Commonwealth of Australia

Radiocommunications Act 1992

Radiocommunications Spectrum Conversion Plan (500 MHz Band) 1996.

I, CHRISTINE MARY GOODE, Spectrum Manager, prepare on behalf of the Spectrum Management Agency the following Conversion Plan under section 38 of the *Radiocommunications Act 1992*.

Dated 6 November 1996.

CHRISTINE M. GOODE
Spectrum Manager

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Summary of conversion scheme

Parts of the 500 MHz Band have been designated under s.36 of the *Radiocommunications Act 1992* as being available for allocation by issuing spectrum licences. Vacant spectrum will be allocated by auction, as set out in the marketing plan prepared by the SMA under s.39 of the Act. (Details of the auction system are in the procedures determined by the SMA under s.60.) Holders of existing apparatus licences for apparatus that operate in the 500 MHz Band will be offered the opportunity to convert to spectrum licences. The general scheme for converting these existing licences is set out in ss.52-59 of the Act. The Act (s.38) also requires the SMA to prepare a conversion plan to fill in the details of the conversion process.

A summary of the overall conversion scheme follows:

- after this Conversion Plan has been prepared, the SMA will prepare a draft spectrum licence for each apparatus licence (s.53). The replacement licence must allow the operation of radiocommunications devices to at least the same extent as the old apparatus licence. The draft licence will contain core conditions and conditions relating to other aspects of spectrum use (ss.66-71).
- the SMA will then send the draft licence to the existing licensee (s.54), and ask the licensee for comments on the licence. The licensee will have 30 working days to comment (Cl. 20)
- if the licensee gives comments to the SMA about the draft licence, the SMA must consider them, and may change the draft licence (s.55). While considering the comments, the SMA may discuss them, and any proposed changes to the draft licence, with the licensee (Cl. 21).
- the SMA will then offer the licensee a spectrum licence in exchange for the apparatus licence (s.56), and tell the licensee the amount of the spectrum access charge payable. The licensee will have one month to accept the offer (Cl. 22).
- if the licensee accepts the offer and agrees to pay the spectrum access charge, the SMA will issue the spectrum licence to the licensee (s.57)
- if the licensee does not accept the SMA's offer, the SMA may allocate the spectrum licence to someone else and the apparatus licence ceases to be in force (s.58).
- the spectrum licence will come into force on the day specified in the licence, and will be in force for the period set out in the licence (s.65). This period cannot be longer than 10 years. The SMA intends that all spectrum licences for a particular band be in force for approximately 10 years, and expire at the same time.
- Once the band has been designated, no new apparatus licences will be issued except in special circumstances (s.105).

Title

1. This Plan is called the Radiocommunications Spectrum Conversion Plan (500 MHz Band) 1996.

Commencement

2. This Plan commences on 6 November 1996.

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Purpose

3. This Plan sets out procedures and a timetable for converting existing apparatus licences for radiocommunications transmitters and receivers in the 500 MHz band to spectrum licences.

Interpretation

4.(1) In this Plan, unless the contrary intention appears:

Acceptance Form means the form approved by the SMA under clause 6.

Act means the *Radiocommunications Act 1992.*

allocation determination means the determination under section 60 of the Act about the allocation of spectrum licences in the 500 MHz Band.

cell means a square with a side measured in degrees by reference to the Australian National Spheroid.

device boundary, in relation to a receiver or a group of receivers, means the device boundary established in accordance with Part 1 of Schedule 1.

draft licence means a draft of a spectrum licence prepared by the SMA under section 53 of the Act to replace an apparatus licence.

effective antenna height means the effective height of an antenna, calculated in accordance with Schedule 2.

emission limits outside the area means the maximum permitted level of radio emission, outside the geographic area of a licence, that may be caused by operation of radiocommunications devices under the licence.

emission limits outside the band means the maximum permitted level of radio emission, outside the frequency band of a licence, that may be caused by operation of radiocommunications devices.

fixed receiver means a radiocommunications receiver located at a fixed point on land or sea and not established for use while in motion.

geographic area, in relation to a licence, means the area within which operation of a radiocommunications device is authorised under the licence.

group of receivers has the meaning given by clause 5.

horizontally radiated power, in relation to a radiocommunications device, means the radiated maximum true mean power within the frequency band of the licence, summed over all polarizations and measured in units of dBm EIRP, in a direction referenced from, and in the horizontal plane containing, the phase centre of the antenna used with the radiocommunications device.

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in-band, in relation to a transmitter operated under a spectrum licence, means the frequencies within the frequency band of the spectrum to which the licence relates.

level of protection, in relation to a receiver operated under a licence, means the level of protection that:

(a) causes the device boundary of the receiver to be as near as possible to the boundary of the geographic area of the licence while remaining within that geographic area; and

(b) is never less than -139 dBm per 12.5 kHz.

licensee means the holder of an apparatus licence.

LOP criterion (500 MHz) has the meaning given by Part 2 of Schedule 1.

Marketing Plan means the Radiocommunications Spectrum Marketing Plan (500 MHz Band) 1996 prepared by the SMA under section 39 of the Act.
[NOTE: Copies of the Marketing Plan are available from the SMA.]

maximum true mean power means the true mean power measured in a 12.5 kHz rectangular bandwidth that is located within a specified frequency band such that the true mean power is the maximum of true mean powers produced.

mean power means the average mean power measured during an interval of time that is at least ten times the period of the lowest modulation frequency.

mobile receiver means a radiocommunications receiver established for use while in motion or during halts at unspecified points on land or sea.

peak power means the average power during one radio frequency cycle at the crest of the signal envelope measured in a 12.5 kHz rectangular bandwidth that is located within a specified frequency band.

s.145 determination means the determination of unacceptable levels of interference, as in force from time to time, made by the SMA under section 145 of the Act.
[NOTE: Copies of the determination are available from the SMA.]

spectrum map grid means the map grid developed by the SMA for Australia, showing cells the sides of which measure 3 degrees of arc, 1 degree of arc or 5 minutes of arc, published by the SMA, copies of which are available from the SMA.

spurious radio emission means any emission on a frequency whose level may be reduced without affecting the corresponding transmission of information:

(a) including harmonic, parasitic, intermodulation, frequency conversion products and products from instabilities introduced by the modulation process; and

(b) excluding products that are a necessary result of the modulation process and switching transients.

