

APPENDIX 7: Coordination of Apparatus Licences with Spectrum Licences: 1.8, 2.1 and 2.2 GHz Band Fixed Services

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1 Introduction

This document provides guidance on the approach to be taken in coordinating proposed 1.8, 2.1 and 2.2 GHz apparatus licensed (AL) fixed service links with spectrum licences (SL), across both the geographic and the frequency boundaries of SL's. The spectrum arrangements for AL and SL radiocommunication services are outlined in the 1.8, 2.1 and 2.2 GHz RF Channel Arrangements and Assignment Instructions in Appendix 1 of the RALI FX 3. The following sections set out the principles for such coordination and point to the relevant coordination requirements and criteria contained in other documents for anticipated AL/SL coordination scenarios.

Users of this appendix should familiarise themselves with the relevant spectrum licensing framework (either the 1.8 or 2 GHz band arrangements).

Documents required to undertake the coordination described in this appendix are,

for 1.8 GHz Band coordination:

- Radiocommunications (Unacceptable Levels of Interference-1800 MHz Band) Determination 1999 (referred to as "s145 determination-1800");
- Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 1800 MHz Band) 1999 (referred to as "RAG-ALRX-1800");
- Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed and Class-licensed Transmitters - 1800 MHz Band) 1999 (referred to as "RAG-ALTX-1800"); and
- Radiocommunications Advisory Guidelines (Protection of Mobile Base Receivers - 1800 MHz Lower Band) 1999 (referred to as "RAG-BaseRxLower-1800");

and for 2.1 and 2.2 GHz Band¹ coordination:

- Radiocommunications (Unacceptable Levels of Interference-2 GHz Band) Determination 2000 (referred to as "s145 determination-2GHz");
- Radiocommunications Advisory Guidelines (Protection of Apparatus-licensed and Class-licensed Receivers - 2 GHz Band) 2000 (referred to as "RAG-ALRX-2GHz"); and
- Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed and Class-licensed Transmitters - 2 GHz Band) 2000 (referred to as "RAG-ALTX-2GHz").

The above determinations and guidelines form part of the interference management framework for spectrum licences in each of the 1.8 and 2 GHz bands. Spectrum licensees will have acquired their spectrum licences on the basis of that framework. Accordingly, it may be expected that spectrum licensees will anticipate that those determinations and guidelines will normally be followed, and that they (the licensees) will be able to establish services within their spectrum space in accordance with that framework. Nevertheless, in some circumstances it may be possible to depart from the framework, for example with the agreement of relevant spectrum licensees. It should be noted, however, that the position is likely to change when licences are traded. In such an event, either such agreements would need to be re-negotiated, or the operating characteristics of devices would have to be modified, to ensure that the framework is again followed.

¹ Note that the spectrum licensed band overlapping the '2.1 GHz Band' for fixed services, is known as the '2 GHz Band' in context of spectrum licensing arrangements.

2 Basic coordination principles

For every proposed 1.8, 2.1 or 2.2 GHz fixed service AL receiver or transmitter, consideration should be given to whether coordination is required across the geographic boundary and also the frequency boundary of all relevant SL's.

In the context of 1.8 GHz spectrum licensing, the terms "remote", "regional" and "major city" are used in the following text to describe areas. Areas defined in the Spectrum Re-allocation Declarations No. 3 of 1997 for Adelaide, Brisbane, Melbourne, Perth and Sydney constitute "major city" areas. The areas defined in Spectrum Re-allocation Declarations No. 4 of 1997 are referred to as "regional" areas, and the remainder of Australia is referred to as "remote". See also the coordination threshold contours map of the 1.8 GHz band Channel Arrangements and Assignment Instructions in Appendix 1 of RALI FX-3.

In the context of 2 GHz spectrum licensing, terms to group areas are not so relevant to interference management. The term "capital city areas" is used, and all other spectrum licence areas are considered to be "regional". No "remote" areas have been allocated at 2 GHz. Areas are defined in the Spectrum Re-allocation Declaration No. 2 of 2000. See also the coordination threshold contours map of the 2.1 GHz band Channel Arrangements and Assignment Instructions in Appendix 1 of RALI FX-3.

