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| Technical Liaison Group  Discussion Paper #3 Review of the 800MHz Technical FrameworkChanges to the Radiocommunications Advisory Guidelines for the 800MHz Band. |
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Review of the 800MHz Technical Framework 1

Changes to the Radiocommunications Advisory Guidelines for the 800MHz Band. 1

1. Introduction 1

2. Reference Technologies 4

3. Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed Receivers – 800MHz Band) – 1998. 5

Summary: 5

Interpretation 7

Part 2 – Trunked Land-Mobile Receiver 8

Part 3 – Narrowband Point-to-Point Fixed Service Receivers 9

Part – 4 Wideband PP Receivers 9

Part 5 – Studio Transmitter Link Receivers and Sound Outside Broadcast Link Receivers 10

Part 6 – GSM Base Station Receivers 10

Part 7 – AMPS Base and Mobile Receivers 12

Part 8 – Use of Mobile Communications Systems On-Board Aircraft (MCA) 13

Schedule - Propagation Models 17

4. Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed Transmitters – 800MHz Band) – 1998. 18

Part 2 - Managing In-Band and Out-of-Band Interference from Area Adjacent and Frequency Adjacent Services Respectively 18

Part 3 – Minimum Level of Receiver Performance 19

Part 4 – Compatibility Requirement 19

Schedule 1: Notional Base Station Receiver Performance Level 20

Adjacent Channel Selectivity and RF Selectivity 20

Receiver Intermodulation Requirements 22

Receiver Blocking Levels 23

Notional Antenna and Feeder/Branching Combination. 24

Schedule 2: Base Receive Compatibility Requirement 25

Schedule 3 : Managing Interference from 900MHz Mobile Transmitters to 800MHz Mobile Receivers 26

Schedule 4 : Managing Interference from Studio Transmitter Links and Sound Outside Broadcast Links to 800MHz Spectrum Licensed Base Receivers 27

Final Comment from Technical Liaison Group Participants 28

5. References 29

# Introduction

Spectrum licences in the 825-845 / 870-890 MHz (800MHz) band are due to reach their expiry on 17th June 2013. In order to prepare for potential re-issue of spectrum licences in the band a review of the 800MHz technical framework conditions is being conducted to meet the objectives:

* To ensure technology flexibility so that a range of modern technologies can be used in the band, with a particular focus on International Mobile Telecommunications (IMT) technologies.
* Provide conditions that enable continued usage of existing network technologies in the band.
* Provide interference management within the 800MHz band and in adjacent bands.
* To address deficiencies that have come to light during the previous licence period.

The Spectrum Licensing Technical framework in the 800MHz band consists of the following components based on Sections within the Radiocommunications Act (RA).

**Core Conditions (in accordance with RA S66) –** including Out-of-Band Non-spurious emission limits, Spurious emission limits and an out of area radiated power limit. These core conditions perform the function of managing interference from spectrum licensed transmitters into adjacent frequency bands and adjacent geographical areas.

**Radiocommunications (Unacceptable Levels of Interference – 800MHz Band) Determination 1998 (in accordance with RA S145)** - consisting of instruction on the registration of spectrum licensed devices through a device boundary criteria calculated around a transmitter or receiver. The device boundary criterion is used to ensure that devices operating under a spectrum licence are contained within the boundary of the spectrum licence and to avoid co-frequency interference to receivers in an adjacent area.

**Radiocommunications Advisory Guidelines (in accordance with RA 262),** for the purpose of:

* Managing interference from spectrum licensed transmitters into adjacent apparatus licensed receivers.
* Managing interference from apparatus licensed transmitters in adjacent frequency bands or adjacent geographic areas.
* Providing information for use by apparatus and spectrum licensees who may need to coordinate with registered spectrum-licensed receivers.

This discussion paper outlines changes recommended to the Radiocommunications Advisory Guidelines (RAGs) of the 800MHz Spectrum Licensing Technical Framework.

The table below supplies a summary of the proposed changes to the elements of the 800MHz band spectrum licence technical framework covered by this paper. The final section of the paper presents a number of discussion points upon which ACMA seeks comment from members of the Technical Liaison Group.

|  |  |
| --- | --- |
| **Technical Framework Element** | **Proposed Changes** |
| Radiocommunications Advisory Guidelines (Protection of Apparatus Licensed Receivers – 800MHz Band) 1998. | For the RAG Protection of Apparatus Licensed Receivers:  Retain the criteria for Trunked Land Mobile   * Remove the section on Narrowband Point to Point Fixed Services * Remove the section on Wideband Point to Point Receivers * Retain the section on Studio Transmitter Links / Sound Outside Broadcast (STL/SOB) with no changes to protection criteria. * Changes to the criteria for GSM Base Station Receivers * Remove the section on AMPS; shift in focus away from this older technology.   Update the Schedule on Propagation methods to be applied. Some additional comment is included; in performing interference calculations in accordance with the RAGs licensees may implement a suitable Digital Elevation Model (DEM) to ensure the accuracy of these calculations.  New advisory conditions for operation of Mobile Communications On-board Aircraft (MCA) systems under spectrum licences or under a third party agreement with an affected spectrum licensee. |
| Radiocommunications Advisory Guidelines (Managing Interference from Apparatus Licensed Transmitters – 800MHz Band) 1998. | For the RAG Managing Interference from Apparatus Licensed Transmitters:  Re-definition of the Notional Receiver Performance Level, including;   * Adjacent Channel Selectivity, * Receiver Intermodulation Requirements, * Receiver Blocking Levels, * Notional Antenna and Feeder Loss Combinations, * Retention of the existing RF selectivity, * Retention of the existing Spurious Rejection Response.   Re-definition of the Compatibility Requirement.  Inclusion of advisory notes on the management of interference from 900MHz mobile transmitters to 800MHz mobile receivers.  New advisory notes regarding management of interference from Studio Transmitter Links and Sound Outside Broadcast Links to 800MHz Spectrum Licensed Base Receivers. |

Table A.