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standard trading unit (STU) means a parcel of spectrum space that consists of:

(a) a frequency band having lower and upper frequency limits defined by:

(i) 500.99375 + n x .0125 and (n+1) x .0125 respectively; or

(ii) 510.99375 + n x .0125 and (n+1) x .0125 respectively;

where n is any integer from 0 to 319 (inclusive); and

(b) a geographic area equal to a cell of the spectrum map grid.

true mean power means:

(a) if an unmodulated carrier is present - the mean power measured while the unmodulated carrier is present; and

(b) if an unmodulated carrier is not present - the mean power measured while transmitted information is present.

working day means a day that is not a Saturday, a Sunday or a public holiday in the Australian Capital Territory.

500 MHz band means the following frequency bands:

(a) 500.99375 MHz - 504.99375 MHz (the ***500 MHz Lower ban*d**);

(b) 510.99375 MHz - 514.99375 MHz (the ***500 MHz Upper ban*d**).

[NOTE: The following terms, used in this Plan, are defined in the *Radiocommunications Act 1992* and have the meanings given to them by that Act:

apparatus licence	SMA
frequency band	spectrum licence
licensee.]	

(2) In this Plan, the range of numbers that identifies a frequency band includes the higher, but not the lower, number.

Group of receivers

5. (1) For the purpose of this determination, two or more receivers are a group of receivers if:

(a) they have:

(i) the same intended polarisation for their antennas; and

(ii) for the intended polarisation of their antennas - the same forward gain, 3 dB beamwidth and front to back ratio; and

(b) they are operated for the purpose of receiving information from the same transmitter.

(2) A receiver may belong to more than one group.

Approval of form

6. The SMA must approve, in writing, an Acceptance Form.

Allocation of vacant spectrum

7. The SMA will allocate under the Marketing Plan those parts of the spectrum where apparatus licences have not been issued before offering apparatus licensees the opportunity to convert their apparatus licences to spectrum licences.

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Preparation of draft licences

8. Under section 53 of the Act, the SMA will prepare a draft licence to replace each apparatus licence. The SMA will send the licence to the licensee of the apparatus licence, at the licensee's last known address, as soon as practicable after preparing this Plan.

[NOTE: Section 53 of the Act requires that a draft spectrum licence prepared to replace an apparatus licence must, so far as is practicable, authorise the operation of radiocommunications devices to at least the same extent as the apparatus licence.]

Sample spectrum licence

9. A sample spectrum licence is set out in Schedule 3.

Core licence conditions

10. Section 66 of the Act requires a spectrum licence to contain core conditions that define the parts of the spectrum that can be used under the licence, in terms of:

(a) frequency band; and
(b) geographic area; and
(c) emission limits outside the area; and
(d) emission limits outside the band.

These conditions will be included in the draft licence.

Other licence conditions

11. The spectrum licence will also include conditions about:

(a) payment of charges (section 67 of the Act); and
(b) use by third parties (section 68); and
(c) registration of transmitters (section 69); and
(d) other matters that the SMA may include in the licence (section 71).

These conditions will be included in the draft licence.

Determination of core licence conditions

12. To establish the core licence conditions, the SMA will identify the geographic areas and frequency bands to be included in the proposed replacement spectrum licences to be offered to existing licensees in place of their apparatus licences.

How SMA will identify geographic areas

13. (1) To establish the geographic area to be included in a spectrum licence:

(a) the SMA will identify the radiocommunications devices operated under the apparatus licence to be converted; and
(b) the SMA will then calculate the device boundary of each radiocommunications device:
(i) for transmitters - in accordance with the s.145 determination as it relates to the 500MHz band; and
(ii) for receivers - in accordance with Part 1 of Schedule 1.

(2) The geographic area of the proposed replacement spectrum licence is the area, or the aggregation of areas, described in Schedule 4 of the Marketing Plan that wholly encompasses all the device boundaries.

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(3) This geographic area will then become a core condition of the proposed replacement spectrum licence.

How SMA will identify frequency bands

14. (1) To identify the parts of the spectrum to be included in a spectrum licence, the SMA will calculate the bandwidth occupied by each device operated under the existing apparatus licence by reference to the emission limits outside the band as set out in Schedule 4.

(2) The bandwidth occupied by the device is the minimum width of the frequency band that is necessary for emissions from the device to remain below those emission limits.

(3) The SMA will select the frequency bands described in Schedule 5 of the Marketing Plan that wholly encompass the bandwidth occupied by the device. The frequency bands selected must have the same frequency separations as the existing apparatus licence.

(4) Those bands will then become a core condition of the proposed replacement spectrum licence.

Extent of operation of devices under replacement spectrum licences

15. (1) Section 53 of the Act requires that a draft spectrum licence prepared to replace an apparatus licence must, so far as is practicable, authorise the operation of radiocommunications devices to at least the same extent as the apparatus licence.

(2) In preparing the draft licences, the SMA will take the view that the operation of radiocommunications devices under a spectrum licence prepared to replace an apparatus licence is authorised to the same extent as under the apparatus licence when:

(a) the geographic area of the spectrum licence wholly encompasses the areas of the device boundaries of the radiocommunications devices, as established in accordance with the s.145 determination (for transmitters) and Part 1 of Schedule 1 (for receivers); and

(b) the frequency bands of the spectrum licence:

(i) wholly encompass the bandwidths occupied by the devices; and

(ii) maintain the same frequency separations as the existing apparatus licence; and

(c) the emission limits outside the band are as set out in Schedule 4; and

(d) the emission limits outside the area are as set out in Schedule 5; and

(e) the periods of operation of devices under the spectrum licence are the same as those under the apparatus licence.

(3) The SMA will also take the view that the operation of radiocommunications devices under a spectrum licence prepared to replace an apparatus licence is authorised to a greater extent than under the apparatus licence when:

(a) the geographic area of the spectrum licence is greater than the geographic area of the apparatus licence; and

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(b) the bandwidths of the spectrum licence are greater than the bandwidths occupied by the devices under the apparatus licence.

Emission limits

16. (1) The emission limits outside the band for all spectrum licences are worked out in accordance with Schedule 4.

(2) The emission limits outside the area for all spectrum licences are worked out in accordance with Schedule 5.

[NOTE: These core conditions may be varied - see s.72 of the Act.]

Level of Protection

17. (1) The level of in-band emission from a transmitter operating under a licence, measured at a fixed receiver operating otherwise than under that licence, must be, for not more than 99% of the time in any one hour period, not greater than the value calculated for the level of protection for that receiver plus 20dB.

