Radiocommunications (Unacceptable Levels of Interference — 2.5 GHz Band) Determination 2012

Radiocommunications Act 1992

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

Dated *19th December* 2012

Chris Chapman
[signed]
Member

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

Australian Communications and Media Authority

1 Name of Determination

This Determination is the *Radiocommunications (Unacceptable Levels of Interference — 2.5 GHz Band) Determination 2012*.

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.frli.gov.au.

3 Purpose

This Determination sets out what is an unacceptable level of interference caused by a radiocommunications transmitter operating under a spectrum licence issued in the 2.5 GHz band, so as to ensure that high levels of emission from radiocommunications transmitters operated under a spectrum licence are kept within the geographic area and frequency band of the licence.

Note 1 Under section 145 of the Act, the ACMA may refuse to register a radiocommunications transmitter if it is satisfied that the operation of the radiocommunications transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices under that or any other spectrum licence.

Note 2 The ACMA may register a radiocommunications transmitter whose operation could cause an unacceptable level of interference to the operation of other radiocommunications devices, in certain circumstances. An ACMA information paper, which outlines circumstances in which the ACMA may register radiocommunications transmitters titled *Registration of radiocommunications devices under spectrum licences* is available from the ACMA website.

Note 3 The ACMA has made written advisory guidelines under section 262 of the Act about co-ordination 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 (Managing Interference from Transmitters — 2.5 GHz Band) 2012*; and
- *Radiocommunications Advisory Guidelines (Managing Interference to Receivers — 2.5 GHz Band) 2012*.

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

4 Interpretation

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

2.5 GHz band means the following frequency bands:

(a) 2500 MHz to 2570 MHz (the ***2.5 GHz Lower band***); and

(b) 2620 MHz to 2690 MHz (the ***2.5 GHz Upper band***).

Act means the *Radiocommunications Act 1992*.

Australian Spectrum Map Grid (ASMG) means the *Australian Spectrum Map Grid 2012* published by the ACMA, as in force from time to time.

Note The ASMG can be accessed on the ACMA website: www.acma.gov.au.

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

DEM-9S means the "*GEODATA 9 Second Digital Elevation Model (DEM-9S) Version 3*" (Australia New Zealand Land Information Council unique identifier ANZCW070311541) containing modelled terrain height information for Australia, published by Geoscience Australia and as in force from time to time.

Note Copies of the DEM-9S can be obtained from Geoscience Australia: www.ga.gov.au.

DEM-9S cell means an individual height element of the DEM-9S.

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

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

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

EIRP, in relation to a radiocommunications device, means the Equivalent Isotropically Radiated Power of the device.

emission designator means the designation of a radiocommunications transmitter's emission, determined in accordance with section 5.

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

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

Geocentric Datum of Australia 1994 means the geodetic datum designated as the "Geocentric Datum of Australia (GDA94)" gazetted in the Commonwealth of Australia Gazette No. GN 35 on 6 September 1995.

Note The Geocentric Datum of Australia is a coordinate reference system which replaces the Australian Geodetic Datum 1966. More information on the GDA94 can be obtained from Geoscience Australia: www.ga.gov.au.

geographic area, for a licence, means the area within which operation of a radiocommunications device is authorised under the licence.

group of radiocommunications receivers has the meaning given by section 7.

group of radiocommunications transmitters has the meaning given by section 6.

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

(a) the maximum true mean power, in dBm per specified rectangular bandwidth at the antenna connector that is located within the frequency band of the licence authorising the operation of the radiocommunications device; and

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

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

maximum true mean power means the true mean power measured within a specified 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 specified 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 10 times the period of the lowest modulation frequency.

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

Radio Regulations means the 'Radio Regulations' published by the International Telecommunication Union, as in force on the day this Determination commences.

> *Note* Copies of the Radio Regulations can be obtained from the ITU: www.itu.int.

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.

