Expiring spectrum licences—technical framework for the 2 GHz band

Paper Two

March 2015

Canberra

Red Building   
Benjamin Offices  
Chan Street   
Belconnen ACT

PO Box 78  
Belconnen ACT 2616

T +61 2 6219 5555  
F +61 2 6219 5353

Melbourne

Level 32   
Melbourne Central Tower  
360 Elizabeth Street   
Melbourne VIC

PO Box 13112  
Law Courts   
Melbourne VIC 8010

T +61 3 9963 6800  
F +61 3 9963 6899

Sydney

Level 5   
The Bay Centre  
65 Pirrama Road   
Pyrmont NSW

PO Box Q500  
Queen Victoria Building   
NSW 1230

T +61 2 9334 7700 or 1800 226 667  
F +61 2 9334 7799

Copyright notice

[Creative Commons logo](http://i.creativecommons.org/l/by/3.0/88x31.png)

<http://creativecommons.org/licenses/by/3.0/au/>

With the exception of coats of arms, logos, emblems, images, other third-party material or devices protected by a trademark, this content is licensed under the Creative Commons Australia Attribution 3.0 Licence.

We request attribution as: © Commonwealth of Australia (Australian Communications and Media Authority) 2016.

All other rights are reserved.

The Australian Communications and Media Authority has undertaken reasonable enquiries to identify material owned by third parties and secure permission for its reproduction. Permission may need to be obtained from third parties to re-use their material.

Written enquiries may be sent to:

Manager, Editorial and Design  
PO Box 13112  
Law Courts  
Melbourne VIC 8010  
Tel: 03 9963 6968  
Email: [candinfo@acma.gov.au](mailto:candinfo@acma.gov.au)

[Introduction 5](#_Toc444690620)

[Impact on timeframe 5](#_Toc444690621)

[The ACMA’s role 6](#_Toc444690622)

[Scope 7](#_Toc444690623)

[Proposed technical framework revisions 8](#_Toc444690624)

[Conditions on the spectrum licence 8](#_Toc444690625)

[Unacceptable levels of interference 10](#_Toc444690626)

[Radiocommunications advisory guidelines 11](#_Toc444690627)

[Managing interference from spectrum-licensed transmitters 11](#_Toc444690628)

[Managing interference to spectrum-licensed receivers 12](#_Toc444690629)

[Attachment A—2 GHz spectrum licence band arrangements (paired segment) 13](#_Toc444690630)

[Attachment B—Proposed changes to the conditions of the 2 GHz spectrum licences 15](#_Toc444690631)

[B1 Unwanted emission limits 15](#_Toc444690632)

[B2 Additional spurious emission limit requirements 20](#_Toc444690633)

[B3 Out-of-area emission limit 22](#_Toc444690634)

[B4 Exemption from registration requirements 22](#_Toc444690635)

[Attachment C—Proposed changes to the section 145 determination for the 2 GHz band 23](#_Toc444690636)

[C1 System model 23](#_Toc444690637)

[C2 Level of protection 24](#_Toc444690638)

[C3 Propagation modelling 24](#_Toc444690639)

[C4 Device boundary criterion 25](#_Toc444690640)

[C5 Groups of transmitters and receivers 27](#_Toc444690641)

[C6 Deployment constraints 27](#_Toc444690642)

[Attachment D—Proposed changes to the Radiocommunications Advisory Guidelines for managing interference from 2 GHz spectrum-licenced transmitters 28](#_Toc444690643)

[D1 Point-to-point fixed service receivers 28](#_Toc444690644)

[D2 Mobile satellite service 28](#_Toc444690645)

[D3 Cordless telecommunications services 28](#_Toc444690646)

[D4 Space services 29](#_Toc444690647)

[D5 Television outside broadcast (TVOB) services 29](#_Toc444690648)

[D6 Public telecommunications services 29](#_Toc444690649)

[D7 Class-licensed services 29](#_Toc444690650)

[Attachment E—Proposed changes to the Radiocommunications Advisory Guidelines for managing interference to 2 GHz spectrum licenced receivers 30](#_Toc444690651)

[E1 Notional receiver performance level 30](#_Toc444690652)

[E1.1 Adjacent channel selectivity 30](#_Toc444690653)

[E1.2 Intermodulation response rejection 30](#_Toc444690654)

[E1.3 Receiver blocking 31](#_Toc444690655)

[E1.4 Receiver antenna and feeder losses 32](#_Toc444690656)

[E2 Compatibility requirement 32](#_Toc444690657)

# Introduction

The Australian Communications and Media Authority (the ACMA) develops a technical framework for each spectrum-licensed band. 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 1920–1980 MHz and 2110–2170 MHz (the 2 GHz band) is currently allocated via the issue of spectrum licences in various regional and metropolitan areas (see Attachment A, *2 GHz spectrum licence band arrangements*). Existing spectrum licences in the band are due to expire on 11 October 2017. The ACMA reviews the technical framework for a spectrum-licensed band as licences approach expiry. This helps to ensure the framework remains current and can manage interference across the tenure period of spectrum licences in a particular band, which may be up to 15 years.

This paper provides information and seeks comment on the proposed revised technical framework for spectrum licences in the 2 GHz band. The ACMA’s intention is that the updated framework will apply to any licences reissued or reallocated in this band from 12 October 2017.

The following draft legislative instruments that form part of the proposed revised 2 GHz Technical Framework are available on the ACMA website:

* the Radiocommunications (Unacceptable Levels of Interference – 2 GHz Band) Determination 2016, made under section 145 of the Act
* the Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 2 GHz Band) 2016, made under section 262 of the Act
* the Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 2 GHz Band) 2016, made under section 262 of the Act.

The draft sample spectrum licence, which includes the Core Conditions, Statutory Conditions, Other Conditions and Licence Notes that will apply for the new spectrum licence term, is also available on the ACMA website.

## Impact on timeframe

The ACMA’s policy is to provide incumbent and prospective licensees with certainty, where possible, regarding the outcome of expiring spectrum licences in each band, approximately 18 months before expiry of the licence/s.

Consistent with this policy, the ACMA expects to complete the necessary processes for the 2 GHz band, with a view to achieving reissue of licences in June 2016, with payment by 30 May 2016. The ACMA will not establish a technical liaison group (TLG)[[1]](#footnote-2) as has been the case in spectrum licence re-issue processes in other spectrum-licensed bands. In preparing the proposed technical framework, the ACMA has undertaken its own analysis of the technical environment regarding current and future deployments in the 2 GHz band for incorporation in the technical framework.

The proposed revised technical framework for the 2 GHz band also incorporates the evidence obtained and improvements learned from a similar process for the 800 MHz, 1800 MHz, 2.3 GHz and 3.4 GHz bands. As a result, the complexity in developing the proposed revised technical framework for the reissuing of the 2 GHz band spectrum licences is relatively low.

The proposed revised technical framework can generally be considered evolutionary in nature rather than making any substantial impact on the existing arrangements. Attachments B, C, D and E provide a detailed explanation of the proposed amendments to the technical framework in a similar format to that used in the development of the technical liaison group papers for recently reissued spectrum licensed bands.