[NOTES: 1. The level of protection may be taken into account during interference settlement.

2. The level of protection relates to interference caused by in-band emissions from geographically adjacent spectrum licensees and does not relate to interference caused by, for example, intermodulation or services operated under apparatus licences.

3. The level of protection is applied only within an equivalent intermediate frequency bandwidth of the receiver that is based on the effective occupied bandwidth of the transmitter that communicates with the receiver.

4. The same level of protection is provided to a receiver regardless of the gain of the antenna used with the receiver or the bearing of the interfering transmitter.]

(2) The level of emission at the fixed receiver is the level of radio emission received by a notional antenna located as if its phase centre is located at the phase centre of the antenna used with the receiver and measured:

(a) as mean power in units of dBm at the terminals of the notional antenna; and

(b) in relation to 12.5 kHz rectangular bandwidths within the frequency band:

(i) whose upper limit is equal to the emission centre frequency plus half the effective occupied bandwidth of a transmitter that communicates with the receiver; and

(ii) whose lower limit is equal to the emission centre frequency minus half the effective occupied bandwidth of a transmitter that communicates with the receiver.

(3) In subclause (2), ***notional antenna*** means an antenna with a gain of 0 dBi in any direction.

(4) The level of protection for each of the following receivers is never less than -77 dBm per 12.5 kHz:

(a) a fixed receiver whose operation is authorised under a spectrum licence issued for the 500 MHz Lower band when its effective antenna height for segment “m”=1 is greater than 10 metres;

(b) a fixed receiver whose operation is authorised under a spectrum licence issued for the 500 MHz Upper band when its effective antenna height for segment “m”=1 is less than 20 metres;

(c) a mobile receiver.

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[NOTES: 1. Levels of interference up to the level of protection may be encountered in the normal operation of a device under a licence.

2. A receiver may be operated without regard to its level of protection because levels of interference depend upon the existence of any nearby interfering transmitters. For example, in remote areas, receivers operating within the 500 MHz Lower Band at high sites and having poor level of protection may be operated successfully because the likelihood of interference in those locations is low.]

(5) When it is not possible to establish whether a measured level of emission at a fixed receiver meets the requirements of subclause (1) because emission levels cannot be measured in accordance with subclause (2) with equipment of reasonable accuracy and reliability (for example, because of internally generated spurious signals or overload problems in the measuring equipment caused by other transmitters), the SMA will:

(a) estimate the level of emission from the transmitter, having regard to the measurements taken and the circumstances in which the measurements were taken; and

(b) discuss the estimated level with the relevant licensees; and

(c) take whatever action is necessary to resolve any interference that the SMA considers to be the result of the level of transmission. This action may include variation of licence conditions, for example to reduce the level of emission at the receiver.

[NOTES: 1. Measurement of levels of emission at receivers having the benchmark level of protection (down to -119 dBm/12.5 kHz) is often unreliable. In some cases, the interference mechanism is determined by a process of applying remedies to suspected causes rather than by direct measurement.

2. When emission levels can not be reliably measured interference settlement may be effected by providing an acceptable protection ratio between the wanted and unwanted signals, taking account of necessary fading and operating conditions.

3. Operating problems in the absence of a wanted signal, that can be removed by fitting systems such as CTCSS, would not normally be considered to be interference.]

Guidelines

18. The guidelines made by the SMA under section 262 of the Act about interference with radiocommunications may be taken into account in settling interference disputes under Part 4.3 of the Act.

[NOTE: Paragraph 262(2)(c) of the Act authorises the making of guidelines about interference with radiocommunications. Copies of the guidelines are available from the SMA.]

Spectrum access charge

19. (1) Under section 57 of the Act, an apparatus licensee converting to a spectrum licence must agree to pay the spectrum access charge.

(2) The amount of spectrum access charge will be based on the market value of the spectrum described in the draft licence. The SMA will calculate the market value taking into account the value of similar spectrum, by reference to prices paid for lots under the Marketing Plan.

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(3) For each draft licence, the SMA will calculate the spectrum access charge in accordance with the formula:

$$SAC = B \times \frac{\sum (P_{L1}/B_{L1}, P_{L2}/B_{L2}, P_{L3}/B_{L3}, \ldots P_{Ln}/B_{Ln})}{N}$$

where:

SAC is the spectrum access charge to be paid for the licence;

B is the bandwidth of the licence;

$\mathbf{P_{Ln}}$ is the price paid for lot "n" in the same area allocated under the Marketing Plan;

$\mathbf{B_{Ln}}$ is the bandwidth of that lot;

n is the number of lots in that area allocated in the auction.

(4) This charge is determined by the SMA under section 294 of the Act.

For example, in Market "Metropolis" (a single geographic area defined in Schedule 4 of the Marketing Plan), there are four separate frequency bands defined (assume they are not the same bandwidth). One frequency band will be offered to a converting apparatus licensee. The other three (lots A, B and C) are lots defined in the Marketing Plan. The SMA will:

- allocate lots A, B and C under the s.60 determination.
- calculate the price per MHz paid for each lot
- average the prices so calculated
- multiply the frequency bandwidth of the draft licence (in MHz) by the average price.

That will be the SAC for that draft spectrum licence.

(5) If the converted licence will have a shorter term than the spectrum licences allocated under the Marketing Plan, the spectrum access charge will be reduced proportionally.

Licensee's representations

20. (1) Section 54 of the Act allows a licensee to make representations to the SMA about the draft licence, and requires the SMA (in the notice asking the licensee for representations) to give the licensee at least one month to consider and make representations about the draft licence.

(2) In the notice, the SMA will give the licensee 30 working days after the day the notice is given to the licensee in which to make representations to the SMA.

(3) In particular, if the licensee thinks that the draft licence does not authorise the operation of radiocommunications devices to the same extent as the existing apparatus licence, the licensee should tell the SMA this, and give reasons.

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SMA's consideration of licensee's representations

21. (1) Section 55 of the Act requires the SMA to give due consideration to the licensee's representations, and allows the SMA to alter the draft licence.

(2) The SMA will consider all representations and, while considering the representations, will discuss any proposed changes to the draft licence with the licensee.

(3) The SMA will tell the licensee whether or not the SMA has changed the draft licence as a result of the licensee's representations.

