Radiocommunications (Unacceptable Levels of Interference — 2 GHz Band) Determination 2015

The AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY makes this Determination under subsection 145 (4) of the *Radiocommunications Act 1992*.

Dated *15th May 2015*

Chris Chapman
[signed]
Member

Richard Bean
[signed]
Member / ~~General Manager~~

Australian Communications and Media Authority

1 Title

This Determination is the *Radiocommunications (Unacceptable Levels of Interference — 2 GHz Band) Determination 2015*.

2 Commencement

This Determination commences on the day after it is registered.

Note All legislative instruments and compilations are registered on the Federal Register of Legislative Instruments kept under the *Legislative Instruments Act 2003*. See http://www.comlaw.gov.au.

3 Revocation

The *Radiocommunications (Unacceptable Levels of Interference — 2 GHz Band) Determination 2000* [F2005B00282] is revoked.

4 Purpose

This Determination sets out what is an unacceptable level of interference caused by a transmitter operating under a spectrum licence issued in the 2 GHz band, so as to ensure that high levels of emission from transmitters operated under a licence are kept within the geographic area and frequency band of the licence, and that special account is taken of the increase in emission levels caused by placing transmitters at high sites.

Note 1 The ACMA may refuse to register a transmitter if the operation of the transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices — see section 145 of the Act.

Note 2 The ACMA information paper, *Registration of radiocommunications devices under spectrum licences,* (available on the ACMA website: www.acma.gov.au), provides further information about the registration of radiocommunications transmitters under Part 3.5 of the Act.

Note 3 The ACMA has issued written advisory guidelines under section 262 of the Act about compatibility requirements in relation to the assignment of transmitters operated under apparatus licences and the operation of transmitters under spectrum licences. The ACMA will take these guidelines into account during the settlement of interference disputes. Each case will be assessed on its merits. The guidelines do not prevent a licensee negotiating other compatibility requirements with another licensee. The guidelines are:

- *Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers — 2 GHz Band) 2015*;
- *Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed and Class-licensed Transmitters — 2 GHz Band) 2015*.

These instruments can be accessed on the ComLaw website: www.comlaw.gov.au.

5 Interpretation

(1) In this Determination, unless the contrary intention appears:

Act means the *Radiocommunications Act 1992*.

Australian National Spheroid means the Australian National Spheroid published in the *Gazette* on 6 October 1966 and used with the Australian Geodetic Datum 1984.

cell means a square with a side measured in degrees by reference to the Australian National Spheroid.

centre location, in relation to a transmitter, means the centre location of the transmitter calculated in accordance with Schedule 1.

device boundary, in relation to a transmitter or a group of transmitters operated under a spectrum licence, means the device boundary established in accordance with Part 1 of Schedule 2.

device boundary criterion (2 GHz) means the value of the mathematical expression calculated in accordance with Part 2 of Schedule 2.

device boundary scaling parameter means a parameter used in the calculation of the device boundary criterion (2 GHz).

effective antenna height means the effective height of an antenna calculated in accordance with Schedule 3.

effective occupied bandwidth, for a transmitter, means the minimum width of a frequency band having fixed upper and lower limits that is necessary to contain not less than 99% of the true mean power of the transmitter's emission at any time.

effective radius, for a centre location, means the value in kilometres of the effective radius for the centre location, calculated in accordance with Schedule 1.

emission centre frequency, in relation to a transmitter, means the frequency midway between the lower and upper frequency limits of the transmitter's effective occupied bandwidth.

emission designator has the meaning given by section 9.

error (E) means the uncertainty relating to the measured value of a parameter required to achieve a 95 % level of confidence that the true value of the parameter is within the range:

(a) measured value minus the uncertainty; to

(b) measured value plus the uncertainty.

fixed receiver means a receiver located at a fixed point on land or sea and not established for use while in motion.

fixed transmitter means a transmitter located at a fixed point on land or sea and not established for use while in motion.

geographic area, in relation to a spectrum licence, means the area within which operation of a device is authorised under the licence.

group of receivers has the meaning given by section 7.

group of transmitters has the meaning given by section 6.

