# Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 800 MHz Band) 2012

*Radiocommunications Act 1992*

The AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY makes these Advisory Guidelines under section 262 of the *Radiocommunications Act 1992*.

Dated 15 August 2012

Chris Chapman
[signed]
Member

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

Australian Communications and Media Authority

## 1 Name of Advisory Guidelines

These Advisory Guidelines are the *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 800 MHz Band) 2012*.

## 2 Commencement

These guidelines commence on 18 June 2013.

*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 Revocation

The *Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed Transmitters – 800 MHz Band) 1998* are revoked.

## 4 Purpose

The purpose of these guidelines is to manage in-band and out-of-band interference by providing for the protection of fixed radiocommunications receivers, operating under spectrum licences issued for the 800 MHz band, from interference caused by fixed radiocommunications transmitters operating in adjacent bands and adjacent areas under apparatus licences that are issued on or after 18 June 2013.

These guidelines should be used by operators of spectrum licensed services and apparatus licensed services in the planning of services or in the resolution of an interference case.

## 5 Interpretation

(1) In these guidelines, unless the contrary intention appears:

***800 MHz band*** means the frequency bands:
(a) 825 MHz - 845 MHz (the ***800 MHz Lower band***); and
(b) 870 MHz - 890 MHz (the ***800 MHz Upper band***).

***Act*** means the *Radiocommunications Act 1992*.

***adjacent channel*** means a channel with a centre frequency offset on either side of the assigned channel frequency of the occupied channel by a specific frequency relation.

***adjacent channel selectivity*** means a measure of the ability of the radiocommunications receiver to receive a wanted signal without exceeding a specified degradation in output quality due to the presence of an unwanted adjacent channel signal.

***blocking*** means a measure of the ability of a radiocommunications receiver to receive a wanted signal in the presence of a high level unwanted interferer on frequencies other than those of the adjacent channels.

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

***in-band*** means:

(a) for a radiocommunications transmitter or radiocommunications receiver operated under a spectrum licence, the frequencies within the frequency band in which operation of those radiocommunications devices is authorised under the licence; and

(b) for a radiocommunications transmitter or radiocommunications receiver operating under an apparatus licence, the frequencies within the lower frequency limit and the upper frequency limit specified in the licence.

***intermodulation response rejection*** means a measure of the ability of a radiocommunications receiver to receive a wanted signal in the presence of two or more unwanted signals with a specific amplitude and frequency relationship to the wanted signal frequency.

***out-of-band*** means:

(a) for a radiocommunications transmitter or radiocommunications receiver operated under a spectrum licence, the frequencies outside the frequency band in which operation of those radiocommunications devices is authorised under licence; and

(b) for a radiocommunications transmitter or radiocommunications receiver operating under an apparatus licence, the frequencies outside the lower frequency limit and upper frequency limit specified in thelicence.

***RALI FX 11*** means the Radiocommunications Assignment and Licensing Instruction No. FX 11 Studio to Transmitter Links and Sound Outside Broadcasting Services in the 900 MHz Band, published by the ACMA as in force from time to time.

*Note:* The RALI FX 11 can be accessed through the following link: http://www.acma.gov.au/WEB/STANDARD/pc=PC_2708.

***RALI LM 8*** means the Radiocommunications Assignment and Licensing Instruction No. LM 8 Frequency Assignment Requirements for the Land Mobile Service, published by the ACMA as in force from time to time.

*Note:* The RALI LM 8 can be accessed through the following link: http://www.acma.gov.au/WEB/STANDARD/pc=PC_2609.

***Section 145 Determination*** means the *Radiocommunications (Unacceptable Levels of Interference – 800 MHz Band) Determination 2012.*

***spectrum space*** means a 3 dimensional space consisting of a frequency band and a geographic area.

***SPP 2011-08*** means Spectrum Planning Report SPP 2011-08, published in June 2011 by the ACMA, titled 'Compatibility Evaluation between 800 MHz IMT Services and 900 MHz GSM Services' as in force on the day these guidelines commence.