# Reference Technologies

The development of revised technical framework conditions has been based on those technologies considered to be likely candidates for licensing and deployment in the 800MHz band. These technologies include:

|  |  |
| --- | --- |
| Technology | Reference Specifications |
| LTE and LTE-Advanced (E-UTRA) | 36.104, 36.101, 36.106, 36.942, 25.814, ITU-R M.1580, ITU-R M.1581. |
| WCDMA, HSDPA/HSUPA, HSPA, HSPA Evolution (UTRA) | 25.104, 25.101, 25.106, 25.201, 36.942, ITU-R Rec M.1580, ITU-R Rec M.1581. |
| CDMA2000, CDMA Multi-Carrier, CDMA HRPD | ITU-R Rep M.2039, ITU-R Rec M.1580, ITU-R Rec M.1581. 3GPP2 specifications. |

Table B.

The main characteristics for each of the technology types listed here are described in the 800MHz Technical Liaison Group Discussion Paper #1 as released on the TLG share-point site. These characteristics have been used in the derivation of revised conditions in the 800MHz Spectrum Licensing Technical Framework.

# Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed Receivers – 800MHz Band) – 1998.

## Summary:

The Radiocommunications Advisory Guidelines (Protection of Apparatus-Licensed Receivers – 800MHz Band) 1998 (AL RAG) outline the requirements on spectrum licensed transmitters for the protection of apparatus licensed receivers that operate adjacent to the spectrum licensed bands or areas.

The existing guidelines provide coordination and interference management conditions for each of the services which operate within both the 800MHz spectrum licensed bands and the adjacent apparatus licensed bands. Those apparatus licensed services operating within 800MHz spectrum licensed bands have now mostly been re-located from these bands in accordance with the re-allocation timeframes of the Re-allocation Declarations. The existing guidelines provide direction for protection of apparatus licensed receivers of each of the following services.

* Trunked Land-Mobile Base Station Receivers operating in the range 820-825MHz in accordance with RALI LM-08.
* Trunked Land-Mobile Mobile Receivers operating in the range 865-870MHz in accordance with RALI LM-08.
* Narrowband Fixed Point-to-Point Service in the bands 830-831MHz and 875-876MHz. A service affected by the Re-allocation Declarations and their relocation timeframes.
* Wideband Fixed Point-to-Point Service in the bands 835-845MHz and 880-890MHz. A service affected by the Re-allocation Declarations and their relocation timeframes.
* Studio Transmitter Link Receivers and Sound Outside Broadcast Link Receivers (STL & SOB) operating in the range 845-852MHz.
* GSM Base Receivers operating in the 890-915MHz band under PMTS apparatus licences.
* AMPS Base receivers previously operating in the 825-845MHz band and AMPS Mobile receivers previously operating in the 870-890MHz band. (AMPS services were progressively shutdown in these bands prior to 1st January 2000.)

Changes are required of the AL RAG to update it for use throughout the new spectrum licensing period. The types of changes are generalised below and then described in detail throughout this section.

* Modification to the Interpretation section including editorial changes, definition changes and changes to referenced technology specifications and documents. These are not discussed in detail in this document but can be viewed in the draft AL RAG.
* A modernisation of the guidelines through a shift in emphasis away from older technologies that formed the basis of derivation of the current technical framework (i.e. AMPS) to newer technologies now used under spectrum licences or that are likely to be used in the future. (i.e. IMT).
* Removal of those sections that relate to apparatus licensed services that are no longer operational in the 800MHz spectrum licensed bands.
* Changes to protection criteria for receivers of particular services.

## Interpretation

A number of reference standards and specifications have changed following the update of technology usage in the 800MHz band and in adjacent apparatus licensed bands.

The ETSI GSM specification;

*GSM 05.05 means the European Telecommunications Standards Institute ETSI Specification ETS 300 577 – GSM 05.05 “Digital Cellular Telecommunications System (Phase 2): Radio Transmission and Reception” as issued from time to time.*

is replaced with the current version:

*3GPP 45.005 V9.3.0, 3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Radio Transmission and Reception (Release 9), May 2010.*

The Spectrum Planning Report;

*SPP 2/1997 Spectrum Planning Report published in April 1998 by the SMA, titled “Compatibility Assessment – 800MHz AMPS Spectrum Adjacent to GSM Spectrum”,*

is revised considering usage of the 800MHz band by IMT services and replaced with:

*SPP 2011-08 Spectrum Planning Report published June 2011 by the ACMA, titled “Compatibility Evaluation between 800MHz IMT Services and 900MHz GSM Services” made available in conjunction with 800MHz Technical Framework Radiocommunications Advisory Guidelines.*

Spectrum planning reports detailing protection requirements for previously in-band allocations to fixed links are removed from the RAGs following their expiry in accordance with re-allocation timeframes.

*SPP Report 3/86 Guidelines for the Assignment of Frequencies to Two Frequency Single Channel Fixed Services in the 400 and 900MHz Bands, Transmission Policy and Spectrum Planning Branch, Communications Technology Division, October 1989.*

*SPP Report 5/93 Frequency Assignment Procedures for Fixed Service Wideband Links in the 820-960MHz Band, Radiocommunications Policy Branch, Radiocommunications Division, March 1993.*

The AMPS subscriber and land station specifications are considered not valid in the 800MHz band due to the expiry of allocations to these services under the Spectrum Re-allocations Declarations 1997 and 2000. References to these specifications are removed.

*Standard EIA/IS 19-B meaning the USA Electronic Industries Association Interim Standard IS-19-B, titled “Recommended Minimum Standards for 800MHz Cellular Subscriber Units”, published in May 1988.*

*Standard EIA/IS 20-A meaning the USA Electronic Industries Association Interim Standard IS-20-A, titled “Recommended Minimum Standards for 800MHz Cellular Land Stations”, published in May 1988.*

***It is proposed that editorial modifications be made to the AL RAG for various reasons including the update of technology specification references, update of the revised Compatibility Evaluation Study reference and deletion of the remaining obsolete references.***

## Part 2 – Trunked Land-Mobile Receiver

Trunked Land Mobile services operate under apparatus licences in spectrum immediately adjacent to the 800MHz spectrum licensed bands. Land mobile base receivers operate in the lower band segments at 820-825MHz whilst mobile receivers operate in the lower band segment at 865-870MHz.