HAPS means a High Altitude Platform Station, which is a station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the earth.

horizontally radiated power, for a radiocommunications device, means the product of:

(a) the maximum true mean power within the frequency band of the licence authorising the operation of the device, measured in units of dBm per 30 kHz at the antenna connector; and

(b) the antenna gain relative to an isotropic antenna in a specified direction referenced from, and in the horizontal plane containing, the phase centre of the antenna used with the device.

in-band, means:

(a) for a transmitter operated under a spectrum licence, the frequencies within the frequency band to which the licence relates; and

(b) for a receiver operating within the space of a spectrum licence, the frequencies within the frequency band to which the licence relates; and

(c) for a transmitter or receiver operating under an apparatus licence, the frequencies within the lower frequency limit and the upper frequency limit of its spectrum access.

indoor, for a fixed transmitter, means a transmitter having an antenna:

(a) located within an enclosed space; and

(b) for which its half-power beamwidth is contained within the enclosed space.

maximum true mean power means the true mean power measured in a 30 kHz rectangular bandwidth that is located within a specified frequency band such that the true mean power is the maximum of true mean powers produced.

Note The power within a 30 kHz rectangular bandwidth is normally established by taking measurements using either an adjacent channel power meter or a spectrum analyser. The accuracy of measuring equipment, measurement procedure and any corrections to measurements necessary to take account of practical filter shape factors would normally be in accordance with good engineering practice.

mean power means the average power measured during an interval of time that is at least ten times the period of the lowest modulation frequency.

mobile transmitter means a transmitter established for use while in motion or during halts at unspecified points on land or sea.

outdoor, in relation to a fixed transmitter, means a fixed transmitter that is not an indoor fixed transmitter.

publish includes publish electronically.

RadDEM means the digital elevation model developed by the ACMA for radiocommunications purposes that contains modelled terrain height information for Australia in cells of a size of 9 seconds of arc, published by the ACMA, copies of which are available from the ACMA.

spectrum map grid means the *Australian Spectrum Map Grid 2014*, published by the ACMA, copies of which are available from the ACMA.

towns mobile list means the list giving the names of towns, latitude and longitude of the centre location and the effective radius for each town, published by the ACMA, copies of which are available from the ACMA.

true mean power means:

(a) if an unmodulated carrier is present — the mean power measured while the unmodulated carrier is present; and

(b) if an unmodulated carrier is not present — the mean power measured while transmitted information is present.

2 GHz band means the following frequency bands:

(a) 1900 MHz – 1920 MHz (the 2 GHz Lower Band);

(b) 1920 MHz – 1980 MHz (the 2 GHz Upper Band A);

(c) 2110 MHz – 2170 MHz (the 2 GHz Upper Band B).

Note The following terms, used in this Determination, are defined in the Act and have the meanings given to them by the Act:

ACMA	core condition
frequency band	interference
spectrum licence	transmitter.

(2) In this Determination, the range of numbers that identifies a frequency band includes the higher, but not the lower, number.

6 Group of transmitters

(1) For the purpose of this Determination, two or more fixed transmitters are a group of transmitters if:

(a) they have the same:

(i) emission centre frequency; and

(ii) emission designator; and

(b) each has an antenna of the same type, model and manufacturer; and

(c) they are operated for the purpose of communicating with the same receiver or group of receivers; and

(d) they have the same identification number assigned by the ACMA to the antenna used with each transmitter.

(2) A transmitter may belong to more than one group of transmitters.

7 Group of receivers

(1) For the purpose of this Determination, two or more fixed receivers are a group of receivers if:

(a) each has an antenna of the same type, model and manufacturer; and

(b) they are operated for the purpose of communicating with the same transmitter or group of transmitters; and

(c) they have the same identification number assigned by the ACMA to the antenna used with each receiver.

(2) A receiver may belong to more than one group of receivers.

Note The height of a group of receivers is calculated using the same method as that for a group of transmitters as set out in Schedule 3.

8 Unacceptable level of interference

(1) This section sets out what are unacceptable levels of interference for the purposes of section 145 of the Act.

Note Under section 145 of the Act, the ACMA may refuse to register a transmitter if the operation of the transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices.

