Rationale for Proposed 1785 -1805 MHz BWA Technical Framework

Spectrum Planning Discussion Paper SPP 5/06
## Contents

1. **INTRODUCTION** ................................................................................................................. 1

2. **STRUCTURE OF THIS PAPER** ......................................................................................... 1

3. **SPECTRUM ARRANGEMENTS** ......................................................................................... 1
   3.1. 1.8 GHz Fixed Point-to-Point Links .............................................................................. 2
   3.2. 1.8 GHz Spectrum Licensing ....................................................................................... 4
   3.3. Apparatus-Licensed GSM1800 .................................................................................... 4

4. **INTERFERENCE MECHANISMS AND SCENARIOS** ......................................................... 5

5. **1.8 GHZ SPECTRUM LICENSING TECHNICAL FRAMEWORK** ........................................... 5
   5.1. Technical Parameters .................................................................................................. 5
   5.2. Interference Management in Spectrum Licensing ....................................................... 7
   5.3. Typical Location of Spectrum-Licensed Transmitters and Receivers ......................... 7

6. **INTERFERENCE ASSESSMENT ASSUMPTIONS** ............................................................... 9
   6.1. BWA Deployment Scenarios ........................................................................................ 9
   6.2. Separation Distances ................................................................................................... 9
   6.3. Likelihood of Interference & Mitigation Factors .......................................................... 10
   6.4. Nominal BWA Parameters ........................................................................................ 11

7. **BWA TRANSMITTER OUT-OF-BAND EMISSIONS TO 1.8 GHZ SPECTRUM-LICENSED RECEIVERS** .................................................................................................................................................. 12
   7.1. Methodology ............................................................................................................... 12
   7.2. Interference Assessments ............................................................................................ 12
   7.3. Discussion of Results .................................................................................................. 13

8. **BWA TRANSMITTERS BLOCKING 1.8 GHZ SPECTRUM-LICENSED RECEIVERS** .......... 15
   8.1. Methodology ............................................................................................................... 15
   8.2. Interference Assessments ............................................................................................ 15
   8.3. Discussion of Results .................................................................................................. 16

9. **SPECTRUM LICENSING OUT-OF-BAND EMISSIONS TO BWA RECEIVERS** ............ 16
   9.1. Methodology ............................................................................................................... 16
   9.2. Interference Assessments ............................................................................................ 17
   9.3. Discussion of Results .................................................................................................. 18

10. **BWA RECEIVERS ADJACENT CHANNEL SELECTIVITY** .................................................. 18
    10.1. Methodology ............................................................................................................. 18
    10.2. Interference Assessments .......................................................................................... 18
    10.3. Discussion of Results ................................................................................................ 20

11. **SPECTRUM LICENSING BOUNDARY ISSUES** .................................................................. 20
    11.1. Major City Spectrum-licensed Areas/Regional BWA .................................................... 20
    11.2. Separation Distances: Regional Spectrum-licensed Areas/Remote BWA ................. 21

12. **DISCUSSION AND SUMMARY OF PROPOSED TECHNICAL FRAMEWORK** ............ 22
    12.1. Available Channels and Areas .................................................................................... 22
12.2. EIRP and Out-of-Band Emission Levels ................................................................. 22
12.3. Assignment Priority .......................................................................................... 23

13. REFERENCES ........................................................................................................ 24

Attachments
A: Extract from Spectrum Plan
B: Areas and Maps
C: Analysis of Technical Characteristics of Regional 1900-1920 MHz BWA Systems
1. Introduction
The purpose of this paper is to outline the rationale for the technical framework proposed for regional and remote broadband wireless access (BWA) services operating in the band 1785-1805 MHz [1]. The paper is also intended to assist:

- 1.8 GHz spectrum licensees in assessing the effect of BWA operation on 1.8 GHz spectrum-licensed services; and
- Prospective BWA licensees to assess the potential for interference with 1.8 GHz spectrum-licensed services, risks associated in operating in that environment and understand the required performance of BWA equipment.

2. Structure of this Paper
This paper:

- Outlines spectrum arrangements and identifies services operating in and adjacent to the band 1785-1805 MHz (section 3);
- Identifies interference mechanisms between BWA services and spectrum licensing services and interference scenarios to be investigated (section 4);
- Summarises 1.8 GHz spectrum licensing characteristics (section 5);
- Outlines assumption used in interference assessments including deployment scenarios, separation distances, likelihood of interference and nominal BWA characteristics (section 6);
- Studies interference between BWA services and spectrum licensing services (sections 7-11);
- Considers the interference studies and summaries requirements of the technical framework (section 12).

3. Spectrum Arrangements
The Australian Radiofrequency Spectrum Plan (the Spectrum Plan) allocates the band 1785-1805 MHz to the fixed service and mobile service on a primary basis [2] (see extract from Spectrum Plan at Figure 3.1). Other services supported include radio astronomy (footnotes AUS87 & 149), aeronautical public correspondence (1800-1805 MHz, footnote 380), and space operation/research (Earth-to-space, 1750-1850 MHz, footnote 386). Full text of all footnotes is at Attachment A.

![Figure 3.1: Extract from the Australian Radiofrequency Spectrum Plan](attachment:figure_3.1.png)

<table>
<thead>
<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
<th>Australian Table of Allocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1710 – 1930</td>
<td>FIXED</td>
<td>MOBILE 380 384A 388A</td>
<td>1710 – 1930</td>
</tr>
<tr>
<td></td>
<td></td>
<td>149 341 385 386 387 388</td>
<td>FIXED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUS87</td>
<td>MOBILE 380 384A 388A</td>
</tr>
</tbody>
</table>

In Australia the band 1785-1805 MHz is between the base receive (1710-1785 MHz) and base transmit (1805-1880 MHz) segments of spectrum used primarily for mobile
telecommunications services conforming to the European global system for mobiles standard (known as GSM1800\(^1\)). Services operate under 1.8 GHz spectrum licences in major capital cities (Adelaide, Brisbane, Melbourne, Perth, and Sydney) and regional areas. A handful of GSM1800 services also operate under apparatus licences in remote areas.

The 1785-1805 MHz band also overlaps part of the 1.8 GHz (1700-1900 MHz) channel plan for fixed point-to-point links.

Spectrum relationships between spectrum licensing (GSM1800), 1.8 GHz fixed links and the BWA band 1785-1805 MHz are illustrated in Figure 3.2. Under Spectrum Embargo 38 no new assignments are allowed in the band 1785-1805 MHz Australia-wide while planning for BWA is under consideration [3].

**Figure 3.2: 1785-1805 MHz Proposed BWA Band and Related Spectrum Arrangements**

3.1. 1.8 GHz Fixed Point-to-Point Links

Arrangements for 1.8 GHz point-to-point links are contained in Radiocommunications Assignment and Licensing Instruction (RALI) FX 3 “Microwave Fixed Services Frequency Coordination” [4]. Fixed links operating in this band typically operate under a bi-directional arrangement using a ‘go’ and ‘return’ link on paired channels (e.g. channel 5M paired with 5M').

**Fixed Link Distribution**

Based on November 2006 ACMA radiocommunications licensing data, the 1.8 GHz band accommodates a total of 1886 point-to-point spectrum accesses; of those 71 (52 in regional areas, 19 in remote areas) overlap the band 1785-1805 MHz (channels 6M and 6I) and would require co-channel coordination. Fixed links on adjacent channels will also require consideration, but in most cases the required adjacent channel protection criteria is likely to be achieved. Breakdown of assignments in the 1.8 GHz fixed channel plan are shown in Table 3.3. Geographic distribution of links requiring co-channel coordination (i.e. those overlapping the band 1785-1805 MHz) is shown in the maps at Attachment B.

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\(^1\) GSM: Global System for Mobile Communications. GSM1800 is the colloquial description of digital cellular telecommunications systems meeting the requirement of the GSM standard operating in the bands 1710-1785/1805-1880 MHz, sometimes also known as DCS1800.
Table 3.3: Assignments per Channel – 1.8 GHz Channel Plan

<table>
<thead>
<tr>
<th>Channel Number</th>
<th>Assigned Frequency (MHz)</th>
<th>Number of Assignments</th>
<th>Channel Number</th>
<th>Assigned Frequency (MHz)</th>
<th>Number of Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1M</td>
<td>1713.5</td>
<td>119</td>
<td>1M'</td>
<td>1832.5</td>
<td>123</td>
</tr>
<tr>
<td>1I</td>
<td>1720.5</td>
<td>67</td>
<td>1I'</td>
<td>1839.5</td>
<td>72</td>
</tr>
<tr>
<td>2M</td>
<td>1727.5</td>
<td>104</td>
<td>2M'</td>
<td>1846.5</td>
<td>105</td>
</tr>
<tr>
<td>2I</td>
<td>1734.5</td>
<td>116</td>
<td>2I'</td>
<td>1853.5</td>
<td>116</td>
</tr>
<tr>
<td>3M</td>
<td>1741.5</td>
<td>148</td>
<td>3M'</td>
<td>1860.5</td>
<td>148</td>
</tr>
<tr>
<td>3I</td>
<td>1748.5</td>
<td>125</td>
<td>3I'</td>
<td>1867.5</td>
<td>127</td>
</tr>
<tr>
<td>4M</td>
<td>1755.5</td>
<td>124</td>
<td>4M'</td>
<td>1874.5</td>
<td>124</td>
</tr>
<tr>
<td>4I</td>
<td>1762.5</td>
<td>19</td>
<td>4I'</td>
<td>1881.5</td>
<td>15</td>
</tr>
<tr>
<td>5M</td>
<td>1769.5</td>
<td>29</td>
<td>5M'</td>
<td>1888.5</td>
<td>24</td>
</tr>
<tr>
<td>5I</td>
<td>1776.5</td>
<td>22</td>
<td>5I'</td>
<td>1895.5</td>
<td>19</td>
</tr>
<tr>
<td>6M</td>
<td>1783.5</td>
<td>18</td>
<td>6M'</td>
<td>1902.5</td>
<td>17</td>
</tr>
<tr>
<td>6I</td>
<td>1790.5</td>
<td>52</td>
<td>6I'</td>
<td>1909.5</td>
<td>53</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td><strong>943</strong></td>
<td></td>
<td></td>
<td><strong>943</strong></td>
</tr>
</tbody>
</table>

Total assignments in band 1886

Given the light use of the 1785-1805 MHz band by fixed point-to-point links it is considered that BWA services and fixed point-to-point links can share the band on a coordinated basis.