Formal offer of spectrum licence

22. (1) Section 56 of the Act requires the SMA to offer a spectrum licence to the licensee as soon as practicable after the closing date for making representations. The offer will be made by a letter addressed to the licensee, at his or her last known address, and will be sent by certified mail.

(2) The offer will contain:

(a) details of the spectrum access charge determined under section 294 of the Act; and

(b) the expiry date of the licence.

Closing date of offer

23. (1) Section 56 of the Act requires the SMA to specify the day the offer will close. This must be at least one month after the date of the offer.

(2) The closing day for the offer will be one month after the day the offer is made to the licensee.

Accepting offer

24. (1) Section 57 of the Act requires a licensee who wants to accept the SMA's offer to give the SMA a written notice before the closing date. The notice must be in accordance with the Acceptance Form and must be given to the SMA by recorded delivery.

(2) As well as doing this, the licensee must sign and return the agreement to pay the spectrum access charge to the SMA before the closing date.

Issue of spectrum licence

25. (1) The spectrum licence to replace the apparatus licence will be issued under section 57 of the Act.

(2) The new licence will be in the same form as a spectrum licence issued under the Marketing Plan for unencumbered spectrum, but core conditions will vary from licence to licence. Re-allocation of the new licence will be in accordance with the Marketing Plan.

[NOTE: Ss.80-82 of the Act deal with re-allocating spectrum licences.]

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Duration of licences

26. (1) The spectrum licences issued under this Plan:

(a) will be for fixed terms as close as possible to, but not exceeding, 10 years; and

(b) will have a common expiry date.

[NOTE: Section 65 of the Act provides that the maximum duration of a spectrum licence is 10 years.]

(2) The expiry date will be the same as the expiry date of licences in the 500 MHz band issued under the Marketing Plan.

Registration of licences

27. (1) The SMA will register spectrum licences, as required by section 144 of the Act.

[NOTE: Details about registration are in the Radiocommunications (Register of Spectrum Licences) Determination 1996, copies of which are available from the SMA.]

(2) Transmitters that are part of a group of transmitters may be registered individually or as a group.

(3) The SMA does not propose to register mobile transmitters that operate:

(a) outside the limits of a town on the towns mobile list; or

(b) on a road that is not on the roads mobile list; or

(c) at sea and only communicate with a mobile receiver at sea.

Trading in licences

28. (1) As permitted by Division 5 of Part 3.2 of the Act, a licensee may assign or otherwise deal with the whole or any part of his or her licence. The SMA will determine rules under section 88 of the Act governing trading in licences. The rules will not allow trading other than in whole standard trading units.

Licences that are about to expire

29. (1) As required by section 78 of the Act, the SMA will publish notices periodically in the *Gazett*e:

(a) stating where information can be obtained about spectrum licences that are due to expire within the next 2 years; and

(b) inviting expressions of interest from people who want to have these licences issued to them.

This information will also be available through area offices of the SMA.

(2) The SMA will also send licensees regular reminders during the last 2 years of their licences that the licences are due to expire.

Re-issue of licences

30. (1) The SMA will re-issue spectrum licences, as required by sections 78-84 of the Act.

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(2) As a general rule, licences will only be re-issued after the lots they cover are offered for re-allocation by auction, tender, or predetermined or negotiated price. In re-allocating the licences, the SMA will follow the procedures set out in the determinations as in force at the time under section 60 of the Act.

(3) However, as set out in section 82 of the Act, the SMA may re-issue a licence to the previous licensee without re-allocating the licence if it is in the public interest to do so. Licensees should not assume that they will be reallocated their existing licence.

Refund of apparatus licence tax

31. (1) Under section 58 of the Act, if a licensee does not accept the offer, the SMA may allocate the spectrum licence to someone else under the procedures determined under section 60 of the Act. The apparatus licence ceases to be in force on issue of the spectrum licence, and the SMA must refund a proportion of the apparatus licence tax paid by the licensee.

(2) The SMA will refund the tax as soon as practicable after the issue of the spectrum licence.

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SCHEDULES

SCHEDULE 1

Clause 4(1)

PART 1

Device boundary of a receiver or a group of receivers

1. The device boundary of a receiver or a group of receivers is established as follows:

Step 1: Calculate the LOP-Criterion (500 MHz) for each increment (m·5) minutes in distance by reference to the Australian National Spheroid, where m is any integer beginning 1 to 30, along each of 36 radials. All increments m=1, begin at the common central point of the radials. The common central point is the centre location of the receiver. The 36 radials have bearings given by the sequence ϕ_0 ϕ_1, ϕ_2,... ϕ_{33}, ϕ_{34}, ϕ_{35} (ϕ_n) according to the sequence rule $\phi_n = n \cdot 10$ degrees referenced to true north.
[NOTE: In the expression "m·5", and similar expressions, the symbol "·" represents the operation of multiplication.]

Step 2: Calculate an end point for each radial as the point corresponding to the sum of :

(a) the distance along the radial equal to the length corresponding to the number of 5 minute increments from the centre location of the receiver that corresponds to the calculated value of the LOP-Criterion (500 MHz) being zero or negative when either all the previous values calculated for that radial are positive, or the number of the increment is equal to 1; and

(b) the effective radius of the centre location, calculated in accordance with Schedule 6.

[Notes: 1. The value of m for each increment is the same as the value of m for the segment referred to in paragraph 2(c) of Schedule 2.

2. The actual distance in kilometres for a 5 minute increment in distance varies according to the direction and location of the radial by reference to the Australian National Spheroid. Distances measured in minutes are accepted usage in mapping.]

Step 3: Identify the location of each end point by reference to the spectrum map grid.

Step 4: Connect the end point of each radial consecutively to draw a polygon in relation to the spectrum map grid cells.

Step 5: Aggregate the spectrum map grid cells that either fall within or are intersected by the polygon. The boundary of this aggregated area is the device boundary of the receiver.

2. In the case of a group of receivers some of which operate in a town that is on the towns mobile list and some of which operate on a section of major road that is on the roads mobile list, a device boundary is to be calculated for each number of receivers that operates in the town or on the major road.

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SCHEDULE 1 - *continued*

3. If there is more than one centre location for a mobile receiver, a device boundary is to be calculated for each centre location.

4. In the case of a receiver that operates at sea and receives information from more than one fixed transmitter, a device boundary is calculated for each fixed transmitter.