2.1 Coordination across the geographic boundary

AL fixed stations requiring coordination with a SL need to coordinate with a "spectrum space" as opposed to traditional coordination which is undertaken with respect to other radiocommunications devices. Therefore, SL coordination principles need to be utilised for coordination of AL fixed stations with SL's.

To determine whether coordination is required across the geographic boundary, a coordination threshold distance is used. The coordination threshold distances for AL fixed stations are specified in section 3 of this appendix and illustrated in the 1.8 and 2.1 GHz Band Channel Arrangements in Appendix 1 of RALI FX-3. Proposed fixed stations (transmitters or receivers) outside this distance should not require coordination with SL's.

2.1.1 Co-channel - Apparatus licence transmitter

To protect a SL from a proposed (ie new or re-tuned) co-channel² AL transmitter, the AL transmitter should be treated as though it were spectrum licensed. That is, the proposed AL transmitter will be considered to not interfere with the SL if the device boundary (a polygon) of the AL transmitter does not intrude into the co-channel SL area. The device boundary criterion and the method to determine the device boundary polygon are specified in a determination made under Section 145 of the *Radiocommunications Act 1992* (referred to as either *s145 determination-1800* or *s145 determination-2GHz*).

Proposed AL (and SL) transmitters in the 1.8 GHz lower band near "areas of high mobile use", in addition to meeting the device boundary criterion specified in the *s145 determination-1800*, must meet a second device boundary requirement. (Areas of high mobile use are defined in

² As SL's are not channelised the term "in-band" is used in spectrum licensing documentation instead of "co-channel". The terms "in-band" or "co-channel" include any AL service with an occupied bandwidth that overlaps the frequency band of the SL considered.

s145 determination-1800 and include all major city areas plus Canberra.) This additional device boundary requirement is set out in RAG-BaseRxLower-1800.

Proposed AL transmitters in the 2 GHz lower band must all meet a second device boundary requirement. This additional device boundary requirement is set out in section 6 of this appendix.

2.1.2 Co-channel - Apparatus licence receiver

As detailed in the relevant RAG-ALRX, proposed (ie. new or re-tuned) AL receivers must accept emissions from devices operated within the SL space up to the maximum levels permitted by the s145 determination and core conditions of the SL. Existing AL receivers are provided with protection as per the RAG-ALRX which points to the protection requirements specified in Appendix 1 to RALI FX 3.

Should a proposed AL receiver fail the standard coordination procedure described in this appendix, the licence applicant may wish to make their own assessment of the risk involved in operating the receiver close to the SL boundary. In doing so they might consider possible locations for SL transmitters such as existing radiocommunications sites or other locations suitable for radiocommunications transmission sites (for example hill or mountain tops) and the probability that a spectrum licensee would deploy systems in the area. If the applicant wishes to proceed with the assignment, such receivers may be proposed for licensing on a “no protection” basis.

2.2 Coordination across the frequency boundary

Coordination across the AL/SL frequency boundary is performed on the basis of potential interference between the proposed device and existing SL devices.

2.2.1 Adjacent band - Apparatus licence transmitter

In coordinating proposed AL transmitters, protection is to be provided to registered SL receivers as per the notional receiver specified in the relevant RAG-ALTX.

2.2.2 Adjacent band - Apparatus licence receiver

AL receivers can expect protection from new SL transmitters to the levels specified in RAG-ALRX which points to the protection requirements specified in Appendix 1 to RALI FX 3. When assigning a new fixed receiver, an assessment of the interference potential of registered SL transmitters should be made.

3 Coordination threshold distance

For fixed service assignments in areas adjacent to SL areas, the coordination threshold distance is specified in Table 3.1.

