



Australian
Communications
Authority

Establishing Conditions for Australian Spectrum Licences in the 27 GHz Band

Spectrum Planning Team
Radiofrequency Planning Group
Australian Communications Authority

Document: SP 8/03
Date: May 2003

Establishing Conditions for Australian Spectrum Licences in the 27 GHz Band

Table of Contents

1.	INTRODUCTION.....	1
1.1	Purpose.....	1
1.2	Background.....	2
2.	The System Model at 27 GHz.....	2
3.	Space Services	3
3.1	Inter-Satellite Service	3
3.2	Earth Exploration-Satellite (space to Earth)	4
4.	Licensed Services in Adjacent Spectrum	5
4.1	Fixed services in the 24.5 – 26.5 GHz Band	6
5.	Equipment	6
6.	Overseas Arrangements	6
6.1	United States of America (USA)	6
6.2	Canada.....	7
7.	Band Segmentation and Uplink / Downlink Designation	7
8.	Agreements	8
9.	System Model.....	APPENDIX A
	System Model.....	1
	Transmitter Power.....	1
	Transmitter Stability.....	1
	Antenna Gain	1
	Maximum Radiated Power.....	1
	Wide Beamwidth and Narrow Beamwidth Emissions.....	2
	Propagation Model.....	2
	Receiver Threshold Margin.....	3
	Receiver Sensitivity and Compatibility Requirement.....	3
	Reliability.....	3
	Managing Near-Far Interference.....	3
	Broadband Emission Limit Outside the Band.....	4
	Broad band Emission Limits in the Adjacent STU.....	4
	Broad band Emission Limits Beyond the First Adjacent STU	4
	Narrowband Emission Limits Outside the Band.....	5
	Emission Limits Outside the Area.....	5
	Notional Receiver.....	6
10.	Technical Framework..... (Chapter 5 Applicant Information Package).....	APPENDIX B
	Introduction.....	1
	Licence Core Conditions.....	4
	Other Licence Conditions.....	6
	Radiocommunications Advisory Guidelines.....	9
	Receiver Performance.....	10
	Deployment Considerations.....	11
	Interference that the Technical Framework Does Not Prevent.....	11

	Registering Groups of Transmitters.....	12
	International Coordination.....	12
	Health and Safety	12
	Environmental and Other Considerations	13
	Obtaining a Permit to Operate Non-standard Devices.....	13
11.	Sample Licence Schedules.....(Schedule 3 Marketing Plan).....	APPENDIX C
	Part 1 – Licence Details.....	1
	Part 2 – Technical Details.....	2
	Part 3 – Geographic Area.....	3
	Core Conditions.....	4
	Statutory Conditions.....	7
	Conditions Included by the ACA.....	8
	Licence Notes.....	11
12.	Radiocommunications (Unacceptable Levels of Interference – 27 GHz Band)	
	Determination 2000.....	APPENDIX D
13.	Radiocommunications Advisory Guidelines (Managing Interference From	
	Non-Spectrum-Licensed Transmitters – 27 GHz Band) 2000.....	APPENDIX E
14.	Radiocommunications Advisory Guidelines (Protection of Non-Spectrum-	
	Licensed Receivers – 27 GHz Band) 2000.....	APPENDIX F
15.	Radiocommunications Advisory Guidelines (Managing Interference	
	between 27 GHz and 28 GHz Spectrum-Licensed Services) 2000.....	APPENDIX G

1. INTRODUCTION

1.1 Purpose

The purpose of this document is to describe the methodology and important assumptions used to develop the technical framework associated with spectrum licensing of the 27 GHz band, the band 26.5 GHz to 27.5 GHz.

This document collects together materials used by the Australian Communications Authority (ACA) in establishing the technical conditions and framework for spectrum licences issued for the 27 GHz band.

Readers are assumed to have a moderate level of technical knowledge and an understanding of spectrum licensing as practiced in Australia.

1.2 Background

This spectrum was first proposed for allocation by spectrum licensing by the Spectrum Management Agency (SMA) (a predecessor to the ACA) in April 1997 in a paper inviting comments on appropriate licensing arrangements for the band 25.35 GHz to 29.5 GHz.

A number of respondents argued that the ACA should delay any auction of spectrum in the band 25.35 GHz to 27.5 GHz band because of the potential for interference to the Inter-satellite Service which also operates in this band. Having considered all submissions, the ACA developed a new proposal excluding spectrum below 27.5 GHz. The ACA allocated by means of spectrum licensing the bands 28 GHz (27.5-28.35 GHz) and 31 GHz (31-31.3 GHz) in November 1998.

The International Telecommunication Union (ITU) in response to overseas demands developed a draft revision to recommendation ITU-R F.1249 on sharing arrangements between the Inter-satellite service and fixed services in the band 25.25 GHz to 27.5 GHz in February 2000. This cleared the way for the ACA to allocate the band 26.5 GHz to 27.5 GHz.

