Commonwealth of Australia

Radiocommunications Act 1992

Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 1800 MHz Band) 1999

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

Dated 3 November 1999.

A.J SHAW
Chairman

G.W LUTHER
Senior Executive Manger
Radiocommunications

Australian Communications Authority

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Clause

BACKGROUND

The Minister has designated parts of the 1800 MHz band for re-allocation by the issue of spectrum licences. Receivers of apparatus licensed and class licensed services currently operate in those frequency bands and in adjacent frequency bands. These receivers may suffer interference from unwanted emissions and blocking, caused by a spectrum licensed transmitter. Unwanted emissions are by-products of a transmitter's emissions and include broadband noise, harmonics, intermodulation products, transient signals and other spurious signals. Blocking occurs when a high level off-tune signal overloads a receiver's front-end and causes a degradation in the quality of the wanted output signal. Intermodulation products can be generated in-band in the input stages of receivers in the presence of 2 or more high level signals at the receiver input.

These guidelines have been made for the management of all these types of interference to apparatus licensed receivers operating in the following circumstances:

- Point to Point fixed services operating in and adjacent to the 1800 MHz spectrum licensed bands;
- Meteorological-Satellite Services operating in the band below 1710 MHz, adjacent to the 1.8 GHz spectrum licensed bands; and
- Cordless Telecommunications Services authorised by apparatus licences or class licences and operating in the band 1880-1900 MHz.

Spectrum licensees in the 1800 MHz band are able to implement any type of system, including mobile services, subject to meeting the required technical criteria. As radio waves propagate in different ways because of factors such as frequency, terrain, atmospheric conditions and topography, there are a number of ways to predict path loss, in addition to those discussed in RALI FX-3. Some suitable propagation models appropriate to the 1800 MHz bands and various system types are set out in the Schedule.

PART 1—INTRODUCTION

Title

1.1. These guidelines are called the *Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 1800 MHz 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 manage interference by providing for the protection of receivers of apparatus licensed or class-licensed services operating in or adjacent to the 1800 MHz band.

The ACA will take these guidelines into account in determining whether a spectrum licensed transmitter is causing interference to an apparatus licensed or class-licensed receiver operating in the circumstances set out in these guidelines. These guidelines do not prevent a licensee negotiating other protection requirements with another licensee.

Interpretation

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

designation, in relation to spectrum space, means a Declaration made under subsection 153B(1) of the *Radiocommunications Act 1992* (the Act)to subject parts of the spectrum in designated areas to re-allocation by the issue of spectrum licences.

in-band, in relation to a receiver operated under an apparatus licence, means frequencies within the frequency band of its spectrum access.

incumbent receiver, means a receiver that has part of the frequency band of its spectrum access, and its location, within a designation for the 1800 MHz band.

ITU means the International Telecommunication Union.

ITU Recommendation means a Recommendation made by the ITU.

RALI FX-3 means the Radiocommunications Assignment and Licensing Instruction No. FX-3 issued by the ACA, as in force from time to time, copies of which are available from the ACA.

RALI MS-25 means the Radiocommunications Assignment and Licensing Instruction No. MS-25 issued by the ACA, as in force from time to time, copies of which are available from the ACA.

1.8 GHz band means the frequency band 1.7 to 1.9095 GHz.

[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:
1800 MHz band]

Propagation models

1.5. The propagation models set out in the Schedule may be used to establish the protection requirements in Part 2 and Part 3.

Revocation

1.6. The *Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed Receivers - 1800 MHz Band) 1998* are revoked.

PART 2—POINT TO POINT FIXED SERVICE RECEIVERS

Background

2.1. The 1.8 GHz fixed service operates in the 1700 MHz to 1909.5 MHz band. The band supports use by low to medium capacity fixed point to point links in line with ITU Recommendation F-283. The band contains six main and six interleaved 14 MHz channels with a 119 MHz paired spacing. 14 MHz is the reference bandwidth for these services.
[NOTE: For more information on the band, see the 1.8 GHz section of RALI FX-3.]