<i>AL fixed service band</i>	<i>Coordination threshold distance</i>
1.8 GHz Band	200 km
2.1 GHz Band	200 km
2.2 GHz Band	None

Table 3.1

Any proposed fixed station within this distance of a co-channel SL boundary will need to be coordinated with the SL area as described in this appendix. Outside this distance normal microwave fixed services coordination criteria and procedures apply.

In certain scenarios, the coordination threshold distance for transmitters (only) can be reduced. The coordination threshold distance was determined on the basis of protecting an AL fixed service receiver from SL devices within the spectrum space. As a different interference framework applies to SL receivers compared with AL fixed service receivers, lower power AL fixed service transmitters may use a reduced coordination threshold distance if certain criteria are met. These criteria are shown in Table 3.2.

<i>AL fixed service band</i>	<i>AL fixed transmitter criteria</i>	<i>Reduced Tx coordination threshold distance</i>
1.8 GHz Band	AL transmitter EIRP < 54.5 dBm/30 kHz, AND effective antenna height ³ < 400 m.	50 km
2.1 GHz Band	Any AL transmitter in 2.1 GHz Upper Band: 2100 – 2294.5 MHz	50 km
2.2 GHz Band	All cases	None

Table 3.2

4 Coordination scenarios - 1.8 GHz Band

This section addresses each coordination case possible in the 1.8 GHz fixed services band.

4.1 Coordination across the geographic boundary - 1.8 GHz Band

This section addresses each coordination case for 1.8 GHz AL fixed stations that are co-channel with a SL and are outside the SL area.

4.1.1 Co-channel - Apparatus licence transmitter located in the remote area and within 200 km of the regional spectrum licence boundary

The frequency ranges available for this transmitter are:

Lower Band: 1706 - 1805 MHz

Upper Band: 1805 - 1880 MHz and 1900 - 1917 MHz

If the effective occupied bandwidth of the proposed AL transmitter overlaps the frequency ranges 1710 - 1725 MHz or 1805 - 1820 MHz⁴ then coordination with the regional SL is necessary if the proposed transmitter is within 50 km of the regional SL boundary. Coordination should also be undertaken for transmitters more than 50 km from the SL boundary if the EIRP and effective antenna height of the AL transmitter exceed those specified in section 3 of this appendix.

Note: In some areas, particularly Western Australia, an AL transmitter in the remote area may also be within 200 km of a major city area and must coordinate as per section 4.1.3 of this appendix.

To coordinate: A device boundary polygon should be determined in accordance with s145 determination. If the device boundary polygon intrudes into the regional SL area then the assignment is NOT permitted. (If the applicant wishes to pursue the assignment further they could consider ways of reducing the device boundary polygon such as a reduction in power, reducing the effective antenna height, or improved antenna discrimination.)

³ Effective antenna height is defined in Schedule 3 of s145 determination.

⁴ 1710 - 1725 MHz and 1805 - 1820 MHz are the frequency ranges of the regional SL's.

4.1.2 Co-channel - Apparatus licence receiver located in the remote area and within 200 km of the regional spectrum licence boundary

Proposed AL receivers located in the remote area must be coordinated with the regional SL if their related transmitter's effective occupied bandwidth overlaps the frequency ranges 1710 - 1725 MHz or 1805 - 1820 MHz, and the proposed AL receiver is within 200 km of the SL boundary.

Note: In some areas, particularly Western Australia, an AL receiver in the remote area may also be within 200 km of a major city area and must coordinate with the major city area as per section 4.1.4 of this appendix.