The Minister for Communications, Information Technology and the Arts in the Radiocommunications (Spectrum Designation) Notice No.1 of 2000 dated 31 May 2000 gave the ACA under s36 of the *Radiocommunications Act 1992* written notice designating the band 26.5 GHz to 27.5 GHz across the whole of Australia to be allocated by issuing spectrum licences.

When this technical framework was developed, the band had no apparatus licence allocations recorded within it. There were no class licences with permitted operating frequencies including the band. The band had not been previously allocated by issuing spectrum licences. The band is however, the first spectrum licensed band developed immediately adjacent to an existing spectrum licensed band.

2. The System Model at 27 GHz

While spectrum licensing does not specify equipment or specific use of a band, the technical requirements of a spectrum licence may be developed based upon an assumed model of a type of service which would most likely be used in the band. The type of service may be determined from previous licensing in the band, or use of the band in other countries etc.

The types of service used in the modelling of systems in the band 26.5 to 27.5 GHz are broadband two way point-to-multipoint and point-to-point fixed services. These services are currently in use in this band in Canada and in adjoining spectrum in the United States of America (USA) and Australia.

The system model is based on the parameters established for equipment in the 28 GHz and 31 GHz spectrum licensed bands. These parameters having been established and having no request for change from industry, the setting up of a Technical Liaison

Group was considered unnecessary. The system model details are presented in Appendix A.

3. Space Services

The 27 GHz spectrum licensed band differs from the 28 / 31 GHz spectrum licensed bands in that the band includes shared allocations of equal primary basis with the Inter-Satellite Service and in part with the Earth Exploration-Satellite Service. These space services are subject to international agreements regarding sharing and protection requirements. It was necessary in the development of the 27 GHz technical framework for spectrum licences in the 28 / 31 GHz bands to give appropriate protection to these space services.

3.1 Inter-Satellite Service

The Inter-Satellite Service (ISS) accommodates radio links between satellites and other spacecraft. The service involves geostationary and non-geostationary satellites. The links provided to manned space craft in particular, involve safety of life issues. International Footnote 536 limits the use of the Inter-Satellite Service in this band to space research and Earth Exploration-Satellite service applications and the transmission of data originating from industrial and medical activities in space.

International agreement was first reached in 1997 on technical limits for Fixed Services in the band 25.25-27.5 GHz to enable sharing with the Inter-Satellite Service. Recommendation ITU-R F.1249 *Maximum Equivalent Isotropically Radiated Power of Transmitting Stations in the Fixed Service Operating in the Frequency Band 25.25-27.5 GHz Shared with the Inter-Satellite Service* specifies radiated power limits for Fixed Services in the direction of the GSO.

This recommendation applies to narrow beamwidth (i.e. point-to-point) transmitters as operated under the 27 GHz Spectrum licence. Its requirements have been included in the technical framework by way of reference in the Radiocommunications Advisory Guidelines (Protecting Non-Spectrum-Licensed Receivers). Specific emission limits have also been included as conditions of licence to increase their legal weight and visibility.

Subsequent to the development of Recommendation F.1249, for point-to-point fixed systems sharing with the ISS, it became apparent that further consideration of the sharing requirements for point-to-multipoint systems was also necessary. Accordingly, ITU-R Joint Rapporteur Group 7D/9D developed a Draft New Recommendation (DNR) ITU-R F.[PMP] *Technical and Operational Requirements that Facilitate Sharing between Point-to-Multipoint Systems in the Fixed Service and the Inter-Satellite Service in the Band 25.25 – 27.5 GHz* for accelerated approval.

The DNR set out additional limits on emissions from wide beamwidth (hub station) transmitters in point-to-multipoint systems, in order to protect both geostationary and non geostationary ISS receivers. The sharing arrangements set out in the DNR are incorporated in the 27 GHz technical framework both by reference in the Advisory Guidelines for the protection of non-spectrum-licensed receivers and directly through conditions of the licence itself.

The limits of the DNR are included as a condition of the licence to improve their visibility to licensees. Notes were also placed within the licence to indicate the ACA's intention to update the licence when the final new Recommendation was released. The Radiocommunications Advisory Guidelines (Protection of Non-Spectrum Licensed Receivers – 27 GHz Band) 2000 contains references to existing ITU-R recommendations and the DNR.

Licensees have also been advised in the Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum Licensed Transmitters – 27 GHz Band) 2000 of the need to accept in-band interference from the Inter-Satellite Service presenting power densities on the surface of the earth not exceeding the levels set down by the ITU-R Radio Regulations S21.16.

Update

The DNR led to the new Recommendation ITU-R F.1509 which was published in March 2001 after the 27 GHz Band Spectrum licences were issued. The new recommendation included some relaxation of the limits set out in the DNR.