*Note* Copies of this publication are available from the ACMA.

***spurious response immunity*** means a measure of the ability of a radiocommunications receiver to discriminate between the wanted signal and an unwanted signal at any frequency, outside the frequency band of the licence, to which the receiver responds.

***unwanted signal*** means all emissions from any radiocommunications transmitter which is not communicating with the radiocommunications receiver of a service protected by these guidelines.

***wanted signal*** means the radiofrequency emission from a radiocommunications transmitter designed for communication between the transmitter and the radiocommunications receiver of a service protected by these guidelines.

(2) Unless the contrary intention appears, terms used in these guidelines that are defined in the Section 145 Determination have the same meaning as in that determination:

*Note 1* The following terms that are used in these guidelines are defined in the Section 145 Determination:

- centre frequency
- device boundary
- device boundary criterion
- effective antenna height
- fixed receiver
- fixed transmitter
- geographic area
- mobile transmitter

*Note 2* The following terms used in these guidelines, are defined in the Act and unless the contrary intention appears, have the meanings given to them by the Act including:

- ACMA
- frequency band
- interference
- radiocommunications receiver
- radiocommunications transmitter
- Register
- spectrum licence



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## Part 1 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 provisions of the Act. These include:

- the core licence conditions that all spectrum licences are subject to (see section 66 of the Act), about:
  - emission limits outside the geographic area; and
  - emission limits outside the frequency band;
- the determination under subsection 145 (4) of the Act about what constitutes unacceptable levels of interference; and
- advisory guidelines made under section 262 of the Act, about managing interference in specific circumstances.

The following guidelines have been made to provide guidance on the management and resolution of cases of interference to radiocommunications receivers operating under spectrum licences in the 800 MHz band and caused by radiocommunications transmitters operating under apparatus licences.

## Part 2 Managing In-band and Out-of-Band Interference from Area Adjacent and Frequency Adjacent Services Respectively

### 2.1 In-band interference

(1) In-band interference to a radiocommunications receiver operating under a spectrum licence in the 800 MHz band caused by a radiocommunications transmitter operating under an adjacent spectrum licence is managed by the core licence conditions imposed on the spectrum licences under section 66 of the Act and by the device boundary criteria prescribed in the Section 145 Determination.

(2) In-band interference to a radiocommunications receiver operating under a spectrum licence in the 800 MHz band caused by a radiocommunications transmitter operating under an apparatus licence that is issued on or after 18 June 2013, is managed as if the transmitter is operated under a spectrum licence. The same device boundary criteria, as applied to spectrum licensed radiocommunications transmitters is also applied to new apparatus licensed radiocommunications transmitters. Therefore, spectrum licensed receivers are afforded the same level of in-band protection from new apparatus licensed radiocommunications transmitters as they are afforded from radiocommunications transmitters operated under adjacent spectrum licences.

(3) Application of the device boundary criteria manages in-band interference and these criteria incorporate emission limits that provide reasonable protection throughout the total geographic area of a licence. Emission limits are also used to manage out-of-band interference but these do not provide protection along the frequency boundaries of a spectrum licence throughout the entire geographic area. Because of the nature of out-of-band interference, emission limits cannot be used to provide protection from out-of-band interference for devices that are located near each other, for example, at multi-operator sites.

### 2.2 Out-of-band interference

(1) Out-of-band interference is difficult to predict because the levels and frequencies of unwanted emissions depend on both the nearness of, and the operating frequencies of, radiocommunications transmitters and radiocommunications receivers that are close in terms of both frequency and distance. In addition, out-of-band interference:



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(a) can extend for many MHz either side of the frequency boundary of a spectrum licence;
(b) is dependent on the quality of the radiocommunications receiver as well as the levels of radiocommunications transmitter emission; and
(c) is very difficult to model accurately.

Because out-of-band interference from unwanted intermodulation products, harmonic and parasitic signals and other spurious signals may extend for many MHz outside the licensed frequency band, it is possible for devices operating under non-adjacent spectrum licences to interfere with each other.