## The ACMA’s role

Section 9 of the *Australian Communications and Media Authority Act 2005* (the ACMA Act) sets out the spectrum management functions of the ACMA including:

* to manage the radiofrequency spectrum in accordance with the *Radiocommunications Act 1992* (the Act)
* to advise and assist the radiocommunications community.

The spectrum management functions set out in section 9 of the ACMA Act is related to, and consistent with, the object set out in section 3 of the Act for the management of the radiofrequency spectrum in order to achieve a number of goals, and particularly relevant to the present circumstances is to:

* maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using the radiofrequency spectrum.

The ACMA is also guided by the [*Principles for Spectrum Management*](http://www.acma.gov.au/theACMA/About/The-ACMA-story/Facilitating/decisionmaking-process-fyso-25-1)[[2]](#footnote-3)(the Principles), which are:

1. Allocate spectrum to the highest value use or uses.
2. Enable and encourage spectrum to move to its highest value use or uses.
3. Use the least cost and least restrictive approach to achieving policy objectives.
4. To the extent possible, promote both certainty and flexibility.
5. Balance the cost of interference and the benefits of greater spectrum utilisation.

The technical framework proposed in this paper focuses in particular on supporting Principles 2, 4 and 5.

These Principles are supported by:

* Optimising the technical framework for use by internationally harmonised next-generation mobile technologies, while providing flexibility for 2 GHz band spectrum licensees to deploy other technologies, if and when they desire.
* Providing certainty through the development of appropriate core conditions on the licence and clear guidance on how interference is managed, both to and from devices operating under the 2 GHz band spectrum licence.
* Providing flexibility by allowing the 2 GHz spectrum licensees to come to agreement on various aspects of the interference management framework to implement different arrangements.
* Allowing higher levels of emissions to leave the geographical area of a spectrum licence in order to support services being deployed closer to the boundary.

## Scope

Initially, when the 2 GHz spectrum licences were offered, they included a paired and unpaired segment. The unpaired segment included:

* 20 MHz of spectrum in the band 1900–1920 MHz in Sydney, Melbourne, Adelaide, Perth, Brisbane, Canberra, Darwin and Hobart.

This unpaired segment is outside the scope of the revised technical framework for the 2 GHz band. This is because the unpaired segment was not included in the Minister’s Class of Service Determination[[3]](#footnote-4) and there have been no expressions of interest to reissue these licenses from existing licensees. For this reason, the ACMA intends to allow these licences to expire, and will run a separate process to determine the best future use of this spectrum.

The paired segments included:

* 2 x 60 MHz in the 1920–1980 MHz/2110–2170 MHz bands in Sydney, Melbourne, Adelaide, Perth, Brisbane, Darwin and Hobart
* 2 x 45 MHz in the 1935–1980 MHz/2125–2170 MHz bands in Canberra
* 2 x 20 MHz in the 1960–1980 MHz/2150–2170 MHz bands in regional areas.

It should be noted that there are some parts of the 2 GHz band that were never sold as spectrum licences. These parts have since reverted to apparatus licensing.

The revised technical framework described in this discussion paper only applies to the paired segments of the 2 GHz band that are subject to spectrum licensing after 11 October 2017. However, the revised technical framework has been designed to allow for the future re-incorporation of any segments of the 2 GHz band that have reverted to apparatus licensing, if and when desired.

# Proposed technical framework revisions

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).
* Radiocommunications advisory guidelines that provide assistance and advice for coordination with stations in other services when and where required (section 262 of the Act).

Each of these three components of the technical framework has been reviewed as part of this assessment of the 2 GHz spectrum licence technical framework. Proposed changes to each element of the framework are discussed in detail below.

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).

## 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).

Details of the changes to the conditions that are proposed to take effect for reissued or reallocated spectrum licences in the 2 GHz band are outlined in Attachment B. These include:

* Changes to the core conditions relating to out-of-band, non-spurious and spurious emissions (Licence Schedule 2 core conditions 2–14) include:
* adoption of an ‘unwanted emission limit’ that both spurious and out-of-band emissions must meet. This removes any confusion regarding overlap between the spurious and out-of-band domains.
* adoption of unwanted emission limits to better reflect standards developed for Long Term Evolution (LTE) technologies, this takes into account the differences between user terminals and base stations. However, changes also ensure that existing 3G services operating under 2 GHz band licences can seamlessly migrate to the new framework without modification.
* unwanted emissions below 2110 MHz have, for interference management purposes, been made more stringent than those defined by the 3rd Generation Partnership Project (3GPP).
* spurious emissions are required to meet both the unwanted emission limit (radiated power limit) as well as a limit measured at the antenna port. The latter matches the spurious emission limits defined by 3GPP and removes complications involved in defining a frequency response for antennas so a radiated spurious emission limit can be defined.

Particular changes to other conditions on licences proposed for reissued or reallocated spectrum licences in the 2 GHz band include:

* refining the definition for devices that are exempt from registration to allow for the deployment of femtocells and other outdoor fixed terminals below the defined emission limit. This means that any device operating with an EIRP equal to or less than of 25 dBm per occupied bandwidth will be exempt from registration.
* including high altitude platform stations (HAPS) as transmitters that are exempt from registration if they do not exceed a power flux density of -121.5 dBW/m2/MHz at any point on the Earth’s surface, in line with ITU-R Recommendation M.1456.

There are a number of other minor or consequential amendments to the text, format and definitions in the licence that are also proposed, including the use of the *Hierarchical Cell Identification Scheme (HCIS)* to describe geographic areas in the *Australian Spectrum Map Grid 2012* published by the ACMA. These changes are aimed at improving clarity and aligning the spectrum licence template for the 2 GHz band with other bands.

## 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, unless the transmitter is of a kind exempt from registration under the licence.

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. The ACMA makes a determination under subsection 145(4) of the Act (section 145 determinations) that sets out the unacceptable levels of interference for each spectrum-licensed band.

The section 145 determinations set out the circumstances in which devices may cause unacceptable levels of interference. These circumstances include:

* if any part of the device boundary falls outside the licensed geographical area of the licence
* if the operation of the transmitter will cause a breach of a core condition of the licence
* if the deployment of the device is outside the deployment constraints set for the band.

The ACMA is proposing to revoke the existing section 145 determination for the 2 GHz band and replace it with a new determination.[[4]](#footnote-5) Details of the differences between the existing determination and the new determination are outlined in Attachment C, with a draft of the Radiocommunications (Unacceptable Levels of Interference – 2 GHz Band) Determination 2016available on the ACMA website. Some of the key proposed differences between the existing determination and the new determination are:

* A revised device boundary criterion (DBC) method. The revised method is now similar to that currently implemented in the 700 MHz, 800 MHz, 1800 MHz and 2.5 GHz bands. This includes simplifying the calculation for effective antenna height as well as a greater resolution for calculation points (to improve accuracy and better reflect actual terrain)—in this case, performing calculations along 360 one-degree radials every 500 metres.
* Use of a new digital elevation model (DEM-9S) based on the GDA94 datum. DEM-9S is made available by Geoscience Australia.
* Allow devices that were registered under a 2 GHz band spectrum licence that expires on 11 October 2017 to be exempt from the device boundary criterion when being re-registered under a re-issued spectrum licence. A provision to this clause is that specific technical parameters used for coordination do not change.
* Removed the ‘Towns mobile list’ method for group registration, this is replaced by the new and simpler registration exemption provisions specified on the licence.
* Removed HAPS transmitters from the Determination and define conditions for their operation on the licence that allow them to be exempt from registration.
* Removed unnecessary deployment constraints that apply to devices exempt from registration.
* Reduced the distance from the boundary, from 70 km to 46 km, at which a transmitter is deemed to meet the device boundary criteria.
* Allowed the device boundary to be exceeded at geographical boundaries at the outer edge of the ASMG.