Note A number of terms used in this Determination, are defined in the Act and have the meanings given to them by the Act, including:

- ACMA
- core condition
- frequency band
- interference
- radiocommunications device
- radiocommunications receiver
- radiocommunications transmitter
- radio emission
- Register

- spectrum licence.

5 Emission designator

For the purpose of working out the designation of the radiocommunications transmitter's emission in accordance with Appendix 1 of the Radio Regulations, the references to necessary bandwidth for a given class of emission are taken to be references to the occupied bandwidth of the transmitter.

6 Group of radiocommunications transmitters

(1) In this Determination, two or more fixed transmitters are a group of radiocommunications transmitters if:

(a) they have the same centre frequency and emission designator; and

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

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

(d) the antenna used with each fixed transmitter is located on the same structure and within 20 metres of the phase centre of all antennas within the group of radiocommunications transmitters; and

(e) the identification number assigned by the ACMA to the antenna used with each radiocommunications transmitter is the same.

(2) A radiocommunications transmitter must not belong to more than one group of radiocommunications transmitters.

(3) The location of a group of radiocommunications transmitters is worked out in accordance with Schedule 1.

7 Group of radiocommunications receivers

(1) In this Determination, two or more fixed receivers are a group of radiocommunications receivers if:

(a) the receivers are operated for the purpose of communicating with the same radiocommunications transmitter or same group of radiocommunications transmitters; and

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

(c) the antenna used with each fixed receiver is located on the same structure and within 20 metres of the phase centre of all antennas within the group of radiocommunications receivers;

(d) the identification number assigned by the ACMA to the antenna used with each radiocommunications receiver is the same.

(2) A radiocommunications receiver must not belong to more than one group of radiocommunications receivers.

(3) The location of a group of radiocommunications receivers is worked out as if it were a group of radiocommunications transmitters under Schedule 1.

8 Unacceptable level of interference

(1) A level of interference caused by a radiocommunications transmitter operated under a spectrum licence issued for the 2.5 GHz band is unacceptable if:

(a) the operation results in a breach of a core condition of the licence relating to the maximum permitted level of radio emission from the radiocommunications transmitter:

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

(ii) outside the geographic area of the licence; or

(b) subject to subsection (2) – any part of the device boundary of the transmitter lies outside the geographic area of the licence; or

(c) the device boundary of the transmitter cannot be calculated in accordance with Part 1 of Schedule 2.

(2) A level of interference mentioned in paragraph (1)(b) is not unacceptable in relation to a part of the device boundary that:

(a) lies outside the boundary of the *Australian Spectrum Map Grid 2012*; and

(b) is connected to a radial that:

(i) is mentioned in Part 1 of Schedule 2; and

(ii) does not cross the geographic area of another licence.

(3) Without limiting subsection (1), a level of interference caused by a radiocommunications transmitter operated under a spectrum licence issued for the 2.5 GHz band is unacceptable if the operation results in emissions above the horizontal plane greater than 45 dBm/30kHz EIRP.

(4) Without limiting subsection (1), a radiocommunications transmitter that operates in the 2.5 GHz lower band is taken to cause unacceptable interference if it has an effective antenna height greater than 10 metres.

Note The ACMA does not intend to require the registration of certain radiocommunications transmitters described in the relevant condition included in a 2.5 GHz band spectrum licence which exempts those transmitters from the requirement to be registered.

9 Accuracy

Unless otherwise specified, the value of a parameter in Schedules 2 and 3 must be estimated with a level of confidence of not less than 95 percent that the true value of the parameter will always remain below the requirement specified in this Determination.

Schedule 1 Location of a transmitter

(subsections 4(1), 6(3) and 7(3))

1. The location of a radiocommunications transmitter, (l_t, L_t), is the location (by latitude and longitude with reference to the Geocentric Datum of Australia 1994) of the phase centre of the radiocommunications transmitter's antenna.

2. The location of a group of radiocommunications transmitters, (l_t, L_t), is the location (by latitude and longitude with reference to the Geocentric Datum of Australia 1994) of the centre point between the phase centre of each radiocommunications transmitter antenna within the group.