Land mobile receivers are protected in accordance with the criteria of RALI LM-08. Protection is based on the following parameters:

* A wanted to unwanted level at the receiver input.
* A receiver blocking level at the receiver input.
* An unwanted signal level at the receiver input in any trunked channel that does not exceed the adjacent channel power requirement.
* A receiver IF bandwidth as specified in LM-08.
* A base station antenna performance as specified in LM-08.
* A base station receiver RF selectivity filter performance defined in the RALI LM-08.

The continued operation of the Trunked Land-Mobile service in these bands means the coordination and protection criteria described in the AL RAG and referencing RALI LM-08 must be retained.

***It is proposed that this section of the AL RAG regarding Trunked Land-Mobile Receivers remain unchanged.***

## Part 3 – Narrowband Point-to-Point Fixed Service Receivers

Narrowband point to point fixed links that previously operated in the in the band segments 830-831MHz and 875-876MHz under apparatus licences in accordance with the provisions of the *Radiocommunications 900MHz Band Plan* 1992. There are currently no assignments to fixed links in these bands in the Register of Radiocommunications Licences (RRL) and no new assignments may be made to the service. On this basis it is recommended that the requirement to coordinate with Narrowband fixed links and the reference to the protection requirements of SPP Report 3/86 be removed from the AL RAG.

***It is proposed that the requirement to coordinate with existing Narrowband point-to-point fixed links and the reference to protection requirements of SPP Report 3/86 be removed from the AL RAG.***

## Part – 4 Wideband PP Receivers

Wideband point to point fixed links previously operated in the band segments 835-845MHz and 880-890MHz under apparatus licences in accordance with the *Radiocommunications 900MHz Band Plan 1992*. These band segments were allocated to spectrum licensing only in accordance with *Spectrum Re-allocation Declaration No.1 of 1997* such that these apparatus licensing links were required to vacate the band by the re-allocation deadline. There are currently no assignments in the RRL to fixed links operating under apparatus licences in these band segments.

Wideband fixed links may still be operated in these band segments upon relocation from another portion of the 900MHz Band Plan provided they meet the conditions of the 800MHz Spectrum Licensing Technical Framework.

On this basis it is recommended that the requirement to coordinate with Wideband fixed links and the reference to the protection requirements of SPP Report 5/95 be removed from AL RAG.

***It is proposed that the requirement to coordinate with Wideband point to point fixed links and the reference to the protection requirements of SPP Report 5/95 be removed from the AL RAG.***

## Part 5 – Studio Transmitter Link Receivers and Sound Outside Broadcast Link Receivers

Studio Transmitter Links (STL) and Sound Outside Broadcast (SOB) Links operating in the 845-852MHz band are a combination of digital and analogue services set up as one-way single frequency fixed links. The bandwidths for these services vary from 60kHz to 400kHz. STL and SOB services share the frequency ranges 845-846.5MHz and 850.5-852MHz on a co-primary basis, whilst SOB services are a secondary allocation in the 846.5-850.5MHz frequency range.

STL receivers are protected in accordance with RALI FX-11. SOB receivers operate on a no interference - no protection basis. There are no changes proposed to the coordination and protection arrangements for STL’s and SOB’s in regards to the re-issue of 800MHz spectrum licenses and future use of new technologies.

***It is proposed that the existing protection requirements for the Fixed Service for Studio Transmitters Link and Sound Outside Broadcast (STL/SOB) be retained in the AL RAG.***

## Part 6 – GSM Base Station Receivers

The protection of apparatus licensed GSM services in the 900MHz band remains an ongoing requirement with their continued usage of this band conforming to the standard FDD arrangement of base receive in the 890-915MHz segment and base transmit in the 935-960MHz segment.

In the Protection Requirements section the following changes are planned.

***Protection Requirements – Required C/I Level***

It is recommended that the GSM receivers be protected to a carrier to interference (C/I) level of 9dB for co-channel scenarios in accordance with the GSM specification 3GPP TS 45.005. The wanted to unwanted signal ratio arriving at the GSM receiver should meet this C/I level. This is a change from the previous C/I ratio of 13dB.

***Protection Requirements – Base station receiver IF bandwidth***

It is recommended that the base station receiver IF bandwidth is updated from 250kHz between the 3dB attenuation points as quoted in the Compatibility Study to that of 200kHz representing the necessary bandwidth.

***Protection Requirements – Minimum Receiver Threshold.***

It is recommended that the minimum wanted signal at the GSM receiver be updated to -104dBm per channel in accordance with the GSM receiver protection requirements of the current specification 3GPP TS 45.005. This is an adjustment to the previous minimum signal level of -106dBm per channel.

***Additional Information on GSM Protection Requirements***

There are proposed changes to the text of this section of the RAGs entitled “*Additional Information on GSM Protection Requirements*”. Emphasis in this section changes from AMPS usage of the 800MHz band to IMT usage of the band and the modified coordination arrangements ensuring interference management between the services are described in a revised compatibility study SPP Report 2011-08 (which replaces SPP Report 2/1997).

The requirement to implement filtering on 800MHz base transmitters and 900MHz base receivers is retained. The objective of this filtering is to reduce potential interference to apparatus licensed GSM base stations from out-of-band emissions, receiver blocking and intermodulation product type mechanisms. This is particularly the case where 800MHz base transmitters are co-sited with 900MHz base receivers.

It is planned that the text of the AL RAG under this section be replaced with this paragraph.