## Radiocommunications advisory guidelines

Further guidance on interference management with other 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 service and another service, the ACMA will refer to the provisions of the RAGs in resolving the matter.

Currently, there are two section 262 guidelines relevant to the deployment of services in the 2 GHz band:

* [Radiocommunications Advisory Guidelines (Managing Interference to Apparatus Licensed Receivers - 2 GHz Band) 2015](https://www.comlaw.gov.au/Details/F2015L00722)
* [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 20](https://www.comlaw.gov.au/Details/F2015L00721)15.

The ACMA proposes to revoke and remake these RAGs to include updated requirements for existing services and take into account new services that have been or will soon be deployed. The ACMA also proposes to modify the titles of the RAGs to ensure consistency in the terminology used across various spectrum-licensed bands.

### Managing interference from spectrum-licensed transmitters

The [[Radiocommunications Advisory Guidelines (Managing Interference to Apparatus Licensed Receivers - 2 GHz Band) 2015](https://www.comlaw.gov.au/Details/F2015L00722)](http://www.comlaw.gov.au/Details/F2009C00972) (existing guidelines) 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 2 GHz band. The existing guidelines also explain the protection criteria and coordination arrangements that apply to these services by reference to various RALIs, international standards and the ACMA’s technical studies.[[5]](#footnote-6)

Details of the differences between the existing guidelines and the proposed new guidelines are outlined in Attachment D, with a draft of the Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 2 GHz Band) 2016available on the ACMA website. Some of the key differences between the existing guidelines and the proposed new guidelines are:

* update to existing guidelines for point-to-point fixed services, mobile satellite services, space services, public telecommunications services (PTS) and television outside broadcast (TVOB) services.
* removal of provisions no longer required for Multipoint Distribution Systems and cordless telephone services.
* the addition of new provisions for class licensed services and public telecommunications services operated under apparatus licences.
* Removal of the schedule relating to propagation models, and replacing it with a reference to ITU-R Recommendation P.1144 *Guide to the application of the propagation methods of Radiocommunications Study Group 3*; and
* Updating of references to ITU-R and other documents incorporated by reference.

### Managing interference to spectrum-licensed receivers

The [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 20](https://www.comlaw.gov.au/Details/F2015L00721)15 (existing guidelines) provides guidance on the management of out-of-band interference to receivers operating under a 2 GHz band spectrum licence. The existing guidelines also provide some guidance on the management of in-band interference.

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. For this reason, the ACMA recommends that all receivers operating under a spectrum licence have a performance level at least equal to the notional performance level.

Details of the differences between the existing guidelines and the proposed new guidelines are outlined in Attachment E, with a draft of the Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 2 GHz Band) 2016available on the ACMA website. Some of the key differences between the existing guidelines and the proposed new guidelines are:

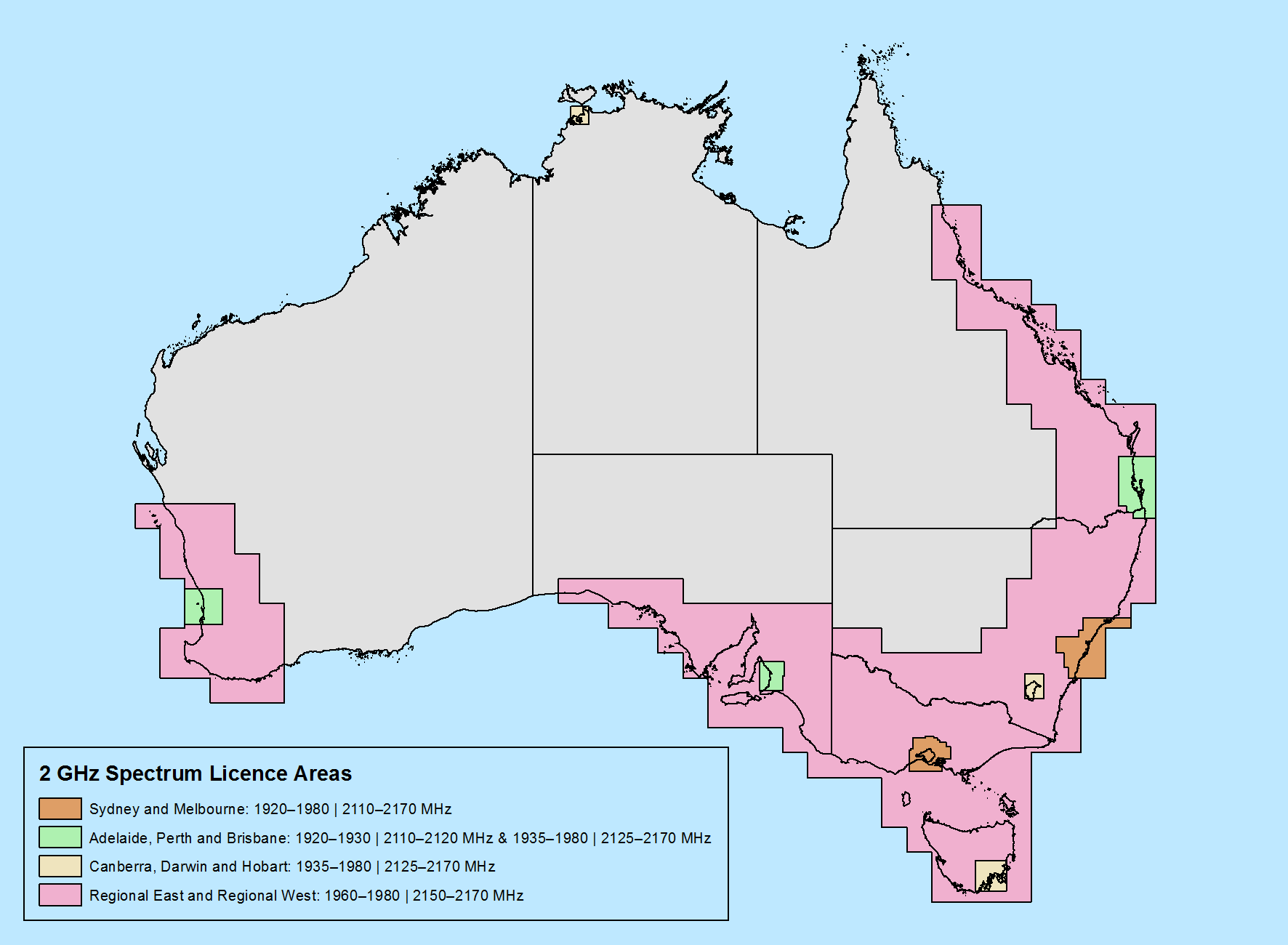
* updates to the adjacent channel selectivity, intermodulation and blocking parameters of the notional receiver performance level to suit existing and future mobile technologies
* changes to the compatibility requirement to better reflect existing and future mobile technologies.