To coordinate: A number of methodologies are possible for coordination of an AL receiver with an SL as follows:

(a) A device boundary polygon may be calculated for the receiver using a device boundary criterion. The device boundary is calculated in a manner similar to that for a transmitter as described in s145 determination except that the device boundary criterion is replaced by:

$$\text{RLOP} - \text{LOP}$$

where:

RLOP is the level of protection required by the AL fixed service receiver for normal operation; and

LOP is the level of protection that would be achieved at a particular distance from the SL boundary.

$$\text{RLOP} = \text{WL} - \text{PR} - \text{AD}$$

where:

WL = Wanted receive input Level (dBm) of the fixed service receiver;

PR = Protection Ratio as specified in the 1.8 GHz Assignment Instructions in Appendix 1); and

AD = Antenna Discrimination for the particular radial.

$$\text{LOP} = 63 - L - \text{LL} + 10 \cdot \text{Log}_{10}(\text{N})$$

where:

L = The greater of either FSL or OHL;

LL = Transmission line losses including feeder and combiner losses; and

N = The likely number of 200 kHz bandwidth spectrum licensed transmitters within the receiver bandwidth (suggest N = 4 for coordination with regional boundaries and N= 10 for major city boundaries);

and where:

FSL = free space loss

$$\text{FSL} = 32.45 + 20 \cdot \text{Log}_{10}(\text{Freq}) + 20 \cdot \text{Log}_{10}(\text{Dist})$$

OHL = over the horizon loss⁵

$$\text{OHL} = 29.73 + 30 \cdot \text{Log}_{10}(\text{Freq}) + 10 \cdot \text{Log}_{10}(\text{Dist}) + 30 \cdot \text{Log}_{10}(\text{Theta}) + 20 \cdot \text{Log}_{10}(5 + (0.27 \cdot \text{Theta} \cdot \text{Dist})/4000) + 0.00125 \cdot \text{Theta}^2$$

and where:

⁵ OHL is based on median troposcatter loss for a continental temperate climate (refer to Recommendation P.617-1).

$\text{Theta} = (\text{Dist} - \text{dh})/8.5$ (OHL not valid for $\text{Theta} < 0$);
 $\text{Dist} = \text{Distance}$ along each radial to the boundary (in km) plus 48 km;
 $\text{Freq} = \text{Frequency}$ (in MHz);
 $\text{dh} = 4.123 * (\text{he}_1(\phi_n)^{0.5} + 19.5)$ (OHL not valid for $\text{dh} > \text{Dist}$); and
 $\text{he}_1(\phi_n)$ = the effective antenna height above average terrain for segment 1 for each bearing ϕ_n (in metres) as defined in s145 determination;

OR

(b) A device boundary polygon may be calculated for the receiver using a device boundary criterion as in (a) except that L is the propagation loss determined in accordance with the general method for estimating diffraction loss described in ITU Recommendation P.526, using a path profile derived from the ACMA's digital elevation model RadDEM and an effective earth radius factor of $k=3$, or some other appropriate method.

To calculate L, a notional transmitter is assumed to be located in the geographic area of the SL at a point on each radial 48 km inside the boundary. The notional site height for these transmitters is 350 metres and the notional antenna height above ground is 30 metres.

If coordination fails: If the receiver fails coordination under methods (a) or (b) above, the licence applicant may wish to make their own assessment of the risk involved in operating the receiver close to the SL boundary (refer section 2.1.2 of this appendix). Should the applicant wish to proceed with the assignment **advisory note FA** must be applied to the spectrum access record.

Advisory note FA reads:

“If interference to a station operated under this licence is caused by a radiocommunications device that is authorised to operate under a spectrum licence, the ACMA will consider any dispute from the starting point that the spectrum licence has priority over this licence, irrespective of the date that the spectrum licensed device was first operated.”

4.1.3 Co-channel - Apparatus licence transmitter located in the regional area and within 200 km of the major city spectrum licence boundary

The frequency ranges available for this transmitter are:

Lower Band: 1725 - 1805 MHz

Upper Band: 1820 - 1880 MHz and 1900 - 1917 MHz

If the effective occupied bandwidth of the proposed AL transmitter overlaps the frequency ranges 1725 - 1785 MHz or 1820 - 1880 MHz⁶ then coordination with the major city SL is necessary if the proposed transmitter is within 200 km of the regional SL boundary.