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SCHEDULE 1 - *continued*

PART 2

LOP-Criterion (500 MHz)

If:

(a) LOP is the level of protection of a receiver; and

(b) $he_m(\phi_n)$ is the effective antenna height of the receiver (referred to in this Schedule as "he") and measured in metres for segment m (m being any integer from 1 to 30) for each bearing ϕ_n; and

(c) $d_m(\phi_n)$ is the distance m·5 minutes with reference to the Australian National Spheroid (referred to in this Schedule as "he") and calculated for segment m and measured in kilometres for each bearing ϕ_n;

then:

(d) if the receiver is authorised to operate under a spectrum licence issued for frequency bands in the 500 MHz Lower Band, the LOP-Criterion (500 MHz) is either:

(i) the value, rounded to one decimal place, of the mathematical expression:

$LOP - 3.2 \cdot (\log_{10}(11.8\ he))^2 + 30 \cdot \log_{10}(d) + 93$:

when:

$0.1\ km < \quad d \quad \leq 10\ km$; and

$1.5\ m \leq \quad he \quad \leq 10\ m$; or

(ii) the value, rounded to one decimal place, of the mathematical expression:

$LOP - 3.2 \cdot (\log_{10}(11.8\ he))^2 + 60 \cdot \log_{10}(d) + 59$:

when:

$10\ km < \quad d$; and

$1.5\ m \leq \quad he \quad \leq 10\ m$; or

(e) if the receiver is authorised to operate under a spectrum licence issued for frequency bands in the 500 MHz Upper Band, the LOP-Criterion (500 MHz) is either:

(i) the value, rounded to one decimal place, of the mathematical expression:

$LOP - (1.6\ he)^{½} + 30 \cdot \log_{10}(d) + 90$:

when:

$0.1\ km < \quad d \quad \leq 10\ km$; and

$20\ m \leq \quad he \quad \leq 1600\ m$; or

(ii) the value, rounded to one decimal place, of the mathematical expression:

$LOP - (1.6\ he)^{½} + 60 \cdot \log_{10}(d) + 55$:

when:

$10\ km < \quad d$; and

$20\ m \leq \quad he \quad \leq 1600\ m$.

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SCHEDULE 2

Clause 4(1)

Effective Antenna Height

1. The effective height of an antenna is determined in accordance with its receiver, as set out in this Schedule.

[Note: To simplify the calculation of mean ground height by persons accredited under s.263 of the Act to issue interference certificates under s.145(3) of the Act, the SMA provides lists of the average of the elevation attributes for the RadDEM cells within 5 minute segments of 2.5 degree sectors for any location in Australia.]

2. Effective Antenna Height of a Fixed Receiver (see Diagram 1 below)

If:

(a) *hg* is the vertical height in metres of the phase centre of the fixed receiver's antenna measured relative to the point:

(i) located on the line of intersection between the external surface of the structure supporting the antenna and the surface of the ground or sea; and

(ii) having the lowest elevation on that line; and

(b) *hs* is the sum of:

(i) the elevation attribute of the RadDEM cell containing the location of the phase centre of a fixed receiver's antenna; and

(ii) *h*g; and

(c) $hag_m(\phi_n)$ is average ground height, as described below, for each of the segments 'm' of a sector of 10 degrees arc centred along each of the bearings ϕ_n, calculated by taking the average of the elevation attributes for all of the cells that have either half or more than half their area within each segment 'm'; and

(d) each sector is divided into 30 segments "m" (as illustrated in Diagram 2 below) with:

(i) any two consecutively numbered segments 1 to 30 being contiguous; and

(ii) each segment being a 5 minute increment in radial distance; and

(iii) segment 1 beginning at the centre location;

then:

(e) for fixed receivers operating in the 500 MHz Lower Band the effective antenna height:

(i) for segment "m" = 1, $he_1(\phi_n)$, is *hg* for that centre location except when $(hs - hg - hag_1(\phi_n))$ is > 48 in which case $he_1(\phi_n)$ is $(hs - hag_1(\phi_n))$ for that centre location; and

(ii) for segments "m" = 2 to 30, $he_m(\phi_n)$, is $(hs - hag_m(\phi_n))$ for that centre location except when $(hs - hag_m(\phi_n))$ is > 10 in which case $he_m(\phi_n)$ is 10 for that centre location;

(f) for fixed receivers operating in the 500 MHz Upper Band the effective antenna height:

(i) for segment "m" =1, $he_1(\phi_n)$, is *hg* for that centre location except when $(hs - hg - hag_1(\phi_n))$ is > 0 in which case $he_1(\phi_n)$ is $(hs - hag_1(\phi_n))$ for that centre location; and

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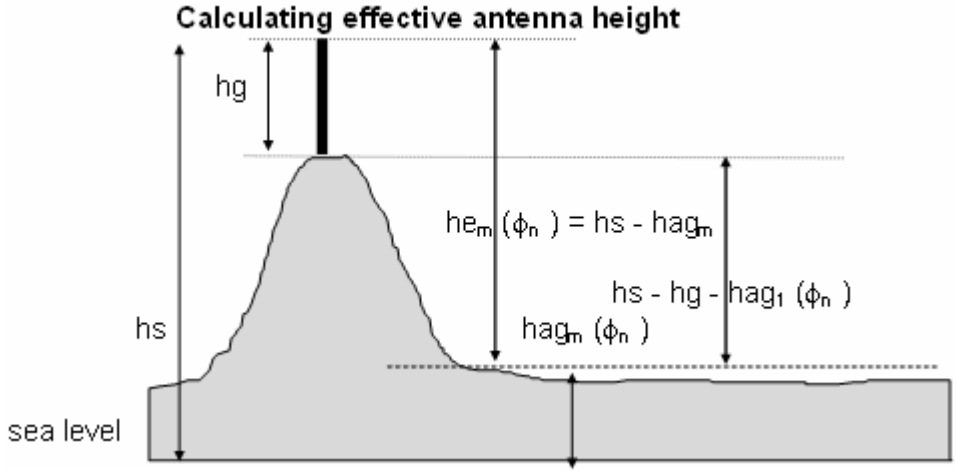
SCHEDULE 2 - *continued*

(ii) for segments "m" = 2 to 30, $he_m(\phi_n)$, is $(hs - hag_m(\phi_n))$ for that centre location except when $(hs - hag_m(\phi_n))$ is < 20 in which case $he_m(\phi_n)$ is 20 for that centre location.