Coordination Criteria: 1785-1805 MHz BWA with 1.8 GHz Fixed Links
Coordination criteria between BWA services and 1.8 GHz fixed links are available in RALI FX 19 [5]. The same criteria are applicable to the band 1785-1805 MHz, with the exception that coordination will be on an equal co-primary basis. That is, coordination on a first-in-time basis where new services are only approved if coordination criteria are achieved.

Requirements are contained in Tables 3.4 and 3.5. In applying the criteria note that:

- Frequency offset is the difference between centre frequencies.
- A protection criterion at an offset applies at offsets up to but not including the next specified offset. For example in Table 3.4 the -102 dBm level applies for centre frequencies with offsets ≥ 0 MHz and < 9.5 MHz.
- Propagation modelling for path profile analysis for:
  - BWA base station transmitter to fixed link receiver is to use interference criteria which apply to short-term (0.01% of time) effects (refer Appendix 4 “Fixed Service Propagation Modelling” of RALI FX 3 [4]).
  - Fixed link transmitter to BWA base station receiver is to use interference criteria which apply to short-term (1% of time) effects (refer “Protection Criteria: 1900-1920 and 2010-2025 MHz band BWA receivers”, RALI FX 19 [5]).

Table 3.4: Victim BWA Receiver and Interfering 1.8 GHz Fixed Link Transmitter

<table>
<thead>
<tr>
<th>Frequency Offset (MHz)</th>
<th>PROTECTION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Digital Interferer Tx → Digital Victim Rx</td>
</tr>
<tr>
<td></td>
<td>14 MHz → 5 MHz</td>
</tr>
<tr>
<td>0</td>
<td>-102 dBm</td>
</tr>
<tr>
<td>9.5</td>
<td>-72 dBm</td>
</tr>
<tr>
<td>14.5</td>
<td>NA</td>
</tr>
</tbody>
</table>
### Table 3.5: Victim 1.8 GHz Fixed Link Receiver and Interfering BWA Transmitter

<table>
<thead>
<tr>
<th>Frequency Offset (MHz)</th>
<th>REQUIRED PROTECTION RATIO (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Digital Interferer Tx → Digital Victim Rx 5 MHz → 14 MHz</td>
</tr>
<tr>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>9.5</td>
<td>30</td>
</tr>
<tr>
<td>23.5</td>
<td>0</td>
</tr>
<tr>
<td>37.5</td>
<td>NA</td>
</tr>
</tbody>
</table>

### 3.2. 1.8 GHz Spectrum Licensing

Spectrum licences in the 1.8 GHz band were issued for 15 years under auction processes in 1998 and 2000 (i.e. the licences do not expire until 2013 or 2015). In major capital city areas (Adelaide, Brisbane, Melbourne, Perth and Sydney) services operate in the bands 1710-1785 MHz and 1805-1880 MHz. In regional areas use is limited to 1710-1725 MHz and 1805-1820 MHz. No services operate in remote areas.

Major capital city areas and regional areas are defined in the 1.8 GHz spectrum re-allocation declarations [6], [7] and are illustrated at Attachment B. Remote areas are areas outside major capital city and regional areas.

As of 1 November 2006 ACMA’s register of radiocommunications licences recorded 6644 devices (6236 in major capital city areas, 408 in regional areas) in the 1.8 GHz spectrum licensing upper band (1805-1880 MHz), the base station transmit segment for GSM1800. Geographic distribution is shown in maps at Attachment B. The maps illustrate high usage in metropolitan areas of major capital cities and low usage in regional areas and fringes of major city areas.

The interference potential between BWA services and 1.8 GHz spectrum licensing is considered in detailed later in this paper.

### 3.3. Apparatus-Licensed GSM1800

In addition to spectrum-licensed GSM1800 services, there are also nine locations in remote Western Australia and one in Victoria where GSM1800 services operate under a PMTS B (public mobile telecommunications service class B) apparatus licence (see ACMA apparatus licence information paper on Public Telecommunications Service (PTS)) [8]. Applications are considered on a case-by-case basis.

Apparatus-licensed GSM1800 services operate in the 1710-1725 MHz (base receive/mobile transmit) and 1805-1820 MHz (base transmit/mobile receive) bands. For interference modelling purposes GSM1800 services are assumed to have the same technical characteristics as 1.8 GHz spectrum-licensed services. Geographic distribution is shown in maps at Attachment B.

Given the low number of apparatus licensed GSM1800 services, coordination with BWA services will be considered on a case-by-case basis.
4. Interference Mechanisms and Scenarios

Interference mechanisms considered between 1785-1805 MHz BWA transmitters and 1.8 GHz spectrum-licensed receivers in this paper are as follows:

- Interference to spectrum licensed receivers due to out-of-band emissions from adjacent band BWA transmitters; and
- Spectrum-licensed receiver blocking performance (a receiver’s ability to receive a wanted signal in the presence of a high level unwanted signal at frequencies offset from the wanted signal).

Worst case scenarios are represented by an interfering transmitter located in close proximity to a base station which is receiving signals from a mobile station operating on a cell boundary, or by an interfering transmitter in close proximity to a mobile station which is operating on a cell boundary. These worst case scenarios are represented in Figures 4.1 and 4.2.

Figure 4.1: Interference to a Spectrum-Licensed Base Station Receiver

Figure 4.2: Interference to a Spectrum-Licensed Mobile Station Receiver

5. 1.8 GHz Spectrum Licensing Technical Framework

5.1. Technical Parameters

The 1.8 GHz spectrum licensing technical framework was designed to support GSM1800 services. While different technologies can be used, they must meet the requirements of the technical framework. Interference assessments in this paper have been based on parameters of the technical framework supplemented, where necessary, with information from the ESTI GSM standard [11].
Frequency Bands and Area of Operation
1710-1725 MHz major capital city and regional areas (base receive/mobile transmit)
1725-1785 MHz major capital city areas (base receive/mobile transmit)
1805-1820 MHz major capital city and regional areas (base transmit/mobile receive)
1820-1880 MHz major capital city areas (base transmit/mobile receive)

Major capital city areas (areas around Adelaide, Brisbane, Melbourne, Perth and Sydney) and regional areas are defined in the 1.8 GHz spectrum re-allocation declarations [6], [7] and illustrated at Attachment B.

Base Station
Maximum base station radiated power: 54.5 dBmEIRP/30kHz [12], [13]
Channel width: 200 kHz [11]
Base receiver antenna gain: 19 dBi [14]
Feeder loss: 4 dB [14]
Wanted signal level: -114.5 dBm (measured in a 30 kHz rectangular bandwidth) [14]
C/I (co-channel): 9dB [14]
Maximum interference level: -123.5 dBm/30kHz (by calculation)
Blocking performance: 85 dB (with respect to wanted signal) [14]

Out-of-Band Emission Limits
In the 1.8 GHz spectrum licensing technical framework different emissions limits apply inside and outside the spectrum band (ie 1710-1785/1805-1880 MHz). Emission limits relevant for assessing interference to BWA services are the limits outside the spectrum licence band. Emission limits are specified in the Spectrum Marketing Plans for the 1.8 GHz band [12, 13] and summarised in Table 5.1.

Table 5.1: Out-of-band emission limits outside the spectrum band 1710-1785/1805-1880MHz

<table>
<thead>
<tr>
<th>Band Edge (MHz)</th>
<th>Frequency Offset</th>
<th>Limit</th>
<th>Radiated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1710</td>
<td>0 to 0.5 MHz</td>
<td>-8.5 dBm EIRP/30kHz</td>
<td>true mean power</td>
</tr>
<tr>
<td>1710</td>
<td>Greater than 0.5 MHz</td>
<td>-33.5 dBm EIRP/30kHz</td>
<td>true mean power</td>
</tr>
<tr>
<td>1785, 1805, 1880</td>
<td>0 to 5.6 MHz</td>
<td>-8.5 dBm EIRP/30kHz</td>
<td>true mean power</td>
</tr>
<tr>
<td>1785, 1805, 1880</td>
<td>Greater than 5.6 MHz</td>
<td>-33.5 dBm EIRP/30kHz</td>
<td>true mean power</td>
</tr>
<tr>
<td>All</td>
<td>0 kHz to 300 kHz</td>
<td>10 dBm EIRP/300kHz</td>
<td>peak power</td>
</tr>
</tbody>
</table>

Mobile Stations:
Maximum mobile radiated power: 24.5 dBmEIRP/30 kHz [12], [13]
Channel width: 200 kHz [11]
Assumed mobile receiver antenna gain: 0dBi [11]
Mobile reference sensitivity: -102 dBm in 200 kHz [11]
Mobile reference sensitivity: -110.2 dBm/30kHz (by calculation)
Maximum interference level: -119.2 dBm/30kHz (by calculation)
-33.2 dBm/30kHz. (by calculation)

2 Continuous, static sine wave.
5.2. Interference Management in Spectrum Licensing

Interference management between apparatus and spectrum-licensed radiocommunications devices is normally managed through the use of advisory guidelines under section 262 of the Radiocommunications Act 1993 and coordination procedures derived from the relevant section 145 determination of unacceptable levels of interference. Also licensees are expected to cooperate and resolve interference where the source of interference is co-sited, taken as being within 200 metres (see conditions “Co-sited devices” in Conditions Included by ACA in the sample licence in the Spectrum Marketing Plan for the 1.8 GHz Band [13]).

Requirements of the 1.8 GHz spectrum licensing technical frame work were developed based on existing services at the time of the 1998/2000 spectrum auctions. Changing those requirements (for example to support the introduction of 1785-1805 MHz BWA) would require consultation with 1.8 GHz spectrum licensees.

