Expiring spectrum licences—technical framework for the 2 GHz band

Paper Two – Final Appendix Update

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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

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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)

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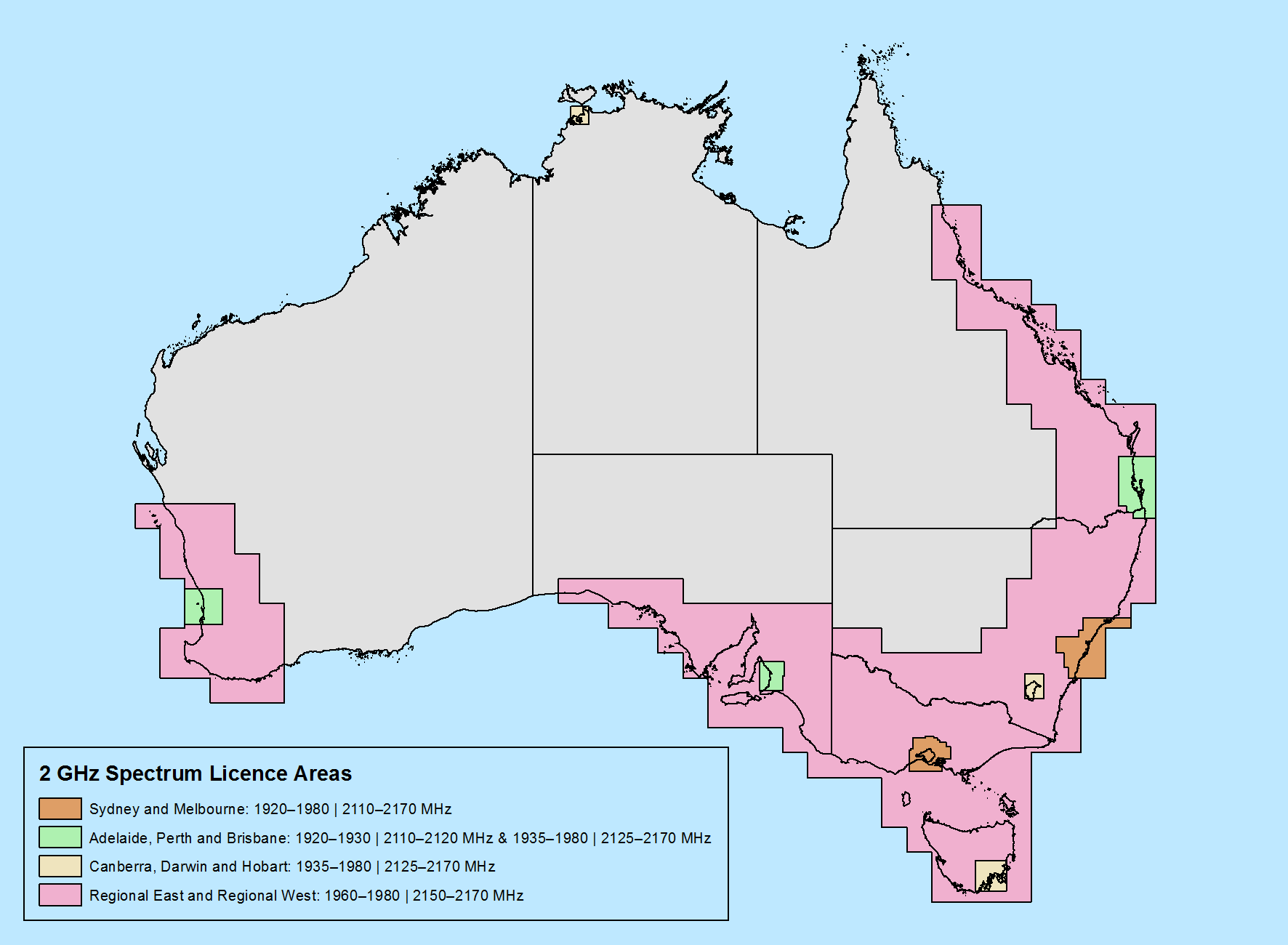
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# Attachment A—2 GHz spectrum licence band arrangements (paired segment)

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.

**Transmitters operating in the 2110-2170 MHz band**

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 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[[1]](#footnote-2);
* The addition of a 19 dBi antenna gain and 1 dB of losses, 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 are shown in Table B1.1. Note: **foffset** is the frequency offset from the upper or lower frequency limits of the licensed spectrum held in each area. The closest -3dB point of the specified bandwidth to the upper or lower frequency limits of the licence is placed at **foffset.**

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 the 2110–2170 MHz band

Unwanted Emission Limits below 2110 MHz

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[[2]](#footnote-3), with the addition of a 19 dBi gain antenna and 1 dB 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 (noting two different levels are specified in this range); and
* 10 MHz below the band edge (below 2100 MHz), a radiated power level of -11 dBm/MHz which. This is based on the Category B spurious emission limit for LTE base station transmitters above 1 GHz (i.e. -30 dBm/MHz) with the addition of a 19 dBi gain antenna (feeder losses have not been included to provide flexibility for the re-registration of existing equipment). It applies at a 10 MHz offset since 3GPP 36.104 states that the spurious domain for LTE base stations commences ± 10 MHz outside the 2110-2170 MHz band.