[Note: A RadDEM cell is represented as raster data such that the western and southerly boundary of the cell is part of the cell but the northerly and easterly boundary are parts of the adjacent cells. This is an important consideration when a location falls on a cell boundary.]

Diagram 1



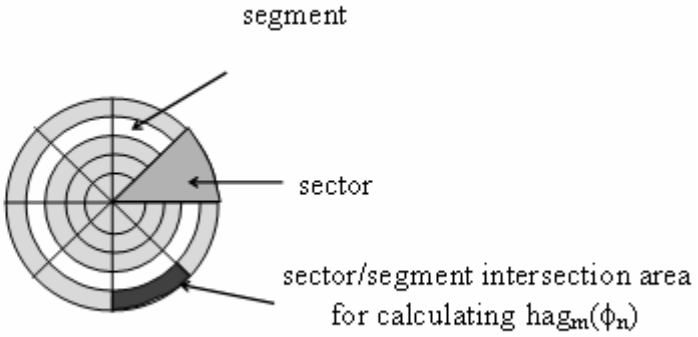
hg : antenna height above ground
hs : antenna height above sea level
$hag_m(\phi_n)$: average ground height above sea level in segment 'm' of sector 'n'
$he_m(\phi_n)$: effective antenna height for segment 'm' of sector 'n'

(note: for this case $hs - hg - hag_1(\phi_n) > 0$)

Diagram 2

Segments and sectors

(not to scale)



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SCHEDULE 2 - *continued*

3. Effective antenna height of a mobile receiver

The effective antenna height of a mobile receiver for any segment "m" =1 to 30, $he_m(\phi_n)$ is *hg* metres, where *hg* is greater than the height of the phase centre of the receiver's antenna above any three points of contact between the receiver's mobile support and:

(a) if the receiver is operating in an enclosed space - any surface; or

(b) in any other case - the surface of the earth or sea.

4. Effective Antenna Height of a Group of Mobile Receivers

For a group of mobile receivers, the group of receivers is to be treated as if it is a single mobile receiver that has an effective antenna height equal to the highest effective antenna height in the group.

5. Effective Antenna Height of a Group of Fixed Receivers

For a group of fixed receivers, where hg_{max} is less than 10 metres, then:

(a) the group of receivers is to be treated as if it is a single mobile receiver; and

(b) the effective antenna height of the group $he_m(\phi_n)$, is hg_{max} for any segment "m"=1 to 30, and any bearing (ϕ_n), where hg_{max} is greater than any *hg* established for each receiver in the group calculated in accordance with clause 2(a).

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SCHEDULE 3

Clause 9

Sample Spectrum Licence

COMMONWEALTH OF AUSTRALIA

SPECTRUM MANAGEMENT AGENCY

Radiocommunications Act 1992

Spectrum Licence

This licence is issued under section 64 of the *Radiocommunications Act 1992* ('the Act') by the person named at Item 8 of Schedule 1 of this licence.

1. The person named at Item 1 of Schedule 1 of this licence ('the licensee') is authorised to operate radiocommunications devices subject to:
   (a) the Act; and
   (b) the core conditions set out in Schedule 2 of this licence; and
   (c) the statutory conditions set out in Schedule 3 of this licence; and
   (d) the other conditions (if any) included in this licence by the SMA and set out in Schedule 4 of this licence.

2. This licence comes into force on the date shown at Item 4 of Schedule 1 of this licence and remains in force until the end of the day shown at Item 5 of Schedule 1 of this licence.

3. Terms and expressions used in this licence have the meaning given to them by the Radiocommunications Spectrum Marketing Plan (500 MHz Band) 1996.

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SCHEDULE 3 - *continued*

LICENCE SCHEDULE 1

LICENCE AND TECHNICAL DETAILS

Part 1 - Licence Details

Item	
1	*Name of Licensee* *Address of Licensee*
2	*Client Number*
3	*Band Release*
4	*Date of Licence Effect*
5	*Date of Licence Expiry*
6	*Licence Number*
7	*Date of Licence Issue*
8	*Issuing Officer*

Part 2 - Technical Details

Item	
9	*Upper limit of frequency band*
10	*Lower limit of frequency band*
11	*Offsets for purposes of core condition 3(a)*
12	*Offsets for purposes of core condition 3(b)*
13	*Power conversion function* k1(d) *for the purposes of core condition 3*
14	*Power conversion function* k2(d) *for the purposes of core condition 3*
15	*Peak power for the purposes of core condition 4(a)*
16	*Maximum true mean power for the purposes of core condition 4(b)*
17	*Maximum true mean power for the purposes of core condition 4(c)*
18	*Mean power for the purposes of core condition 5*
19	*Mean power for the purposes of core condition 6*
20	*Section 145 Determination for registration of transmitters*

Part 3 - Geographic Area

For the purposes of core condition 2, the area within which operation of radiocommunications devices is authorised by this licence is as follows:

[Description of area]

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SCHEDULE 3 - *continued*

LICENCE SCHEDULE 2

CORE CONDITIONS

Frequency Band

1. The frequency band in which operation of radiocommunication devices is authorised by this licence is the contiguous range of frequencies that are between the upper and lower frequency limits at Items 9 and 10 of Part 2 of Schedule 1, respectively.

Geographic Area

2. The area within which operation of radiocommunications devices is authorised by this licence is the geographic area set out at Part 3 of Schedule 1.

Emission Limits Outside the Area

3. The emission limits outside the area are:

(a) for frequency bands only containing frequencies that are removed from the upper and lower frequency limits of the licence by the offsets set out at Item 11 of Part 2 of Schedule 1 of this licence - a horizontally radiated power of P1 dBm EIRP; and

(b) for frequency bands only containing frequencies that are removed from the upper and lower frequency limits of the licence by the offsets set out at Item 12 of Part 2 of Schedule 1 of this licence - a horizontally radiated power of P2 dBm EIRP;

where:

$P1 = 49.2 - k1(d)$; and
$P2 = 70 - k2(d)$; and

where:
d is the distance in kilometres of the device from the boundary of the geographic area and k1(d) and k2(d) are the power conversion functions set out at Items 13 and 14 of Part 2 of Schedule 1, respectively.