To coordinate: In this case the coordination process differs depending upon whether the proposed transmitter is within the lower or upper bands as additional requirements are placed on transmitters

⁶ 1710 - 1785 MHz and 1805 - 1880 MHz are the frequency ranges of the major city SL's. The lower 15 MHz of each of these blocks is common to the regional SL licences and cannot be used by AL fixed services in regional areas.

in the lower band. Step 1 must be satisfied for transmitters in both bands within 50 km⁷ of the SL boundary. However, Step 2 must also be satisfied for transmitters in the lower band below 1785 MHz that are within 200 km of the major city SL boundary.

Step 1: A device boundary polygon should be determined in accordance with s145 determination. If the device boundary polygon intrudes into the major city SL area then the assignment is NOT permitted. (If the applicant wishes to pursue the assignment further they could consider ways of reducing the device boundary polygon such as a reduction in power, reducing the effective antenna height, or improved antenna discrimination.)

Step 2: If the proposed AL transmitter is in the lower band, below 1785 MHz, then an additional device boundary requirement must also be met as described in clauses 4.2 and 4.3 of RAG-BaseRxLower-1800. An additional device boundary polygon should be calculated in accordance with the additional device boundary criterion set out in schedule 1 of RAG-BaseRxLower-1800 and using the basic methodology set out in s145 determination.

4.1.4 Co-channel - Apparatus licence receiver located in the regional area and within 200 km of the major city spectrum licence boundary

Proposed AL receivers located in the regional area must be coordinated with the major city SL if their related transmitter's effective occupied bandwidth overlaps the frequency ranges 1725 - 1785 MHz or 1820 - 1880 MHz, and the proposed AL receiver is within 200 km of the SL boundary. As SL transmitters in the lower of these bands are restricted to low effective antenna heights (10 m or less), AL receivers in the lower band will be able to be sited closer to the SL boundary than in the upper band.

To coordinate: A number of methodologies to coordinate an AL receiver with an SL are possible:

(a) For receivers operating in either of the above mentioned bands, a device boundary polygon could be calculated using the device boundary criterion set out in section 4.1.2 of this appendix except that for frequency range 1725 - 1785 MHz:

Dist = Distance along the radial in km to the point where the radial crosses the 48 metre elevation contour of RadDEM after entering a (major city) area of high mobile use; and

$$dh = 4.123 * (he_1(\phi_n)^{0.5} + 7.6) - \text{for (major city) areas of high mobile use.}$$

OR

(b) A device boundary polygon may be calculated for the receiver using a device boundary criterion as in (a) except that L is the propagation loss determined in accordance with the general method for estimating diffraction loss described in ITU Recommendation P.526, using a path profile derived from the ACMA's digital elevation model RadDEM and an effective earth radius factor of k=3, or some other appropriate method.

To calculate L, a notional transmitter is assumed to be located inside the geographic area of the SL on each radial at the point where the radial crosses the 48 metre elevation contour of RadDEM after

⁷ A coordination threshold distance of 50 km is appropriate only if the EIRP and effective antenna height of the proposed AL transmitter are consistent with that specified in section 3 of this appendix. Transmitters not meeting these requirements must be coordinated when within 200 km of the SL boundary.

entering a (major city) area of high mobile use. The notional antenna height above ground for the transmitter is 10 metres.

If coordination fails: If the receiver fails coordination under methods (a) or (b) above, the licence applicant may wish to make their own assessment of the risk involved in operating the receiver close to the SL boundary (refer section 2.1.2 of this appendix). Should the applicant wish to proceed with the assignment **advisory note FA** must be applied to the spectrum access record.

Advisory note FA reads:

“If interference to a station operated under this licence is caused by a radiocommunications device that is authorised to operate under a spectrum licence, the ACMA will consider any dispute from the starting point that the spectrum licence has priority over this licence, irrespective of the date that the spectrum licensed device was first operated.”

4.2 Coordination across the frequency boundary - 1.8 GHz Band

1.8 GHz AL fixed stations sited within SL areas but outside the SL frequency bands must be coordinated as described in this section. AL fixed stations in close proximity to SL boundaries should also pay regard to protection of and interference from SL devices.