The relaxation for Time Domain Duplex equipment is based on the proportion of the time the station is transmitting. The limits in the direction of the geostationary orbit positions have been relaxed in ITU-R F.1509 (2001) for TDD transmitters by $7\text{Log}(1/\delta)$ dB up to a maximum of 3 dB where δ is the proportion of time when the wide beamwidth transmitter is emitting signals.

The spectrum licence is expected to be updated in late 2002 to replace references to the DNR with references to the new Recommendation ITU-R F.1509. The update will also rewrite Paragraph 5 of licence schedule 4 Conditions Included by the ACA to reflect the requirements of the new Recommendation. This has been done to make the changes more obvious to licensees and to provide greater legal weight.

3.2 Earth Exploration-Satellite (space to Earth)

The Earth exploration-satellite service is allocated as a primary service in the band 25.5 GHz up to 27 GHz. The Bureau of Meteorology in a submission on an ACA "proposal for allocating Radiofrequency Spectrum for Broadband Wireless Access (BWA) above 20 GHz" indicated their concern regarding the future availability of this spectrum for Earth exploration-satellite services. This concern was based on what they believed to be a growing need for spectrum and congestion in other bands allocated to the service.

The technical framework of the licence includes arrangements regarding protection and sharing as international Earth exploration-satellite services may operate in this band in the future and are subject to international agreements. The Earth exploration-satellite service allocation in the 28 / 31 GHz spectrum licence band is as a secondary service.

The Earth exploration-satellite service allocation in the band extends 1 GHz below the spectrum covered by the 27 GHz spectrum licences. The need for sharing is unlikely

to arise in the initial period of the licence. Protection of Earth explorations satellite receivers through individual agreements with spectrum licence holders is also possible. For these reasons it was considered unnecessary to produce specific conditions within the licence to protect this service.

The Radiocommunications Advisory Guidelines (Protection of Non-Spectrum Licensed Receivers – 27 GHz Band) 2000 encourages licensees to support the introduction of Earth-Exploration-Satellite earth stations in Australia as an important scientific activity. The Guidelines point to Recommendation ITU-R SA.1278 “Feasibility of sharing between the Earth exploration-satellite service (space to Earth) and the Fixed, Inter-satellite, and Mobile services in the Band 25.5 – 27.0 GHz” when considering sharing issues.

Licensees have also been advised in the Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum Licensed Transmitters – 27 GHz Band) 2000 of the need to accept in-band interference from the Earth exploration-satellite service presenting power densities on the surface of the earth not exceeding the levels set down by the ITU-R Radio Regulations S21.16. ITU Radio Regulations Chapter SVI Section V of Article S21 specifies limits on the power flux density (PFD) from space stations at the Earth’s surface in the 27 GHz band; the values are listed in table S21-4.

Limit (dB(W/m ²)) in 1 MHz bandwidth for angle of arrival α above the		
0° – 5°	5° – 25°	25° – 90°
-115	-115 + 0.5(α -5)	-105

4. Licensed Services in Adjacent Spectrum

The surrounding spectrum from 25 GHz to 29 GHz contained only 11 assignments (May 2000). These consisted of:

- 8 x point-to-multipoint assignments on 25.654 GHz;
- 2 x point-to-point assignments on 25.238 GHz; and
- a non-geostationary satellite assignment (Teledesic) on 28.85 GHz.

The minimum frequency separation between these assignments and the 27 GHz band was 846 MHz. The assignments were seen as therefore unlikely to effect or be effected by, devices operating in the 27 GHz band.

To attend to possible interference risk between devices operated under spectrum licences in the 27 GHz band and spectrum licences in the 28 GHz band a new set of advisory guidelines were developed, the Radiocommunications Advisory Guidelines (Managing Interference between Devices operated under the 27 GHz Spectrum Licenses and Devices operating under 28 GHz Spectrum Licenses) 2000.

These guidelines the first drawn up with respect to two adjacent spectrum licence bands was greatly simplified by the fact that both spectrum licence bands are covered by similar Section 145 determinations. This allowed guidelines that they should treat licensees in the 28 GHz spectrum licence band in the same way as they would other licensees in the 27 GHz spectrum licensed band.

4.1 Fixed services in the 24.5 – 26.5 GHz Band

The band 24.5 – 26.5 GHz has been proposed for fixed point-to-point services in Australia [Microwave Spectrum Trends] in line with Recommendation ITU-R F.748-4 Radio-frequency arrangements for systems of the fixed service in the 25, 26 and 28 GHz bands. This Recommendation includes a 47 MHz guard band on the top and bottom edges of the band which will provide some protection to and from spectrum licensed services in the 27 GHz band.

This fixed service is likely to be used for short hop (<10km) broad band two-way links due to the EIRP limit requirements to protect the Inter-satellite service and the necessary rain fade margins. Equipment of similar characteristics to that proposed for the 27 GHz band system model is highly likely.