Emission Limits Outside the Band

4. For radio emission that is caused by transmitters and is not spurious radio emission, the emission limits outside the band are:

(a) for frequency bands containing frequencies that are removed from the upper and lower frequency limits of the licence by offsets within the range 1.25 kHz to 13.75 kHz - the peak power set out at Item 15 of Part 2 of Schedule 1; and

(b) for frequency bands only containing frequencies that are removed from the upper and lower frequency limits of the licence by offsets within the range 13.75 kHz to 300 kHz - the maximum true mean power set out at Item 16 of Part 2 of Schedule 1; and

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SCHEDULE 3 – *continued*

LICENCE SCHEDULE 2 - *continued*

(c) for frequency bands only containing frequencies that are removed from the lower and upper frequency limits of the licence by offsets within the range 300 kHz to 1.5 MHz - the maximum true mean power set out at Item 17 of Part 2 of Schedule 1.

5. For radio emission that is spurious radio emission and caused by transmitters, the emission limits outside the band are the mean power set out at Item 18 of Part 2 of Schedule 1 measured at frequencies from 100 kHz to 2.9 GHz.

6. For radio emission caused by receivers, the emission limits outside the band are the mean power set out at Item 19 of Part 2 of Schedule 1 measured at frequencies from 100 kHz to 2.9 GHz.

[NOTE: 1. The procedure for calculating the device boundary of a transmitter has a consequence that receivers also operating under a spectrum licence are afforded lower levels of protection as they move closer to the geographic boundary of the licence. The procedure for calculating the device boundary of a receiver according to a specified level of protection is set out in the Schedules of the Radiocommunications Spectrum Marketing Plan (500 MHz Band) 1996.]

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SCHEDULE 3 - *continued*

LICENCE SCHEDULE 3

STATUTORY CONDITIONS

Liability to pay charges

1. The licensee must meet all obligations to pay charges fixed by determinations made under s293 and s294 of the Act.

Third Party Use

2. (1) The licensee must notify any person authorised to operate radiocommunications devices under the licence of that person's obligations under the Act, in particular of any registration requirements under Part 3.5 of the Act for operation of radiocommunications devices under the licence, and any rules made under s68(3) of the Act.

2. (2) Any operation of a radiocommunications device under the licence by a person other than the licensee must comply with any rules made by the SMA under subsection 68(3) of the Act.

Transmitter registration requirements

3. The licensee must not operate a transmitter under this licence unless the transmitter has been exempted from the registration requirements under the following condition, or:

(a) the requirements of the SMA under Part 3.5 of the Act relating to registration of the transmitter have been met; and

(b) the transmitter complies with the details about it that have been entered in the register.

Exemption from registration requirements

4. The following kinds of transmitters do not have to be registered:

(a) a mobile transmitter that only operates:

(i) outside the limits of a town that is on the towns mobile list; or

(ii) on a road that is not on the roads mobile list;

(b) a mobile transmitter that only transmits at sea and only communicates with a mobile receiver at sea.

[NOTE: 1. The Determination that sets out the unacceptable levels of interference for the purpose of registering transmitters to be operated under this licence, and which is to be used for the issue of certificates by accredited people under s.145(3) of the Act is set out at Item 20 of Part 2 of Schedule 1 of this licence.]

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SCHEDULE 3 - *continued*

LICENCE SCHEDULE 4

CONDITIONS INCLUDED BY THE SMA

Interference Management

1.1 In this licence:

"Level of Protection" has the meaning it is given in the *Radiocommunications Conversion Plan (500 MHz Band) 1996*.

"manage interference" includes investigation of the possible causes of the interference, taking all steps reasonably necessary to resolve disputes concerning interference where more than one person is involved, taking steps (or requiring persons authorised to operate devices under this licence to take steps) reasonably likely to reduce interference to acceptable levels, and negotiating with other persons for the purpose of reducing interference to acceptable levels.

Responsibility to Manage Interference

2.1 The licensee must manage interference between radiocommunications devices operated under this licence, and interference between radiocommunications devices operated under this licence and operated under any other spectrum licence held by the licensee.

Responsibility for Interference - Receivers

3.1 The licensee must accept interference to a receiver operated under this licence that is caused by emissions outside the frequency band of this licence where the receiver has:

(a) an adjacent channel selectivity performance; or
(b) an intermodulation immunity performance; or
(c) blocking immunity performance; or
(d) spurious response immunity performance ;

that is less than the level of performance set out in Australian Standard AS 4295-1995 as in force on 1 November 1996.

3.2 For the purposes of subparagraph 3.2, the level of performance set out in Australian Standard AS 4295-1995 is taken to be a notional level of performance, irrespective of whether that Australian Standard applies to the receiver.

3.3 The licensee must accept levels of emission measured at a receiver operated under this licence that are below the receiver's Level of Protection plus 20dB for up to and including 99% of the time in any one hour period.

3.4 Nothing in clause 3.1 or 3.3 is to be taken to imply that the licensee is prevented from negotiating with other licensees for additional protection from interference.

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SCHEDULE 3 - *continued*

LICENCE SCHEDULE 4 - *continued*

Responsibility for Interference — Transmitters

4.1 The licensee must not operate a transmitter under this licence in such a manner that the level of in-band emission from that transmitter, measured at a fixed receiver operating under another spectrum licence, exceeds the level of protection for that receiver plus 20dB for more than 1% of the time in any one hour period.

Co-sited devices

5. Where:

(a) interference occurs between a radiocommunications device operated under this licence and a radiocommunications device operated under another licence that is located within 200 metres of the first device; and

(b) that interference is not the result of operation of a radiocommunications device in a manner that is not in accordance with the conditions of the relevant licence; and

(c) either the licensee or the holder of the other licence wishes to resolve the interference;

the licensee must take reasonable steps to negotiate arrangements reasonably likely to reduce the interference to acceptable levels with:

(d) the holder of the other licence; or

(e) if a site manager is responsible for managing interference at that location, that site manager.

Information for Register

6. The licensee must give the SMA all information as required by the SMA from time to time for inclusion in the Register.

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SCHEDULE 3 - *continued*

LICENCE NOTES

Variation to licence conditions

The SMA may, with the written agreement of the licensee of a spectrum licence, vary this licence by including one or more further conditions, or revoking or varying any conditions of the licence provided that the conditions as varied still comply with the requirements of Subdivision C of Division 1 of Part 3.2 of the Act.

The SMA may, by written notice given to the licensee, vary a licence by including one or more further conditions or revoking or varying any non core conditions of the licence provided that the licence as varied complies with the requirements of Subdivision C of Division 1 of Part 3.2 of the Act.