# Attachment A—2 GHz spectrum licence band arrangements (paired segment)

The 2 GHz spectrum licence band (the paired segment) is contained within the 1920–1980 MHz and 2110–2170 MHz frequency ranges. The portion of the band that is subject to spectrum licensing differs in metropolitan, regional and remote areas of Australia.

Figure A1 indicates the areas and frequencies that are subject to spectrum licensing in the 2 GHz band. Figure A2 provides a summary of current arrangements in the 1900–2200 MHz band.

**Figure A1: Areas and frequencies corresponding to the 2 GHz spectrum licence band**



**Figure A2: Summary of existing arrangements in the 1900–2200 MHz band**

| Frequency (MHz) | Melbourne  Sydney | Adelaide  Brisbane  Perth | Canberra  Darwin  Hobart | | Regional | Remote |
| --- | --- | --- | --- | --- | --- | --- |
| 1900–1920 |  |  |  |  |  |  |
| 1920–1930 |  |  |  | |  |  |
| 1930–1935 |  |  |  | |  |  |
| 1935–1960 |  |  |  | |  |  |
| 1960–1980 |  |  |  | |  |  |
| 1980–2010 |  |  |  | |  |  |
| 2010–2025 |  |  |  | |  |  |
| 2025–2110 |  |  |  | |  |  |
| 2110–2120 |  |  |  | |  |  |
| 2120–2125 |  |  |  | |  |  |
| 2125–2150 |  |  |  | |  |  |
| 2150–2170 |  |  |  | |  |  |
| 2170–2200 |  |  |  | |  |  |

**Key:**

|  |  | Spectrum licence: 2 GHz unpaired segment |
| --- | --- | --- |
|  |  | Apparatus licenced: Point-to-point, point-to-multipoint (Broadband wireless access (BWA)) |
|  |  | Spectrum licenced: 2 GHz paired segment |
|  |  | Apparatus licenced: Embargoed |
|  |  | Apparatus licenced: public mobile telecommunications service (PMTS) Class B, point-to-point |
|  |  | Apparatus licenced: Television outside broadcast (TVOB) (with some localized restrictions) |
|  |  | Apparatus licenced: TVOB (with some localized restrictions), point-to-point |
|  |  | Apparatus licenced: Space operations, Earth exploration satellite, space research, point-to-point, TVOB |
|  |

# Attachment B—Proposed changes to the conditions of the 2 GHz spectrum licences

## B1 Unwanted emission limits

It is proposed to define an ‘unwanted emission limit’ (as a radiated emission limit) rather than separate spurious and non-spurious radiated emission limits. This removes any confusion regarding overlap between the spurious and out-of-band domains. It also better accounts for the different frequency offsets that the spurious domain starts for devices such as UMTS and LTE user terminals (UEs). For example the spurious domain starts at an offset of 25 MHz and 10 MHz for UE devices operating with a 20 MHz and 5 MHz channel size respectively.

Unwanted Emission Limits within the 2110-2170 MHz band

For devices operating in the 2110-2170 MHz band, it is proposed that the radiated unwanted emission limits within the 2110–2170 MHz band be based on:

* the levels stated in 3GPP 36.104 for Category B (option 1) wide-area base stations operating in bands greater than 1 GHz[[6]](#footnote-7);
* the addition of a 19 dBi antenna gain and 1 dB feeder loss, this is based in the analysis of current 2 GHz band device registrations shown in Figure B1.1. Eighty-two per cent of current device registrations have an antenna gain of 19 dBi or less.

The resulting radiated unwanted emission limits within the 2110–2170 MHz band are shown in Table B1.1.

Table B1.1: Radiated unwanted emission limits within the 2110–2170 MHz band

| Frequency offset range | Radiated maximum true mean power  (dBm EIRP) | Specified bandwidth |
| --- | --- | --- |
| 0 kHz ≤ foffset < 5 MHz |  | 100 kHz |
| 5 MHz ≤ foffset < 10 MHz | 4 | 100 kHz |
| foffset ≥ 10 MHz | 3 | 1 MHz |

Figure B1.1: Antenna gain of device registrations in 2110–2170 MHz

Unwanted Emission Limits from the 2110 MHz band edge

For devices operating in the 2110-2170 MHz band, it is proposed that the radiated unwanted emission limits below 2110 MHz be based on:

* from 0-4 MHz below the band edge (2106-2110 MHz), the levels stated in 3GPP 36.104 for Category B (option 1) wide-area base stations operating in bands greater than 1 GHz[[7]](#footnote-8), with the addition of a 18 dBi gain antenna (including feeder loss);
* from 4-10 MHz below the band edge (2100-2106 MHz), the existing non-spurious emission limits defined for 2 GHz spectrum licences; and
* 10 MHz below the band edge (below 2100 MHz), a radiated power level of -11 dBm/MHz.

A stricter unwanted emission level is defined below 2110 MHz to provide coexistence with Television Outside Broadcasting (TOB) services operating in 2010-2110 MHz frequency range. RALI FX21 indicates that TOB services operate at frequencies below 2106 MHz. Therefore, the unwanted emission limits have been relaxed in the 2106-2110 MHz frequency range. However, in order to maintain a similar interference environment as currently exists below 2106 MHz, the same emission limits are defined in the 2100-2106 MHz range. Emissions below 2100 MHz have been made 10 dB stricter than currently defined levels.

The unwanted emission limit below 2100 MHz is based on the spurious emission limit for an LTE base station transmitters with the addition of a 19 dBi gain antenna. 3GPP 36.104[[8]](#footnote-9) defines the spurious domain for LTE base stations commencing ± 10 MHz outside the 2110-2170 MHz band.

The resulting radiated unwanted emission limits below 2110 MHz are shown in Table B1.2.

Table B1.2: Radiated unwanted emission limits below the 2110 MHz band edge

| Frequency offset range | Radiated maximum true mean power  (dBm EIRP) | Specified bandwidth |
| --- | --- | --- |
| 0 kHz ≤ foffset < 4 MHz |  | 100 kHz |
| 4 MHz ≤ foffset < 5 MHz |  | 100 kHz |
| 5 MHz ≤ foffset < 10 MHz |  | 1 MHz |
| foffset ≥ 10 MHz | 12 | 1 MHz |

Unwanted Emission Limits from the 2170 MHz band edge

For devices operating in the 2110-2170 MHz band, it is proposed that the radiated unwanted emission limits above 2170 MHz be based on:

* from 0-10 MHz above the band edge (2170-2180 MHz), the levels stated in 3GPP 36.104 for Category B (option 1) wide-area base stations operating in bands greater than 1 GHz[[9]](#footnote-10), with the addition of a 19 dBi gain antenna; and
* 10 MHz above the band edge (above 2180 MHz), a radiated level of -11 dBm/MHz.

The levels defined mirror the out-of-band and spurious emission limits defined for an LTE base station in 3GPP 36.104[[10]](#footnote-11), with the addition of appropriately assumed antenna gain.