5. Equipment

A limited amount of technical information is available for equipment operating in this and adjacent bands. Information from Nortell (Reunion), Newbridge (Mainstreet), Hewlet Packard, Netro (AirStar), Floware, Wavetrace and Harris have provided some new material regarding on the technologies in use in this and adjacent bands. The information describes equipment suitable for use in providing digital point-to-multipoint networks. There are however, few other similarities in the equipment provided by these equipment manufacturers.

Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA) and combinations of these two are used to support multiple users. Single frequency Time Division Duplex TDD operation is used by some systems extremely flexible data rate distribution between users. Frequency Division Duplex (FDD) is used in some systems to provide higher data rates.

Transmission bandwidths used vary between 1.15 MHz to 36 MHz. The narrow bandwidth channels are transmitted by the customer equipment as the uplink being part of a larger frequency multiplex received by the central hub. The 50 MHz trading unit proposed for the 27 GHz Band should be suitable to carry either single frequency broadband signals or the broadband downlink signal and frequency multiplex uplink signal received at the hub station.

There is no apparent consistency in the way FDD systems assign uplink and downlink frequencies with examples of both uplink frequencies being higher than the frequencies used for the downlink and uplink frequencies being lower than those used for the downlink.

6. Overseas Arrangements

6.1 United States of America (USA)

The LMDS service is not currently in use in the 27 GHz band in the USA. The LMDS service is in use in adjacent spectrum and equipment manufacturers indicate

that equipment in use in the USA can be modified to operate in the 27 GHz band. The LMDS bands in the USA exist in three segments. The largest is the band 27.5 – 28.35 GHz. The others are the band 29.1-29.25 GHz and the band 31.0-31.3 GHz. This spectrum has been divided into two blocks Block A includes 3 segments of spectrum one of 850MHz and two of 150MHz. Block B has two segments of 75 MHz. There appears to be no specification of mode to be used in each segment. The block arrangements allow for both symmetrical and asymmetrical data flow systems. Manufacturers do however indicate their preferred arrangements in each segment.

6.2 Canada

Four bands of 500 MHz have been released by the Canadian government for point-to-multipoint services in the Canadian Local Multipoint distribution Systems (LMCS) service. The four LMCS band are LMCS A (27.85-28.35 GHz), LMCS B (27.35-27.85 GHz), LMCS C (26.85-27.35 GHz) and LMCS D (26.35-26.85 GHz). The LMCS C band lies completely in the frequency range of the 27 GHz band.

Uplink / downlink modes do not appear to have been specified by the Canadian government. There is however, some manufacturer supplied information suggesting each band may be subdivided to provide 250 MHz in each direction with the lower frequencies for the Uplink.

7. Band Segmentation and Uplink / Downlink Designation

Initially it was proposed for marketing and competition reasons to break the band into four 250 MHz segments (to be allocated in two pairs, supporting two licensees in each area). This would support five Standard Trading Units (STU) in each segment.

This would provide sufficient spectrum in each segment to set up a cellular network to cover larger areas. However after representations from potential purchasers, the band was broken into six segments of 3 different sizes (100 MHz, 150 MHz and 250 MHz) to enable matching with the Canadian Local Multipoint Communications Systems (LMDS) Band C¹.

A review of available equipment specifications found that a 250 MHz split is at the lower end of the possible range for existing FDD equipment. A 500 MHz split is better although not optimal as some of the equipment reviewed having been initially designed for the United States LMDS bands has a minimum split of 1 GHz or more. The segment splits do not affect the use of TDD equipment.

Consideration was also given to the designation of Uplink and Downlink bands and high site low site segmentation to reduce problems caused by Near-Far interference between different licensees. It was determined however that the 200m site interference management requirement of the licence together with other parameters of the model made this an unnecessary requirement in this band.

¹ The Canadian LMDS band C extends from 26.85 GHz to 27.35 GHz.

A review of available equipment specifications indicated no preferred uplink / downlink mode. No uplink / downlink mode was specified for the 28 GHz band technical framework on which the 27 GHz framework is based so it was decided not to specify uplink / downlink bands in the 27 GHz technical framework.

8. Agreements

The 27 GHz licence framework unlike the 28/31 GHz licence framework contains specific arrangements for setting up agreements between licensees to allow core condition limits to be exceeded. This has been a feature of spectrum licences since it made its first formal appearance in the 3.4 GHz spectrum licence framework. Licence schedule 5 sets out the form of the agreement between licensees.

The agreements between adjacent licensees (both geographic and in frequency) allow extension of the core condition limits out to the outer boundary of the adjacent licensee

While these arrangements appear to give significant scope to vary the actual limits of the licence and therefore the impact upon other users of the spectrum, the scope of the variations which can be made is limited. For example the other conditions of licence, in particular, those added to protect international satellite services, will limit the maximum EIRP which can be used by licensees.

