

*Radiocommunications Advisory Guidelines (Protection of Mobile Base Receivers -
1800 MHz Lower Band) 1999*

Commonwealth of Australia

Radiocommunications Act 1992

**Radiocommunications Advisory Guidelines (Protection of Mobile
Base Receivers - 1800 MHz Lower Band) 1999**

THE AUSTRALIAN COMMUNICATIONS AUTHORITY makes the following
guidelines under section 262 of the *Radiocommunications Act 1992*

Dated 3 November 1999.

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BACKGROUND

A spectrum licence consists of a frequency band and a geographic area. Interference occurring between adjacent spectrum licences consists of:

- in-band interference, across the geographic boundaries; and
- out-of band interference, across the frequency boundaries.

This interference is managed by creating emission buffer zones along the geographic and frequency boundaries of the licence, using a number of tools provided by the *Radiocommunications Act 1992*. These tools are:

- the core conditions in all spectrum licences (see s.66 of the Act), about:
 - emission limits outside the area; and
 - emission limits outside the band
- the determination under s.145 of the Act about what constitutes unacceptable interference;
- advisory guidelines made under s.262 of the Act, about managing interference in specific circumstances.

The following advisory guidelines have been made for the management of interference to mobile base receivers operating in specific areas of high mobile use and in the 1800 MHz lower band.

PART 1 - INTRODUCTION

Title

1.1. These guidelines are called the *Radiocommunications Advisory Guidelines (Protection of Mobile Base Receivers - 1800 MHz Lower Band) 1999*.

Commencement

1.2. These guidelines commence on 3 November 1999.

Purpose of these guidelines

1.3. The purpose of these guidelines is to provide for the protection of mobile base receivers, operated under spectrum licences in the 1800 MHz lower band in areas of high mobile use, from certain transmitters in adjacent areas (normally fixed services) that are located at high sites and that operate under spectrum or apparatus licences. These guidelines do not apply to fixed services for which licences are issued before the date of issue of the *Radiocommunications Spectrum Marketing Plan (800 MHz and 1.8 GHz Bands) 1998*.

Interpretation

1.4. In these guidelines, unless the contrary intention appears:

Act means the *Radiocommunications Act 1992*.

additional device boundary criterion means the device boundary criterion worked out in accordance with Schedule 2.

emission buffer zone means a zone along the frequency or geographic boundary of a spectrum licence where emission levels of transmitters are reduced to ensure that significant levels of emissions stay within the geographic area and frequency band of the licence.

lower band means the frequency band 1710 MHz - 1785 MHz.

s.145 determination means the *Radiocommunications (Unacceptable Levels of Interference-1800 MHz Band) Determination 1999*.

upper band means the frequency 1805 MHz - 1880 MHz.

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

(3) A term used in these guidelines that is defined in the s.145 determination has the same meaning as in that determination.

[NOTES: 1. The following terms, used in this determination, are defined in the *Radiocommunications Act 1992* and have the meanings given to them by that Act:

ACA	frequency band
interference	spectrum licence
transmitter.	

2. The following terms are defined in the *Radiocommunications (Unacceptable Levels of Interference-1800 MHz Band) Determination 1999* and have the meanings given to them by that Determination:

area of high mobile use	Australian National Spheroid
horizontally radiated power	in-band
RadDEM	

1.5. Revocation

The *Radiocommunications Advisory Guidelines (Protection of Mobile Base Receivers - 1800 MHz Lower Band) 1998* are revoked.

PART 2 - EMISSION BUFFER ZONES

2.1 The emission buffer zones along the geographic boundaries of 1800 MHz spectrum licences are created by employing device boundary criteria set out in the s.145 Determination. The device boundary criteria are based on a high site, low site propagation model. Except in a few areas designated as areas of high mobile use where transmitters are restricted, when operating in the lower band, to heights of 10 metres, the s.145 Determination for 1800 MHz allows transmitters to operate at high sites in both the upper and lower bands, in order to support the use of point to point or fixed services as well as mobile services. Because transmitters are allowed to operate

at high sites, in both bands, outside areas of high mobile use, receivers are then only protected at low sites in both bands when they are located near the geographic boundary of their licences.

[NOTE: Under spectrum licensing (for example, at 500 MHz) the height of transmitters in one band (the upper band at 500 MHz) is usually kept low to protect receivers at high sites. In these cases fixed services are accommodated by operating at the two high sites (in a frequency domain duplex configuration) with both transmit frequencies taken from the band which supports that type of operation (the lower band at 500 MHz). This is not possible for current fixed services at 1800 MHz because those transmitters operate in both the upper and lower bands.]

PART 3 - ADDITIONAL CRITERIA TO PROTECT MOBILE BASE RECEIVERS IN AREAS OF HIGH MOBILE USE

3.1 In the lower band, the fixed service uses transmitters at high sites while the mobile service uses base receivers at high sites. This leads to conflict between the requirements of a fixed service and the requirements of a mobile service when there are many services in an area. In looking to accommodate both services, a compromise is necessary between how future fixed and mobile services are to be treated.