The goal for the 1785-1805 MHz technical framework is a framework where no coordination is required between 1785-1805 MHz BWA services and 1.8 GHz spectrum licensing services, avoiding the need to develop additional advisory guidelines or coordination procedures and a possibly lengthy consultation process with spectrum licensees.

5.3. Typical Location of Spectrum-Licensed Transmitters and Receivers

Under the 1.8 GHz spectrum licensing technical framework, spectrum-licensed base station transmitters (and hence associated base station receivers) cannot be located on the area boundary of a spectrum licence. Transmitters are required to be set back from the boundary so that the signal level in an adjacent area is below a “typical” sensitivity level of receivers in the adjacent area. Correspondingly mobile stations are also set back from the boundary. The result is an area known as the “dead zone” (or guard area) where no transmitters or receivers are located. The concept of setback distances from geographic boundaries is illustrated in Figure 5.1.

Setback requirements for base stations can be determined from application of Radiocommunications (Unacceptable Levels of Interference - 1800 MHz Band) Determination 1999 [9], for an overview see Chapter 5 “Technical Framework” in the Applicant Information Package for the PCS 2000 Auction [10].

The reason mobiles are set back is that with a 9 dB C/I ratio (see section 5.2), it can then be assumed that stations will not be located on the area boundary of a spectrum licence where C/I will equal zero (ie the level received on a boundary from base transmitters in different areas is the same). Mobile stations will be located a sufficient distance from an area boundary to achieve a 9 dB C/I ratio.
Under Radiocommunications (Unacceptable Levels of Interference - 1800 MHz Band) Determination 1999 [9], interference criteria are tested every 5 minutes (approximately 9 km) from the location of the spectrum-licensed base station along radials separated by 2.5 degrees. This results in a base station transmitter being located at least 5 minutes (≈ 9 km) from a spectrum licence boundary. Exact distance depends on antenna height, terrain and radiated power pattern.

The system model considered in developing the 1.8 GHz spectrum licensing technical framework (not publicly available) assumed a cell radius of 1.5 km, which is based on an antenna height of 30 m for a base station, and 1.5 m for a mobile. A cell radius of 1.5 km implies that mobile stations are at least 7.5 km (9-1.5 km) from a licence boundary.

Noting the frequency band and areas spectrum-licensed at 1.8 GHz (see section 3.2 and Figure 3.2), when considering coordination with 1785-1805 MHz BWA services in terms of frequency and geographic separation, it can be assumed that:

- Spectrum-licensed base station receivers in the band 1725-1785 MHz are at a minimum distance of 9 km from major capital city/regional area boundaries;
- Spectrum-licensed base station receivers in close proximity to major capital city/regional area boundaries are those operating in the band 1710-1725 MHz, a frequency separation of 60 MHz from the 1785-1805 MHz band.
- Spectrum-licensed mobile transmitters in the band 1725-1785 MHz will be at least 7.5 km from the major capital city/regional area boundary;
- Spectrum-licensed base station transmitters in the band 1805-1820 MHz are at a minimum distance of 9 km from the regional/remote area boundaries; and
- Spectrum-licensed mobile receivers in the band 1805-1820 MHz will be at least 7.5 km from the regional/remote area boundary.
6. Interference Assessment Assumptions

6.1. BWA Deployment Scenarios

BWA Base Stations: A mature BWA service can be expected to use a combination of large cell sizes with high base station antenna heights (e.g. antenna heights of 30 m or greater) and small cells with low base station antenna heights (e.g. antenna heights of 10-15 m).

The WiMAX forum believes that a typical 802.16 BWA deployment will have a 15 m base station height [15].

BWA Subscriber Stations: BWA subscriber stations are expected to be a combination of fixed and mobile (nomadic) stations with subscriber heights ranging from 1.5 m (mobile stations) to 6 m (fixed outdoor stations) [15].

6.2. Separation Distances

Guidance on appropriate separation distances between BWA and 1.8 GHz spectrum licensing can be found in a number of documents including:

- ETSI IMT2000 TDD standards which assume a worst case base-to-base separation of 10 m (see section 10 “Antenna-to-Antenna Isolation” of [16] which is the origin of the ESTI/3GPP base station emission levels requirements for 3G TDD systems [17]);
- ITU-R report on coexistence between IMT2000 TDD and FDD systems around 2600 MHz (for example see Table 16 “Reference separation distances”) [18].
- ITU-R draft new report on mitigation techniques between TDD and FDD IMT2000 systems (for example Annex 2 “Support material for antenna separation” which sites a 10 m base-to-base separation distance) [19]).
- ITU-R Working Party 8F initial coexistence analysis of IEEE802.16 BWA systems and IMT2000 systems (for example see section 4.3 with separation distance between mobiles of 10 m and Annex G) [20].

In comparison with the spectrum licensing principle of interference self management when co-sited (within 200 m, see section 5.2) the distances in the above references are considered worst case. However, they can be used to scope the worst case scenario with results assessed based on the likelihood of interference in the scenario being considered.

After consideration of the above documents and deployment scenarios of section 6.1, the following worst case assumptions are made about 1.8 GHz spectrum licensing and BWA separation distances.

- 20 m base station separation distance, line of sight conditions. At closer distances antennas are assumed to be on the same tower with additional loss due to antenna discrimination.
- 50 m separation between BWA base station and 1.8 GHz spectrum-licensed mobile station. Based on low height (street level deployment scenario) for mobile stations.
- 50 m separation between 1.8 GHz spectrum-licensed base station and BWA subscriber station. Based on low height (roof level deployment scenario) for BWA subscriber stations.
6.3. Likelihood of Interference & Mitigation Factors

The interference scenarios identified in section 4 combined with the separation distances of section 6.2 result in worst case interference scenarios. They assume that a spectrum-licensed receiver is operating at a cell edge or receiving from a transmitter at a cell edge (i.e. minimum wanted signal) at the same time a BWA transmitter is transmitting in close proximity (20-50m). Figure 6.1 illustrates these scenarios. There are a number of mitigating factors that can be considered when assessing the likelihood of interference in such an environment.

Figure 6.1: Area of Greatest Interference Potential

Area of Greatest Interference
In both the scenarios illustrated in Figure 6.1 the probability of interference decreases when spectrum licensed mobile stations (transmitters or receivers) are closer to a spectrum licensed base station (i.e outside “cell fringes”, the dotted areas in Figure 6.1).

System Performance and Interference to Mobiles and Base Stations
In terms of overall system performances, interference to a spectrum-licensed mobile receiver, while resulting in localised interference, will have negligible impact on system performance. That is, scenario B has greatest impact on system performance and even more so when the interferer is a BWA base station (which is likely to be continuously operated).

Time of Interference
The time division duplex (TDD) nature of BWA services to be used in the 1785-1805 MHz band and the asymmetric nature of internet traffic (download volume greater than upload volume) means that a BWA base station will have greater impact on a spectrum licensing receiver than the impact of a BWA subscriber station transmitter.

Antenna Discrimination
No allowance for antenna discrimination has been made in the various interference scenarios under consideration. In practice some antenna discrimination is likely, particularly on BWA base station to spectrum licensing mobile station interference paths, where at the reference...
separation distance (50m) mobile stations are unlikely to be in the main beam of the BWA base station antenna. Similarly, spectrum licensing mobile receivers are unlikely to be in the main beam of the BWA fixed outdoor subscriber station antenna.

**Propagation Model**

A worst case scenario of free space propagation conditions has been assumed in the various interference scenarios under consideration. Additional propagation losses, mainly on interference paths between spectrum licensing mobiles and BWA fixed outdoor subscriber stations, are likely in practice. For interference paths involving base stations, at the reference separation distances, the assumption of free space propagation is consider reasonable.

**6.4. Nominal BWA Parameters**

This section details nominal BWA parameters for use in interference assessments. To assist comparison with 1.8 GHz spectrum licensing criteria, interference assessments will be undertaken in spectrum licensing reference units (dBm/30 kHz).

**EIRP**

Analysis of BWA services in the 1900-1920 MHz band (see Attachment C) indicates that 95% of services have a base station radiated power (EIRP) of 10 W/MHz or less. Nominal BWA base station EIRP for interference assessments will be 10 W/MHz which in spectrum licensing reference units is 24.77 dBm/30 kHz. This value is 13 dB lower than the RALI FX 19 deployment model value of 60 dBm/5 MHz (200 W/MHz or 38 dBm/30kHz).

Subscriber stations (remote stations in ACMA licensing terminology) normally operate at a lower radiated power level than base stations. Nominal subscriber station EIRP for interference assessments will be assumed to be 10 dB less than base stations. That is, an EIRP of 1 W/MHz (14.77 dBm/30 kHz). This value is approximately the same as the RALI FX 19 deployment model value of 38 dBm/5 MHz (1.3 W/MHz, 16 dBm/30 kHz).

**Out-of-Band Emissions**

For interference assessment purposes it shall be assumed that the level of out-of-band emissions from BWA base stations is reduced by 60 dB with respect to the radiated power of BWA base station transmitters, and the level of out-of-band emissions from subscriber station transmitters is reduced by 50 dB with respect to the radiated power of BWA subscriber stations. The resulting value for both base stations and subscriber stations, in spectrum licensing units, is -35.23 dBm EIRP/30 kHz.

**Net Antenna Gain**

Analysis of BWA services in the 1900-1920 MHz band indicates that 95% of services have a net base station antenna gain (antenna gain – feeder loss) of 14 dBi or less (see Attachment C). Nominal BWA base station net receiver gain for interference assessments will be 14 dBi.
BWA Interference Criteria
From RALI FX 19 [5] specifies an interference protection level of –102 dBm/5 MHz at the receiver (ie after antenna/feeder) for BWA services in the band 1900-1920 MHz. The same value shall be assumed for BWA services in the band 1785-1805 MHz. The FX 19 requirement is based on a 5 MHz BWA system with a 5 dB noise figure, that is:

\[ kTB + NF = -174 + 67 + 5 \text{ dBm} = -102 \text{ dBm/5MHz} \]
\[ = -124.2 \text{ dBm/30kHz} \]

Cell Radius
RALI FX 19 specifies a 15 km BWA cell radius for BWA services in the band 1900-1920 MHz. Under coordination requirements of RALI FX 19 subscriber stations are inherently protected when located within 15 km of the associated base station. For 1785-1805 MHz BWA services, while the nominal subscriber station EIRP is approximately the same as RALI FX 19, base station EIRP is 13 dB lower. A reduced cell radius is likely with a lower base station EIRP, probably less than 10 km (using the Hata suburban propagation model).