4.2.1 Adjacent band - Apparatus licence transmitter located in the regional area

If an AL transmitter is proposed for operation in a regional area it must be coordinated with all registered SL receivers in the frequency ranges 1710 - 1725 MHz and 1805 - 1820 MHz in accordance with RAG-ALTX. Protection for SL receivers is provided to the levels required by the notional SL receiver specified in schedule 1 of RAG-ALTX. (Refer also to clause 2.5; to part 4; and to schedule 2; of RAG-ALTX). AL transmitters must comply with the emission criteria requirements specified in Part 3.2.3 of RALI FX 3.

4.2.2 Adjacent band - Apparatus licence receiver located in the regional area

If an AL receiver is proposed for operation in a regional area it must be coordinated with registered SL transmitters in the frequency ranges 1710 - 1725 MHz and 1805 - 1820 MHz in accordance with clause 2.5 of RAG-ALRX.

4.2.3 Adjacent band - Apparatus licence transmitter located in a major city area

If an AL transmitter is proposed for operation in a major city area it must be coordinated with all registered SL receivers in the frequency ranges 1710 - 1785 MHz and 1805 - 1880 MHz in accordance with RAG-ALTX. Protection for SL receivers is provided to the levels required by the notional SL receiver specified in schedule 1 of RAG-ALTX. (Refer also to clause 2.5; to part 4; and to schedule 2; of RAG-ALTX). AL transmitters must comply with the emission criteria requirements specified in Part 3.2.3 of RALI FX 3.

4.2.4 Adjacent band - Apparatus licence receiver located in a major city area

If an AL receiver is proposed for operation in a major city area it must be coordinated with all registered SL transmitter in the frequency ranges 1710 - 1785 MHz and 1805 - 1880 MHz in accordance with clause 2.5 of RAG-ALRX.

5 Coordination scenarios - 2.1 and 2.2 GHz Bands

This section addresses each coordination case possible in the 2.1 and 2.2 GHz fixed services bands.

5.1 Coordination across the geographic boundary - 2.1 GHz Band

This section addresses each coordination case for 2.1 GHz AL fixed stations that are co-channel with a SL and are outside the SL area. 2.2 GHz AL fixed stations do not operate co-channel and are therefore not addressed in the following sections.

5.1.1 Co-channel - Apparatus licence transmitter within 200 km of the spectrum licence boundary

The frequency ranges available for this transmitter are:

Lower Band: 1893 - 2100 MHz

Upper Band: 2100 – 2294.5 MHz

If the effective occupied bandwidth of the proposed AL transmitter overlaps the frequency ranges 1900 - 1980 MHz or 2110 - 2170 MHz⁸ then coordination with the major city SL is necessary if the proposed transmitter is within 200 km of the major city SL boundary. If the effective occupied bandwidth of the proposed AL transmitter overlaps the frequency ranges 1960 - 1980 MHz or 2150 - 2170 MHz then coordination with the regional SL is necessary if the proposed transmitter is within 200 km of the regional SL boundary.

To coordinate: In this case the coordination process differs depending upon whether the proposed transmitter is within the lower or upper bands as additional requirements are placed on transmitters in the lower band. Case 1 must be satisfied for transmitters in the Upper Band within 50 km⁹ of the SL boundary. Case 2 must be satisfied for transmitters in the Lower Band below 1980 MHz that are within 200 km of the SL boundary.

Case 1: A device boundary polygon should be determined in accordance with s145 determination. If the device boundary polygon intrudes into the SL area then the assignment is NOT permitted. (If the applicant wishes to pursue the assignment further they could consider ways of reducing the device boundary polygon such as a reduction in power, reducing the effective antenna height, or improved antenna discrimination.)

Case 2: If the proposed AL transmitter is in the Lower Band, below 1980 MHz, then the additional device boundary requirement must be met. The additional device boundary polygon should be calculated in accordance with the additional device boundary criterion set out in section 6 "Additional Device Boundary Requirement -- 2.1 GHz Band transmitters", which follows the basic methodology set out in s145 determination.