2.2 The receivers of fixed services operating in the 1.8 GHz band, and in relation to interference caused by transmitters operating under spectrum licences, belong to one of the following categories:

Category (1) for an incumbent receiver; or

Category (2) for a receiver that is not an incumbent receiver and whose apparatus licence was issued before the date of issue of the *Radiocommunications Spectrum Marketing Plan (800 MHz and 1.8 GHz Bands) 1998*; or

Category (3) for a receiver that is not an incumbent receiver and whose apparatus licence was issued after the date of issue of the *Radiocommunications Spectrum Marketing Plan (800 MHz and 1.8 GHz Bands) 1998*.

2.3. Fixed services in the 1.8 GHz band are licensed in accordance with the frequency assignment criteria detailed in RALI FX-3. This RALI provides details about channel plans for individual microwave bands and guidance on interference criteria and frequency coordination between microwave links to achieve certain

performance objectives. Criteria are provided for each frequency band, with the basis for deriving the protection provided in other parts of the RALI (as referenced in each frequency band section). In bands that are shared with other services, e.g. fixed satellite and cordless systems, RALI FX-3 directs the reader to other relevant RALIs or guidelines for additional coordination criteria and advice. The criteria are usually based on internationally accepted ITU recommendations.

2.4. RALI FX-3 is subject to continuing review in consultation with industry, to incorporate improved assignment techniques and changing technology requirements. Particular account is taken of changes in ITU recommendations and standards made by other bodies. As revisions seek to improve spectrum access opportunities, without undue detriment to current licensees, users of the RALI are urged to consult the current version when planning systems, to increase spectrum productivity.

Protection requirements

2.5 The protection requirements for fixed services operating in the 1.8 GHz band are specified in the 1.8 GHz section of RALI FX-3. In planning for the operation of transmitters under a spectrum licence, spectrum licensees are to provide a level of out-of-band and in-band protection from those transmitters as would be provided from apparatus licensed fixed service transmitters whose frequencies are assigned in accordance with RALI FX-3.

For the categories of fixed service receivers listed in clause 2.2:

Category (1) receivers are to be provided with out-of-band and in-band protection from interference for the re-allocation period set out in the relevant Declaration made under subsection 153B(1) of the Act;

Category (2) receivers are to be provided with continuing out-of-band and in-band protection from interference for the full period of the spectrum licence; and

Category (3) receivers:
(a) are to be provided with out-of-band protection from interference caused by frequency adjacent transmitters that were registered after the issue date of the apparatus licence under which the receiver operates; and
(b) are required to accept levels of in-band emissions from a device operated under a spectrum licence, if the device is operated in accordance with the core conditions of the licence and the relevant s.145 determination under the Act of unacceptable levels of interference.

PART 3— METEOROLOGICAL SATELLITE (SPACE TO EARTH) SERVICE

Background

3.1. The Meteorological Satellite (Met-Sat) Service operates in the band below 1710 MHz and adjacent to the 1.8 GHz spectrum licensed band. Satellite earth stations use this band for the reception of data to assist in meteorological forecasting and other scientific purposes. The service uses both geo-stationary (GSO) and non geo-stationary (NGSO) satellite transmitters. The bands 1698-1710 MHz are typically utilised for NGSO purposes, with GSO operating below 1698 MHz (see ITU-R Recommendation SA.1158-1). Apparatus licensed earth stations of this service will require continuing protection from spectrum licensed services in the 1800 MHz band. As well as complying with spectrum licence conditions limiting out of band emission levels, the following interference criteria apply in meeting the protection requirements of the Met-Sat service.

Protection requirements

3.2. The protection requirements for Met-Sat service earth station receivers operating in the band below 1710 MHz are set out in the following ITU Recommendations:

- ITU Recommendation SA.1026-2: Interference Criteria for Space-to-Earth Data Transmission Systems Operating in the Earth Exploration-Satellite and Meteorological-Satellite Services Using Satellites in Low-Earth Orbit.
- ITU Recommendation SA.1160-1: Interference Criteria for Data Dissemination and Direct Data Readout Systems in the Earth Exploration-Satellite and Meteorological-Satellite Services Using Satellites in the Geostationary Orbit.