7. BWA Transmitter Out–of-Band Emissions to 1.8 GHz Spectrum-Licensed Receivers

7.1. Methodology
The spectrum licensing maximum interference levels are used to determine the maximum level of radiated out-of-band emission from a BWA transmitter allowed at various separation distances both as an absolute level and as a ratio of in-band radiated power to out-of-band emission limit.

7.2. Interference Assessments
From the equation: \( Pr = Pt(BWA) + Gr(SL) - Lr(SL) - PL(d) \), put \( Pr = Imax(SL) \); and \( Pt(BWA) = OOB(BWA) \), rearranging the radiated level out of band emission level can be calculated as follows:

\[ OOB(BWA) = Imax(SL) - Gr(SL) + Lr(SL) + PL(d) \]

Or as ratio to maximum radiated power:

\[ Atten(BWAadj) = Pt(BWA) - OOB(BWA) \]

Where

- \( OOB(BWA) \): Level of out-of-band emissions (EIRP dBm/30kHz)
- \( Imax(SL) \): 1.8 GHz spectrum licensing maximum allowed interference (dBm/30kHz)
- \( Gr(SL) \): 1.8 GHz spectrum-licensed receiver station antenna gain (dBi)
- \( Lr(SL) \): 1.8 GHz spectrum-licensed receiver station feeder loss (dB)
- \( d \): Distance separation between stations (km)
- \( PL(d) \): Path loss at distance d (km), free space in this case (dB)*
- \( Atten(BWAadj) \): BWA OOB as a ratio to radiated power (dB)
- \( Pt(BWA) \): BWA base station radiated power (EIRP) (nominal 24.77 dBm/30kHz)

*Frequency 1785 MHz GSM1800 base, 1805 MHz GSM1800 mobile
### Table 7.1: Results - BWA OOB to 1.8 GHz Base Rx (1710-1785 MHz)

<table>
<thead>
<tr>
<th>Pt(BWA) dBi/30kHz</th>
<th>Gr(SL) dBi</th>
<th>Lr(SL) dB</th>
<th>d km</th>
<th>PL(d) dB</th>
<th>Imax(SL) dBm/30kHz</th>
<th>OOB(BWA) dBm/30kHz</th>
<th>Atten(BWAadj) dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.77</td>
<td>19</td>
<td>4</td>
<td>0.01</td>
<td>57.5</td>
<td>-123.5</td>
<td>-81.0</td>
<td>105.7</td>
</tr>
<tr>
<td>24.77</td>
<td>19</td>
<td>4</td>
<td>0.02</td>
<td>63.6</td>
<td>-123.5</td>
<td>-74.9</td>
<td>99.7</td>
</tr>
<tr>
<td>24.77</td>
<td>19</td>
<td>4</td>
<td>0.05</td>
<td>71.5</td>
<td>-123.5</td>
<td>-67.0</td>
<td>91.8</td>
</tr>
<tr>
<td>24.77</td>
<td>19</td>
<td>4</td>
<td>0.1</td>
<td>77.5</td>
<td>-123.5</td>
<td>-61.0</td>
<td>85.7</td>
</tr>
<tr>
<td>24.77</td>
<td>19</td>
<td>4</td>
<td>0.2</td>
<td>83.6</td>
<td>-123.5</td>
<td>-54.9</td>
<td>79.7</td>
</tr>
<tr>
<td>24.77</td>
<td>19</td>
<td>4</td>
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<td>91.5</td>
<td>-123.5</td>
<td>-47.0</td>
<td>71.8</td>
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<tr>
<td>24.77</td>
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<td>103.6</td>
<td>-122.5</td>
<td>-33.9</td>
<td>58.7</td>
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</table>

**Reference separation distance (20m):** BWA_{BT} - SL_{BR}

**Reference separation distance (50m):** BWA_{SubT} - SL_{BR}

### Table 7.2: Results - BWA OOB to 1.8 GHz Mobile Rx (1805-1880 MHz)

<table>
<thead>
<tr>
<th>Pt(BWA) dBi/30kHz</th>
<th>Gr(SL) dBi</th>
<th>Lr(SL) dB</th>
<th>d km</th>
<th>PL(d) dB</th>
<th>Imax(SL) dBm/30kHz</th>
<th>OOB(BWA) dBm/30kHz</th>
<th>Atten(BWAadj) dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.77</td>
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<td>0.01</td>
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<td>-119.2</td>
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<td>0</td>
<td>0</td>
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<td>-119.2</td>
<td>-53.6</td>
<td>78.4</td>
</tr>
<tr>
<td>24.77</td>
<td>0</td>
<td>0</td>
<td>0.05</td>
<td>71.6</td>
<td>-119.2</td>
<td>-47.6</td>
<td>72.4</td>
</tr>
<tr>
<td>24.77</td>
<td>0</td>
<td>0</td>
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<td>77.6</td>
<td>-119.2</td>
<td>-41.6</td>
<td>66.3</td>
</tr>
<tr>
<td>24.77</td>
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<td>0</td>
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<td>83.7</td>
<td>-119.2</td>
<td>-35.5</td>
<td>60.3</td>
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<tr>
<td>24.77</td>
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<td>0</td>
<td>0.5</td>
<td>91.6</td>
<td>-119.2</td>
<td>-27.6</td>
<td>52.4</td>
</tr>
<tr>
<td>24.77</td>
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<td>1</td>
<td>97.6</td>
<td>-119.2</td>
<td>-21.6</td>
<td>46.3</td>
</tr>
</tbody>
</table>

**Reference separation distance (25m):** BWA_{SubT} - SL_{MR}

**Reference separation distance (50m):** BWA_{BT} - SL_{MR}

### 7.3. Discussion of Results

**Interference to Spectrum Licensing Base Station Receivers**

The results of Table 7.1 show that at the reference separation distances (20m: BWA_{BT} to SL_{BR}; 50m: BWA_{SubT} to SL_{BR}) the required out-of-band emission level is –74.9 dBmEIRP/30 kHz for BWA base stations and –67.0 dBmEIRP/30 kHz for BWA subscriber stations. Those levels correspond to an out-of-band attenuation of 99.7 dB (for BWA base stations) and 81.8 dB (for BWA subscriber stations) for BWA stations operating at nominal EIRP levels. Approximately an additional reduction of 40 dB (for BWA base stations) and 32 dB (for BWA subscriber stations) from the nominal -35.23 dBmEIRP/30 kHz BWA out-of-band emission level (section 6.4).

For BWA transmitters operating at nominal out-of-band emission levels (-35.23 dBm EIRP/30 kHz), the spectrum licensing base station receiver protection requirements are achieved at a separation distance of approximately 2 km.

For immediate adjacent BWA stations the required out-of-band attenuation is very demanding and a guard band of at least 5 MHz is likely to be required, and possibly more unless additional filtering is employed. Alternatively, BWA EIRP could be reduced, though the required reduction may result in an EIRP level below that required for a viable BWA service.
A guard band is still likely to be required even with application of the mitigation factors (section 6.3) or leaving interference management to licensees in accordance with the spectrum licensing co-site rule. That is, when an interference source is within of 200 metres licensees are expected to cooperate and resolve any interference (section 5.2).

Interference to Spectrum Licensing Mobile Station Receivers
The results of Table 7.2 show that at the reference separation distances (25m: BWA_{SubT} to SL_{MR}; 50m: BWA_{BT} - SL_{MR}) the required out-of-band emission level is –47.6 dBmEIRP/30 kHz for BWA base stations and –53.6 dBmEIRP/30 kHz for BWA subscriber stations. Those levels correspond to an out-of-band attenuation of 72.4 dB (for BWA base stations) and 68.4 dB (for BWA subscriber stations) for BWA stations operating at nominal EIRP levels. Which is an additional reduction of 12.4 dB (for BWA base stations) and 18.4 dB (for BWA subscriber stations) from the nominal -35.23 dBmEIRP/30 kHz out-of-band emission level (section 6.4). It can also be observed that at 200m separation (the spectrum licensing interference self management distance – see section 5.2) no reduction from nominal levels is required.

The results indicate that, depending on the out-of-band performance of BWA transmitters and mobile/subscriber station density, a guard band may be required to protect spectrum-licensed mobile receivers from BWA out-of-band emissions. As shall be discussed in sections 9 & 10 a guard band is also required to protect BWA receivers from interference from spectrum-licensed base station transmitters in the band 1805-1880 MHz.

Considering the mitigation factors of section 6.3, it is believed that the calculated limits, which are based on conservative worst case interference scenarios, are overly stringent and that a 10 dB reduction from nominal out-of-band levels is appropriate. That is, an out-of-band level of -45.23 dBm EIRP/30 kHz for both BWA base and subscriber stations, for which a separation distance of 66 m is required under worst case conditions.

Major Capital City Areas
In 1.8 GHz major capital city spectrum-licensed areas where there is a higher density of spectrum-licensed services (see Maps at Attachment B), without more detailed assessment (including consideration of other interference mechanisms), operation of BWA services in the band 1785-1805 MHz on an uncoordinated basis with 1.8 GHz spectrum licensing services is not considered viable.