5.1.2 Co-channel - Apparatus licence receiver within 200 km of the spectrum licence boundary

If the effective occupied bandwidth of the proposed AL receiver's related transmitter overlaps the frequency ranges 1900 - 1980 MHz or 2110 - 2170 MHz then coordination with the major city SL is necessary if the proposed receiver is within 200 km of the major city SL boundary. If the effective occupied bandwidth of the proposed AL receiver's related transmitter overlaps the frequency ranges 1960 - 1980 MHz or 2150 - 2170 MHz then coordination with the regional SL is necessary if the proposed receiver is within 200 km of the regional SL boundary.

⁸ 1900 - 1980 MHz and 2110 - 2170 MHz are the frequency ranges of the major city SL's. The upper 20 MHz of each of these blocks is common to the regional SL licences and cannot be used by AL fixed services in regional areas.

⁹ This reduction is because coordination is in the 2 GHz SL band typically used for 'mobile Rx' (high site-to-low site).

To skip receiver coordination: Instead of following the receiver coordination method below, the licence applicant may wish to make their own assessment of the risk involved in operating the receiver close to the SL boundary (refer section 2.1.2 of this appendix). In this case, **advisory note FA** must be applied to the spectrum access record.

Advisory note FA reads:

“If interference to a station operated under this licence is caused by a radiocommunications device that is authorised to operate under a spectrum licence, the ACMA will consider any dispute from the starting point that the spectrum licence has priority over this licence, irrespective of the date that the spectrum licensed device was first operated.”

To coordinate: The method for coordination of an AL receiver with a SL is:

A device boundary polygon may be calculated for the receiver using a device boundary criterion. The device boundary is calculated in a manner similar to that for a transmitter as described in s145 determination except that the device boundary criterion is replaced by:

$$\text{RLOP} - \text{LOP}$$

where:

RLOP is the level of protection required by the AL fixed service receiver for normal operation; and

LOP is the level of protection that would be achieved at a particular distance from the SL boundary.

$$\text{RLOP} = \text{WL} - \text{PR} - \text{AD}$$

where:

WL = Wanted receive input Level (dBm per 30 kHz¹⁰) of the fixed service receiver;

PR = Protection Ratio as specified in the 2 GHz Assignment Instructions in Appendix 1); and

AD = Antenna Discrimination for the particular radial.

$$\text{LOP} = 55 - \text{L}$$

where:

L = The greater of either FSL or OHL;

and where:

FSL = free space loss

$$\text{FSL} = 32.45 + 20 \cdot \text{Log}_{10}(\text{Freq}) + 20 \cdot \text{Log}_{10}(\text{Dist} + 48)$$

OHL = over the horizon loss¹¹

$$\text{OHL} = 29.73 + 30 \cdot \text{Log}_{10}(\text{Freq}) + 10 \cdot \text{Log}_{10}(\text{Dist} + 48) + 30 \cdot \text{Log}_{10}(\text{Theta}) + 20 \cdot \text{Log}_{10}(5 + (0.27 \cdot \text{Theta} \cdot (\text{Dist} + 48)) / 4000) + 0.00125 \cdot \text{Theta}^2$$

and where:

$$\text{Theta} = (\text{Dist} + 48 - \text{dh}) / 8.5 \quad (\text{OHL not valid for } \text{Theta} < 0);$$

Dist = Distance along each radial to the boundary (in km);

¹⁰ Note bandwidth conversion required here.

¹¹ OHL is based on median troposcatter loss for a continental temperate climate (refer to Recommendation P.617-1).

Freq = Frequency (in MHz);
 $dh = 4.123 * (he_1(\phi_n)^{0.5} + 7.6)$ (OHL not valid for $dh > Dist+48$); and
 $he_1(\phi_n)$ = the effective antenna height above average terrain for segment 1 for each bearing ϕ_n (in metres) as defined in s145 determination;

In this above calculation of L, a notional transmitter is assumed to be located in the geographic area of the SL at a point on each radial 48 km inside the boundary. The notional site height for these transmitters is 350 metres and the notional antenna height above ground is 30 metres.