9. Appendix A - System Model

System Model

The system model is identical to that developed for the spectrum licences issued for the 28 GHz and 31 GHz bands¹. The system model incorporates arrangements to support both short distance point-to-point links as well as point-to-multipoint services. The model starts with a Standard Trading Unit (STU) with a minimum frequency bandwidth of 50 MHz. The minimum STU distance dimension is 5 minutes of Arc or about 9 km in major city areas. The system model assumes digital modulation and uses QPSK as a basis.

Transmitter Power

The nominal transmitter power for both customer and hub stations is 2 W. Equipment of this power level is feasible although not yet available. The model assumes a 3 dB back-off of the power of the transmitter to reduce inter-modulation product generation or blooming in multi-carrier systems.

The bandwidth of currently available equipment varies substantially, particularly between customer stations (narrow) and hub stations (wide). A maximum spectral density has been assumed as 30 dBm / MHz. This is based on the 2 W transmitter backed-off 3 dB within a narrow 1 MHz bandwidth.

Transmitter Stability

Typical transmitter stability figures quoted in equipment sheets vary between 0.6 ppm and 8 ppm depending upon crystal and synthesizer performance.

Antenna Gain

Narrow beamwidth antennas for point-to-point applications and customer terminals in point-to-multipoint systems have typical gains ranging from 35 for a 30 cm dish to 44 dBi for a 75 cm dish.

Hub stations typically use wide beamwidth antennas. Antenna gains vary between 3.5 dBi for an omni directional antenna up to 27 dB for a 15 degree sector antenna.

To cope with the broad range of antenna types the system model defines requirements for narrow-beamwidth (<5 deg.) and wide-beamwidth antenna equipment.

Maximum Radiated Power

Radiated Power has been specially defined for spectrum licensing in order to take into account the many different forms of modulation schemes that are possible. The limits specified take into account the maximum spectral density of 30 dBm/MHz and the

¹ Further information regarding the development of the System Model for the 28 GHz and 31 GHz bands can be found in Spectrum Planning Report SP 07/02.

antenna gain of a 75 cm dish (44 dBi) giving 74 dBm EIRP/MHz. Hub stations where the wide-beamwidth antennas are typically used have been limited to 60 dBm EIRP/MHz because of their greater interference potential and to be in line with limits found overseas.

Note the values which appear on the licence are 5 dB higher. This provides a 95% confidence level that any measurements of the radiated signal will not exceed the limits calculated above. The 5 dB is based on allowances which must be made for manufacturing variation from specified values of antenna gain (± 2 dB) and transmitter power (± 3 dB). The limit has been expressed as a flat EIRP value across the licence area.

The maximum radiated power limit in the 27 GHz spectrum licence is presented in a different way to the limit in the 28 GHz and 31 GHz spectrum licences. The limit has been specified directly as a radiated power limit rather than a more obscure power conversion function from which the radiated power limit must be calculated.

Wide Beamwidth and Narrow Beamwidth Emissions

The significant difference in the antenna gain of antenna used at hub stations and the antenna used for customer stations or point-to-point links has lead to the need to specify individual limits for wide beamwidth devices (hub stations) and narrow beamwidth devices (customer stations). A similar arrangement is found in spectrum licence for the 28 GHz and 31 GHz bands.

The Propagation Model

Paths in this band are typically short line of sight paths. Free space loss has been augmented for additional losses due to gaseous attenuation and rain. The rain fall attenuation like that for the 28/31 GHz bands model is based on 0.01% of the time in Sydney where the worst month figure is 40 mm/hr.

Distance	Free Space Loss (27 GHz)	Rain Loss (.01% Reliability)	Total (dB)
200 m	107	2	109
500 m	115	5	120
1.0 km	121	9	130
1.5 km	125	13	138
2.0 km	127	17	144
2.5 km	129	21	150
3.0 km	131	24	155
3.5 km	132	28	160
4.0 km	133	31	164
4.5 km	134	35	169
5.0 km	135	38	173

Receiver Threshold Margin

The notional receiver threshold margin is 14 dB based on the Carrier to Noise ratio for QPSK with a Bit Error Rate 1×10^{-6} . This figure comes directly from the 28 / 31 GHz spectrum licence technical framework. The variety of modulation schemes and error correction methods used by manufactures makes the choice of the value used otherwise extremely difficult.

Receiver Sensitivity and Compatibility Requirement

The notional receiver sensitivity is based on a thermal noise of -174 dBm/Hz and a minimum receiver bandwidth of 1 MHz. Thermal noise power is -114 dBm/MHz. The typical receiver noise figure is 8 dB. The noise floor of the typical receiver is -106 dBm/MHz. Including the threshold margin gives a receiver sensitivity of -92 dBm/MHz.

The receiver compatibility requirement which appears in the advisory guideline dealing with interference from non-spectrum-licensed transmitters provides for:

- a wanted to unwanted signal level of not less than 14 dB for not less the 1% of the time in any 1 hour period; and
- with a wanted signal level never less than -92 dBm; and
- measured within a 1 MHz rectangular bandwidth.