Regional Areas
In regional areas, with over 60 MHz separation between the 1.8 GHz spectrum-licensed base receive band (1710-1725 MHz) and the BWA band (1785-1805 MHz), technical limitations required to support operation of BWA services on an uncoordinated basis with spectrum licensing services are seen as achievable in part of the 1785-1805 MHz band. Technical limitations are required to ensure that:

- The combination of a guard band and/or out-of-band emissions restrictions is sufficient to protect spectrum-licensed mobile receivers (in the band 1805-1820 MHz) from interference due to out-of-band emissions from adjacent band BWA transmitters.
- BWA stations operating in the band 1785-1790 MHz are sufficiently distant from 1.8 GHz major city spectrum-licensed areas to avoid interference to spectrum-licensed base station receivers operating in the band 1710-1785 MHz and interference from associated spectrum licensed mobile transmitters operating in the band 1710-1785 MHz.
• There is a guard band to protect BWA receivers from interference (due to out-of-band emissions and adjacent channel selectivity) from adjacent band 1805-1820 MHz spectrum-licensed base stations (see sections 9 & 10);

Remote Areas
In remote areas operation in the entire band 1785-1805 MHz is considered feasible on an uncoordinated basis with spectrum licensing services subject to the consideration of the need for BWA base stations operating in the band 1795-1805 MHz to be sufficiently distant from regional areas to avoid:
• interference from spectrum-licensed base station transmitters operating in the band 1805-1820 MHz; and
• interference to associated spectrum licensed mobile receivers operating in the band 1805-1820 MHz.

8. BWA Transmitters Blocking 1.8 GHz Spectrum-Licensed Receivers

8.1. Methodology
The 1.8 GHz spectrum-licensed receiver blocking performance requirement is used to determine the distance required to meet compatibility requirement for various values of BWA radiated power. The scenario to be modelled assumes a minimum 5 MHz guard band between spectrum-licensed receivers and BWA transmitters.

8.2. Interference Assessments

1.8 GHz spectrum-licensed base receiver

\[ \text{Pr} \text{(wanted)} + \text{PR} \text{(Blocking)} = \text{Pt} \text{(BWA)} + \text{Gr} \text{(SL)} - \text{Lr} \text{(SL)} - \text{PL} \text{(d)} \]

Re-arranging: \[ \text{PL} \text{(d)} = \text{Pt} \text{(BWA)} + \text{Gr} \text{(SL)} - \text{Lr} \text{(SL)} - \text{Pr} \text{(wanted)} - \text{PR} \text{(Blocking)} \]

Solve using free space loss.

1.8 GHz spectrum-licensed mobile receiver

\[ \text{Pr} \text{(blocking)} = \text{Pt} \text{(BWA)} + \text{Gr} \text{(SL)} - \text{Lr} \text{(SL)} - \text{PL} \text{(d)} \]

Re-arranging: \[ \text{PL} \text{(d)} = \text{Pt} \text{(BWA)} + \text{Gr} \text{(SL)} - \text{Lr} \text{(SL)} - \text{Pr} \text{(blocking)} \]

Solve using free space loss.

\[
\begin{align*}
\text{Gr(SL)} & : \quad 1.8 \text{ GHz spectrum-licensed receiver station antenna gain (dBi)} \\
\text{Lr(SL)} & : \quad 1.8 \text{ GHz spectrum-licensed receiver station feeder loss (dB)} \\
\text{d} & : \quad \text{Distance separation between stations (km)} \\
\text{PL(d)} & : \quad \text{Path loss at distance d (km), free space in this case (dB)*} \\
\text{Pt(BWA)} & : \quad \text{BWA base station EIRP (nominal 14.77 dBm/30kHz)} \\
\text{Pr(SL wanted)} & : \quad \text{Spectrum-licensed base wanted signal level (-114.5 dBm/30kHz)} \\
\text{PR(Blocking)} & : \quad \text{Spectrum-licensed base blocking performance (85 dB (U/W))} \\
\text{Pr(blocking)} & : \quad \text{Spectrum-licensed mobile blocking level (-33.2 dBm/30 kHz)}
\end{align*}
\]

*Frequency 1785 MHz GSM1800 base, 1805 MHz GSM1800 mobile
### Table 8.1: 1.8 GHz Spectrum-Licensed Base Station

<table>
<thead>
<tr>
<th>BWA EIRP</th>
<th>BWA EIRP</th>
<th>Gr(SL)</th>
<th>Lr(SL)</th>
<th>Pr(SLwanted)</th>
<th>PR (U/W)</th>
<th>PL(d)</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBm/30kHz</td>
<td>W/MHz</td>
<td>dBi</td>
<td>dB</td>
<td>dBm/30kHz</td>
<td>dB</td>
<td>dB</td>
<td>(m)</td>
</tr>
<tr>
<td>4.77</td>
<td>0.1</td>
<td>19</td>
<td>4</td>
<td>-114.5</td>
<td>85</td>
<td>49</td>
<td>3.8</td>
</tr>
<tr>
<td>14.77</td>
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<td>19</td>
<td>4</td>
<td>-114.5</td>
<td>85</td>
<td>59</td>
<td>12</td>
</tr>
<tr>
<td>24.77</td>
<td>10</td>
<td>19</td>
<td>4</td>
<td>-114.5</td>
<td>85</td>
<td>69</td>
<td>38</td>
</tr>
<tr>
<td>34.77</td>
<td>100</td>
<td>19</td>
<td>4</td>
<td>-114.5</td>
<td>85</td>
<td>79</td>
<td>121</td>
</tr>
</tbody>
</table>

### Table 8.2: 1.8 GHz Spectrum-Licensed Mobile Station

<table>
<thead>
<tr>
<th>BWA EIRP</th>
<th>BWA EIRP</th>
<th>Gr(SL)</th>
<th>Lr(SL)</th>
<th>Pr (blocking)</th>
<th>PL(d)</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>dBm/30kHz</td>
<td>W/MHz</td>
<td>dBi</td>
<td>dB</td>
<td>dBm/30kHz</td>
<td>dB</td>
<td>(m)</td>
</tr>
<tr>
<td>4.77</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>-33</td>
<td>38</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>-33</td>
<td>48</td>
<td>3.2</td>
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<td>24.77</td>
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<td>0</td>
<td>-33</td>
<td>58</td>
<td>10</td>
</tr>
<tr>
<td>34.77</td>
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<td>0</td>
<td>0</td>
<td>-33</td>
<td>78</td>
<td>102</td>
</tr>
</tbody>
</table>

### 8.3. Discussion of Results

For 1.8 GHz spectrum-licensed base station receivers, considering separation distances (20m base-to-base), a 5 MHz guard band should ensure that blocking requirements can be achieved in all scenarios except for high-powered co-sited BWA transmitters (EIRP above 34.77dBm/30 kHz). In regional areas with over 60 MHz separation between the 1.8 GHz spectrum-licensed base receive band (1710-1725 MHz) and the BWA band (1785-1805 MHz) this requirements is achieved.

For 1.8 GHz spectrum-licensed mobile receivers with a minimum separation distance of either 25m (from BWA subscriber stations) or 50m (from BWA base stations), limiting BWA radiated power to 24.77 dBm/30 kHz is sufficient to ensure that the blocking requirement can be achieved.

### 9. Spectrum Licensing Out-of-Band Emissions to BWA Receivers

#### 9.1. Methodology

Determine the level of interference to a BWA receiver at various distances based on out-of-band emission levels from adjacent bands spectrum-licensed base station transmitters in comparison to the BWA interference protection criteria.
9.2. Interference Assessments

From the equation: \( Pr = Pt + Gr - Lr - PL(d) \), put \( Pr = I \); and \( Pt = OOB \), rearranging
\[
I = OOB + Gr - PL(d)
\]
\[
Imax_{BWA}/I = Imax_{BWA} - I
\]

Where
- \( I \): Interference level at BWA receiver (dBm/30kHz)
- \( OOB \): spectrum licensing out-of-band emissions (EIRP dBm/30kHz)
- \( Gr \): Nominal BWA receiver antenna gain including feeder loss (14 dBi)
- \( d \): Distance separation between BWA receiver and spectrum-licensed transmitter stations (km)
- \( PL(d) \): Free space path loss (dB) at distance \( d \) (km)
- \( I_{BWA}/I \): Ratio of maximum BWA interference level (\( Imax_{BWA} \)) to unwanted spectrum licensing out-of-band emissions (dB)
- \( Imax_{BWA} \): BWA maximum allowed interference (-124.2 dBm/30kHz)

Spectrum licensing base station transmitter out-of-band emissions (see section 5):
- -8.5 dBm/30 kHz at 1799.6-1805 MHz, use 1802.5 MHz for interference assessment
- -33.5 dBm/30kHz at below 1799.6 MHz, use 1797.5 MHz for interference assessment

<table>
<thead>
<tr>
<th>OOB</th>
<th>Gr</th>
<th>d(km)</th>
<th>PL(d)</th>
<th>I</th>
<th>Imax_{BWA}</th>
<th>Imax_{BWA}/I</th>
</tr>
</thead>
<tbody>
<tr>
<td>-33.5</td>
<td>14</td>
<td>0.02</td>
<td>63.6</td>
<td>-83.1</td>
<td>-124.2</td>
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<td>0.5</td>
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<td>-124.2</td>
<td>-1.1</td>
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<td>71.6</td>
<td>-66.1</td>
<td>-124.2</td>
<td>-58.1</td>
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<td>14</td>
<td>0.1</td>
<td>77.6</td>
<td>-72.1</td>
<td>-124.2</td>
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<td>-8.5</td>
<td>14</td>
<td>0.2</td>
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<td>-46.1</td>
</tr>
<tr>
<td>-8.5</td>
<td>14</td>
<td>0.5</td>
<td>91.6</td>
<td>-86.1</td>
<td>-124.2</td>
<td>-38.1</td>
</tr>
<tr>
<td>-8.5</td>
<td>14</td>
<td>1</td>
<td>97.6</td>
<td>-92.1</td>
<td>-124.2</td>
<td>-32.1</td>
</tr>
<tr>
<td>-8.5</td>
<td>14</td>
<td>2</td>
<td>103.6</td>
<td>-98.1</td>
<td>-124.2</td>
<td>-26.1</td>
</tr>
<tr>
<td>-8.5</td>
<td>14</td>
<td>5</td>
<td>111.6</td>
<td>-106.1</td>
<td>-124.2</td>
<td>-18.1</td>
</tr>
<tr>
<td>-8.5</td>
<td>14</td>
<td>10</td>
<td>117.6</td>
<td>-112.1</td>
<td>-124.2</td>
<td>-12.1</td>
</tr>
</tbody>
</table>

Reference separation distance (20m): \( SL_{BT} - BWABR \)
Reference separation distance (50m): \( SL_{BT} - BWASubR \)

Note that positive values of \( Imax_{BWA}/I \) indicated that the BWA protection criteria have been achieved. Negative values indicated that the protection criteria have not been achieved and that performance of the BWA system will be degraded unless additional isolation can be achieved (eg antenna discrimination).
9.3. Discussion of Results

Regional Areas
As can be seen from Table 9.1, a BWA receiver operating in the same area as a 1.8 GHz spectrum-licensed base station transmitter in the band 1799.4-1805 MHz, where the out-of-band emission level is -8.5 dBm EIRP/30 kHz, are prone to interference from spectrum licensing out-of-band emissions. Depending on antenna discrimination and terrain characteristics required separation distances could exceed 20 km. Consequently a guard band is likely to be required to support operation of BWA and spectrum licensing services on an uncoordinated basis.