3. In determining the location of a radiocommunications transmitter, the measurement error should be less than 10 metres.

Note 1 The ACMA issues site identifiers for established radiocommunications locations available in the Register.

Note 2 The ACMA provides advice for determining the location and measurement error of a transmitter site in the document titled *Business Operating Procedure (BOP) - Radiocommunications Site Data Requirement*s available from the ACMA website.

Schedule 2 Device boundaries and device boundary criteria

(subsection 4(1))

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

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

Step 1 Calculate the device boundary criterion at each m × 500 metre increment along each of n-degree radials, where:

m has the values 1 through 100; and

n has the values 0 (true north) through 359.

Step 2 For each radial, find the latitude and longitude of the first point (lowest value of m) where either:

(a) the device boundary criterion is less than or equal to 0, or

(b) m is equal to 100.

Step 3 The end point of each radial is the device boundary of the radiocommunications transmitter.

Note 1 It is not necessary to calculate a device boundary for radiocommunications transmitters with a horizontally radiated power less than or equal to 35 dBm/5 MHz as the ACMA does not intend to require these radiocommunications transmitters to be registered (see subsection 69(2) of the Act and the licence conditions relating to registration of devices under the spectrum licence).

Note 2 The device boundary criterion is calculated under Part 2 of this Schedule.

2. For a group of radiocommunications transmitters the device boundary is to be calculated as if for a single radiocommunications transmitter. The radiated power (***RP***) for the group of radiocommunications transmitters is taken:

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

(b) to have a value that is equal to the maximum horizontally radiated power, in any direction, of any radiocommunications transmitter in the group.

Part 2 Device boundary criterion

The device boundary criterion is the value of the mathematical expression:

$$RP - MP$$

where:

MP	:	$PL(l_{mn},L_{mn}) + LOP$
RP	:	is the horizontally radiated power, in dBm EIRP per 30 kHz
LOP	:	is the level of protection at the boundary set as -116 dBm/30kHz
$PL(l_{mn},L_{mn})$	:	is the propagation loss, in dB set out in Part 3 for the m^{th} increment on the n^{th} radial

Part 3 Calculation of propagation loss

1. In calculating $PL(l_{mn}, L_{nm})$:

$he_m(\phi_n)$: is the transmit effective antenna height (metres) as defined in Part 1 of Schedule 3; and

$d(l_{mn},L_{mn})$: is the distance in kilometres between the location of the radiocommunications transmitter, (l_t,L_t), and the m^{th} increment on the n^{th} radial (l_{mn},L_{mn})

2. The propagation loss for the m^{th} increment on the n^{th} radial is established as follows:

Step 1: Calculate the parameters required

$$he = \min[(\max[he_m(\phi_n);1.5]);500]$$

$$d = d(l_{mn},L_{mn})$$

for $d \leq 20$ km $\alpha = 1$

for $d > 20$ km $\alpha = 1 + (0.63 + 0.00107 \times he) \times (\log(d)/20))^{0.8}$

Step 2: Calculate the propagation loss for the m^{th} increment on the n^{th} radial

$$PL(l_{mn},L_{mn}) = 159.38 – 13.82 \times \log_{10}(\max[30; he]) –$$

$$\min[0;(20 \times \log_{10}(he / 30))] - 4.65 +$$

$$\{44.9 – 6.55 \times \log_{10}(\max[30; he])\} \times (\log_{10}(d))^{\alpha}$$

Schedule 3 Ground and effective antenna height

(subsection 4(1))