Additional Information on Meteorological Satellite Service Protection

3.3. The following ITU Recommendations are relevant to, and provide information on, the prediction of appropriate coordination distances, propagation models, threshold coordination levels, and earth station receiver and antenna characteristics, that may assist in assessing compliance with interference criteria:

- ITU Recommendation SA.1027-2: Sharing and Coordination Criteria for Space - to-Earth Data Transmission Systems Operating in the Earth Exploration -Satellite and Meteorological -Satellite Services Using Satellites in Low-Earth Orbit.
- ITU Recommendation SA.1161: Sharing and Coordination Criteria for Data Dissemination and Direct Data Readout Systems in the Earth Exploration -Satellite and Meteorological -Satellite Services Using Satellites in the Geostationary Orbit.
- ITU Recommendation SA.1158-1: Sharing of the 1675-1710 MHz Band Between the Meteorological -Satellite Service (Space-to-Earth) and the Mobile Satellite Service (Earth-to-Space).

- ITU Recommendation IS.849: Determination of the coordination area for earth stations operating with non-geo-stationary spacecraft in bands shared with terrestrial services.
- ITU Recommendation IS.847: Determination of the coordination area of an earth station operating with a geostationary space station and using the same frequency band as a system in a terrestrial service.

PART 4— CORDLESS TELECOMMUNICATIONS SERVICES

Background

4.1. Cordless Telecommunications Services (CTS) operate in the frequency band 1880-1990 MHz in accordance with the 1.9 GHz Band Plan[1]. This band is adjacent to the 1.8 GHz spectrum licensed band. Technologies which may operate in the band[2] are those complying with the Digital Enhanced Cordless Telecommunications (DECT) and the Japanese Personal Handyphone Service (PHS) standards[3]. Typical CTS applications, referred to as "private CTS" and for which radiocommunications licensing arrangements are established, include domestic and business telephones, wireless PABX and wireless local area networks. These CTS technologies may also be used for wireless local loop (WLL) applications, however at this time there are no WLL systems in operation and suitable licensing arrangements for these "public CTS" applications would need to be developed should demand for this service arise.

4.2 The following licensing arrangements apply to the operation of private CTS in the 1.9 GHz band:

Until 30 June 2001. All CTS base station operations must be authorised by apparatus licences. The issue of a licence is subject to successful frequency coordination with fixed service point-to-point link receivers operating in the same band (see Part 2 of this guideline for discussion of the fixed service). CTS handset and other terminal operation connected with an apparatus licensed base station is authorised by the class licence: *Radiocommunications Class Licence (Cordless Telecommunications Handsets and Other Radiocommunications Devices).* The licensing arrangements and frequency coordination procedure are described in the ACA RALI MS-25.

From 1 July 2001. Following extensive consultation with relevant industry stakeholders, the ACA has adopted a policy whereby apparatus licensing of private CTS base stations will not be required from this date. That is, fixed service receivers will no longer be protected from interference from CTS transmitters. Ongoing operation of all private CTS devices in this band will be authorised by a class licence. There will be no requirement for frequency coordination or location registration.

4.3. European studies show that a significant interference risk exists between uncoordinated DECT stations and the technology most likely to be used in the 1.8 GHz band, the DCS1800 (also called GSM1800) system. This risk is particularly high when the frequency separation between carriers of each technology is less than about 5 MHz. Following consultation with industry, the ACA has determined that the most effective way of ensuring reasonably equitable spectrum access for users of each band is to impose a limit on the allowable radiated power of spectrum licensed devices

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1 Gazetted 14 March 1996.

2 As at September 1999.

3 ACA Standards TS-028 and TS -034. The DECT standard supports operation over the entire 1880-1900 MHz band, whilst the PHS standard restricts operation to 1895-1900 MHz.

in the upper 2.5 MHz [4]segment of the 1.8 GHz band. This limit is specified in the *Radiocommunications (Unacceptable Levels of Interference - 1800 MHz Band) Determination 1999.*

Protection requirements

4.4. Provided that a spectrum licensee complies with the in-band emission limits specified in the *Radiocommunications (Unacceptable Levels of Interference - 1800 MHz Band) Determination 1999* and with all relevant core conditions of the spectrum licence, then unacceptable interference is taken not to be caused to any private CTS device.

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[4] 1875.5-1880 MHz.

SCHEDULE

Clause 1.5

PROPAGATION MODELS

Introduction

A number of propagation models have been developed to estimate the path loss between a transmitter and receiver. The choice of a particular propagation model will depend on a number of factors such as the terrain between the radio path end points, any obstructions on the path either natural or man-made, the heights of the transmit and receive antennas, and the limitations of applicability of the various propagation models.