(2) A level of interference caused by a transmitter operated under a spectrum licence issued for the 2 GHz band is unacceptable if the operation results in a breach of a core condition of the licence relating to the maximum permitted level of radio emission from the transmitter:

(a) outside the parts of the spectrum the use of which is authorised by the licence; or

(b) outside the geographic area of the licence.

Note Subsection 66 (1) of the Act deals with core conditions relating to maximum permitted levels of radio emissions.

(3) A level of interference caused by a transmitter operated under a spectrum licence (the 'first licence') issued for the 2 GHz band is unacceptable if any part of the device boundary of the transmitter lies outside:

(a) the geographic area of the first licence; and

(b) the geographic area of:

(i) a second licence, if the licensee of the first licence has an agreement with the licensee of the second licence for the purpose of core condition 7 of the first licence; or

(ii) a geographically adjacent licence, if the licensee of the first licence is also the licensee under the adjacent licensed service.

(4) A level of interference caused by a transmitter operated under a spectrum licence issued for the 2 GHz band is unacceptable if any part of the device boundary of the transmitter lies outside the geographic area of the licence.

(5) If a device boundary of a fixed transmitter cannot be calculated in accordance with Schedule 2, the transmitter is taken to cause unacceptable interference.

(6) In spite of subsections (3), (4) and (5), a device that operates in the 2 GHz band that is:

(a) a mobile transmitter or an indoor fixed transmitter with a horizontally radiated power always less than or equal to 25 dBm EIRP per 30 kHz and is not a mobile transmitter that operates in the band 1900–1900.5 MHz; or

(b) a fixed transmitter that is further than 70 km from the spectrum licence boundary in all directions; or

(c) a HAPS transmitter;

is taken not to cause unacceptable interference if it operates in accordance with the core conditions of its licence.

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Note The ACMA does not intend to require the registration of mobile transmitters — see subsection 69 (2) of the Act and the registration conditions of spectrum licences. The ACMA does not require a device boundary to be calculated for devices mentioned in this subsection (6).

(7) A mobile transmitter that operates in the 2 GHz band with a horizontally radiated power greater than 25 dBm EIRP per 30 kHz is taken to cause unacceptable interference.

(8) A mobile transmitter that operates in the band 1900.0–1900.5 MHz with a horizontally radiated power greater that 10 dBm EIRP per 30 kHz is taken to cause unacceptable interference.

Note Emission levels for mobile transmitters in this band are limited to manage unacceptable interference to cordless telecommunications services in the 1895–1900 MHz band.

(9) Subject to paragaph (6)(b), a fixed transmitter that operates in the band 1920 to 1980 MHz, that:

(a) has an effective antenna height for any segment 1, $he_1(\phi_n)$ greater than 20 metres; or

(b) has a horizontally radiated power greater than 25 dBm EIRP per 30 kHz for 1% of the time in any 1 hour period;

is taken to cause unacceptable interference.

Note Repeater devices and other fixed transmitters exceeding this subsection (9) may still be registered if the 'guard space' requirements referred to in the ACMA information paper, *Registration of radiocommunications devices under spectrum licences,* (available on the ACMA website: www.acma.gov.au) can be met.

9 Emission designator

(1) In this Determination, a reference to an emission designator, in relation to a transmitter, is a reference to the designation of the transmitter's emission worked out in accordance with Appendix 1 of the Radio Regulations published by the International Telecommunication Union as in force from time to time.

(2) For the purpose of working out the designation of the transmitter's emission, the references in Appendix 1 to necessary bandwidth for a given class of emission are taken to be references to the effective occupied bandwidth of the transmitter.

Schedule 1 Centre location and effective radius of a transmitter

(subsection 5 (1))

Note A model for the location of a group of transmitters (the effective location) is the circumference of the circle defined by the centre location and the effective radius.

1. The centre location of a transmitter is the centre of a circle l_C with an effective radius r_E. This Schedule sets out the l_C and r_E of particular transmitters.

2. Centre location and effective radius of a fixed transmitter

(1) For a fixed transmitter, l_C is the location (by latitude and longitude with reference to the Australian National Spheroid) of the phase centre of the transmitter's antenna and r_E is zero.