*6.1. The previous usage of the 800MHz band by AMPS has now concluded. These services were progressively phased-out of the band by 1st January 2000 - excepting rural areas where there was continued usage for a period up until the final re-location timeframes of the Spectrum Re-Allocation Declaration #3 of 2000.*

*6.2. GSM services commenced operation in the adjacent band 890-915MHz paired with 935-960MHz (900MHz) in 1995. The resulting frequency duplex division (FDD) arrangement between the bands here is atypical for spectrum management practices in that the 800MHz base transmit sector (870-890MHz) is directly adjacent to the 900MHz base receive sector (890-915MHz). This situation reflects the government requirements at the time to ensure competition between telecommunications services and the constraints presented by frequency arrangements set by regional standards making bodies.*

*6.3. The spectrum licensing technical framework in 800MHz has now been updated to allow for the usage of modern digital cellular technologies in the band; in particular it is considered that the class of IMT technologies are likely to be used in this band. For this purpose, a new Compatibility Evaluation Report (SPP 2011-08) addresses the protection requirements for GSM apparatus licensed receivers from adjacent band IMT spectrum licensed transmitters. This report covers the out-of-band emission limits at the 890MHz band edge and isolation requirements to prevent interference due to receiver blocking and intermodulation products.*

*6.4. A feature of the previous framework was that filters were fitted at many sites to 800MHz base transmitters and GSM base receivers in addition to those used in normal system configurations. This was necessary to minimise the likelihood of interference to GSM and thus optimise the use of these bands for both technologies. This requirement was critical at the actual frequency boundary of 890MHz between the bands, but also implemented in other parts of the GSM bands on an as required basis by licensees. Previously, there has been a requirement to implement filters at locations where 800MHz transmitters and 900MHz receivers were co-sited. An example characteristic of an additional GSM receiver RF filter fitted at co-located sites is described in SPP 2011-08, or alternatively specific characteristics may be obtained from GSM licensees.*

*6.5. Similarly, the implementation of filters will be necessary for modern usage of the 800MHz and 900MHz bands to ensure optimal usage and to minimise potential interference. These conditions will facilitate the ongoing deployment of IMT technologies in the 800MHz band as well as GSM and IMT technologies in the 900MHz band. It is also noted that some operators have already deployed IMT systems in the 900 MHz band and it is anticipated that the remaining GSM services may be migrated to IMT technologies in the future. It is expected that licensees in both bands will find it difficult to deploy equipment without interference to adjacent band systems within several kilometres, unless additional high performance filtering and appropriate network planning is employed, in the same way as previously done in the AMPS/GSM solution. The filters already in place on GSM systems can assist in this regard. Negotiation between affected parties is seen as essential to optimising spectrum utility and access at the 890MHz boundary situation.*

***It is proposed that the following changes be made to the protection requirements of GSM base receivers;***

***C/I ratio of 9dB.***

***IF bandwidth of 200kHz.***

***Minimum received wanted level of -104dBm/channel.***

***It is further proposed that the above editorial changes be made to the AL RAG.***

## Part 7 – AMPS Base and Mobile Receivers

The 800MHz band was historically used by the analogue AMPS cellular service up until re-allocation to spectrum licensing under the Spectrum Re-allocation Declaration No.1 of 1997, Spectrum Re-allocation Declaration No.2 of 1997 and Radiocommunications (Spectrum Re-allocation) Declaration No.3 of 2000. AMPS no longer operates in the 800 MHz band and has subsequently been replaced by IMT services.

As a result, the previous protection requirements for incumbent AMPS base and mobile receivers do not apply under the current 800MHz spectrum licensing technical framework.

***It is proposed the section detailing background information on AMPS usage in the 800MHz band and the protection requirements for AMPS Base and Mobile Receivers be deleted from the AL RAG.***

## Part 8 – Use of Mobile Communications Systems On-Board Aircraft (MCA)

Recent years has seen increased interest and growing demand for the use of mobile communications on-board aircraft (MCA). These systems are expected to provide enhanced customer experiences and greater connectivity when travelling on international and domestic flights. In Australia the first trial of these devices was conducted in 2007 by Aeromobile on a single Qantas operated passenger aircraft over flights paths within Australia. The trial tested SMS and GPRS functionality with positive results and with no reports of interference received.

MCA systems comprise of two main transmitting components.

* The base station (BTS) transmitter which is typically a low powered pico-cell connected to a leaky cable antenna system run through the passenger cabin of the aircraft.
* The system controller being either a CRFMU (Cell-phone Radio Frequency Management Unit) or NCU (Network Control Unit), which transmits a broadband noise signal in PCS bands designed to mask reception of terrestrial mobile networks within the aircraft. Again this is a low powered signal transmitted over a leaky cable antenna system run throughout the passenger cabin of the aircraft. The transmission of this signal is designed to control mobile terminals on-board the aircraft such that they cannot connect to the terrestrial network, may only connect to the on-board BTS and only operate at low power, thereby minimising interference to terrestrial mobile communications networks.

The ACMA has seen it fit to develop licensing arrangements for the operation of MCA systems which aim to provide interference management for the protection of terrestrial radiocommunications networks.

The operation of an MCA system may be authorised through either of the following licensing arrangements.

* In apparatus licensed frequency bands and geographic areas through the new PMTS Class C licence announced by ACMA in 2010. Use of mobile handsets and UE devices on aircraft in conjunction with an apparatus licensed MCA system are authorised under the amended Radiocommunications (Cellular Mobile Telecommunications Devices) Class Licence (2002) which states that these mobile devices may only be used above the height restriction specified in the PMTS Class C apparatus licence.
* In spectrum licensed frequency bands and geographic areas either directly under the corresponding spectrum licence or through a third party agreement with the affected spectrum licensee. Where the MCA system is operated by the licensee it must adhere to the existing core conditions of the spectrum licence. Where the MCA system is operated by a third party, it is the spectrum licensee’s responsibility to ensure that its operation is in accordance with the core conditions of the spectrum licence. Third party agreements must be obtained for both BTS and CRFMU/NCU transmitters in each spectrum-licensed band of operation. Under current spectrum licensing arrangements, licensees/operators providing a mobile telephone service must authorise each mobile handset or UE device that operates in their spectrum space.