(2) If emission limits were used to manage out-of-band interference for devices in close proximity, the interference modelling inaccuracy would require large probability margins to be added to those limits. These margins would place severe constraints on use of the spectrum because the frequency boundaries of a licence extend throughout the entire geographic area of a licence. Therefore, emission limits that manage out-of-band interference throughout the entire geographic area of a spectrum licence cannot be used because they would lead to a severe loss of utility of the spectrum on both sides of the frequency boundary.

(3) Instead of making large tracts of spectrum space unusable through the imposition of emission limits, out-of-band interference is managed through interference management procedures based on a compatibility requirement for radiocommunications receivers. A minimum level of receiver performance has to be specified in conjunction with the compatibility requirement because the performance level of receivers:
(a) affects the level of interference; and
(b) varies widely for receivers operating under spectrum licences.

## 2.3 Recording radiocommunications receiver details in the Register

In these guidelines, for a radiocommunications receiver operated under a spectrum licence to be afforded protection from interference caused by an apparatus licensed radiocommunications transmitter, the details of the receiver must be on the Register before the date of issue of the apparatus licence under which the transmitter operates.

*Note* See Part 4 (Compatibility Requirement).

## 2.4 Mobile devices

The transient nature of mobile radiocommunications devices operating under either apparatus or spectrum licences makes it difficult to implement a practical interference management procedure through a compatibility requirement. Schedule

3 contains advice on the performance of 800 MHz mobile handsets and on mitigation of adjacent band interference. Specifically, it addresses the likelihood of interference from adjacent band (890 MHz – 915 MHz) Global System for Mobile communications (GSM) mobile transmitters to International Mobile Telecommunication (IMT) mobile radiocommunications receivers when operating within close proximities.

## Part 3 Minimum Level of Receiver Performance

### 3.1 Notional Receiver Performance

(1) The level of interference caused by out-of-band emissions depends on the interference susceptibility of a radiocommunications receiver. Emission levels from radiocommunications transmitters should not have to be reduced below a point where the performance of the receiver is the source of the problem.

(2) Therefore, it is necessary to establish a benchmark notional (minimum) receiver performance level for the radiocommunications receiver when setting a compatibility requirement for radiocommunications receivers. The recommended notional receiver performance level is set out in Schedule 1. A receiver must meet the notional level of performance to gain protection from interference from radiocommunications transmitters under these guidelines.



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## Part 4 Compatibility Requirement

### 4.1 Compatibility

(1) The licensee of a fixed radiocommunications transmitter operating under an apparatus licence should ensure that the transmitter meets the compatibility requirements in Schedule 2, in relation to a fixed receiver, if the receiver:

(a) has the notional level of performance set out in Schedule 1; and
(b) is registered in the Register before the date of issue of the apparatus licence under which the transmitter operates; and
(c) operates under a spectrum licence:
    (i) in the 800 MHz Lower band, with an effective antenna height (for any increment 1, $he_1(\phi_n)$) greater than 20 metres; or
    (ii) in the 800 MHz Upper band, with an effective antenna height (for any increment 1, $he_1(\phi_n)$) less than 10 metres.

*Note 1* The effective antenna height (in each increment 1, he1(ϕn)) for a receiver is calculated in accordance with the formula specified in the Section 145 Determination, as if the receiver is a transmitter.
*Note 2* The 20 and 10 metre effective antenna height limit is chosen to be consistent with common deployment practice.

### 4.2 Apparatus licensed services near the lower band

Spectrum licensed radiocommunications receivers operating in the 800 MHz Lower band have to contend with emissions from trunked mobile transmitters in the 820 - 825 MHz band, studio to transmitter links (STLs) and sound outside broadcast transmitters (SOBs) in the 845 - 852 MHz band. SOBs operate on a "no interference no protection" basis. See RALI FX11 and RALI LM8 for details of these services. Schedule 4 contains advice on reducing interference between STL/SOB radiocommunications transmitters and spectrum licensed receivers when operating in close proximity.