The unwanted emission limit below 2100 MHz is based on the spurious emission limit for LTE base station transmitters with the addition of a 19 dBi gain antenna. 3GPP 36.104[[11]](#footnote-12) defines the spurious domain for LTE base stations commencing ± 10 MHz outside the 2110-2170 MHz band.

The resulting radiated unwanted emission limits above 2170 MHz band are shown in Table B1.3.

Table B1.3: Radiated unwanted emission limits above the 2170 MHz band edge

| Frequency offset range | Radiated maximum true mean power  (dBm EIRP) | Specified bandwidth |
| --- | --- | --- |
| 0 kHz ≤ foffset < 5 MHz |  | 100 kHz |
| 5 MHz ≤ foffset < 10 MHz |  | 100 kHz |
| foffset ≥ 10 MHz | 12 | 1 MHz |

Unwanted Emission Limits within the 1920-1980 MHz band

For devices operating in the 1920-1980 MHz band, it is proposed that the radiated unwanted emission limits within the 1920-1980 MHz band be based on:

* the general limits for user terminals stated in 3GPP 36.101[[12]](#footnote-13). Specifically:
  + the 5 MHz channel limit is used in the first 1 MHz;
  + 1-5 MHz is based on a 20 MHz channel limit;
  + A level of -13 dBm/MHz is set for frequency offsets greater than 5 MHz;
* the addition of a 0 dBi antenna gain which is common for user terminals.

The emission limit has been formed to ensure everything from an LTE (or UMTS) UE using a 5 MHz channel to an LTE UE employing 20 MHz + 20 MHz carrier aggregation can operate in the 2 GHz band. The out-of-band emission limits for the latter case drop to -25 dBm/MHz at an offset of 39.8 MHz. However, by the time one licensee has access to two 20 MHz channels and an offset of 39.8 MHz is reached, the emissions are already well outside the 1920-1980 MHz frequency range. Therefore the unwanted emission limit does not drop below -13 dBm/MHz within the 1920-1980 MHz frequency range.

The resulting radiated unwanted emission limits within the 1920-1980 MHz band are shown in Table B1.4.

Table B1.4: Radiated unwanted emission limits within the 1920–1980 MHz band

| Frequency offset range | Radiated maximum true mean power  (dBm EIRP) | Specified bandwidth |
| --- | --- | --- |
| 0 kHz ≤ foffset < 1 MHz | -15 | 30 kHz |
| 1 MHz ≤ foffset < 5 MHz | -10 | 1 MHz |
| 5 MHz ≤ foffset < 20 MHz | -13 | 1 MHz |
| foffset ≥ 20 MHz | -25 | 1 MHz |

Unwanted Emission Limits below 1920 MHz and above 1980 MHz

For devices operating in the 1920-1980 MHz band, it is proposed that the radiated unwanted emission limits below 1920 MHz and above 1980 MHz be based on:

* from 0-45 MHz offset, the general limits for user terminals stated in 3GPP 36.101[[13]](#footnote-14) with the addition of a 0 dBi antenna gain. Specifically:
  + 0-1 MHz offsets, the 5 MHz bandwidth limit emission;
  + 1-5 MHz offsets, the 20 MHz channel limit emissions (which also corresponds to 20 MHz + 20 MHz carrier aggregation emission limits);
  + 5-45 MHz offsets, 20 MHz + 20 MHz carrier aggregation emission limits;
* At offsets greater than 45 MHz, a level of -30 dBm/MHz.

The unwanted emission limit has been developed to ensure everything from a UE using a 5 MHz channel to an LTE UE employing 20 MHz + 20 MHz carrier aggregation can operate in the 2 GHz band. The unwanted emission limits at offsets greater than 45 MHz from the band edge are based on the commencement of the spurious domain for an LTE UE employing 20 MHz + 20 MHz carrier aggregation, as defined in 3GPP 36.101[[14]](#footnote-15).

The resulting radiated unwanted emission limits below 1920 MHz and above 1980 MHz band are shown in Table B1.5.

Table B1.5: Radiated unwanted emission limits below 1920 MHz and above 1980 MHz

| Frequency offset range | Radiated maximum true mean power  (dBm EIRP) | Specified bandwidth |
| --- | --- | --- |
| 0 kHz ≤ foffset < 1 MHz | -15 | 30 kHz |
| 1 MHz ≤ foffset < 5 MHz | -10 | 1 MHz |
| 5 MHz ≤ foffset < 39.8 MHz | -13 | 1 MHz |
| 39.8 MHz ≤ foffset < 45 MHz | -25 | 1 MHz |
| foffset ≥ 45 MHz | -30 | 1 MHz |

Comparison of unwanted emission limits

Figure B1.2 visually compares the proposed unwanted emission limits against the current 2 GHz band radiated emission limits.

Figure B1.2: Comparison of the proposed unwanted emission limits and the current 2 GHz band radiated emission limits

## B2 Additional spurious emission limit requirements

In addition to the unwanted radiated power limits, spurious emission limits have also been defined at the antenna connector of the device. Therefore spurious emissions must meet both the ‘unwanted emission limit’ defined in section B1 and ‘the spurious emission limit’ defined in this section. This allows spurious emission limits to be defined the same way as specified in 3GPP standards. It also removes complications involved in defining a frequency response for antennas so a radiated spurious emission limit can be defined.

The proposed transmitter spurious emission limits for the 1920-1980 MHz and 2110-2170 MHz frequency ranges are the levels defined in 3GPP 36.101[[15]](#footnote-16) (for UEs) and 3GPP 36.104[[16]](#footnote-17) (for base stations) respectively. These levels are defined at the antenna connector.

3GPP 36.101[[17]](#footnote-18) and 36.104[[18]](#footnote-19) defines the boundary between the E-UTRA out of band and spurious emission domain. For LTE (and UMTS) base stations the transmitter spurious domain starting ±10 MHz from the band edge. However, the transmitter spurious domain for LTE (and UMTS) user terminals starts at different frequency offsets depending on the relevant channel sizes. For this reason the spurious emission limit requirement is defined to start at the worst case offset from the 1920-1980 MHz band edge. The worst case relates to an LTE UE employing 20 MHz + 20 MHz carrier aggregation. In this scenario the spurious domain is deemed to start at offsets greater than 45 MHz from the band edge.

Receiver spurious emission limits are defined in table B2.2. For UEs operating in the 1920-1980 MHz band, 3GPP 36.101[[19]](#footnote-20) defines the receiver spurious limits applying across the entire frequency range (i.e. both inside and outside the 1920-1980 MHz band). For base stations operating in the 2110-2170 MHz band, 3GPP 36.104[[20]](#footnote-21) defines that the limits do not apply within the 2100-2180 MHz frequency range.

The resulting radiated transmitter and receiver spurious emission limits are shown in Table B2.1 and Table B2.2 respectively. Since these limits, as specified, do not meet the definition of a radio emission[[21]](#footnote-22) as applied to section 66(1)(b) of the Radiocommunications Act (emissions outside the frequency limits of the licence), they will be included in Schedule 4 ‘Other Conditions’ of the licence. It is intended that the ‘unwanted emission limits’ will satisfy the requirements of 66(1)(b) of the Radiocommunications Act.