It is recommended that operators of MCA systems in spectrum-licensed bands also adhere to the same specific conditions of the PMTS Class C licence. These conditions were specifically developed for the protection of terrestrial receivers from airborne MCA transmitters and are designed to ensure the protection of spectrum-licensed receivers in PTS bands and apparatus-licensed receivers in the adjoining bands. For this purpose, it is recommended that these conditions are to be placed into the Radiocommunications Advisory Guidelines. The conditions are as follows:

***Frequencies of Operation***

Operation of the CRFMU/NCU unit is limited to these frequency ranges:

* 870-890MHz
* 935-960MHz
* 1805-1880MHz
* 2110-2170MHz

Operation of the BTS unit is limited to these frequency ranges:

* 1710-1785MHz
* 1805-1880MHz

***Height Restriction***

The licensee must not operate a station below a height of 5000m above ground level.

***Emission Limits***

CRFMU

Emissions from the CRFMU shall not exceed the following power levels, measured in a 30kHz bandwidth, at any point outside the aircraft;

-20.6dBm within the frequency range 870-890MHz,

-25dBm within the frequency range 935-960MHz,

-20dBm within the frequency range 1805-1880MHz,

-20dBm within the frequency range 2110-2170MHz.

BTS

Emissions from the BTS shall not exceed -12dBm, measured within a 30kHz bandwidth at any point outside the aircraft.

Mobile stations connected to the BTS shall be controlled to operate at a power control level of 15 (nominal output power 0dBm), as specified for DCS1800 in part 4.1.1 of specification 3GPP TS 45.005.

***Out-of-Band Emission Limits***

Out of band emission power levels of the CRFMU in a frequency band shall be attenuated, relative to the maximum power level of the CRFMU in the frequency band, by the corresponding minimum values:

* 870-890MHz operating range – A minimum attenuation of 6dB, 25dB and 45dB at offsets greater than 1.6MHz, 5MHz and 40MHz respectively from the operating range;
* 935-960MHz operating range – A minimum attenuation of 6dB, 25dB and 45dB at offsets greater than 2MHz, 6.25MHz and 50MHz respectively from the operating range;
* 1805-1880MHz operating range – A minimum attenuation of 6dB, 25dB and 45dB at offsets greater than 6MHz, 18.75MHz and 50MHz respectively from the operating range;
* 2110-2170MHz operating range – A minimum attenuation of 6dB, 25dB and 45dB at offsets greater than 4.8MHz, 15MHz and 120MHz respectively from the operating range.

***Antenna***

Only radiating cable type antennas shall be used with the BTS and CRFMU to transmit and receive signals to and from the onboard mobile devices. At a range of 2m, this antenna must have a coupling loss of at least 69dB within the frequency range 1805-1880MHz, and at least 66dB within the frequency ranges 870-960MHz and 2110-2170MHz.

***Additional Conditions***

Additional conditions applicable to the operation of MCA systems in spectrum-licensed bands concerning;

* operation of an MCA system whilst an aircraft is on the ground,
* compliance of an MCA system installation in regards to Civil Aviation Safety Authority Regulations (1998),

as specified for PMTS Class C stations and published in the Radiocommunications Licence Conditions (PTS) Determination (2003).

It is noted that the use of MCA systems is dependent on certified installation on a particular aircraft type to verify and validate that the MCA system does not cause interference to aircraft avionics following by approval by the national aviation safety authority.

**It is proposed:**

**That MCA systems may be operated under a spectrum licence directly by the licensee. Where another party who is not the licensee operates an MCA system in a spectrum licensed band and geographic area, then a third party agreement with the affected spectrum licensee must be obtained.**

**That licence conditions described above are recommended to apply to use of approved MCA systems in spectrum licensed frequency bands and geographic areas; these conditions are to be referenced through the Radiocommunications Advisory Guidelines of the 800MHz band.**

**That approved MCA systems that operate below the registration exemption power limits of 30dBm EIRP per 1MHz will *not* be required to be registered through the S145 Determination device boundary method.**

## Schedule - Propagation Models

The schedule entitled Propagation Models outlines a number of propagation models that may be selected and used in the coordination of apparatus licensed services with 800MHz spectrum licensed services. These include point-to-point models that calculate the attenuation over a path from individual transmitter to individual receiver. They include point-to-area models that enable prediction of field strength in an area surrounding a particular transmitter.

This schedule included in the original RAGs is to be retained in the new version to provide spectrum and apparatus licensees with information as to the appropriate propagation calculations to apply to interference paths. It is also proposed to include further comment regarding use of digital elevation models (DEMs) in combination with a selected propagation model.

The Introductory section here is updated with the following comment:

*When assessing interference, licensees are advised to select the propagation model that most accurately reflects terrain and environmental conditions over the interference path. Licensees should use local knowledge, environmental knowledge and radio engineering expertise to justify selection of a particular propagation model. Licensees may also be required to certify that coordination is successful against the relevant criteria when using the selected propagation model. In combination with the selected propagation model, licensees may choose to implement a digital elevation model (DEM) of sufficient resolution to ensure accuracy in interference calculations performed in accordance with these guidelines.*

The Point-to-Area Models section is updated for replacement of the reference to ITU-R Rec P.529 which has now been suppressed by the ITU and inclusion of text on the Modified Hata propagation models. A new table is included which specifies the valid ranges for input parameters to these models. The original table in this schedule setting out details on a variety of prediction methods for the 800MHz bands is deleted because it simply replicates the information contained within ITU-R Rec P.1144. A reference to this latter recommendation remains in the early parts of the text.

***It is proposed that the Schedule on Propagation Models be updated with the above text and described changes.***

# Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed Transmitters – 800MHz Band) – 1998.

The Radiocommunications Advisory Guideline (Managing Interference from Apparatus-licensed Transmitters) 1998 (the SL RAG) sets out the conditions and criteria for the protection of spectrum licensed receivers operating in the 800MHz band from apparatus licensed transmitters. These apparatus licensed transmitters may be operating on an in-band or adjacent-band basis or in areas adjacent to the geographic areas of the 800MHz spectrum licensing technical framework.

For this purpose the existing guideline documentation sets out two methods for the protection of spectrum licensed receivers. The notional receiver performance level and the compatibility requirement. Key alterations to the guidelines include updating these criteria to suit modern usage of the 800MHz band by IMT technologies. The guidelines have also been modified to include advisory notes to address the susceptibility of 800MHz mobile receivers to blocking interference from 900MHz mobile transmitters when operating within close proximity.