*Note* The phrase "no interference no protection" refers to a service operating on the basis that it does not cause interference to a primary service and will not receive protection from that service. SOB apparatus licences operating in the 845 - 852 MHz band are subject to a special licence condition that no interference shall be caused to any radiocommunications station nor service operating on a primary basis and no protection from such stations is able to be afforded.

### 4.3 Apparatus licensed services near the upper band

Spectrum licensed radiocommunications receivers operating in the 800 MHz Upper band have to contend with emissions from trunked base radiocommunications transmitters in the 865 - 870 MHz band and GSM mobile transmitters operating in the frequency band above 890 MHz.

## Schedule 1 Notional Receiver Performance Level

(section 3.1)

(1) The notional level of performance for a radiocommunications receiver operating under a spectrum licence issued for the 800 MHz band in relation to interfering signals from a radiocommunications transmitter operated under an apparatus licence is:

(a) an adjacent channel selectivity greater than or equal to the following relative figures for respective channel bandwidths:

| Channel Bandwidth | Relative ACS |
|---|---|
| ≤5 MHz | 50dB |
| >5 MHz | 48dB |

(b) an intermodulation response rejection greater than or equal to the following figures for frequency offsets between the edge of the wanted channel and the centre of the interfering intermodulation product bandwidth:

| Frequency Offset from Wanted Channel Edge to Centre Frequency of Intermodulation Product Bandwidth (MHz) | Intermodulation Performance Requirement (dB) |
|---|---|
| 2.5 MHz | 50dB |
| 7.5 MHz | 50dB |
| 12.5 MHz | 54dB |
| 17.5 MHz | 54dB |
| 27.5 MHz | 80dB |

(c) a receiver blocking level greater than or equal to the following figures for interfering signals in the frequency ranges set out below:

| Frequency range of interfering signals | Relative Blocking Requirements (dB) |
|---|---|
| 1 MHz to 805 MHz | 85dB |
| 805 MHz to 865 MHz | 60dB |
| 865 MHz to 12750 MHz | 85dB |

(d) a spurious response performance greater than or equal to 65dB.

(2) This level of performance is taken to be a notional level of performance with reference to a radiocommunications receiver sensitivity level of -101dBm measured within a 5 MHz rectangular bandwidth that is within the frequency band of the spectrum licence.

(3) A notional radiofrequency (RF) selectivity for the radiocommunications receiver (between the antenna and the antenna connector of the equipment) may be assumed to be at least equal to:

(a) $2 + 60 \cdot \log_{10}[1+(2 \cdot \text{FreqOffset}/5)^{1.5}]$ dB for FreqOffset ≤ 2.5 MHz;

(b) $2 + 60 \cdot \log_{10}[1+(2 \cdot \text{FreqOffset}/5)^{2}]$ dB for 2.5 < FreqOffset ≤ 9 MHz; and

(c) 70dB for FreqOffset > 9 MHz,

*where* "FreqOffset" is the smallest frequency difference between either the upper or lower limits of the frequency band of the spectrum licence under which the receiver operates and any frequency outside that frequency band.

(4) These performance parameters of the notional radiocommunications receiver are defined at the antenna connector port of the receiver unit, or in the case where additional devices such as filters or amplifiers are installed in the signal path ahead of the receiver, then the values are defined at the outer antenna connector port.

(5) The notional antenna for a radiocommunications receiver has a gain of 18dBi, a feeder loss of 3dB and a combiner loss of 2dB in all directions and is located at the phase centre of the actual antenna.

## Schedule 2 Compatibility Requirement

(section 4.1)

(1) The compatibility requirement for a fixed receiver, operating under a spectrum licence, to be provided by a radiocommunications transmitter operating under an apparatus licence is:

(a) a wanted to unwanted ratio of 24dB corresponding to a bit error rate of 0; and
(b) a minimum wanted signal level of -83dBm/5 MHz 001 for an annual availability of 99.99%.