Table B2.1: Radiocommunications transmitter spurious emission limits at antenna connector. For transmitters in the 1920-1980 MHz frequency range this applies outside the 1875-2025 MHz band. For transmitters in the 2110-2170 MHz frequency range this applies outside the 2100-2180 MHz band.

| Frequency range (f) | Radiated mean power (dBm EIRP)  at the antenna connector | 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 MHz ≤ f < 12.75 GHz | -30 | 1 MHz |

Table B2.2: Radiocommunications receiver spurious emission limits at antenna connector. For receivers in the 1920-1980 MHz frequency range this applies outside across the entire 30 MHz to 12.75 GHz frequency range. For receivers in the 2110-2170 MHz frequency range this applies outside the 2100-2180 MHz band.

| Frequency range (f) | Radiated mean power (dBm EIRP)  at the antenna connector | Specified bandwidth |
| --- | --- | --- |
| 30 MHz ≤ f < 1 GHz | -57 | 100 kHz |
| 1 MHz ≤ f < 12.75 GHz | -47 | 1 MHz |

## B3 Out-of-area emission limit

The current framework sets the horizontally radiated power for the out-of-area emission limit to 55 dBm per 30 kHz (equivalent to 77.2 dBm per 5 MHz).

It is proposed that the current the out-of-area emission limit be maintained, but defined in a 5 MHz reference bandwidth (i.e. as 77.2 dBm per 5 MHz). This will support 4x4 and higher order MIMO schemes, beam forming and higher gain antenna deployments in the future.

## 

## B4 Exemption from registration requirements

It is proposed that transmitters operating in the 2 GHz band with a maximum EIRP of less than or equal to 25 dBm per occupied bandwidth be exempt from registration requirements. This is based on the user equipment (UE) maximum output power of 23 dBm plus the 2 dB tolerance defined in 3GPP 36.101.[[22]](#footnote-23) Previously, this exemption applied only to mobile terminals and indoor fixed terminals. The exemption now extends to all transmitters below this EIRP, including outdoor fixed transmitters such as femotocells.

It is proposed that HAPS transmitters operating in the 2 GHz band also be exempted from registration if the emissions outside any frequency band-geographical area combination of the licence do not exceed a power flux density of -121.5 dBW/m2/MHz at any point on the Earth’s surface. This matches the level defined in ITU-R Recommendation M.1456.

# Attachment C—Proposed changes to the section 145 determination for the 2 GHz band

This attachment looks in detail at the following items of the technical framework that are used to develop the section 145 Unacceptable levels of interference determination (section 145 determination):

* system models
* level of protection
* propagation modelling
* groups of transmitters and receivers
* device boundary criterion
* deployment constraints.

## C1 System model

System models are used to simplify the analysis of the technical framework with regard to the reference technologies. The reference technologies applicable to the 2 GHz band are shown in Table C1.

Table C1: Reference technologies

| Reference technology | Applicable standards and reports |
| --- | --- |
| UMTS  (UTRA, WCDMA, HSPA, HSPA+) | ITU-R Report M.2039-3, 3GPP TS 25.101, 3GPP TS 25.104, 3GPP TS 25.942 |
| LTE  (E-UTRA, LTE-Advanced) | ITU-R Report M.2292-0, 3GPP TS 36.101, 3GPP TS 36.104, 3GPP TS 36.942 |

The development of the system models does not exclude the use of other technologies under the licence. The system models for the deployment are simply a tool for the development of the technical framework.

It is proposed that the system model be optimised for FDD services, as existing services operating under the 2 GHz spectrum licence, are deployed in this manner. Table C2 shows the user equipment receiver parameters necessary for determination of the level of protection.

Table C2: UE receiver

| Parameter | UMTS | LTE |
| --- | --- | --- |
| Antenna gain (including losses) | 0 dBi | |
| Antenna height (AGL) | 1.5 m | |
| Noise figure (F) | 9 dB | 9 dB |
| Noise floor (kTBF) | -99.13 dBm/3.84 MHz | -98.43 dBm/4.515 MHz |
| Reference sensitivity | -113 dBm/3.84 MHz[[23]](#footnote-24) | -100 dBm/5 MHz |

## C2 Level of protection

The level of protection (LOP) is the benchmark protection given to receivers from co-channel emissions from transmitters operating in adjacent geographic licence areas. The level of protection is a compromise between the level of emissions over the geographic boundary of the licence and the protection requirements of receivers.

This benchmark level is necessary for the calculation of the device boundary criterion.

Two methods are proposed for determining the LOP:

1. noise floor plus interference-to-noise margin (I/N) of -6 dB resulting in a 1 dB increase in noise floor (equivalent to –104 dBm per 5 MHz);
2. maintain the LOP of -96 dBm/5MHz as defined in the existing section 145 determination.

To maintain the existing deployment flexibility in the 2 GHz band, it is proposed to maintain the existing LOP of -96 dBm per 5 MHz. This will help to minimise dead zones close to geographical boundaries.

## 

## C3 Propagation modelling

The propagation model chosen for the technical framework appears in the section 145 determination as part of the device boundary criterion. The propagation model selected for the technical framework needs to be:

* suitable for FDD systems
* a generic model that does not require detailed information on terrain or land usage
* not too complex and capable of being repeated with certainty
* suitable for use in the 2 GHz band.

The propagation model selected does not need to be suitable for the detailed planning of services, and licensees are free to use any model for their own planning needs. The selected propagation model will be the basis of the device boundary criterion on which the ACMA may decide to reject the registration of a transmitter to be operated under the spectrum licence.

The ACMA proposes to use the modified HATA suburban propagation model, as defined in ERC Report 68, in device boundary calculations. This means the relevant equation for the 1500–2000 MHz and 2000–3000 MHz frequency ranges will be used for the 1920–1980 MHz and 2110–2170 MHz bands respectively.

The proposed implementation of this propagation model in the device boundary criteria is provided in the draft of the Radiocommunications (Unacceptable Levels of Interference – 2 GHz Band) Determination 2016, available on the ACMA website.

## C4 Device boundary criterion

The device boundary of a radiocommunications transmitter, calculated using the device boundary criterion, must lie within the geographic boundary of the licence; otherwise the transmitter may be declared under the subsection 145(4) determination to cause unacceptable interference.

Further description of the device boundary and the methodology updated for spectrum licensing is available in *SPP 02/12* – *Device boundary methodology*. It mirrors the methodology put in place for the new/revised technical frameworks for the 800 MHz, 1800 MHz, 700 MHz and 2.5 GHz bands.

The ACMA considers the propagation model in section C3 of this attachment and the level of protection in section C2 of this attachment to be appropriate to provide adequate radiocommunications transmitter separation from the geographic boundary. It will enable co-existence between adjacent area services, while not placing overly restrictive constraints on transmitter deployment near the geographic boundary.

In recent technical frameworks, development has resulted in an effective antenna height cap of 500 metres being chosen (though occasionally, some site scenarios may result in an effective antenna height greater than this level). It is proposed to maintain this effective antenna height restriction in the 2 GHz band.

Note that the implementation of the proposed methodology in *SPP 02/12* – *Device boundary methodology* requires the definition of two variables:

* hgr = nominal receive antenna height above ground level (m)
* Gr = nominal receiving antenna gain including feeder loss set (dBi).