3.2 The compromise is to favour mobile services in areas of potentially high mobile use and place fixed and mobile services on relatively equal terms in areas of potentially low mobile use. Because they are to be on equal terms in areas of potentially low mobile use and the services have conflicting requirements, there can be a resultant loss of spectrum utility in those areas, depending on how adjacent licensees decide to use their spectrum.

PART 4 - DESIGNING IN FAVOUR OF A MOBILE SERVICE

Out-of-band interference - antenna height

4.1 The technical framework is designed to favour mobile services in areas of expected high mobile use. The areas of high mobile use are the same as those used in the *Radiocommunications (Unacceptable Levels of Interference-1800 MHz Band) Determination 1999*. Within those areas, the effective antenna height for each segment 1, ($he_1(\phi_n)$), for transmitters operating under spectrum licences in the lower band is limited to 10 metres in order to manage out-of-band interference (mainly receiver intermodulation) in base receivers for mobile systems used at high sites. This manages interference across frequency boundaries within those areas.

[NOTES:

1. Effective antenna height is defined in the s.145 Determination.
2. In urban areas, mobile service base stations are typically spread in a homogeneous fashion throughout a service area, sometimes as close as a few hundred metres in the type of situations where DCS 1800, for example, will be used. Out-of-band compatibility would be very difficult to achieve under these circumstances if transmit antenna height was not limited in the band used for base receivers.]

In-band interference - additional device boundary

4.2 The areas of high mobile use also need to be protected from in-band interference. Under the device boundary criteria in the s.145 determination, which is based on a high site low site propagation model, receivers operating at high sites in the lower band would normally need to be placed well within the boundary to achieve a reasonable level of protection from transmitters operating at high sites. This is unacceptable for receivers operated in areas of high mobile use because those areas have been made as small as possible in an effort to limit the impact of spectrum licensing on existing apparatus licensed services. Therefore, additional emission buffer zones are required outside areas of high mobile use, to allow base receivers operating in the lower band at high sites to be placed close to the boundary inside an area of high mobile use and still achieve a high level of protection. These additional emission buffer zones are created by an additional device boundary requirement (that is, in addition to that described in the s.145 determination and required under this advisory guideline) for both spectrum licensed and apparatus licensed transmitters operated outside the defined areas of high mobile use. However, to aid self-management, the additional emission buffer zones will only be required for a transmitter operating under a spectrum licence when it is operated by a licensee who does not also own the spectrum containing the particular area of high mobile use.

4.3 The additional device boundary requirement will be based on:

- the definition of areas of high mobile use;
- selection of an appropriate high site, high site propagation loss model; and
- notional base receiver parameters.

The device boundary criterion is set out in Schedule 1.

PART 5 - DESIGNING FOR BALANCED USE BY FIXED AND MOBILE SERVICES OUTSIDE AREAS OF HIGH MOBILE USE

5.1 Outside the defined areas of high mobile use, transmitters may be sited at any height both in the upper and the lower band. This has certain consequences for spectrum licensees.

In-band emission buffers along the geographic boundary

5.2 A licensee who wants to operate a receiver at a high site will have to either:

- place the receiver at a large distance inside the geographic boundary; or
- negotiate with the adjacent licensee not to place its transmitters near its geographic boundary in that particular area.

Out-of-band emission buffers along the frequency boundary

5.3 A licensee who wants to operate a receiver at a high site where transmitters in adjacent bands are likely to be operating may have to either:

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- provide guard bands and/or high performance filters at the edges of its spectrum; or
- negotiate with the adjacent licensee either:
 - (a) to employ transmit filtering; or
 - (b) to not place transmitters near the frequency boundary at that particular location.

Possible loss of spectrum utility

5.4 In regional areas, mobile base stations are usually located at the best vantage point for serving a country town. Sites are difficult to procure. Therefore, it is likely that both mobile and fixed services in regional areas will be in close proximity to each other, as they often are in urban areas now. Therefore, it is likely that a high level of negotiation could occur at sites that do not fall within the defined areas of high mobile use. There could be a proportionate loss of utility of that spectrum and consequently a reduction in its value.

5.5 For example, under the framework it is possible for two adjacent spectrum licensees to operate mobile services with dissimilar configurations, for example frequency domain duplex (FDD) frequency adjacent to a time domain duplex (TDD) service. This is a similar problem to that experienced at the old AMPS-GSM boundary where there was a loss of spectrum utility. TDD equipment is already available for these bands and more equipment will become available over the licence period of 15 years. A licensee who wants to operate DCS 1800 in a regional area needs to be aware that someone in an adjacent spectrum licence may wish to operate transmitters at high sites near the licensee's DCS 1800 base receivers. This would affect the value of the licence.