In measuring the latitude and longitude, the following errors are acceptable:

(a) in a high density area — less than 10 metres, measured using, for example, a differential GPS unit;

(b) in a medium density area — less than 100 metres, measured using, for example, a standard GPS unit;

(c) in any other area — less than 1 kilometre.

(2) For the purposes of subclause (1), ***high density*** and ***medium density*** have the meanings ascribed by items 201 and 202 of Part 2 of the *Radiocommunications (Transmitter Licence Tax) Determination 2015* and the *Radiocommunications (Receiver Licence Tax) Determination 2015*.

Note The ACMA issues site identifiers for established radiocommunications locations.

3. Centre location and effective radius of a group of fixed transmitters operating on land and not covered in paragraph 4

For a group of fixed transmitters operating within the limits of a town specified in the towns mobile list, l_C and r_E are taken to be those specified in the towns mobile list for that town.

4. Centre location and effective radius of a group of fixed transmitters located near a central point

For a group of fixed transmitters:

(a) supported by the same structure; and

(b) having the phase centre of each transmitter's antenna located within 10 metres of the same central point;

l_C is the central point and r_E is zero.

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Schedule 2 Device boundaries

(subsections 5 (1) and 8 (5))

Part 1 Device boundary of a transmitter or a group of transmitters

Note It is not necessary to calculate a device boundary for mobile transmitters as the ACMA does not intend to require these to be registered — see subsection 69 (2) of the Act and the registration conditions of spectrum licences.

1. The device boundary of a transmitter is established as follows:

Step 1: Calculate the device boundary criterion (2 GHz) for each increment ($m \cdot 1$) minutes in distance by reference to the Australian National Spheroid, where m is any integer beginning 1 to 55, along each of 144 radials. All increments m = 1, begin at the common central point of the radials. The common central point is the centre location of the transmitter. The 144 radials have bearings taken clockwise and given by the sequence ϕ_0, ϕ_1, ϕ_2,... ϕ_{142}, ϕ_{143}, (ϕ_n) according to the sequence rule $\phi_n = ((n \cdot {}^5/_2) + {}^5/_4)$ degrees referenced to true north.

Note In the expression '$(n \cdot {}^5/_2)$', and similar expressions, the symbol '$\cdot$' represents the operation of multiplication.

Step 2: Calculate an end point for each radial as the point corresponding to the sum of:

(a) the distance in kilometres along the radial equal to the length corresponding to the number of 1 minute increments from the centre location of the transmitter that corresponds to the calculated value of the device boundary criterion (2 GHz) being zero or negative when either all the previous values calculated for that radial are positive, or the number of the increment is equal to 1; and

(b) the effective radius of the centre location.

Note 1 The value of 'm' for each increment is the same as the value of 'm' for the segment referred to in paragraph 2 (c) of Schedule 3.

Note 2 The actual distance in kilometres for a 1 minute increment in distance varies according to the direction and location of the radial by reference to the Australian National Spheroid. Distances measured in minutes are accepted usage in mapping.

Step 3: Identify the location of each end point by reference to the spectrum map grid.

Step 4: Connect the end point of each radial consecutively to draw a polygon in relation to the spectrum map grid cells.

Step 5: Aggregate the spectrum map grid cells that either fall within or are intersected by the polygon. The boundary of this aggregated area is the device boundary of the transmitter.

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2. (1) For a group of transmitters:

(a) the device boundary of the group is to be calculated as if for a single transmitter; and

(b) when calculating the device boundary criterion (2 GHz), for each transmitter in the group the horizontally radiated power is calculated in accordance with subclause (2).

(2) The horizontally radiated power is taken:

(a) to be equal for each bearing ϕ_n ; and

(b) to have a value that is greater than or equal to the horizontally radiated power, in any direction, of any transmitter in the group, but never less than 55 dBm EIRP per 30 kHz.

Part 2 Device boundary criterion (2 GHz)

The device boundary criterion (2 GHz) is the value of the mathematical expression:

$$RP - MP$$

where:

RP is the Radiated Power, being:

$$HRP + E$$

where:

HRP is the horizontally radiated power for each bearing ϕ_n measured with an error of ±E dB; and

E is error as defined in subsection 5(1).