Operation of BWA services below 1799.4 MHz in the same area as a 1.8 GHz spectrum-licensed base station transmitter is more viable where the specified out-of-band emission level is -33.5 dBm EIRP/30 kHz. In the band 1799.4-1800 MHz filter rolloff characteristics may result in lower emission levels than those specified, supporting use of the channel 1795-1800 MHz. Detailed investigation is required to confirm that use of the band 1795-1800 MHz could be supported, including whether the required reduction in BWA out-of-band emissions could be achieved in 5 MHz instead of 10 MHz (see section 7). On that basis uncoordinated BWA/spectrum licensing use of the band 1795-1800 MHz in regional areas is not supported, particularly as the difference between -8.5 dBm and -33.5 dBm (25 dB) is over a 20 fold increase in required distance separation (assuming free space propagation conditions). An alternative is to reduce the channel bandwidth to 4 MHz (ie 1795-1799 MHz). That option can be investigated further at a later date if required.

Remote Areas
In remote areas no 1.8 GHz spectrum-licensed services operate. BWA operation on an uncoordinated basis with spectrum licensing services can be supported provided BWA services are sufficiently distant from 1.8 GHz regional spectrum-licensed areas to avoid interference from spectrum-licensed base station transmitters and interference to spectrum-licensed mobile receivers operating in the band 1805-1820 MHz.

10. BWA Receivers Adjacent Channel Selectivity

10.1. Methodology
The required BWA adjacent channel selectivity is determined at various distances from 1.8 GHz spectrum-licensed base station transmitters.

10.2. Interference Assessments
Adjacent channel selectivity (ACS) is a measure of a receiver’s ability to receive a wanted signal in the presence of an unwanted signal on an adjacent channel. Scenarios are:

- BWA base station receiver located in close proximity to 1.8 GHz spectrum-licensed base transmitter (1805-1880 MHz), BWA subscriber located on BWA cell boundary; and
- BWA subscriber receiver located in close proximity to 1.8 GHz spectrum-licensed base transmitter (1805-1880 MHz), BWA base station transmitter located on BWA cell boundary.

Note interference from spectrum-licensed mobile transmitters is not considered as in regional areas operation is limited to the band 1710-1725 MHz.
Required BWA ACS is determined using the equations:

\[ I_{\text{adj}} = P_t(\text{SL}) + G_r - PL(d) \]
\[ ACS_{\text{(req)}} = I_{\text{adj}} - Pr(\text{BWA}) \]

Where:

- \( ACS_{\text{(req)}} \): Required adjacent channel selectivity (dB)
- \( Pr(\text{BWA}) \): Wanted BWA received power (dBm)
- \( I_{\text{adj}} \): Interference level in the adjacent channel (dBm/30 kHz)
- \( P_t(\text{SL}) \): Spectrum-licensed base radiated power (54.5 dBm EIRP/30kHz)
- \( G_r \): BWA receiver station antenna gain including feeder loss (14 dBi)
- \( d \): Distance separation between base stations (km)
- \( PL(d) \): Path loss at distance \( d \) (km), free space propagation model (frequency 1805 MHz) in this case (dB)

**Values:**

Assume a 5 MHz BWA channel

Under IEEE802.16 received power in a 5 MHz channel can be modelled as varying from -80 to -30 dBm, which in a 30 kHz channel (22.2 dB adjustment) is -102.2 to -52.2 dBm [21].

Assume a BWA receiver operating at low signal levels (-80 to -70 dBm in 5 MHz or -102.2 to -92.2 dBm/30 kHz)

**Table 10.1: Required BWA Adjacent Channel Performance V Distance**

<table>
<thead>
<tr>
<th>( P_t(\text{adj}) )</th>
<th>( G_r )</th>
<th>( d )</th>
<th>( PL(d) )</th>
<th>( BWA \text{ Pr} )</th>
<th>( I_{\text{adj}} )</th>
<th>Required ACS</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.02</td>
<td>63.7</td>
<td>-102.2</td>
<td>4.8</td>
<td>107.0</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.05</td>
<td>71.6</td>
<td>-102.2</td>
<td>-3.1</td>
<td>99.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.1</td>
<td>77.6</td>
<td>-102.2</td>
<td>-9.1</td>
<td>93.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.2</td>
<td>83.7</td>
<td>-102.2</td>
<td>-15.2</td>
<td>87.0</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.5</td>
<td>91.6</td>
<td>-102.2</td>
<td>-23.1</td>
<td>79.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>1</td>
<td>97.6</td>
<td>-102.2</td>
<td>-29.1</td>
<td>73.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>2</td>
<td>103.7</td>
<td>-102.2</td>
<td>-35.2</td>
<td>67.0</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>5</td>
<td>111.6</td>
<td>-102.2</td>
<td>-43.1</td>
<td>59.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>10</td>
<td>117.6</td>
<td>-102.2</td>
<td>-49.1</td>
<td>53.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>20</td>
<td>123.7</td>
<td>-102.2</td>
<td>-55.2</td>
<td>47.0</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.02</td>
<td>63.7</td>
<td>-92.2</td>
<td>4.8</td>
<td>97.0</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.05</td>
<td>71.6</td>
<td>-92.2</td>
<td>-3.1</td>
<td>89.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.1</td>
<td>77.6</td>
<td>-92.2</td>
<td>-9.1</td>
<td>83.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>0.2</td>
<td>83.7</td>
<td>-92.2</td>
<td>-15.2</td>
<td>77.0</td>
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<tr>
<td>54.5</td>
<td>14</td>
<td>0.5</td>
<td>91.6</td>
<td>-92.2</td>
<td>-23.1</td>
<td>69.1</td>
</tr>
<tr>
<td>54.5</td>
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<td>97.6</td>
<td>-92.2</td>
<td>-29.1</td>
<td>63.1</td>
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<tr>
<td>54.5</td>
<td>14</td>
<td>2</td>
<td>103.7</td>
<td>-92.2</td>
<td>-35.2</td>
<td>57.0</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>5</td>
<td>111.6</td>
<td>-92.2</td>
<td>-43.1</td>
<td>49.1</td>
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<tr>
<td>54.5</td>
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<td>10</td>
<td>117.6</td>
<td>-92.2</td>
<td>-49.1</td>
<td>43.1</td>
</tr>
<tr>
<td>54.5</td>
<td>14</td>
<td>20</td>
<td>123.7</td>
<td>-92.2</td>
<td>-55.2</td>
<td>37.0</td>
</tr>
</tbody>
</table>

Reference separation distance (20m): \( SL_{\text{BT}} - BWA_{\text{AR}} \)

Reference separation distance (50m): \( SL_{\text{BT}} - BWA_{\text{SubR}} \)
10.3. Discussion of Results
Considering minimum separation distances between BWA receivers and spectrum-licensed base station transmitters (1805-1880 MHz), the required BWA receiver ACS requirements are demanding and a guard band of at least 5 MHz is likely to be required unless BWA stations have additional filtering.

11. Spectrum Licensing Boundary Issues

11.1. Major City Spectrum-licensed Areas/Regional BWA
As previously noted (see section 7.3), the band 1785-1790 MHz can be used in regional areas provided BWA services are sufficiently separated from major city spectrum-licensed areas to avoid interference to 1.8 GHz spectrum-licensed base receivers operating in the band 1710-1785 MHz in those areas. The dominant interference mechanism is assumed to be interference due to BWA out-of-band emissions (required separation distances for receiver blocking are less than the reference separation distances, see section 8).

Separation distances can be determined by substituting EIRP and out-of-band emission levels into the equation:

\[ \text{Imax}(\text{SL}) = \text{OOB}(\text{BWA}) - \text{PL}(d) + \text{Gr}(\text{SL}) - \text{Lr}(\text{SL}) \]

Rearranging: \[ \text{PL}(d) = \text{OOB}(\text{BWA}) + \text{Gr}(\text{SL}) - \text{Lr}(\text{SL}) - \text{Imax}(\text{SL}) \]
and solve for \( d \) using free space

Where
- \( \text{Imax}(\text{SL}) \): 1.8 GHz spectrum licensing maximum allowed interference (dBm/30kHz)
- \( \text{OOB}(\text{BWA}) \): Level of out-of-band emissions (-35.23 dBm EIRP/30kHz)
- \( \text{Pt}(\text{BWA}) \): BWA station nominal EIRP (dBm/30kHz)
- \( \text{PL}(d) \): Path loss at distance \( d \) (km), free space in this case (dB)
- \( d \): Distance separation between stations (km)
- \( \text{Gr}(\text{SL}) \): Spectrum-licensed base station receiver antenna gain (dBi)
- \( \text{Lr}(\text{SL}) \): Spectrum-licensed base station receiver feeder loss (dB)

Table 11.1: Required Distance Separation Across Major Capital City/Regional Boundary

<table>
<thead>
<tr>
<th>BWA Station</th>
<th>BWA EIRP</th>
<th>( \text{Gr}(\text{SL}) )</th>
<th>( \text{Lr}(\text{SL}) )</th>
<th>( \text{OOB}(\text{BWA}) )</th>
<th>( \text{Imax}(\text{SL}) )</th>
<th>( \text{PL}(d) )</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>24.77</td>
<td>19</td>
<td>4</td>
<td>-35.23</td>
<td>-123.5</td>
<td>103.3</td>
<td>1.94</td>
</tr>
<tr>
<td>Subscriber</td>
<td>14.77</td>
<td>19</td>
<td>4</td>
<td>-35.23</td>
<td>-123.5</td>
<td>103.3</td>
<td>1.94</td>
</tr>
</tbody>
</table>

Discussion: BWA Base Station Transmitters to Spectrum Licensing Base Receivers
In section 5.3 it was observed that 1725-1785 MHz spectrum-licensed base station receivers are at a minimum 9 km from the licence boundary, compared to a required separation distance of 1.94 km in Table 11.1. Consequently it is considered that BWA base stations operating in the band 1785-1790 MHz can be located on spectrum licensing major capital city/regional area boundaries with a low probability of interference to spectrum-licensed base station receivers operating in the band 1725-1785 MHz.