Reliability

Systems in this band are generally connected to telecommunications facilities or provide rapid deployment of telecommunications facilities. The expected reliability is therefore high i.e. 99.995%. To achieve this reliability, operators will need to provide for adequate fade margins during planning of services or the implementation of Automatic Power Control (APC) and the selection of suitable Forward Error Correction (FEC) code rates.

Managing Near-Far Interference

Near-far interference is caused by the out of band emission level of an adjacent transmitter approaching that of a wanted in-band signal. Consideration was given to dividing the band to provide uplink / downlink frequency separation. It was determined however, that band segmentation was unnecessary due to the 200 m interference management transmitter site licence condition along with other characteristics of the services in the band.

The narrow beamwidth (<5degrees) of customer and point-to-point link antenna is one of these characteristics which provides a means of eliminating near-far interference should it occur. Out-of-band emission limits also play a role in preventing near-far interference from being a significant concern.

Broadband Emission Limits Outside the Band

Broadband emissions are:

- modulation or inter-modulation products associated with the transmitted information; or
- transmitter broadband noise; or
- emissions caused by switching transients.

The limits are identical to those for spectrum licenses in the 28 GHz and 31 GHz bands.

Broadband Emission limits in the Adjacent STU

The broadband emission limit for broad beamwidth (hub station) transmitters within the first 50 MHz (the STU bandwidth) is calculated below. The calculation is based on a worst case configuration. This would be where the antenna of the two hub stations operating in adjacent bands look directly at each other and the stations are located just beyond the 200m site interference management zone of the other.

From the receiver compatibility requirement:

Minimum receive level	-92 dBm/MHz
Minimum C/N = C/I	14 dB
Maximum level of interference	-106 dBm/MHz
Minus Hub station antenna gain (90 degree sector)	23 dBi
Plus Free Space Loss at 200m	107 dB
Maximum radiated broadband adjacent channel power	-22 dBm EIRP/MHz

The maximum broadband emission limit for narrow beamwidth (customer station) transmitters is based on the limit for broad beamwidth transmitters. The objective in calculating the limit as set out below is to insure that the customer station transmitters are not subject to a more restrictive limit than that of the hub station transmitter.

The broadband emission limit for narrow beamwidth (customer station) transmitter	
Hub station radiated broadband adjacent channel power	-22 dBm EIRP/MHz
Minus Hub station antenna gain (90 degree sector)	23 dBi
Plus Customer station antenna gain	44 dBi
Maximum radiated broadband adjacent channel power	-1 dBm EIRP/MHz

Broadband Emissions Beyond the First Adjacent STU

Beyond the first STU 50 MHz the inherent broadband noise of a power amplifier of the transmitter becomes the dominant component of broadband emissions from the transmitter. The inherent broadband noise of a broad beamwidth (hub station) may be calculated using:

Thermal Noise	=	-114 dBm/MHz
Noise figure	=	15 dB (typical)
Gain	=	40 dB (typical)

Giving a broadband noise level of -59 dBm/MHz.

Including the antenna gain of 23 dB (90 degree sector antenna) gives a radiated emission of -36 dBm EIRP/MHz.

The broadband emission limit for a narrow beamwidth transmitter is determined from that of the broad beamwidth transmitter as in the previous case giving a value of -15 dBm EIRP/MHz.

Narrowband Emissions Limits Outside the Band

Narrowband emissions do not include broad band noise. The limits for narrowband emissions are derived from traditional transmitter spurious emissions limits of -36 dBm from 9 kHz up to 1 GHz measured in a 100 kHz bandwidth and -30 dBm for measurements from 1 GHz up to 18 GHz measured in a 1 MHz band width.

The radiated power limits have been derived from these limits by applying antenna gain. The antenna gain assumed for frequencies below 18 GHz and is 0 dBi. These frequencies are assumed to be below the cut-off frequency of the waveguide of the antenna. The above power levels then simply translated to a radiated power limit of -36 dBm EIRP/100 kHz and -30 dBm EIRP/MHz respectively.

The antenna gain assumed for frequencies between 18 GHz and 37 GHz is the full gain of the antenna. Adding 23 dBi for a broad beamwidth antenna gives -7 dBm EIRP/MHz. Alternatively adding 44 dBi for a narrow beamwidth antenna gives 14 dBm EIRP/MHz.

A similar method has been used in the derivation of out-of-band emission limits for receivers. The limit for a receiver in standby mode is -57 dBm EIRP/100kHz. When the receiver is operating the limit is -47 dBm EIRP/MHz.

Emission Limits Outside the Area

Emissions outside the area are directly limited by the EIRP limits specified for Wideband (Hub station) transmitters and Narrowband (customer stations). The 200m site interference management requirement, the propagation characteristics of signals in this band and the antenna characteristics provide effective management regime for out-of-area emissions. The 200m site interference management requirement while requiring licensees to manage any interference they may cause by operating a transmitter on a boundary.