PART 6 - NEW APPARATUS LICENSED FIXED SERVICES

6.1 The additional device boundary criterion applies to apparatus licensed fixed transmitters in areas adjacent to areas of high mobile use whose licences are issued after the date of issue of the *Radiocommunications Spectrum Marketing Plan (800 MHz and 1.8 GHz Bands) 1998*. In addition, these services will be required to accept any in-band emission from a device operated under a spectrum licence if the device is operated in accordance with the conditions of the licence.

6.2. Re-tuning of any apparatus licensed fixed services out of spectrum designated for spectrum licensing after the date of issue of the *Radiocommunications Spectrum Marketing Plan (800 MHz and 1.8 GHz Bands) 1998*, is only possible if the retuned services comply with the additional device boundary criterion.

SCHEDULE 1 clause 4.3

ADDITIONAL DEVICE BOUNDARY CRITERION

The additional device boundary is calculated according to the distance that is necessary to satisfy the following device boundary criterion. This distance is measured along radials of a maximum length of 150 minutes (measured by reference to the Australian National Spheroid) at every 2.5 degrees of arc (beginning at 1.25 degrees from True North) and centred on the transmitter location. The additional device boundary criterion must be satisfied for each radial, at the point where the radial lies below the 48 metre elevation contour of RadDEM after entering an area of high mobile use (except the Canberra area of high mobile use where the 650 metre elevation contour is to be used), for each transmitter operating under either a spectrum or apparatus licence outside areas of high mobile use. However, this additional criterion does not have to be satisfied if:

- (a) the licensee owns a spectrum licence whose geographic area contains the entire area of high mobile use that is intersected by the radials and whose frequency band contains the effective occupied bandwidth of the transmitter; or
- (b) the licensee has an agreement with the licensee(s) of a spectrum licence whose geographic area contains the entire area of high mobile use that is intersected by the radials and whose frequency band contains the effective occupied bandwidth of the transmitter, to operate transmitters that do not comply with the additional device boundary criterion; or
- (c) in the case of a transmitter operating under an apparatus licence;
 - (i) the effective occupied bandwidth of the transmitter is completely outside the 1800 MHz lower band; or
 - (ii) the licence was issued before the date of issue of the *Radiocommunications Spectrum Marketing Plan (800 MHz and 1.8 GHz Bands) 1998*.

The device boundary criterion is:

$$(\text{HRP} - \text{Lb} - \text{CR}) \leq 0;$$

where HRP = Horizontally Radiated Power; and
Lb = Propagation Loss; and
CR = Compatibility Requirement for a notional receiver.

Calculation of Horizontally Radiated Power (HRP)

HRP (dBm EIRP per 30 kHz) is the horizontally radiated power for each radial. Note that there is a cap on HRP of 54.5 dBm EIRP per 30 kHz for transmitters operating under spectrum licences.

High Site-High Site Propagation Model (Lb)

The propagation loss for a high site-high site transmit-receive path (Lb) may be worked out in accordance with the general method for estimating diffraction loss described in ITU Recommendation P.526 using a path profile derived from the ACA's digital elevation model RadDEM and an effective earth radius factor of $4/3$, or some other appropriate method.

[Note: 1. The spherical earth (smooth earth) diffraction model is not applicable over most land paths because of the lack of a suitable reference plane for the two ends of the path.

2. For Rec. P.526-4:

- at equation (37b), d_{wv} should equal $(d_x + d_y)/2 - d_w$; and
- at equation (48), the empirical smoothing function is not stable for all values of 't' and is unnecessary in most practical situations; and
- cylinder loss is zero for any single-point obstruction; and
- the effective earth radius is 6364.963 km.]

The path profile may be obtained by calculating equi-spaced (in degrees) locations every 9 seconds along the radial from the transmitter site to RadDEM cell where the elevation is less than or equal to 48 metres immediately after entering an area of high mobile use (except the Canberra area of high mobile use where the elevation must be less than or equal to 650 metres), and reading the elevation of the RadDEM cell in which each calculated location occurs.

[Note: Path profiles may also be obtained by bi-linear interpolation]

The notional receiver antenna height above ground is 30 metres.

The procedure of Rec. P.526 for calculating propagation loss is unusually complex and licensees should exercise particular care when establishing whether a particular service might meet the compatibility requirements under these guidelines. Licensees would be well advised to, for example, confirm results calculated under the guidelines before taking any decisions in relation to proposed services.

Compatibility Requirement

The level of protection for notional receivers is -142.5 dBm/30 kHz.

This level of protection is based on:

- a receiver sensitivity of -106 dBm; and
- an antenna gain of 19 dBi; and
- a bandwidth conversion factor (250 kHz to 30 kHz) of 8.5 dB; and
- a feeder loss of 4 dB; and
- a combiner loss of 0 dB; and
- a protection ratio of 13 dB.

[Note: A bandwidth conversion factor of 8.5 dB was determined through measurement and enables the power level that would be measured in a 30 kHz rectangular bandwidth at the centre frequency to be derived with respect to the total GSM carrier power.]