ITU Recommendation P.1144 gives a guide on the applications of the various propagation methods developed internationally by the ITU. Table 1 is an extract of the 1995 issue of ITU Recommendation P.1144 and provides a summary of the ITU propagation models relevant to services operating in the 1800 MHz bands. The models provide an estimation of either path loss or received field strength.

Most models include statistical evaluation of path loss or signal levels expected at certain percentages of locations for certain percentages of times. Some propagation models produce a result that represents the median signal level. The median signal level corresponds to a level that is exceeded 50% of the time in 50% of locations. The median level is useful for estimating coverage. It is not suitable for interference calculations as interference for 50% of the time is generally considered unacceptable. Therefore, care must be taken when using propagation models to predict interference levels to ensure that the result represents the signal level exceeded for a sufficiently small percentage of locations for a sufficiently low percentage of time, as appropriate for the circumstance. Median signal levels may be converted to other time and location percentages (eg, 1% of the time and 10% of locations) by applying appropriate correction factors.

Propagation models

Propagation models can be classified into two different types; point-to-point and point-to-area.

Point-to-Point Models

Point-to-point models allow the prediction of path loss between a fixed transmitter and a fixed receiver. Two of the main propagation modes are:

- free space loss (line-of-sight); and
- diffraction loss including smooth earth diffraction and diffraction over obstacles and irregular terrain (knife-edge diffraction).

The free space loss propagation model is usually used where paths are line-of-sight and there are no obstructions within the first Fresnel zone for a given k-factor. This usually occurs with services located on high sites such as mountain tops, towers or buildings.

The diffraction loss propagation model is typically used where paths are obstructed by the earth's curvature or terrain. The model gives a loss due to diffraction which must be added to the free space loss to give the total path loss.

A plot of the terrain profile is usually generated to determine which propagation model is most appropriate to a particular propagation path.

Information on how to determine propagation losses due to free space and diffraction over a spherical earth, obstacles and irregular terrain can be found in ITU-R Recommendation P.526. Additional propagation loss due to effects such as tropospheric scatter, ducting, layer reflections and clutter can be found in ITU-R Recommendation P.452. The ITU has available a computer program to predict propagation loss in accordance with ITU-R Recommendation P.452.

Point-to-Area Models

Point-to-area models provide for the prediction of field strength levels in a geographic area from a base station transmitter. They are useful for estimating the coverage area of base stations in which receivers are to be protected from interference and to estimate interference to mobile receivers from other services. They are statistical in nature and usually based on the statistical analysis of measured data and take into account factors such as Raleigh fading, shadowing and clutter loss.

ITU-R Recommendation P.529 provides guidance on the prediction of field strength for the land mobile service in the VHF and UHF bands. It contains curves for predicting median field strengths for 50% of locations for 50% of the time under average conditions. It also provides various correction factors which can be used to refine the average predictions to take account of the terrain. The curves are based on measurements made by Okamura and Hata in Japan. They are normally applied to mobile applications where the base station antenna is high and the mobile antenna is low (typically 1.5 metres above ground). Correction factors can be applied to the curves to accommodate other percentages of time and percentages of locations.

Other point-to-area models such as those developed by Hata (Okumura) or Longley-Rice may also be appropriate as they include factors for clutter (buildings, trees etc) with low receive antenna heights. The Hata model also makes allowance for the difference in path losses between urban, suburban and rural areas. The Hata model was derived from experiments measuring signal levels of land mobile services in Japan, so care must be taken when applying it to Australian environments.

It should be noted that there are significant restrictions in the range of applicability of the Hata model as it is:

- limited to propagation paths up to 20 km in length; and

- limited in the range of valid antenna heights: the low antenna must be in the range 1 to 10 m; and the high antenna must be in the range 30 to 200 m. It should be noted that the Hata model does not take into account specific path variations, so the antenna heights used should be the effective height above the surrounding terrain and not solely the antenna height above ground level.

The Modified Hata model (ITU-R Report 567-4) extends the path length range to 100 km.