This has made it possible not to specify a device boundary condition in the Section 145 Determination of Unacceptable Interference. The lot sizes and minimum STU geographic size also play a role in limiting the possibility of out of area interference.

Notional Receiver

The spectrum licensing framework also considers the management of interference across frequency boundaries between apparatus and spectrum licences. Like in the case of the 28/31 GHz band licences it is currently not possible to define the receiver because of the variety of equipment available. A notional RF / IF filter characteristic taken from the 28/31 GHz framework has been included to provide a minimum basis for coordination studies.

The notional receiver characteristic also tells a licensee the level of selectivity that is necessary in order to gain protection under the framework, noting that receivers also achieve protection across frequency boundaries under a first-in-time policy relating to device registration. A full notional receiver level of performance may be developed at some time in the future as the characteristics of equipment chosen by licensees for used in the band become more focused. Receiver performance characteristics which may be included are:

- a) Adjacent channel selectivity;
- b) Intermodulation immunity;
- c) Blocking; and
- d) Spurious response performance.

A notional RF/IF selectivity for the receiver may be assumed to be at least equal to that given in the following table.

Frequency Offset (MHz)	RF / IF Selectivity dB
0	3
5	10
10	20
15	40
40	60

Receiver RF / IF Filter Characteristics
(Offset referenced to edge of necessary bandwidth)

The receiver necessary band width is assumed to be never less than 8 MHz from the frequency boundary. This guard band assumption is based on typical equipment bandwidths of 28 MHz and the STU size of 50 MHz. Adjacent channel emissions greater than 2 MHz from the licence boundary lead to an adjacent channel isolation of at least 20 dB.

**10. Appendix B - Technical Framework
(Chapter 5 Applicant Information Pack)**

Technical Framework

In This Chapter...

- an explanation of the technical framework underpinning spectrum licensing in the 27 GHz band
- an explanation of the purpose and operation of the s.145 Determination of unacceptable interference
- an explanation of the three Advisory Guidelines that manage in-band and out-of-band interference with other services
- other important information about the technical framework.

Introduction

The technical framework for 27 GHz has been established by the ACA to support broadband wireless access (BWA) services provided by two way fixed point-to-point and point-to-multipoint radiocommunications systems. It has evolved from the frameworks of previous spectrum licence allocations, in particular that for the 28 GHz and 31 GHz bands, which were also established to support BWA services. There are several new ways in which flexibility has been increased in the technical framework for the 27 GHz band.

The 27 GHz framework maximizes flexibility and certainty for access to the spectrum space of the licence and is based on the circumstances existing at the date of issue of the Marketing Plan. The framework seeks to minimise negotiation between adjacent licensees for the management of both in-band and out-of-band interference. The technical framework is a benchmark upon which further flexibility may be negotiated between licensees. Spectrum licensees may negotiate among themselves and, where relevant, apparatus licensees, for alternative management arrangements about emission levels.

Spectrum licensees should, however, note that alternative arrangements are not possible unless all affected and potentially affected licensees have agreed to the arrangements. In this allocation, the ACA has amended a number of parts of the technical framework for the bands to provide explicitly for agreements between spectrum licensees and between spectrum licensees and adjacent apparatus licensees. Included in these procedures is a prescribed Form of Agreement (included in the *Radiocommunications Spectrum Marketing Plan (27 GHz Band) 2000* at **Attachment 3**). The form of agreement provides a template for any agreements that relate to licensees agreeing to accept emissions that would, in the absence of those agreements, exceed the core conditions of the licence.

For example, spectrum licensees might agree alternative arrangements with other licensees for higher levels of emission outside the frequency band of the spectrum licence or for higher levels of radiated power closer to a geographic area boundary than would have otherwise been allowed. The new arrangements are explicitly provided for in the core conditions on the licence to give effect to the agreement between licensees.

Applicants are advised to review carefully the arrangements set out for agreements between spectrum licensees and between spectrum licensees and apparatus licensees contained in the *Radiocommunications Spectrum Marketing Plan (27 GHz Bands) 2000 (Attachment 3)*.

The inherent flexibility of a spectrum licence acquired in this allocation is left for the licensee to extract. However, this needs to be based on a careful technical and commercial assessment before the auction taking into account the harmonised generic emission limits and amount of spectrum available and purchased in relation to the performance of the equipment the bidder desires to operate. The spectrum lots and subsequently issued licences are not pre-designed to accommodate any particular standard. However, they may accommodate the operation of a particular standard (or even non-standard equipment) at a particular location and frequency, depending on the size and shape of the licence that a bidder has acquired.

The framework is crafted using four interlocking regulatory elements. They are:

- Licence core conditions, which are mandatory requirements made under the s66 of the Act,
- Other licence conditions, made under s71 of the Act,
- A determination of unacceptable interference for the purpose of device registration, made under s145 of the Act, and
- Radiocommunications advisory guidelines, made under s262 of the Act.