Part 1 Effective antenna height of a transmitter

1. 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

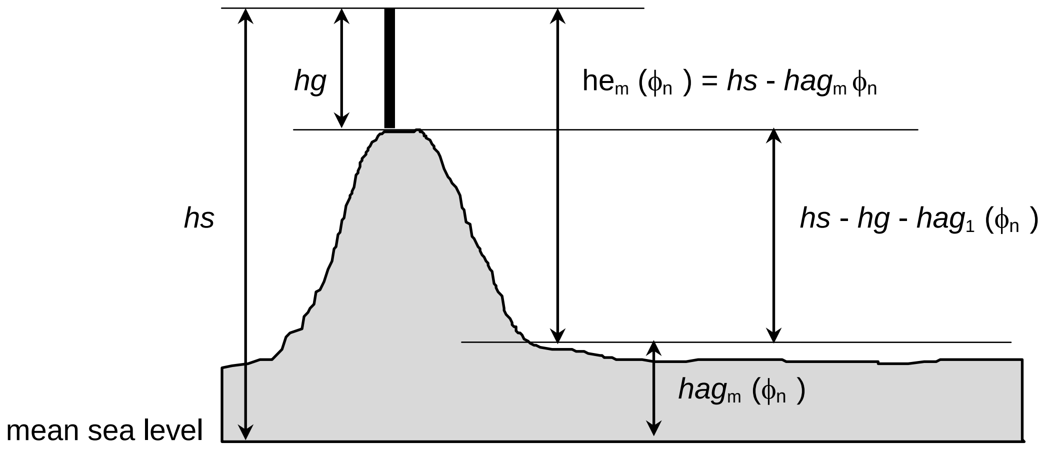
(b) *hs* is the sum of the elevation attribute of the DEM-9S cell containing the location of the phase centre of a radiocommunications transmitter's antenna and *hg*; and

(c) $hag_m(\phi_n)$ is average ground height for the location at each of the increments 'm' along each of the bearings ϕ_n, calculated in accordance with Part 2;

then the effective antenna height $he_m(\phi_n)$, is ($hs - hag_m(\phi_n)$) (as shown in Diagram 1) except when ($hs - hag_m(\phi_n)$) is less than *hg*, in which case $he_m(\phi_n)$ is *hg*.

2. For a group of radiocommunications transmitters, hg is the greatest of the hg for each individual transmitter in the group, calculated as in (a).

Diagram 1 Calculating effective antenna height



Where: *hg* is antenna height;

hs is antenna height above sea level; and

$hag_m(\phi_n)$ is average ground height above sea level at increment 'm' along radial 'n'.

3. If the latitude or longitude of the radiocommunications transmitter as defined in Schedule 1 has a modulus of zero when divided by 0.0025, then h_s is the sum of h_g and the maximum height of the adjacent DEM-9S cells.

Note Additional information for the purpose of calculating h_s where the latitude or longitude of the radiocommunications transmitter as defined in Schedule 1 correspond to a DEM-9S cell boundary is provided in the document titled *Digital Elevation Model Interpretation* available on the ACMA website.

Part 2 Average ground height

1. The average ground height for the m^th increment on the n^th radial is calculated as follows:

Step 1: determine the associated latitude and longitude (l_{mn}, L_{mn}) of the m^th increment on the n^th radial as calculated in Part 3.

Step 2: identify the DEM-9S cell represented by the latitude and longitude of the m^th increment on the n^th radial.

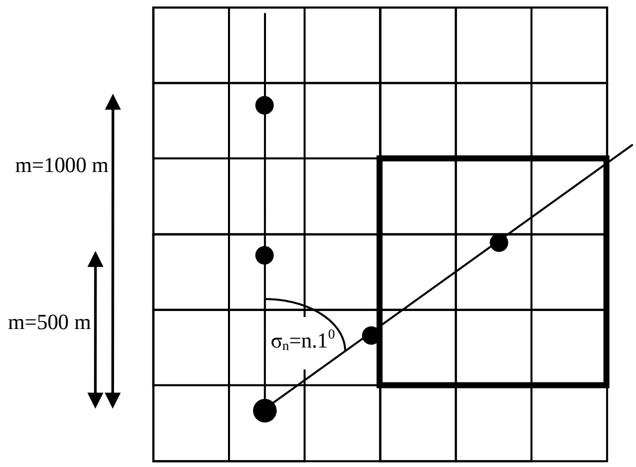
Step 3: bound the identified DEM-9S cell with the 8 adjacent DEM-9S cells in a 3x3 matrix and obtain each DEM-9S cell height attribute (as shown in Diagram 2).