(2) The minimum wanted signal level here is inclusive of a 1dB increase in the receiver noise floor. Logarithmic scaling should be used to find the appropriate level in alternative bandwidths.



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## Schedule 3 Managing Interference from 900 MHz Mobile Transmitters to 800 MHz Mobile Receivers

(section 2.4)

(1) At the 890 MHz frequency boundary 900 MHz mobile station radiocommunications transmitters may operate directly adjacent to 800 MHz mobile station radiocommunications receivers. When these devices are located in near proximity to each other there may be potential for receiver blocking interference to mobiles operating in the 800 MHz band. Investigations carried out by the 3GPP standards group, however, indicate that where the adjacent channel interference ratio (ACIR) between the stations is maintained at 30dB, then only marginal reductions in network capacity can be expected. For non-synchronised operation of adjacent mobiles, such that the transmit time of the 900 MHz mobile coincides with the receive time of the 800 MHz receiver, the relative capacity reduction (for receivers) is slightly greater than 2%. These results indicate that there is not expected to be significant disruption to adjacent mobile services operating in the 800 MHz band. Further information outlining the relevance of these studies to the 800 MHz band is contained in the SPP Report 2011-08. Full results of the study are contained within '*3GPP Report TR 25.942 Radio Frequency System Scenarios'* published by the 3GPP standards organisation.

*Note* Copies of the 3GPP report can be obtained through the 3GPP standards organisation website: http://www.3gpp.org.

(2) In order to reduce the probability of mobile station to mobile station interference, licensees should ensure that mobile handsets adhere to industry technology standards. In cases where mobile to mobile interference becomes problematic, then licensees may consider the following mitigation options for resolution of this interference:

(a) Conduct frequency planning to avoid use of the immediately adjacent channels at the 890 MHz frequency boundary within the same area. This option is likely to be feasible for GSM services operating on narrowband channels which provide more flexibility for tuning to another channel further from the frequency boundary.

(b) Use of power control within the network such that mobile handsets only operate at maximum power when absolutely necessary. Higher powered 900 MHz GSM mobile transmitters, rather than IMT mobile transmitters, are more likely to be the cause of interference to 800 MHz mobile radiocommunications receivers.

(3) Licensees operating services in the 800 MHz and 900 MHz bands may negotiate and seek to resolve cases of interference between themselves.

## Schedule 4 Managing Interference from Studio Transmitter Links and Sound Outside Broadcast Links to 800MHz Spectrum Licensed Receivers

(section 4.2)

(1) Studio Transmitter Links (STLs) and Sound Outside Broadcast (SOBs) links operate in the 845 - 852 MHz band segment adjacent to 800 MHz spectrum licensed radiocommunications receivers. These STL/SOB services are apparatus licensed and coordinated in accordance with RALI FX 11.

(2) ACMA studies indicate that there may be potential for interference from out-of-band emissions from STL/SOB radiocommunications transmitters to 800 MHz spectrum licensed radiocommunications receivers when they are operated within close proximity. In order to reduce the likelihood of this occurrence, licensees operating STL/SOB transmitters should ensure that:

(a) the Compatibility Requirement set out in section 4.1 is met for a spectrum licensed receiver;
(b) the characteristics and parameters of their STL/SOB system conform to the limits specified in RALI FX 11;
(c) the assignment priority set out in RALI FX 11 is followed in conducting frequency coordination and licensing; and
(d) the recommendations regarding assignments of wideband channels described in RALI FX 11 are followed.

(3) In situations where interference is caused to an 800 MHz spectrum licensed radiocommunications receiver due to out-of-band emissions from an STL/SOB radiocommunications transmitter, the licensee of the latter service may, for example, resolve the situation by installing transmit side filtering to reduce these emissions and manage the interference.

*Note* A 'no interference no protection' licence condition applies to SOB fixed links operating in the 845 - 852 MHz band.