Based on the *LOP* values derived in section C2 of this attachment, the values for these parameters are set to *hgr* = 1.5 m and *Gr* = 0 dBi at the boundary.

Assuming a maximum base station height of 500 metres, the propagation model described in section C3, the outside the area emission limit of section B3 (77.2 dBm per 5 MHz) and the proposed level of protection in section C2 of this attachment, the maximum radial length achievable is approximately 46 kilometres. This is based on a propagation loss of LOP-EIRPmax-GRx = -96 dBm/5MHz – 77.2 – 0 = 173 dB (assuming Hb = 500m and Hm = 1.5m).

Therefore, devices located greater than 46 kilometres from the geographic boundary of the licence that meet the core conditions of the licence, are deemed to comply with the device boundary criterion because of the radio horizon, and are taken not to cause unacceptable interference.

**The following parameters are proposed for the device boundary criterion:**

**> a nominal receive antenna height above ground level, hgr = 1.5 metres**

**> a nominal receiving antenna gain, Gr = 0 dBi**

**> a maximum radial length of 46 kilometres.**

An indicative Schedule 2 of the subsection 145(4) determination is provided in the draft of the *Radiocommunications (Unacceptable Levels of Interference – 2 GHz Band) Determination 2016*, available on the ACMA website.

**Specified situations that the DBC does not apply**

Devices that were registered under a 2 GHz band spectrum licence that expired on 11 October 2017 will be exempt from the device boundary criteria when being re-registered under a re-issued spectrum licence, provided technical parameters used for coordination do not change

Where a part of the device boundary lies outside the boundary of the Australian Spectrum Map Grid 2012 (ASMG)[[24]](#footnote-25), then further additional consideration need to be given to whether the device causes a level of interference taken to be unacceptable in calculation of the device boundary. A radiocommunications transmitter operated under a spectrum licence is taken not to be unacceptable for those parts of the device boundary where the device boundary:

1. lies outside the boundary of the ASMG; and
2. is connected to a radial that:
   1. is mentioned in Part 1 of Schedule 2 of the subsection 145(4) determination; and
   2. does not cross the geographic area of another licence.

This is illustrated in Figure C1, where the resulting DBC pass point is located outside the ASMG, and illustrates a fail if the radial crosses the geographic area of another licence.

**Figure C1: The DBC and ASMG**

ASMG

Licensee 1

Licensee 2

Coastline

## C5 Groups of transmitters and receivers

Group registration arrangements provide additional flexibility to licensees when deploying systems within the band. Two or more fixed transmitters may be registered as a group of transmitters if all transmitters in the group have the same centre frequency and emission designator, and the associated antennas have the same identification number.

Two or more fixed receivers may be registered as a group of receivers if the associated antennas have the same identification number and all receivers are associated with either a single transmitter or a group.

Current arrangements permit a fixed transmitter or receiver to belong to more than one group.

In the TLGs for the 800 MHz, 1800 MHz, 700 MHz and 2.5 GHz bands, the consensus was for group registration to primarily support the registration of systems that have their antenna phase centres located within a defined proximity (20 metres in this case). Additionally, the parameters of the equipment being considered in the group should be essentially identical, and a radiocommunications transmitter or radiocommunications receiver can only belong to one group.

The ACMA proposes that when determining the location of a group of radiocommunications transmitters, the location is the centre point between the phase centres of each radiocommunications transmitter antenna within the group.

The proposed implementation of group registration applicable in the 2 GHz band is provided in the draft of the Radiocommunications (Unacceptable Levels of Interference – 2 GHz Band) Determination 2016, available on the ACMA website.

## C6 Deployment constraints

The existing 2 GHz technical framework permits high altitude platform stations (HAPS) located on an object 20 to 50 kilometres in altitude, at a specified, nominal, fixed point relative to the earth.

Notionally, the HAPS station is taken not to cause unacceptable interference if it is operated in accordance with the core conditions of the licence.

It is proposed, rather than make the HAPS transmitters subject to registration under the new framework, that they be exempt from registration. See section B4 of attachment B to this consultation paper for further detail.

Licensees should be aware that constraints apply to some transmitters operated under the registration exempt requirements proposed in section B4 of attachment B to this consultation paper.

# Attachment D—Proposed changes to the Radiocommunications Advisory Guidelines for managing interference from 2 GHz spectrum-licenced transmitters

The major substantive changes that are proposed in making the Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Receivers – 2 GHz Band) 2016,compared with the [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers — 2 GHz Band) 2015](https://www.comlaw.gov.au/Details/F2015L00721) are provided below.

A number of wording and structural changes are also proposed. These changes are in line with those that have occurred in reviews of technical frameworks in other spectrum licensed bands.

## D1 Point-to-point fixed service receivers

Point-to-point fixed services operate in and adjacent to the 2 GHz spectrum licensed band. Point-to-point fixed receivers are category 1 or category 2 devices, depending on when the point-to-point fixed licence was issued.

As the device boundary methodology in the 2 GHz band is proposed to change (see section C4), the continued use of 4 December 2000 to define which category a fixed service falls within is not preferred.

It is proposed that for the purpose of these guidelines, category 1 devices are those registered before 12 October 2017, and category 2 thereafter—that is, the proposed change is from 4 December 2000 to 12 October 2017.

Changing this date to 12 October 2017 assumes that existing point-to-point fixed licences issued in the band meet the existing device boundary criteria. Analysis has shown that there is only one point-to-point licence that is co-channel and within 200 kilometres of a 2 GHz spectrum licence boundary, which was approved on 12 December 2001.

## D2 Mobile satellite service

While there are some wording changes, the substance of this part is unchanged.

## D3 Cordless telecommunications services

This part has been deleted due to the removal of the 1900–1920 MHz band from the scope of the technical framework. Cordless telecommunications services are therefore no longer an adjacent band service for frequencies covered by this technical framework.

## D4 Space services

The section ‘Additional information on space service protection’ has been removed due to the suppression of the ITU-R Recommendations previously referred to in this section. The use of ITU-R Recommendation M.1456 is sufficiently covered elsewhere in these guidelines.

## D5 Television outside broadcast (TVOB) services

This part is unchanged. However, an amendment will be made to RALI FX21 before existing spectrum licences expire. This amendment will ensure that, when considering the first-in-time registration status with respect to adjacent-frequency Television Outside Broadcast (TOB) services, the original registration dates for existing devices that are re-registered under the renewed spectrum licences will apply. A provision to this clause is that specific technical parameters used for coordination do not change.

## D6 Public telecommunications services

This is a new part added to these guidelines regarding public telecommunications services (PTS) operating under apparatus licences in the 2 GHz band. Transmitters operating in accordance with the conditions of the spectrum licence are taken not to cause unacceptable interference to these services.

## D7 Class-licensed services

This is a new part added to these guidelines regarding radiocommunications devices operated under various class licences. Transmitters operating in accordance with the conditions of the spectrum licence are taken not to cause unacceptable interference to these services.