Discussion: BWA Subscriber Stations to Spectrum Licensing Base Receivers
In section 5.3 it was observed that 1725-1785 MHz spectrum-licensed base station receivers are at a minimum 9 km from the licence boundary. In section 6.4 it was observed that BWA cell radius was likely to be less than 10 km. In section 6.3 it was observed that no allowance
had been made for antenna discrimination and that the free space propagation model had been used in considering interference from a BWA subscriber transmitter to spectrum licensing base receiver.

It is considered that BWA subscribers stations operating in the band 1785-1790 MHz, provided the associated base station is located in a regional area, can be located in major capital city 1.8 GHz spectrum licensing areas with a low probability of interference to spectrum-licensed base station receivers operating in the band 1725-1785 MHz. Any interference that does occur could be resolved by requiring BWA subscriber stations to operate on a no interference/no protection basis with respect to spectrum licensing stations.

Discussion: Spectrum Licensing Mobile Transmitters to BWA Base Receivers
In section 5.3 it was observed that 1725-1785 MHz mobile transmitters are likely to be at least 7.5 km from a licence boundary. On that basis interference to regional BWA base station receivers is considered remote.

Discussion: Spectrum Licensing Mobile Transmitters to BWA Subscriber Receivers
Considering typical cell sizes (BWA and spectrum licensing) BWA subscriber stations and 1725-1785 MHz spectrum licensed mobile transmitters may be operating in the same location if a BWA base station is located on a major city/regional area boundary. Interference in such an environment will be localised and transient in nature and probability of occurrence will be dependent on the density of BWA subscriber stations and spectrum licensing mobile transmitters. Any interference that does occur could be resolved by requiring BWA subscriber stations to operate on a no interference/no protection basis with respect to spectrum licensing stations.

11.2. Separation Distances: Regional Spectrum-licensed Areas/Remote BWA
As noted in sections 7 and 9, the band 1795-1805 MHz can be used in remote areas provided BWA services are sufficiently separated from regional spectrum licensing areas to:

• avoid interference to spectrum-licensed mobile receivers operating in the 1805-1820 MHz band in regional areas; and
• interference from spectrum-licensed base station transmitters operating in the band 1805-1820 MHz in regional areas.

The dominant interference mechanism is assumed to be interference to BWA receivers due to out-of-band emissions from spectrum-licensed base station transmitters in the band 1805-1820 MHz.

Noting that:

• interference due to out-of-band emission from spectrum-licensed base station transmitters in the band 1805-1820 MHz is scoped in section 9. Worst case separation distances are between 20-30 km (for 1799.4-1805 MHz) and 2-5 km (for 1795-1799.4 MHz) depending on antenna discrimination;

• interference to spectrum-licensed base receivers is scoped in section 11.1, with worst case separation distance of 2 km (for both BWA base and subscriber stations);

• the assumption of section 5.3 that spectrum-licensed base station transmitters in the band 1805-1820 MHz are, at a minimum, 9 km away from regional/remote area boundaries; and
• that BWA cell radius is likely to be less than 10 km (section 6.4) meaning that BWA subscriber stations (with external directional antennas) will be located less than 10 km from a BWA base station.

• spectrum-licensed mobile receivers in the band 1805-1820 MHz will be set back at least 7.5 km from regional/remote area boundaries, compared to a BWA cell radius of 10 km (a 2.5 km overlap). Consequently, BWA subscriber stations and 1805-1820 MHz spectrum licensed mobile receivers may be operating in the same location and subject to interference, if a BWA base station is located on a regional/remote area boundary.

Considering the above it is believed that BWA base stations operating in the band 1795-1805 MHz can be located on regional/remote area boundaries with a low probability of interference from spectrum-licensed base station transmitters operating in the band 1805-1820 MHz or interference to mobile station receivers. Uncoordinated operation of 1795-1805 MHz BWA subscriber stations in regional areas is not supported.

12. Discussion and Summary of Proposed Technical Framework

12.1. Available Channels and Areas

Interference assessments show that:

• In 1.8 GHz major capital city spectrum-licensed areas where there is a higher density of spectrum-licensed services operation of BWA services in the band 1785-1805 MHz is not considered viable (see section 7).

• In regional areas a guard band of 10 MHz may be required, which could be reduced to 5.6 MHz with further assessment, to protect BWA receivers from interference from spectrum licensing base stations. The guard band could be further reduced to 5 MHz if spectrum licensing base station out-of-band emissions are lower than those specified in licence conditions or operation is on a coordinated basis (see sections 9 & 10).

• No additional restrictions are required at major capital city/regional boundaries and regional/remote boundaries due to typical spectrum licensing setback distances (“dead zones”) at area boundaries (see section 11).

Resulting channel availability by area is shown in Table 12.1.

Table 12.1: Channel Availability by Area

<table>
<thead>
<tr>
<th>Channel</th>
<th>Major City</th>
<th>Regional</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>1785-1790 MHz</td>
<td>Available</td>
<td>Available</td>
<td></td>
</tr>
<tr>
<td>1790-1795 MHz</td>
<td>Not available (see section 7)</td>
<td>Available</td>
<td></td>
</tr>
<tr>
<td>1795-1800 MHz</td>
<td>Not available (see section 10)</td>
<td>Available</td>
<td></td>
</tr>
<tr>
<td>1800-1805 MHz</td>
<td>Available</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12.2. EIRP and Out-of-Band Emission Levels

Regional Areas

BWA EIRP levels have been chosen so that the required BWA out-of-band emission levels are practicably achievable and support a no coordination framework (between BWA and spectrum licensing). With over 60 MHz of separation between 1785-1805 MHz and regional spectrum licensing base station receivers in the band 1710-1725 MHz, emission limits as
calculated in section 7 should be readily achievable with BWA services operating at the nominal EIRP levels (see section 6).

The band 1725-1785 MHz is not spectrum licensed in regional areas, though it may be in the future, and hence the nominal out-of-band emission levels of section 6 are considered adequate.

In the band 1805-1880 MHz, limitations on out-of-band emissions levels are to protect spectrum licensing mobile receivers. In the interference assessments of section 7 it was considered that an out-of-band emission level of -45.23 dBmEIRP/30 kHz could support a no coordination framework (between BWA and spectrum licensing). That limit requires the emissions outside the band to be reduced by 70 dB for BWA base stations and 60 dB for fixed subscriber stations operating at nominal EIRP levels.

With a 10 MHz guard band (1795-1805 MHz) required to protect BWA receivers (see section 12.1) it is considered that the proposed limit is achievable by base stations, but some subscriber stations, depending on design, may find the proposed limit demanding.

Resulting EIRP and out-of-band emission levels are shown in Table 12.2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Base Station</th>
<th>Remote (Subscriber) Station</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EIRP</strong></td>
<td>10 W/MHz (25 dBm/30 kHz)</td>
<td>1W/MHz (15 dBm/30kHz)</td>
</tr>
<tr>
<td><strong>Out-of-Band Emission Limits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1710-1725 MHz</td>
<td>-75 dBm/30 kHz</td>
<td>-67 dBm/30 kHz</td>
</tr>
<tr>
<td>1725-1785 MHz</td>
<td>-35 dBm/30 kHz</td>
<td>-35 dBm/30 kHz</td>
</tr>
<tr>
<td>1805-1880 MHz</td>
<td>-45 dBm/30 kHz</td>
<td>-45 dBm/30 kHz</td>
</tr>
</tbody>
</table>

* Levels have been rounded to nearest integer.

Remote Areas:
With no spectrum licensing interference issues to consider there are no resulting imitations on EIRP and out-of-band emission levels. General guidance on requirements can be found in Attachment 3 “BWA System Deployment Model” of RALI FX19 [5].

**12.3. Assignment Priority**

Proposed channel assignment priority rules for the band 1785-1805 MHz are similar to those of RALI FX 19 (see section 4.8 of RALI FX19) for the band 1900-1920 MHz.

As a general principle where an applicant already has assigned 1785-1805 MHz band channels in an adjacent area that applicant should whenever possible be assigned the same channels. In other cases channels should be assigned from the highest available channel as listed in Table 12.3.