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

Part 2 of the SL RAG describes the ways in which in-band interference is managed by the 800MHz Technical Framework, considering adjacent-area and adjacent-frequency apparatus-licensed services.

In-band interference from apparatus licences issued in the band after the release of the Radiocommunications Spectrum Marketing Plan (800MHz and 1800MHz) 1998 is managed in the same way as interference from spectrum licensed transmitters – through the device boundary calculation. In-band interference from apparatus licences issued before the release of the Marketing Plan must be accepted by spectrum licensees. Because all such early apparatus licensed services have been cleared from the band in accordance with the Spectrum Re-allocation Declarations, the note to this effect:

“Spectrum licensees must accept any interference caused by apparatus licensed transmitters whose licences were issued before the issue date of the Radiocommunications Spectrum Marketing Plan (800MHz and 1800MHz Bands) 1998”

is to be removed from the SL RAG.

At Section 2.7 of Part 2 the text is to be updated considering the decision to include advisory notes in a new Schedule 3 in the SL RAG for mobile handset units operating in the 800MHz band. The new text at this part is as follows:

*The transient nature of mobile devices operating under either apparatus or spectrum licences makes it difficult to implement a practical interference management procedure through something such as a compatibility requirement. Instead advisory notes on the performance of 800MHz mobile handsets and on mitigation of adjacent band interference are included to provide licensees with guidance as to the susceptibility of interference from adjacent band GSM mobile transmitters when operating within close proximities.*

***It is proposed that this section be updated with the above text detailing the decision to include advisory notes to reduce susceptibility of 800MHz mobile receiver to blocking interference and mitigation options for 900MHz mobile transmitters. These notes are contained in a new Schedule.***

## Part 3 – Minimum Level of Receiver Performance

This part discusses the minimum level of receiver performance for base receivers operating in the 800MHz band and its justification in Sections 3.1 through to 3.5 is to remain unchanged.

***It is proposed that the text describing the Minimum Level of Receiver Performance for base receivers remain unchanged.***

## Part 4 – Compatibility Requirement

This Section 4.1 on definition of the Compatibility Requirement for coordination of apparatus licensed transmitters to spectrum licensed base station receivers is to remain unchanged. Similarly descriptions of the adjacent band services in Sections 4.2 and 4.3 are to remain unchanged.

***It is proposed that the text in this section describing the Compatibility Requirement remain unchanged.***

## Schedule 1: Notional Base Station Receiver Performance Level

The notional receiver performance level applied to 800MHz base stations is a requirement of spectrum licensing technical framework to ensure that poorer performing receivers do not place a disproportionate burden of resolving potential interference on apparatus licensed services in adjacent bands.

The Notional Receiver Performance Level sets requirements for a range of receiver characteristics including:

* Adjacent Channel Selectivity and Notional Receiver RF Selectivity
* Receiver Blocking (Wideband)
* Receiver Intermodulation Rejection Response (Wideband and Narrowband)
* Spurious Rejection Response
* Notional Antenna and Feeder/Branching Combination

The existing notional receiver performance level for base receivers in the 800MHz band is to be updated as described here.

### Adjacent Channel Selectivity and RF Selectivity

Adjacent channel selectivity (ACS) is defined as a receiver’s ability to receive a wanted signal in the RF channel in the presence of an unwanted interfering signal in adjacent channels offset from the centre frequency of the wanted channel. Hence, it is usually specified as attenuation per set frequency channel. In this section the adjacent channel selectivity of each of the technologies considered in this review is evaluated against that of the 800MHz technical framework.

The existing requirement is set out in the Notional Receiver Performance requirement n the SL RAG; the requirement here is stated as 57dB for interfering signals on frequency offsets of at least 12.5kHz. It’s proposed that this requirement is to be replaced with the following values for channel bandwidths that are likely to be used in the 800MHz band.

This ACS value is replaced with new values for prospective bandwidths for use in the band, as set out in Table C.

|  |  |
| --- | --- |
| New Adjacent Channel Selectivity Requirements # | |
| Channel Bandwidth (MHz) | New Relative ACS (dB) |
| 5 | 50 |
| >5 | 48 |

Table C.

# These ACS values are defined at the antenna connector port of the receiver, or in the case of additional devices such as filters and amplifiers installed in the signal path ahead of the receiver, then the values are defined at the outer antenna connector port.

The existing technical framework has a notional RF selectivity curve as described by the following equations;

Where *FreqOffset* is the frequency difference between the upper and lower limits of the frequency band of the spectrum licence under which the receiver operates and any frequency outside that frequency band.

It is considered reasonable that the attenuation specified by these curves should be achievable through modern RF filters. Hence, these RF selectivity curves are to apply to new IMT services deployed in the 800MHz bands.

***It is proposed:***

***that the new ACS values set out in Table C replace the existing requirement of the Notional Receiver Performance Level.***

***that the existing RF selectivity of the Notional Receiver Performance Level requirement is to apply to services deployed in the 800MHz band.***

### Receiver Intermodulation Requirements

Intermodulation performance requirements are included as part of the Notional Receiver Performance requirements of the Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-Licensed Transmitters - 800MHz Band) 1997. The criteria here are designed to provide attenuation of intermodulation products is caused by the mixing of signals present in the receiver (or receiver and site equipment) such that the generated products fall within the pass band of the receiver. The intermodulation response rejection of the receiver is then its ability to receive a wanted signal on an assigned channel in the presence of two other interfering signals that have some frequency relation to the wanted signal. The existing intermodulation performance conditions for notional receiver in the 800MHz band are stated as:

“Intermodulation immunity of greater than or equal to 62dB for two equi-level interfering signals at offsets of at least 120kHz and 240kHz.”

Given that use of the 800MHz band and the adjacent 900MHz band has now shifted from narrowband CDMA and GSM type communications, to wideband WCDMA/HSPA and LTE in the future, it is proposed that the existing intermodulation performance requirements be changed so as to suit new technology receivers.

New intermodulation response rejection requirements are now set for the frequency offsets at which these interfering intermodulation signals are most likely. These offsets correspond to the third order intermodulation products that may affect reception on another channel within the band, when considering a 5MHz raster across the band.