Guidelines

The SMA has issued written advisory guidelines under s.262 of the Act about co-ordination procedures in relation to receivers operated in Telstra's Radio Concentrator System. The guidelines should be read in conjunction with the relevant Determination made under s145(3) of the Act setting out the unacceptable levels of interference for the purpose of the registration of transmitters to be operated under this licence. The guidelines should be followed by licensees (and accredited persons) before operating transmitters.

The SMA does not intend to afford protection to receivers operated under spectrum licences from any interference they may incur from RCS transmitters operated in accordance with their apparatus licence. The SMA also intends to afford protection, in accordance with the guidelines, to RCS receivers from transmitters operated under this spectrum licence. Copies of the guidelines, the *Radiocommunications Advisory Guidelines (Co-ordinating the operation of transmitters in the 500 MHz Bands) 1996*, are available from the SMA.

The suspension and cancellation of spectrum licences

The SMA may by written notice given to a licensee suspend, cancel or revoke a spectrum licence where the SMA is satisfied that the licensee, or a person authorised by the licensee to operate a radiocommunications device under the licence, has contravened a condition of the licence, or in any other way contravened the Act, or operated a radiocommunications device under the licence, or purportedly under the licence in contravention of any other law (whether written or unwritten) of the Commonwealth, a State or a Territory or in the course of contravening such a law.

Re issue

A spectrum licence may not be reissued to the same licensee without a price based allocation procedure except where:

the SMA is satisfied under s.82(1) of the Act that special circumstances exist as a result of which it would in the public interest for that licensee to continue to hold that licence; or

the licensee provides a service of a kind determined by the Minister under s.82(3) of the Act for which reissuing licences to the same licensees would be in the public interest.

Trading

A licensee may assign or otherwise deal with the whole or any part of a spectrum licence provided that this is done in accordance with any rules determined by the SMA under s.88 of the Act.

An assignment under s.85 of the whole or any part of a licence that involves any change to a licence does not take effect until the SMA has been advised of the changes and the Register of Spectrum Licences has been altered accordingly.

Appeals

An application may be made to the SMA for re-consideration of decisions listed under s.285 of the Act and a person affected by and dissatisfied with the decision may seek a re-consideration of the decision by the SMA under s.288(1) of the Act. This decision can be subject to further re-consideration by the Administrative Appeals Tribunal, subject to the provisions of the Administrative Appeals Tribunal Act 1975.

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SCHEDULE 4

Clause 16

Emission limits outside the band

[Note: Emission limits outside the band manage levels of:

(a) modulation products and switching transient emissions (carrier rise times) outside the frequency band of the licence;
(b) sideband noise (vco phase noise);
(c) transmitter broadband noise;
(d) any transmitter spurious signals from frequency combining processes, including multicoupling of transmitters into an antenna; and
(e) any receiver emissions.]

1. For radio emission that is not spurious radio emission and caused by transmitters, the emission limits outside the band are:

(a) under all operating conditions of the transmitter, a peak power of -1 dBm EIRP for frequency bands containing frequencies that are removed from the upper and lower frequency limits of the licence by offsets within the range 1.25 kHz to 13.75 kHz; and
(b) a maximum true mean power of -11 dBm EIRP for frequency bands only containing frequencies that are removed from the upper and lower frequency limits of the licence by offsets within the range 13.75 kHz to 300 kHz; and
(c) a maximum true mean power of -46 dBm EIRP for frequency bands only containing frequencies that are removed from the lower and upper frequency limits of the licence by offsets within the range 300 kHz to 1.5 MHz.

2. For radio emission that is spurious radio emission and caused by transmitters, the emission limits outside the band under all operating conditions are a mean power of -30 dBm EIRP measured at frequencies from 100 kHz to 2.9 GHz.

3. For radio emission caused by receivers, the emission limits outside the band under all operating conditions are a mean power of -57 dBm EIRP measured at frequencies from 100 kHz to 2.9 GHz.

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SCHEDULE 5

Clause 16

Emission limits outside the area

The emission limits outside the area, for frequency bands only containing in-band frequencies, are a horizontally radiated power of:

P dBm EIRP;

where:
P = 49.2 - k1(d);

where:
d is the distance in kilometres of the device from the boundary of the geographic area and k1(d) is the power conversion function:
k1(d) = 0 for d ≥ 0.

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SCHEDULE 6

Schedule 1

Centre location and effective radius of a receiver

[NOTE: 1. A model for the location of a receiver (the effective location) is the circumference of the circle defined by the centre location and the effective radius.

2. The level of protection for a mobile receiver, a group of mobile receivers or a group of fixed receivers that operates outside the limits of a town that is on the towns mobile list, or on a road that is not on the roads mobile list, is -77dBm per 12.5 kHz - see clause 17.]

1. The centre location of a receiver is the centre of a circle lc with an effective radius re. This Schedule sets out the l_c and r_e of particular receivers.

2. Centre location and effective radius of a fixed receiver

For a fixed receiver, l_c is the location (by latitude and longitude) of the phase centre of the receiver's antenna and r_e is zero.

3. Centre location and effective radius of a mobile receiver operating on land

(a) Operating in a town. For a mobile receiver operating within the limits of a town specified in the towns mobile list, l_c and r_e are taken to be those specified in the towns mobile list for that town.

If there is more than one effective location for the mobile receiver, a device boundary is calculated for each effective location.

(b) Operating on a section of a major road. For a mobile receiver that is operating on a section of a major road the centre location and effective radius of the mobile receiver is the centre location and effective radius specified in the roads mobile list for that section of road. A section of road is that part of the road intersected by 2 lines drawn:

(a) starting from each of the 2 sets of coordinates in the roads mobile list from which sections of the road may be identified; and

(b) along the shortest distance from each set of coordinates to the road; and

(c) along the latitude or longitude of the coordinate.

If there is more than one effective location for the mobile receiver, a device boundary is calculated for each effective location.

4. Centre location and effective radius of a mobile receiver operating at sea

For a mobile receiver on the surface of the sea communicating with a fixed transmitter, l_c is the location of the fixed transmitter and r_e is 28 km.

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SCHEDULE 6 - *continued*

5. Centre location and effective radius of a group of fixed receivers

The centre location and effective radius of a group of fixed receivers is to be worked out as if the group were a single mobile receiver.

6. Centre location and effective radius of a group of mobile receivers

The centre location and effective radius of a group of mobile receivers is to be worked out as if the group were a single mobile receiver.

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