<table>
<thead>
<tr>
<th>Assignment Priority</th>
<th>Area</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regional</td>
<td>Remote</td>
</tr>
<tr>
<td>1</td>
<td>1790-1795 MHz</td>
<td>1800-1805 MHz</td>
</tr>
<tr>
<td>2</td>
<td>1785-1790 MHz</td>
<td>1795-1800 MHz</td>
</tr>
<tr>
<td>3</td>
<td>NA</td>
<td>1790-1795 MHz</td>
</tr>
<tr>
<td>4</td>
<td>NA</td>
<td>1785-1790 MHz</td>
</tr>
</tbody>
</table>
13. References


**Extract from Spectrum Plan**

<table>
<thead>
<tr>
<th>Region 1</th>
<th>Region 2</th>
<th>Region 3</th>
<th>Australian Table of Allocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 710 – 1 930</td>
<td>FIXED</td>
<td>MOBILE 380 384A 388A</td>
<td>1 710 – 1 930</td>
</tr>
<tr>
<td></td>
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<td>149 341 385 386 387 388</td>
<td>149 341 385 386 388</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AUS87</td>
</tr>
</tbody>
</table>

**AUS87**  
Radio astronomy facilities operated by the CSIRO at the Paul Wild Observatory Narrabri (latitude 30° 59' 52.048" S, longitude 149° 32' 56.327" E), the Parkes Observatory (latitude 32° 59' 59.8657" S, longitude 148° 15' 44.3591" E), and the Mopra Observatory Coonabarabran (latitude 31° 16' 4.451" S, longitude 149° 5' 58.732" E) and by the University of Tasmania at the Mount Pleasant Observatory Hobart (latitude 42° 48' 12.9207" S, longitude 147° 26' 25.854" E) and the Ceduna Observatory (latitude 31° 52' 08.8269" S, longitude 133° 48' 35.3748" E), and at the Canberra Deep Space Communication Complex (latitude 35° 23' 54" S, longitude 148° 58' 40" E) conduct passive observations in the frequency bands 1 250 - 1 780 MHz, 2 200 - 2 550 MHz, 4 350 - 6 700 MHz, 8 000 - 9 200 MHz and 16 - 26 GHz using receivers that are highly sensitive to interference.
In making assignments to stations of other services to which the bands:

13 360-13 410 kHz, 4 825-4 835 MHz, 48.94-49.04 GHz, 825-835 MHz, 48.94-49.04 GHz,
25 550-25 670 kHz, 4 950-4 990 MHz, 76-86 GHz, 500-670 kHz, 4950-4990 MHz, 76-86 GHz,
37.5-38.25 MHz, 4 990-5 000 MHz, 92-94 GHz, 37.5-38.25 MHz, 4990-5000 MHz, 92-94 GHz,
73-74.6 MHz, 6 650-6 675.2 MHz, 94.1-100 GHz, 73-74.6 MHz, 6650-6675.2 MHz, 94.1-100 GHz,
Regions 1 and 3, 10.6-10.68 GHz, 102-109.5 GHz, 6.65-6.6752 GHz, 10.66-10.68 GHz, 102-109.5 GHz,
150.05-153 MHz in Region 1, 14.47-14.5 GHz, 111.8-114.25 GHz, 150.05-153 MHz in Region 1, 14.47-14.5 GHz, 111.8-114.25 GHz,
322-328.6 MHz, 22.01-22.21 GHz, 128.33-128.59 GHz, 322-328.6 MHz, 22.01-22.21 GHz, 128.33-128.59 GHz,
406.1-410 MHz, 22.21-22.5 GHz, 129.23-129.49 GHz, 406.1-410 MHz, 22.21-22.5 GHz, 129.23-129.49 GHz,
608-614 MHz in Regions 1 and 3, 22.81-22.86 GHz, 130-134 GHz, 608-614 MHz in Regions 1 and 3, 22.81-22.86 GHz, 130-134 GHz,
1 330-1 400 MHz, 23.07-23.12 GHz, 136-148.5 GHz, 1330-1400 MHz, 23.07-23.12 GHz, 136-148.5 GHz,
1 610.6-1 613.8 MHz, 31.2-31.3 GHz, 151.5-158.5 GHz, 1610.6-1613.8 MHz, 31.2-31.3 GHz, 151.5-158.5 GHz,
Regions 1 and 3, 31.5-31.8 GHz, 168.59-168.93 GHz, 1610.6-1613.8 MHz, 31.5-31.8 GHz in Regions 1 and 3, 168.59-168.93 GHz,
1 660-1 670 MHz, 36.43-36.5 GHz, 171.11-171.45 GHz, 1660-1670 MHz, 36.43-36.5 GHz, 171.11-171.45 GHz,
1 718.8-1 722.2 MHz, 42.5-43.5 GHz, 172.31-172.65 GHz, 1718.8-1722.2 MHz, 42.5-43.5 GHz, 172.31-172.65 GHz,
2 655-2 690 MHz, 42.77-42.87 GHz, 173.52-173.85 GHz, 2655-2690 MHz, 42.77-42.87 GHz, 173.52-173.85 GHz,
3 260-3 267 MHz, 43.07-43.17 GHz, 195.75-196.15 GHz, 3260-3267 MHz, 43.07-43.17 GHz, 195.75-196.15 GHz,
3 332-3 339 MHz, 209-226 GHz, 3332-3339 MHz, 43.37-43.47 GHz, 210-226 GHz, 3332-3339 MHz, 43.37-43.47 GHz, 210-226 GHz,
3 345.8-3 352.5 MHz, 241-250 GHz, 252-275 GHz, 3345.8-3352.5 MHz, 43.37-43.47 GHz, 210-226 GHz, 241-250 GHz, 252-275 GHz

are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 4.5 and 4.6 and Article 29).

In the bands 1 400 - 1 727 MHz, 101 - 120 GHz and 197 - 220 GHz, passive research is being conducted by some countries in a programme for the search for intentional emissions of extraterrestrial origin.

The bands 1 670 - 1 675 MHz and 1 800 - 1 805 MHz are intended for use, on a worldwide basis, by administrations wishing to implement aeronautical public correspondence. The use of the band 1 670 - 1 675 MHz by stations in the systems for public correspondence with aircraft is limited to transmissions from aeronautical stations and the use of the band 1 800 - 1 805 MHz is limited to transmissions from aircraft stations.

The bands, or portions of the bands, 1 710 - 1 885 MHz and 2 500 - 2 690 MHz, are identified for use by administrations wishing to implement International Mobile Telecommunications-2000 (IMT-2000) in accordance with Resolution 223 (WRC-2000). This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations.

Additional allocation: the band 1 718.8 - 1 722.2 MHz is also allocated to the radio astronomy service on a secondary basis for spectral line observations.
Additional allocation: the band 1 750-1 850 MHz is also allocated to the space operation (Earth-to-space) and space research (Earth-to-space) services in Region 2, in Australia, Guam, India, Indonesia and Japan on a primary basis, subject to agreement obtained under No. 9.21, having particular regard to troposcatter systems. (WRC-03)

The bands 1 885 - 2 025 MHz and 2 110 - 2 200 MHz are intended for use, on a worldwide basis, by administrations wishing to implement International Mobile Telecommunications-2000 (IMT-2000). Such use does not preclude the use of these bands by other services to which they are allocated. The bands should be made available for IMT-2000 in accordance with Resolution 212 (Rev.WRC-97). (See also Resolution 223 (WRC-2000).)

In Regions 1 and 3, the bands 1 885-1 980 MHz, 2 010-2 025 MHz and 2 110-2 170 MHz and, in Region 2, the bands 1 885-1 980 MHz and 2 110-2 160 MHz may be used by high altitude platform stations as base stations to provide International Mobile Telecommunications-2000 (IMT-2000), in accordance with Resolution 221 (Rev.WRC-03). Their use by IMT-2000 applications using high altitude platform stations as base stations does not preclude the use of these bands by any station in the services to which they are allocated and does not establish priority in the Radio Regulations. (WRC-03)
ATTACHMENT B: AREAS AND MAPS

Major capital city areas
1.8 GHz spectrum-licensed major capital city areas are areas known as “Adelaide”, “Brisbane”, “Melbourne”, “Perth” and “Sydney” as defined in Spectrum Re-allocation Declaration No. 3 of 1997.

Regional areas
Regional areas are the areas known as “Area A—Eastern Coast” and “Area B—Western Australia Rural” as defined in Spectrum Re-allocation Declaration No. 4 of 1997.

Remote areas
Remote areas are areas outside major capital city and regional areas.

Maps
B.1: 1.8 GHz spectrum licensing areas and existing services
- 1.8 GHz spectrum-licensed base station transmitters
- Apparatus licensed GSM 1800 MHz base stations
- Co-channel fixed point-to-point links (1785-1805 MHz)
Analysis of Technical Characteristics of Regional 1900-1920 MHz BWA Systems

The analysis is this attachment is based on November 2006 ACMA radiocommunications licensing data.

Table C.1: EIRP of BWA Base Station Transmitters in the band 1900-1920 MHz

<table>
<thead>
<tr>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
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<tr>
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<td>0.89</td>
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<td>2.5</td>
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<td>2.5</td>
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<td>5</td>
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<tr>
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<td>15</td>
<td>12</td>
<td>15</td>
<td>11</td>
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<td>15</td>
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<td>10.5</td>
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<td>15</td>
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<td>2</td>
<td>2</td>
<td>2</td>
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<td>0</td>
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<td>0.5</td>
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<td>3.0</td>
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<td>5.5</td>
<td>6.0</td>
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<td>7.0</td>
<td>8.0</td>
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<td>17.8</td>
<td>18.8</td>
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<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
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<td>2</td>
<td>36</td>
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<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
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<td>92.3</td>
<td>92.9</td>
<td>94.7</td>
<td>98.9</td>
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Table C.2: Antenna Characteristics of BWA Base Station Transmitters in the band 1900-1920 MHz

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<tr>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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<th>O</th>
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<tbody>
<tr>
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<td>11</td>
<td>15</td>
<td>15</td>
<td>11</td>
<td>12</td>
<td>10.5</td>
<td>11</td>
<td>15</td>
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<td>15</td>
</tr>
<tr>
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<td>2</td>
<td>6</td>
<td>6</td>
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<td>2</td>
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<td>0</td>
</tr>
<tr>
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<td>9</td>
<td>9</td>
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<td>14</td>
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<tr>
<td>Systems with the Same Characteristics</td>
<td>12</td>
<td>3</td>
<td>36</td>
<td>87</td>
<td>1</td>
<td>1</td>
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<td>2</td>
<td>3</td>
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<td>91.6</td>
<td>94.6</td>
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<td>97.6</td>
<td>98.2</td>
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