TABLE 1

ITU-R Propagation Prediction Methods for the 1800 MHz Frequency Bands

Method	Application	Type	Output	Frequency	Distance	% time	% location	Terminal height	Input data
Rec. ITU-R P.370	Broadcasting	Point-to-area	Field strength	30 MHz to 1000 MHz	10 to 1 000 km	1, 5, 10, 50	1 to 99	*Tx:* effective height from less than 0 m to greater than 1 200 m *Rx:* 1.5 to 40 m	Distance Tx antenna height Frequency Percentage time Rx antenna height Terrain clearance angle Terrain irregularity Percentage locations
Rec. ITU-R P.452	Services employing stations on the surface of the Earth; interference and coordination	Point-to-point	Path loss	700 MHz to 30 GHz	Not specified but up to and beyond the radio horizon	0.001 to 50 Average year and worst month	Not applicable	No limits specified	Path profile data Frequency Percentage time Tx antenna height Rx antenna height Latitude and longitude of Tx Latitude and longitude of Rx Meteorological data

Rec. ITU-R P.526	Fixed	Point-to-point	Field Strength	Not specified but generally >30 MHz	Not specified but up to and beyond the radio horizon	Not specified but dependent on k-factor chosen	Not applicable	No limits specified	Path profile data Frequency Tx antenna height Rx antenna height Latitude and longitude of Tx Latitude and longitude of Rx Meteorological data
Rec. ITU-R P.528	Aeronautical mobile	Point-to-area	Path loss	125 MHz to 15 GHz	0 to 1 800 km (For aeronautical applications 0 km horizontal distance does not mean 0 km path length)	5, 50, 95	Not applicable	H1: 15 m to 20 km H2: 1 to 20 km	Distance Transmitter height Frequency Receiver height Percentage time
Rec. ITU-R P.529	Land mobile	Point-to-area	Field strength	30 MHz to 3 GHz (Limited application above 1.5 GHz)	VHF: 10 to 600 km UHF: 1 to 100 km	VHF: 1, 10, 50 UHF: 50	Unspecified	Base: 20 m to 1 km Mobile: 1 to 10 m	Distance Base antenna height Frequency Mobile antenna height Percentage time Ground cover
Rec. ITU-R P.530	Line-of-sight Fixed links	Point-to-point Line-of-sight	Path loss Diversity improve-ment (clear air conditions) XPD	Approximately 150 MHz to 40 GHz	Up to 200 km	All percentages of time in clear-air conditions; 1 to 0.001 in precipitation conditions	Not applicable	High enough to ensure specified path clearance	Distance Transmitter height Frequency Receiver height Percentage time Path obstruction data Climate data
Rec. ITU-R P.617	Trans-horizon fixed links	Point-to-point	Path loss	>30 MHz	100 to 1 000 km	20, 50, 90, 99, and 99.9	Not applicable	No limits specified	Frequency Tx antenna gain Rx antenna gain Path geometry

Rec. ITU-R P.618	Fixed satellite	Point-to-point	Path loss. Diversity gain and (for precipitation condition) XPD	1 to 30 GHz	Any practical orbit height	0.001, 0.01, 0.1, and 1 (for both rain attenuation and XPD)	Not applicable	No limit	Meteorological data Frequency Elevation angle Height of earth station Separation and angle between earth station sites (for diversity gain) Antenna diameter and efficiency (for scin-tillation) Polarization angle (for XPD)
Rec. ITU-R P.620	Earth station frequency coordination	Coordination distance	Distance of which the required pro-pagation loss is achieved	1 to 40 GHz	100 to 1 200 km	0.001 to 1	Not applicable	No limits specified	Frequency Percentage of time Earth-station elevation angle
Rec. ITU-R P.681	Land mobile satellite	Point-to-point	Path fading Fade duration Non-fade duration	0.8 to 3 GHz	Any practical orbit height	Not applicable Percentage of distance travelled 1 to 20%	Not applicable	No limit	Frequency Elevation angle Percentage of distance travelled Approximate level of optical shadowing
Rec. ITU-R P.1146	Land mobile Broadcasting	Point-to-area	Field strength	1 to 3 GHz	1 to 500 km	1 to 99	1 to 99	Tx: ≥ = 1 m Rx: 1 to 30 m	Distance Frequency Tx antenna height Rx antenna height Percentage time Percentage location Terrain information