A stricter unwanted emission level is defined for most frequency offsets below 2110 MHz to provide for 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 existing emission limits are proposed to be maintained in the 2100-2106 MHz range. Emissions below 2100 MHz have been made 10 dB stricter than currently defined levels. This is a result of the methodology used to determine radiated unwanted emission limits in the spurious domain, i.e. the use of Category B spurious emission limits with the addition of a 19 dBi gain antenna. The resulting radiated unwanted emission limits below 2110 MHz are shown in Table B1.2. Note: **foffset** is the frequency offset below 2110 MHz. The closest -3dB point of the specified bandwidth to the 2110 MHz band edge is placed at **foffset.**

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 | 11 | 1 MHz |

Unwanted Emission Limits above 2170 MHz

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[[3]](#footnote-4), with the addition of a 19 dBi gain antenna and 1 dB feeder loss; and
* 10 MHz above the band edge (above 2180 MHz), a radiated level of -11 dBm/MHz. This is based on the Category B spurious emission limit for LTE base station transmitters (i.e. -30 dBm/MHz) with the addition of a 19 dBi gain antenna (feeder losses have not been included to provide flexibility for the re-registration of existing equipment). It applies at a 10 MHz offset since 3GPP 36.104 states that the spurious domain for LTE base stations commences ± 10 MHz outside the 2110-2170 MHz band.

The resulting radiated unwanted emission limits above 2170 MHz band are shown in Table B1.3. Note: **foffset** is the frequency offset above 2170 MHz. The closest -3dB point of the specified bandwidth to the 2170 MHz band edge is placed at **foffset.**

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 | 11 | 1 MHz |

**Transmitters operating in the 1920-1980 MHz band**

Unwanted Emission Limits within the 1875-2025 MHz band

Although OOB and spurious emission limits have similar values for all LTE UEs, the actual frequency offsets and ranges at which they apply differs depending on the channel bandwidth used. To account for this, the unwanted emission limit described below has been developed 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 unmodified in the 2 GHz band. In general this has meant adopting the least conservative out-of-band emission limits for LTE UEs in 3GPP 36.101 (for 5 MHz channels and greater).

This also explains the theory behind why the unwanted emission limits described below are proposed to apply within the 1875-2025 MHz band. Specifically, 3GPP 36.101 states that the spurious domain for an LTE UE employing 20 MHz + 20 MHz carrier aggregation commences at an offset of 45 MHz from the channel edge. This is a larger offset than for any other channel configuration. Since the unwanted emission limits in this section are largely based on OOB emission limits from 3GPP 36.101, the frequency range at which the unwanted limit applies is proposed to be contained within 45 MHz of either end of the 1920-1980 MHz band (i.e. 1875-2025 MHz).

For devices operating in the 1920-1980 MHz band, it is proposed that the radiated unwanted emission limits within the 1875-2025 MHz band be based on:

* The general limits for user terminals stated in 3GPP 36.101[[4]](#footnote-5). Specifically:
  + The 5 MHz channel limit is used in the first 1 MHz. This limit is less stringent than limits defined for 10-20 MHz channels and therefore ensure support for any channel size in the range 5-20 MHz;
  + >1 MHz offsets, LTE UE 20 MHz + 20 MHz carrier aggregation emission limits;

A 0 dBi antenna gain (which is common for user terminals) is used to turn all the conducted limits defined above into radiated limits.

The resulting radiated unwanted emission limits for devices operating within the 1920-1980 MHz band are shown in Table B1.4. Note: **foffset** is the frequency offset from the upper or lower frequency limits of the licensed spectrum held in each area. The closest -3dB point of the specified bandwidth to the upper or lower frequency limits of the licence is placed at **foffset.**

Table B1.4: Radiated unwanted emission limits within the 1875-2025 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 < 39.8 MHz | -13 | 1 MHz |
| 39.8 MHz ≤ foffset | -25 | 1 MHz |

Unwanted Emission Limits below 1875 MHz and above 2025 MHz

For devices operating in the 1920-1980 MHz band, it is proposed that the radiated unwanted emission limits below 1875 MHz and above 2025 MHz be based on:

* The spurious emission limits for an LTE UE stated in 3GPP 36.101[[5]](#footnote-6) employing 20 MHz + 20 MHz carrier aggregation with the addition of a 0 dBi antenna gain to determine a radiated power limit. The spurious domain for such an LTE UE starts 45 MHz from the operating band edge. These spurious limits in 3GPP 36.101 mirror the Category B limits defined in Recommendation ITU-R SM.329.