**Wideband Intermodulation Requirements for IMT Receivers**

|  |  |
| --- | --- |
| Wideband Intermodulation Requirements for 800MHz Receivers # | |
| Frequency Offset from Wanted Channel Edge to Centre Frequency of IM Product Bandwidth (MHz) | Intermodulation Performance Requirement (dB) |
| 2.5MHz | 50.0dB |
| 7.5MHz | 50.0dB |
| 12.5MHz | 54.0dB |
| 17.5MHz | 54.0dB |
| 27.5MHz | 80.0dB |

Table D.

***It is proposed:***

***that existing receiver intermodulation requirements be changed to those in Table D above. The new receiver intermodulation requirements correspond to frequency offsets for third order intermodulation products (2\*f1-f2 & 2\*f2-f1).***

# These Intermodulation Performance Requirement values are defined at the antenna connector port of the receiver, or in the case of additional devices such as filters and amplifiers installed in the signal path ahead of the receiver, then the values are defined at the outer antenna connector port.

### Receiver Blocking Levels

Receiver blocking is a measure of a receiver’s ability to receive a signal on its assigned frequency in the presence of interfering signals on frequencies other than the assigned frequency. The existing receiver blocking requirements of the framework deal with mainly with narrow offset interferers; these are set out in the Notional Receiver Performance Level of Schedule 1 of the Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed Transmitters – 800MHz Band) 1997.

“Blocking level greater than or equal to 80dB with a frequency offset of at least 37.5kHz.”

“Blocking level greater than or equal to 90dB with a frequency offset of at least 1MHz.”

This review proposes to change the required receiver blocking requirements of the Notional Receiver Performance Level to suit new wideband technologies. New performance requirements are specified for a 5MHz channel; sufficient for typical WCDMA bandwidths of 3.84MHz and LTE bandwidths of 4.515MHz.

|  |  |
| --- | --- |
| Wideband Receiver Blocking Levels # | |
| For interfering signals within this range | Relative Blocking Requirements (dB) |
| 1 MHz to 805MHz | 85dB |
| 805MHz to 865MHz | 60dB |
| 865MHz to 12750 MHz | 85dB |

Table E.

# These Receiver Blocking values are defined at the antenna connector port of the receiver, or in the case of additional devices such as filters and amplifiers installed in the signal path ahead of the receiver, then the values are defined at the outer antenna connector port.

***It is proposed:***

***that existing receiver blocking requirements dealing with narrow offset interfering signals be changed to those in Table E above. The new receiver blocking requirements cater for wider bandwidth technologies and suited to the changing usage of the band.***

**Spurious Rejection Response.**

***It is proposed:***

***that the current spurious rejection response requirement of 65dB be retained. Receivers that do not meet the existing level must implement additional filtering in order to gain the full protection offered by the notional receiver.***

### Notional Antenna and Feeder/Branching Combination.

***It is proposed:***

***that the notional receiver is defined with an 18dBi antenna, with feeder losses of 2dB and branching losses of 3dB. It is recommended that this combination of antenna gain and feeder/branching losses be retained in the reviewed Notional Receiver Performance specification. Spectrum licensed base station receivers operating in the 825-845MHz band should meet these requirements.***

## Schedule 2: Base Receive Compatibility Requirement

The compatibility requirement sets basic levels for coordination between apparatus-licensed services and spectrum-licensed services. The previous criteria was derived for older cellular technologies deployed in the 800MHz band. Now with newer IMT technologies using the band the compatibility requirement is updated to ensure a minimum level of performance for the wanted 800MHz service. This requirement protects the 800MHz base station receivers to current IMT uplink performance standards. Thus, it ensures that the presence of a coordinated apparatus-licensed services does not adversely affect the performance of a spectrum-license receiver.

The new compatibility requirement is stated as:

* + A wanted to unwanted ratio of 24dB for 99.99% annual availability.
  + A minimum wanted signal of -83dBm/5MHz corresponding to a bit error rate of 0.001.

The W/UW ratio here provides sufficient protection for higher order modulation schemes used over the air interface of modern mobile technologies and is derived from generic bit error probability curves for these modulations. This ratio here is suitable for application for both WCDMA and OFDM based transmissions. The wanted level is the minimum signal required at a spectrum licensed base station in order to receive a signal from a mobile station for the stated bit error rate of 0.001. These wanted signal levels include 1dB noise rise (receiver threshold degradation) and result in a maximum interfering signal at –6dB below the noise floor.

To find the appropriate level for alternative bandwidths the levels stated here should be converted using the logarithmic scaling equation.

***It is proposed:***

***that the existing Compatibility Requirements for apparatus licensed transmitters coordinated for the protection of spectrum licensed receivers be updated for OFDM and WCDMA modulations based technologies,***

***that the new Compatibility Requirements will provide a wanted to unwanted ratio and minimum wanted signal level for a stated availability and a minimum wanted signal level for a stated BER rate.***

***The Compatibility Requirement has been based on a 5MHz channel, although can be scaled using the standard logarithmic scaling for alternative bandwidths.***

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

ACMA studies indicate that 800MHz mobile stations may be susceptible to receiver blocking interference from 900MHz GSM mobile transmitters when these handsets are within close proximity. These studies also indicated a lesser degree of susceptibility to blocking interference from IMT mobile transmitters operating in the 900MHz band.

In order to reduce the susceptibility to blocking interference, spectrum licensees operating in the 800MHz band are advised to utilise mobile stations that adhere to receiver performance specifications of current technology standards.

Furthermore, licensees operating in the 900MHz band are advised that reasonable measures should be taken to reduce the probability of such interference. There are a number of mitigating factors that might assist in alleviating problematic adjacent band operation between 900MHz mobile transmitters and 800MHz mobile receivers. These factors include:

* Conducting frequency planning such that adjacent GSM channels are not used when 900MHz GSM systems are co-cell or adjacent-cell with the 800Mz IMT systems.
* Enforce reductions in 900MHz GSM mobile stations output power (for example, to 29dBm) so as to reduce the probability of receiver blocking interference.
* Implement transmit power control on the mobile uplink, such that the mobile station operates at maximum power only when absolutely necessary.