MP is the Maximum Power, calculated as set out below, being a function of $he_m(\phi_n)$ and $d_m(\phi_n)$,

where:

$\boldsymbol{he_m(\phi_n)}$ is the effective antenna height of the transmitter measured in metres for segment m (m being any integer from 1 to 55) for each bearing ϕ_n; and

$\boldsymbol{d_m(\phi_n)}$ is the distance 'm'·minutes with reference to the Australian National Spheroid, calculated for segment m and converted to kilometres with an error of less than ±0.1 km, for each bearing ϕ_n.

$\boldsymbol{MP(he_m(\phi_n), d_m(\phi_n))}$ measured in units of dB is as described as 'MP' below.

In calculating MP, for simplification let:

$d_m(\phi_n) = d$; and
$he_m(\phi_n) = h_e$.

If $h_e < 1.5$, then $h_e = 1.5$; and
if $h_e > 1600$ then $h_e = 1600$.

For $0 < d \leq 20$ km:

$MP = 158.5 - 13.82 \cdot \log(\max[30;h_e]) - \min([0;20 \cdot \log(h_e/30)]) - 12.27 + \{44.9 - 6.55 \cdot \log(\max[30;h_e])\} \cdot \log(d+S) - 118$ dB

For $d > 20$ km and $h_e \leq 500$ m:

$MP = 158.5 - 13.82 \cdot \log(\max[30;h_e]) - \min([0;20 \cdot \log(h_e/30)]) - 12.27 + \{1 + (0.54 + 0.00107 \cdot h_e) \cdot (\log[(d + S)/20])^{0.8}\} \cdot \{44.9 - 6.55 \cdot \log(\max[30;h_e])\} . \log(d+S) - 118$ dB

For $d > 20$ km and $h_e \geq 500$ m:

$MP = 58.9 \cdot \log(d+S) + 0.038 \cdot h_e - 2.8 \cdot (h_e)^{1/2} + 116.3 - 118$ dB

where:

$\boldsymbol{S}$ = Device Boundary Scaling Parameter = 0

Schedule 3 Effective antenna height

(subsections 5 (1) and 7 (2), Schedule 2)

1. General

The effective height of an antenna is determined in accordance with its transmitter, as set out in this Schedule.

Note The ACMA publishes software tools that may be used to calculate tables of effective antenna heights for any location in Australia.

2. Effective antenna height of an outdoor fixed transmitter

(see Diagram 1 below)

If:

(a) *hg* is the vertical height in metres of the phase centre of the fixed transmitter's antenna measured with an error of less than 5 parts in 100 and relative to the point:

(i) located on the line of intersection between the external surface of the structure supporting the antenna and the surface of the ground or sea; and

(ii) having the lowest elevation on that line; and

(b) *hs* is the sum of:

(i) the elevation attribute of the RadDEM cell containing the location of the phase centre of a fixed transmitter's antenna; and

(ii) *hg*; and

(c) $hag_m(\phi_n)$ is average ground height, as described below, for each of the segments 'm' of a sector of 2.5 degrees arc centred along each of the bearings ϕ_n, calculated by taking the average of the elevation attributes for all of the cells that have either half (with an error of less than 1 part in 64) or more than half their area within each segment 'm'; and

(d) each sector is divided into 55 segments 'm' (as illustrated in Diagram 2 below) with:

(i) any two consecutively numbered segments 1 to 55 being contiguous; and

(ii) each segment being a 1 minute increment in radial distance; and

(iii) segment 1 beginning at the centre location;

then for an outdoor fixed transmitter operating in the 2 GHz band the effective antenna height:

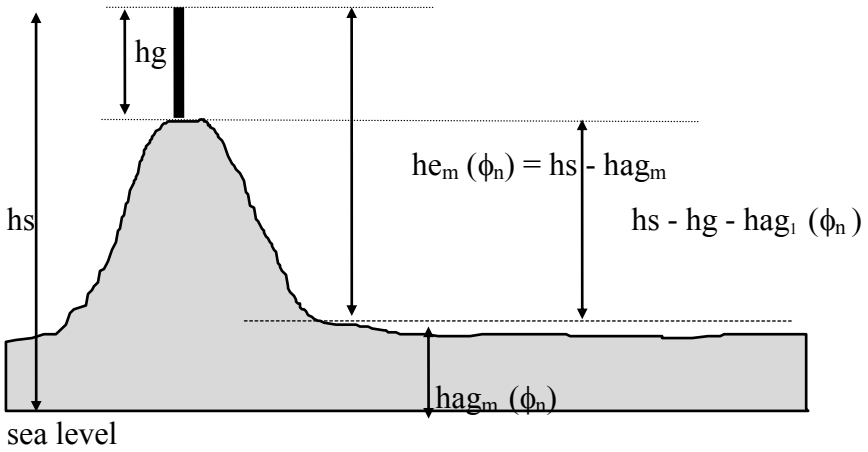
(e) for segment 1, $he_1(\phi_n)$, is *hg* for that centre location, except when $(hs - hg - hag_1(\phi_n))$ is > 48, in which case $he_1(\phi_n)$ is $(hs - hag_1(\phi_n))$ for that centre location; and

(f) for segments 2 to 55, $he_m(\phi_n)$, where m is any integer in the range 2 to 55, is (hs - $hag_m(\phi_n)$) for that centre location, except when (hs - $hag_m(\phi_n)$) is < hg, in which case $he_m(\phi_n)$ is hg for that centre location.

Note 1 A RadDEM cell is represented as raster data such that the western and southerly boundary of the cell is part of the cell but the northerly and easterly boundary is part of the adjacent cells. This is an important consideration when a location falls on a cell boundary.

Note 2 A RadDEM cell is considered to be half within a sector/segment with an error of less than 1 part in 64 when the centre locations of 32 sub-cells that compose the cell are within the sector/segment.

Diagram 1 Calculating effective antenna height

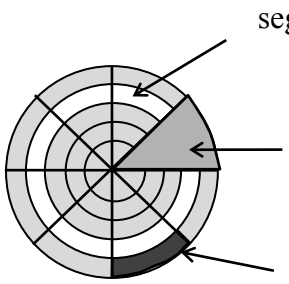


hg:	antenna height
hs:	antenna height above sea level
$hag_m(\phi_n)$:	average ground height above sea level in segment 'm' of sector 'n'
$he_m(\phi_n)$:	effective antenna height for segment 'm' of sector 'n'

Note For this case $hs - hg - hag_1(\phi_n) > 0$

Diagram 2 Segments and sectors

(not to scale)



segment

sector

sector/segment intersection area for calculating $hag_m(\phi_n)$

3. Effective antenna height of an indoor fixed transmitter

The effective antenna height of an indoor fixed transmitter for any segment 'm' = 1 to 55 and any bearing (ϕ_n), $he_m(\phi_n)$ is *hg* metres, where *hg* is the smallest distance, measured vertically, between the phase centre of the transmitter's antenna and any surface in the building where the transmitter is located and on which mobile transmitters are supported.

4. Effective antenna height of a group of fixed transmitters

For a group of fixed transmitters where the antenna height above ground of the highest transmitter (hg_{max}), calculated in accordance with paragraph 2 (a), is equal to or less than 20 metres, the effective antenna height of the group $he_m(\phi_n)$, is hg_{max} for any segment 'm' = 1 to 55, and any bearing (ϕ_n).

However, if a fixed transmitter in the group transmits for more than 5% of the time in any 1 hour period, each transmitter in the group is to be treated as if it were a single fixed transmitter and the effective antenna height of each fixed transmitter is to be worked out as for a single fixed transmitter.

5. Effective antenna height of a group of fixed transmitters located near a central point

For a group of fixed transmitters:

(a) all supported by the one structure; and

(b) having the phase centre of each transmitter's antenna located within 10 metres of the same central point;

the effective antenna height of the group is calculated as if it is a single fixed transmitter located at the central point and with a *hg,* calculated in accordance with paragraph 2 (a), equal to that calculated for the antenna with the largest *hg*.