If coordination fails: If the receiver fails coordination under the method above, the licence applicant may wish to make their own assessment of the risk involved in operating the receiver close to the SL boundary (refer section 2.1.2 of this appendix). Should the applicant wish to proceed with the assignment **advisory note FA** must be applied to the spectrum access record. The text for Advisory Note FA can be found on the previous page of this appendix.

5.2 Coordination across the frequency boundary - 2.1 and 2.2 GHz Bands

2.1 and 2.2 GHz AL fixed stations sited within SL areas but outside the SL frequency bands must be coordinated as described in this section. AL fixed stations in close proximity to SL boundaries should also pay regard to protection of and interference from SL devices.

5.2.1 Adjacent band - Apparatus licence transmitter located in a spectrum licensed area

If an AL transmitter is proposed for operation in a spectrum licensed area it must be coordinated with all registered SL receivers in the frequency ranges shown in Table 5.2, in accordance with RAG-ALTX-2GHz.

Spectrum Licence Area	Frequency range
Adelaide, Brisbane, Darwin, Hobart, Melbourne, Perth and Sydney	1900-1980 and 2110-2170 MHz
Canberra	1900-1920, 1935-1980 and 2125-2170 MHz
Regional areas	1960-1980 and 2150-2170 MHz

Table 5.2: 2 GHz Spectrum Licence frequency ranges

Protection for SL receivers is provided to the levels required by the notional SL receiver specified in schedule 1 of RAG-ALTX-2GHz. (Refer also to clause 2.2; to part 4; and to schedule 2; of RAG-ALTX-2GHz). AL transmitters must comply with the emission criteria requirements specified in Part 3.2.3 and Appendix 3 of RALI FX 3.

5.2.2 Adjacent band - Apparatus licence receiver located in a spectrum licensed area

If an AL receiver is proposed for operation in a spectrum licensed area it must be coordinated with all registered SL transmitters in the frequency ranges shown in Table 5.2, in accordance with clause 2.6 of RAG-ALRX-2GHz.

6 Additional Device Boundary Requirement - 2.1 GHz Band transmitters

The additional device boundary requirement follows a method very similar to that detailed in s145 determination-2GHz, with a replaced device boundary criteria and propagation model. The new propagation model accounts for diffraction and terrain profiles.

The additional device boundary is calculated according to the distance that is necessary to satisfy the following device boundary criterion. This distance is measured along radials of a maximum length of 150 minutes (measured by reference to the Australian National Spheroid) at every 2.5 degrees of arc (beginning at 1.25 degrees from True North) and centred on the transmitter location. However, this additional criterion does not have to be satisfied if:

- (a) the licensee has an agreement with the licensee(s) of a spectrum licence whose geographic area is intersected by the radials and whose frequency band contains the effective occupied bandwidth of the transmitter, to operate transmitters that do not comply with the additional device boundary criterion; or
- (b) in the case of a transmitter operating under an apparatus licence, the licence was issued before the date of issue of the *Radiocommunications Spectrum Marketing Plan (2 GHz Bands) 2000*.

The device boundary criterion is:

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

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

Calculation of Horizontally Radiated Power (HRP)

HRP (dBm EIRP per 30 kHz) is the horizontally radiated power for each radial. Note that there is a cap on HRP of 55 dBm EIRP per 30 kHz for transmitters operating under spectrum licences.

High Site-High Site Propagation Model (Lb)

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

The path profile may be obtained by calculating equi-spaced (in degrees) locations every 9 seconds along the radial from the transmitter site, reading the elevation of the RadDEM cell in which each calculated location occurs.

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

The notional receiver antenna height above ground is 30 metres.

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

Compatibility Requirement

The level of protection for notional receivers (typically a base station) is -126 dBm/30 kHz. The Notional antenna for a fixed receiver has a total gain of 19 dBi in all directions, including feeder losses.