The unwanted emission limit described above has been developed 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 unmodified in the 2 GHz band.

The resulting radiated unwanted emission limits below 1875 MHz and above 2025 MHz band are shown in Table B1.5.

Table B1.5: Radiated unwanted emission limits outside the 1875-2025 MHz frequency range for transmitters operating in the 1920-1980 MHz frequency range

| Frequency | Radiated maximum true mean power  (dBm EIRP) | 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 < 1.875 GHz | -30 | 1 MHz |
| 2.025 GHz ≤ f | -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’ (a radiated limit) defined in section B1 and ‘the spurious emission limit’ defined in this section. The spurious emission limits are defined the same way as specified in 3GPP standards.

The proposed transmitter spurious emission limits for devices operating in the 1920-1980 MHz and 2110-2170 MHz frequency ranges are the levels defined in 3GPP 36.101[[6]](#footnote-7) (for UEs) and 3GPP 36.104[[7]](#footnote-8) (for base stations) respectively. These levels are defined at the antenna connector (i.e. they are conducted limits).

3GPP 36.101[[8]](#footnote-9) and 36.104[[9]](#footnote-10) defines the boundary between the E-UTRA out of band and spurious emission domains. For LTE (and UMTS) base stations the transmitter spurious domain starts ±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 and whether carrier aggregation is implemented. 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.

For transmitter spurious emissions, the limits in Table B2.1 apply:

* outside the 1875-2025 MHz frequency range for transmitters operating in the 1920-1980 MHz frequency range;
* outside the 2100-2180 MHz frequency range for transmitters operating in the 2110-2170 MHz frequency range

For receiver spurious emissions, the limits in Table B2.2 apply:

* at all frequencies specified in the table for radiocommunications receivers operating in the 2110-2170 MHz band; and
* at frequencies outside the 2100-2180 MHz band for receivers operating in the in the 1920-1980 MHz band.

The resulting conducted transmitter and receiver spurious emission limits are shown in Table B2.1 and Table B2.2 respectively.

Table B2.1: Radiocommunications transmitter spurious emission limits at antenna connector.

| Frequency range (f) | Radiated mean power  (dBm EIRP) | 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.

| Frequency range (f) | Radiated mean power  (dBm EIRP) | 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).

Although, at present, typical base stations operate with EIRPs in the range of 62-68 dBm/5MHz, this is likely to change in the future. Base stations are likely to operate at higher EIRPs when the following changes start being adopted: MIMO (4x4 and higher order schemes), beam forming, higher gain antenna deployments and higher transmit powers (particularly in regional/remote areas).

An example EIRP calculation for a system employing what are currently considered standard parameters is given below.

*EIRPmax = (Gtx\_max + Ptx\_max) + 10log(Number of Antennas)*

*= (19 dBi + 43 dBm/5MHz) + 10log(1)*

*= 62 dBm/5 MHz*

An example EIRP calculation for a system employing 8x8 MIMO and a 46 dBm/5MHz transmit power is given below.

*EIRPmax = (Gtx\_max + Ptx\_max) + 10log(Number of Antennas)*

*= (19 dBi + 46 dBm/5MHz) + 10log(8)*

*= 74 dBm/5 MHz*

In order to support the deployment of new technologies in the future, it is proposed that the current out-of-area emission limit be maintained. To further simplify the requirement, it is further proposed that this level be defined as the maximum EIRP in any direction (rather than a horizontally radiated power), and a 5 MHz reference bandwidth be adopted (i.e. as 77.2 dBm per 5 MHz) which better reflects operating bandwidths of current mobile broadband technologies.

## 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.[[10]](#footnote-11) 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 femtocells or repeaters.

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[[11]](#footnote-12) | -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)[[12]](#footnote-13), then further additional consideration needs 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-licensed 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[[13]](#footnote-14) 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[[14]](#footnote-15) 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[[15]](#footnote-16) 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. 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-2)
2. 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-3)
3. 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-4)
4. 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-5)
5. 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-6)
6. 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-7)
7. 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-8)
8. 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-9)
9. 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-10)
10. 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-11)
11. Applicable for DC-HSDPA (see Table 7.3 in 25.101) [↑](#footnote-ref-12)
12. Available at: <http://www.acma.gov.au/webwr/_assets/main/lib410188/australian_spectrum_map_grid_28feb2012.pdf> [↑](#footnote-ref-13)
13. 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-14)
14. 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-15)
15. 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-16)