***It is proposed:***

***To include advice that licensees operating services in the 800MHz and 900MHz bands to take steps to ensure that cases of blocking interference may be resolved. In, particular 900MHz licensees should to take reasonable measures to implement mitigation factors within their networks to minimise the potential for this type of interference.***

***Licensees operating services in the 800MHz and 900MHz bands may negotiate and agree to resolve interference cases between themselves.***

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

Studio Transmitters Link (STL) and Sound Outside Broadcast Links (SOB) operate in the 845-852MHz frequency range adjacent to 800MHz base station receivers. These STL/SOB services are apparatus licensed and coordinated in accordance with Rali FX-11 (“Studio to Transmitter Links and Sound Outside Broadcasting Services in the 900MHz Band”).

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

* to ensure that characteristics and parameters of their STL/SOB system conforms to the limits specified in Rali FX-11.
* to ensure that the assignment priority set out in Rali FX-11 is followed in conducting frequency coordination and licensing.
* to ensure that the recommendations regarding the assignment of wideband channels set out in Rali FX-11 are followed.

In the situations where interference is caused to an 800MHz base station receiver due to the out-of-band emissions of an STL/SOB transmitter, the licensee of this latter service may be required to install transmit side filtering to reduce these emissions and mitigate the interference.

***It is proposed:***

***That licensees of STL/SOB transmitters may be required to install additional transmitter side filtering on STL/SOB links operating in the 845-852MHz frequency range to reduce interference from out-of-band emissions to 800MHz spectrum licensed base receivers.***

# Final Comment from Technical Liaison Group Participants

Technical Liaison Group participants are requested to provide any final comments on the recommended modifications to the Radiocommunications Guidelines for management of interference between Apparatus-licensed services and Spectrum-licensed services. Please provide these comments by closure of the final comment period on 16th December 2011.

# References

**800MHz Technical Framework Documents:**

1. *Radiocommunications Advisory Guidelines (Managing Interference from Apparatus Licensed Transmitters – 800MHz) 1998.* Australian Communications Authority, 1998.
2. *Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed Receivers – 800MHz Band) 1998.* Australian Communications Authority, 1998.
3. *Radiocommunications Spectrum Marketing Plan (800MHz and 1.8GHz Bands) 1998.* Office of Legislative Drafting and Publishing, Attorney-General’s Department, October 2005.
4. *Radiocommunications (Spectrum Re-allocation) Declaration No.3 of 2000.* Minister for Communications, Information Technology and the Arts, 2000.
5. *Radiocommunications (Unacceptable Levels of Interference – 800MHz Band) Determination 1998. (S145)* Australian Communications Authority, 1998.
6. *Spectrum Re-allocation Declaration No.1 of 1997. Minister for Communications and the Arts, 1997.*
7. *Spectrum Re-allocation DeclarationNo.2 of 1997. Minister for Communications and the Arts, 1997.*
8. *SPP Report 2/1997 Compatibility Assessment – 800MHz AMPS Spectrum Adjacent to GSM Spectrum.* Spectrum Management Agency, 1997.

**800MHz Technical Framework Review Planning Documents:**

1. *Recommendations on the Review of the 800MHz Technical Framework (Draft 1g).* Spectrum Licensing Renewal Section, Spectrum Infrastructure Branch, ACMA, April 2011.
2. *SPP Report 2011-08 Compatibility Evaluation between 800MHz IMT Services and 900MHz GSM Services.* Spectrum Infrastructure Branch, Australian Communications and Media Authority, June 2011.

**3GPP Specifications:**

1. 3GPP TS 25.104 V8.0.0, *Technical Specification Group Radio Access Network; Base Station (BS) radio transmission and reception (FDD) (Release 8)*, September 2009.
2. 3GPP TS 25.101 V8.0.0, *Technical Specification Group Radio Access Network; User Equipment (UE) radio transmission and reception (FDD) (Release 8)*, September 2009.
3. 3GPP TS 25.201 V10.0.0, *Technical Specification Group Radio Access Network; Physical Layer; General Description (Release 10)*, March 2011.
4. 3GPP TR 25.814 V.7.1.0, *Technical Specification Group Radio Access Network; Physical Layer Aspects for Evolved Universal Terrestrial Radio Access (UTRA) (Release 7)*, September 2006.
5. 3GPP TS 36.104 V9.2.0, *Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception (FDD) (Release 9)*, December 2009.
6. 3GPP TS 36.101 V9.2.0, *Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (FDD) (Release 9)*, December 2009.
7. 3GPP TS 36.942 V9.0.1, *LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Frequency (RF) system scenarios (Release 9)*, April 2010.
8. 3GPP TS 45.005 V9.3.0. Technical Specifications Group GSM/EDGE Radio Access Network; Radio Transmission and Reception (Release 9), May 2010.

**ITU-R Recommendations:**

1. ITU-R Recommendation M.1580-3. *Generic Unwanted Emission Characteristics of Base Stations Using the Terrestrial Radio Interfaces of IMT-2000.* Working Party 5D, International Telecommunications Union, June 2009.
2. ITU-Rec SM.329-10. Unwanted Emissions in the Spurious Domain. International Telecommunications Union, 2003.
3. ITU-R Report M.2039. *Characteristics of Terrestrial IMT-2000 Systems for Frequency Sharing/Interference Analysis.* International Telecommunications Unions, 2004.
4. ITU-R Recommendation M.1036-3. *Frequency Arrangements for the Implementation of the terrestrial component of International Mobile Telecommunications-2000 (IMT-2000) in the bands 806-960MHz, 1710-2025MHz, 2110-2200MHz and 2500-2690MHz.* International Telecommunications Union, 2007.

**Books:**

1. Couch, L.W. Digital and Analog Communications Systems (5th Ed). Prentice-Hall International, United States of America, 1997.
2. Sklar, B. Digital Communications Fundamentals and Applications (2nd Ed). Prentice-Hall PTR, United States of America, 2001.