# Attachment E—Proposed changes to the Radiocommunications Advisory Guidelines for managing interference to 2 GHz spectrum licenced receivers

While there are a number of wording and structural changes in Parts 1 to 3 of the proposed Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 2 GHz Band) 2016, compared with the [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 20](https://www.comlaw.gov.au/Details/F2015L00721)15, these proposed changes do not affect the substance of the document. These changes are in line with those that have occurred in reviews of technical frameworks in other spectrum licensed bands.

The major substantive changes that are proposed concern the notional receiver performance level and the compatibility requirement.

## E1 Notional receiver performance level

### E1.1 Adjacent channel selectivity

Receiver Adjacent Channel Selectivity (ACS) is a measure of the ability of a receiver to receive a wanted signal without exceeding a specified degradation in output quality due to the presence of an unwanted adjacent channel signal. The value currently stated in the [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 20](https://www.comlaw.gov.au/Details/F2015L00721)15 is 45 dB measured at an offset of 5 MHz.

The minimum ACS value stated in 3GPP 36.104[[25]](#footnote-26) for LTE base station receivers is specified in the form of an unwanted signal level at a given offset from the wanted signal edge. This can be converted to the form of a wanted to unwanted signal ratio by reference to the wanted signal used for the measurement. For example, the wanted level for a 5 MHz channel is -95.5 dBm and the unwanted level is -52 dBm, therefore the ACS expressed as a ratio of wanted to unwanted is:

-52 dBm – -95.5 dBm = 43.5 dB.

Therefore, it is proposed that adjacent channel selectivity shall be greater than or equal to 43.5 dB with a frequency offset of less than 5 MHz based on the LTE specification.

### E1.2 Intermodulation response rejection

Receiver intermodulation rejection is a measure of the ability of a receiver to receive the wanted signal without exceeding a specified degradation in output quality caused by the presence of two or more unwanted signals with a specific amplitude and frequency relationship to the wanted signal frequency. Receiver intermodulation rejection is a function of the receiver front-end linearity and the radio frequency filter characteristic.

Technology standards state the power levels of the interfering signals and the offsets from the receivers tuned frequency. Frequency offsets are typically based on a multiple of the technology’s channel bandwidth, and therefore specific offsets for different technologies will vary.

The value for receiver intermodulation rejection value currently stated in [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 20](https://www.comlaw.gov.au/Details/F2015L00721)15 s -54 dB, per 1 MHz at an offset of 20 MHz or more. The intermodulation requirement stated in 3GPP 36.104[[26]](#footnote-27) for LTE base station receivers is -52 dBm starting at offsets of 2.5 MHz.

A receiver intermodulation rejection level of -52 dBm per occupied bandwidth for each out-of-band signal at frequency offsets greater than or equal to 5 MHz from the upper and lower frequency limit of the licence under which the radiocommunications receiver operates is proposed.

### E1.3 Receiver blocking

Receiver blocking is a measure of the ability of a receiver to receive the wanted signal in the presence of a high-level unwanted signal on frequencies other than the adjacent channel. High levels of unwanted signal can change the operating point of the RF amplifier or mixer stages, reducing receiver sensitivity and effectively blocking the reception of low level wanted signals.

The receiver-blocking requirement is specified as an absolute level rather than a ratio, so its relationship to equipment standards is clear, and is not reliant on other aspects such as the minimum wanted level or the receiver noise floor, which vary across technologies.

The receiver-blocking requirements currently stated in the [Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 2015](https://www.comlaw.gov.au/Details/F2015L00721) are:

* a signal level of -46 dBm per 1 MHz with a frequency offset of 10 MHz or more
* a signal level of -21 dBm per 1 MHz for frequencies outside the band 1880 to 2190 MHz.

The following receiver blocking requirements are proposed:

* -43 dBm per 5 MHz at frequency offsets greater than 5 MHz from the frequency limit of the licence
* a total mean power of -15 dBm for frequencies outside the band 1900 MHz to 2000 MHz.

These proposed requirements mirror the receiver blocking requirement stated in 3GPP 36.104[[27]](#footnote-28) for wide area base stations.

### E1.4 Receiver antenna and feeder losses

A notional antenna gain (including losses) of 18 dBi is proposed. The justification for this figure is outlined in section B1 of attachment B of this consultation paper.

## E2 Compatibility requirement

The present maximum unwanted signal level is -126 dBm for more than one per cent of the time in any one-hour period, when measured as mean power within a 30 kHz rectangular bandwidth that is within the frequency band of the spectrum licence. This is equivalent to a maximum unwanted signal of approximately -104 dBm/5MHz.

It is proposed to change this to a maximum unwanted signal level of ratio of -108 dBm/5MHz is proposed. This results in an I/N of -6 dB and matches the maximum interference level defined in ITU-R Report M.2292-0.

1. A TLG is a short-term advisory body convened by the ACMA as a forum for consultation between the ACMA, industry and other stakeholders with an interest in the technical aspects of spectrum licences. [↑](#footnote-ref-2)
2. Available on the [ACMA website](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/principles-for-spectrum-management). [↑](#footnote-ref-3)
3. [Radiocommunications (Class of Services) Determination 2012](https://www.comlaw.gov.au/Details/F2012L00235) [↑](#footnote-ref-4)
4. The current Radiocommunications (Unacceptable Levels of Interference—2 GHz Band) Determination 2015is available at [www.comlaw.gov.au](http://www.comlaw.gov.au). [↑](#footnote-ref-5)
5. 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-6)
6. See Table 6.6.3.2.1-6 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-7)
7. See Table 6.6.3.2.1-6 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-8)
8. See Table 6.6.3.2.1-6 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-9)
9. See Table 6.6.3.2.1-6 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-10)
10. See Table 6.6.3.2.1-6 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-11)
11. See Table 6.6.3.2.1-6 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-12)
12. See Table 6.6.2.1.1-1 of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-13)
13. See Table 6.6.2.1.1-1 of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-14)
14. See Table 6.6.2.1.1-1 of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-15)
15. See Table 6.6.3.1-2 of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-16)
16. See Table 6.6.4.1.2.1-1 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-17)
17. See Table 6.6.3.1-1 of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-18)
18. See Section 6.6.4 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-19)
19. See Table 6.6.3.1-1 of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-20)
20. See Section 6.6.4 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-21)
21. Section 8(1) of the Radiocommunications Act defines a radio emission as the emission of electromagnetic energy at frequencies less than 420 THz without continuous artificial guide. [↑](#footnote-ref-22)
22. See Table 6.2.2-1 (EUTRA band 1) of [3GPP TS 36.101 version 12.9.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/12.09.00_60/ts_136101v120900p.pdf). [↑](#footnote-ref-23)
23. Applicable for DC-HSDPA (see Table 7.3 in 25.101) [↑](#footnote-ref-24)
24. Available at: <http://www.acma.gov.au/webwr/_assets/main/lib410188/australian_spectrum_map_grid_28feb2012.pdf> [↑](#footnote-ref-25)
25. See Table 7.5.1-3 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-26)
26. See Table 7.8.1-1 and Table 7.8.1-2 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-27)
27. See Table 7.6.1-1 and Table 7.6.1-2 of [3GPP TS 36.104 version 12.8.0 Release 12](http://www.etsi.org/deliver/etsi_ts/136100_136199/136104/12.09.00_60/ts_136104v120900p.pdf). [↑](#footnote-ref-28)