Step 4: determine the average value of height from the 3x3 matrix.

2. If the latitude or longitude (l_{mn}, L_{mn}) of the m^th increment on the n^th radial as calculated in Part 3 has a modulus of zero when divided by 0.0025, then the corresponding DEM-9S cell as identified in Step 2 above, is the cell with the lowest height of the adjacent DEM-9S cells.

Note Additional information where the associated latitude or longitude of the m^th increment on the n^th radial as calculated in Part 3 correspond to a DEM-9S cell boundary is provided in the document titled '*Digital Elevation Model Interpretation*' available on the ACMA website.

Diagram 2 Calculating average ground height



Part 3 Vincenty's Formulae

Note 1: This implementation of Vincenty's Direct Formulae uses the parameters $\{a, f_l, b\}$ *from the GRS80 ellipsoid as referenced by the Geocentric Datum of Australian 1994.*

1. In calculating (l_{mn}, L_{mn}):

l_t : latitude of the fixed transmitter (decimal degrees)
L_t : longitude of the fixed transmitter (decimal degrees)
α : azimuth angle (decimal degrees)
d : separation distance to required point (m×500 metres)
a : semi-major axis of GDA94 (6378137m)
f_l : flattening of GDA94(1/298.25722210)
b : semi-minor axis of GDA94 ($a\times(1-f_l)$)

$$e^2 = (a^2 - b^2)/b^2$$
$$U_1 = \arctan((1 - f_l)\times\tan(l_t))$$
$$\alpha_n = \arcsin(\cos(U_1)\times\sin(\alpha))$$
$$u^2 = \cos^2(\alpha_n)\times e^2$$
$$A = 1 + (u^2/16384)\times(4096 + u^2\times(-769 + u^2\times(320 - 175\times u^2)))$$
$$B = (u^2/1024)\times(256 + u^2\times(-128 + u^2\times(74 - 47\times u^2)))$$

2. Using an initial value $\phi = d/(b\times A)$, iterate the following three equations until the change in ϕ is less than 10^{-12}.

$$\phi_m = \frac{2\times l_t + \phi}{2}$$
$$\Delta\phi = \mathrm{B}\sin\phi\times\left\{\cos(2\phi_m) + \frac{B}{4}\times\left[\cos\phi\times\left(-1 + 2\cos^2(2\phi_m)\right) - \frac{B}{6}\cos(2\phi_m)\times\left(-3 + 4\sin^2\phi\right)\times\left(-3 + 4\cos^2(2\phi_m)\right)\right]\right\}$$
$$\phi = d/(b\times A) + \Delta\phi$$

3. Then,

$$l_{mn} = \arctan\left(\frac{\sin(U_1)\cos(\phi) + \cos(U_1)\sin(\phi)\cos(\alpha)}{(1-f)\sqrt{\sin^2(\alpha_n) + (\sin(U_1)\sin(\phi) - \cos(U_1)\cos(\phi)\cos(\alpha))^2}}\right)$$
$$\lambda = \arctan\left(\frac{\sin\phi\sin\alpha}{\cos U_1\cos\phi - \sin U_1\sin\phi\cos\alpha}\right)$$
$$C = \frac{f}{16}\cos^2\alpha\left[4 + f_l\left(4 - 3\cos^2\alpha\right)\right]$$
$$L = \lambda - (1 - C)f_l\sin\alpha\left\{\phi + C\sin\phi\left[\cos(2\phi_m) + C\cos\phi\left(-1 + 2\cos^2(2\phi_m)\right)\right]\right\}$$
$$L_{mn} = Lt + L$$