MT4P2, MT4P3, MT4P4, MT4P5, MT5E4, MT5E7, MT5I1, MT5I2, MT5I4, MT5I5, MT5I7, MT5M1 |
| Mingenew | BU4B, BU1N, BU1M6, BU1M8, BU1M9, BU1O4, BU1O7, BU1O8, BU4A2, BU4A3, BU4A6, BU4C1, BU4C2, BU4C4 |

# Appendix H – ESPZ coordination points

1. ESPZ coordination points.

|  |  |  |  |
| --- | --- | --- | --- |
| ESPZ name | Point ID | Latitude (GDA94) | Longitude (GDA94) |
| Mingenew | 1 | -29.045905 | 115.350437 |
| 2 | TBD | TBD |
| 3 | TBD | TBD |
| 4 | TBD | TBD |
| 5 | TBD | TBD |
| Quirindi | 1 | -31.278542 | 150.664064 |
| 2 | -31.531797 | 150.392637 |
| 3 | -31.758854 | 150.673901 |
| 4 | -31.334364 | 150.462804 |
| 5 | -31.683343 | 150.483362 |
| 6 | -31.524093 | 150.815250 |
| 7 | -31.472816 | 150.681203 |
| Moree | 1 | -29.202410 | 149.840025 |
| 2 | -29.470438 | 149.530685 |
| 3 | -29.740189 | 149.840030 |
| 4 | -29.436083 | 150.130913 |
| 5 | -29.375475 | 149.730499 |
| 6 | -29.566334 | 149.730211 |
| 7 | -29.566412 | 149.949630 |
| 8 | -29.366173 | 149.949382 |
| Roma | 1 | -26.571626 | 148.633980 |
| 2 | -26.590870 | 148.501616 |
| 3 | -26.708009 | 148.632882 |
| 4 | -26.840857 | 148.784921 |
| 5 | -26.710678 | 148.940348 |
| 6 | -26.588340 | 149.083815 |
| 7 | -26.571818 | 148.935420 |
| 8 | -26.516060 | 148.779018 |
| 9 | -26.589408 | 148.856840 |

1. Refer to [Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Adelaide and Eastern Metropolitan Australia) Declaration 2018](https://www.legislation.gov.au/Details/F2018L00225), [Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Perth) Declaration 2018](https://www.legislation.gov.au/Details/F2018L00221) and [Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Regional Australia) Declaration 2018](https://www.legislation.gov.au/Details/F2018L00222) [↑](#footnote-ref-2)
2. Refer to [Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Adelaide and Eastern Metropolitan Australia) Declaration 2018](https://www.legislation.gov.au/Details/F2018L00225), [Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Perth) Declaration 2018](https://www.legislation.gov.au/Details/F2018L00221) and [Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Regional Australia) Declaration 2018](https://www.legislation.gov.au/Details/F2018L00222) [↑](#footnote-ref-3)
3. Available at: <http://www.acma.gov.au/webwr/_assets/main/lib410188/australian_spectrum_map_grid_28feb2012.docx> [↑](#footnote-ref-4)
4. 3GPP TS 36.104, available at: <http://www.3gpp.org/DynaReport/36104.htm> [↑](#footnote-ref-5)
5. 3GPP TS 36.101, available at: <http://www.3gpp.org/DynaReport/36101.htm> [↑](#footnote-ref-6)
6. 3GPP TS 36.104, available at: <http://www.3gpp.org/DynaReport/36104.htm> and 3GPP TS 38.104, available at <http://www.3gpp.org/DynaReport/38104.htm> [↑](#footnote-ref-7)
7. 3GPP TS 36.101, available at: <http://www.3gpp.org/DynaReport/36101.htm> and 3GPP TS 38.101, available at: <http://www.3gpp.org/DynaReport/38-series.htm> [↑](#footnote-ref-8)
8. In the s.145 determination RP is defined as: *the horizontally radiated power, measured in dBm EIRP per MHz, for each bearing, σn*. [↑](#footnote-ref-9)
9. A dead-zone is an area close the boundary which is effectively rendered unusable (or where there are greater restrictions no how a service can be deployed) due to the DBC or other deployment constraints limiting the deployment of transmitters. [↑](#footnote-ref-10)
10. A full list of RALIs currently in-force is available on the [ACMA website](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Frequency-assignment-and-coordination/frequency-assignment-requirements-spectrum-planning-acma). [↑](#footnote-ref-11)
11. It is noted that the *Unwanted emission limits* section of this paper also sought feedback on whether it is practical for the RAG Tx (and RAG Rx) to require spectrum licensees to work with each other to manage interference including reducing OOB emissions to a more stringently defined level [↑](#footnote-ref-12)
12. It is noted that earth stations operating in the 3400-3600 MHz band are a secondary service and therefore cannot claim protection from interference caused by primary services. [↑](#footnote-ref-13)
13. It is noted that the *Unwanted emission limits* section of this paper also sought feedback on whether it is practical for the RAG Tx and RAG Rx to require spectrum licensees to work with each other to manage interference including reducing OOB emissions to a more stringently defined level. [↑](#footnote-ref-14)