The licence core conditions and the determination of unacceptable interference are used to keep significant levels of emission within the spectrum space of the licence. The advisory guidelines provide a framework for the coordination of specific devices as required, normally spectrum licensed and apparatus licensed services operating within the limits of the 27 GHz band and surrounding spectrum.

The technical framework is predicated on the assumptions that:

- spectrum and apparatus licensees will employ good engineering practice in establishing and maintaining their services;
- receivers employed by spectrum licensees will, as a minimum, meet the minimum receiver performance levels set out in Schedule 1 of the *Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters - 27 GHz Band) 2000 (Attachment 11)* (see **Receiver Performance** below);

- spectrum licensees will be responsible for managing interference that they, or their third party authorisees, cause to their own services through their operation of devices under any spectrum licence or apparatus licence.

The following general principles have been followed in developing the technical framework:

- the ACA has attempted to provide the maximum flexibility to spectrum licensees to establish services;
- emission limits have been specified as absolute power levels rather than power levels relative to the transmitter power allowing licensees to strike a balance between the maximum radiated power of a device and its out-of-band performance;
- the core conditions indirectly specify frequency stability by requiring the emission limits outside the band to be maintained under all conditions allowing a licensee to balance emission bandwidths along with frequency stability, as well as transmitter rise and fall times providing 'internal guard bands' as necessary;
- the size of the Standard Trading Unit (STU) at 50 MHz provides sufficient spectrum for licensees to provide their own guard band arrangements to manage interference between themselves and other licensees;
- other licence conditions impose on spectrum licensees the responsibility to manage interference that arises within 200 metres of devices registered under the licence.

The interference mechanisms that the technical framework seeks to manage are those caused by:

- unwanted in-band emissions;
- emissions falling outside the frequency band of the licence;
- transient unwanted emissions such as those caused by switching a transmitter on and off; and
- intermodulation effects.

These four mechanisms are dealt with by a combination of the core conditions relating to out-of-area and out-of-band emissions, and those parts of the registration process which give effect to those conditions at the point of registration of devices prior to their operation.

It should also be noted that agreements between licensees can only continue to apply while the size and the shape of the spectrum space owned by the licensees remains the same. Where trading of licences takes place and new boundaries are formed, these agreements will need to be re-negotiated. This re-negotiation can occur at any time, that is, before or after the trade, so that there is no loss of flexibility to licensees.

When trading occurs by means of the division of spectrum space, and agreements are not in place, a check will be required to ensure that of devices meet the requirements of the licence within the new geographic area of the relevant licence.

Licence Core Conditions

This part of the chapter explains what the core conditions of the licence are intended to achieve, and how the emissions subject to those conditions are further managed under the technical framework. A sample licence can be found in Schedule 5 of **Attachment 3**. The core conditions of a spectrum licence set out:

- the geographic area;
- the frequency band;
- the out-of-area emission limits; and
- the out-of-band emission limits

of the licence.

Geographic area

The geographic area or aggregate of areas within which the operation of radiocommunications devices is authorised by the licence is described in part 3 of licence schedule 1.

[Note: The coordinate system used in part 3 of licence schedule 1 is different to the coordinate system used to describe the licence areas in schedule 2 of the Marketing Plan.]

Frequency band

The frequency band of the licence within which the operation of radiocommunications devices is authorised by the licence consists of the contiguous range of frequencies between the upper and lower frequency limit set out in part 2 of licence schedule 1.

Out-of-area emissions

Out-of-area emission limits through the determination of unacceptable interference prevent in-band interference between geographically adjacent licensees. A fixed transmitter operated under a 27 GHz spectrum licence may be located anywhere in the geographic area of the licence. However emissions from the transmitter may not cause the radiated powers outside the geographic bounds of the licence to exceed the limit imposed by core conditions 3 to 6 of the licence. As mentioned above these limits can be extended by agreement with adjacent licensees.

The maximum radiated power limit out-of-area for a wide beamwidth transmitter (where the antenna beamwidth is greater than 5 degrees) is 65 dBm/MHz (65 dBm

EIRP measured in a 1 MHz rectangular bandwidth). The radiated power limit out-of-area for a narrow beamwidth transmitter is 79 dBm/MHz. These limits mean that most currently available commercial transmission equipment can be operated without restriction from these core conditions up to the boundary of the licence.

While there is no specific in-area-limit in the core conditions the definition of the out-of-area limit effectively places a cap on the EIRP of transmitters anywhere in the area of the licence.

The distinction between wide beamwidth and narrow beamwidth transmitters takes into account the difference in the potential to cause interference to other services. This distinction is used throughout the technical framework. The antenna beamwidth indirectly distinguishes between hub transmitters in point-to-multipoint systems and customer transmitters in point-to-multipoint systems or transmitters in point-to-point systems.

Out-of-band emissions

Out-of-band emission limits through the determination of unacceptable interference protect licensees in adjacent spectrum. Out-of-band emission limits are imposed by core conditions 7 to 16 of the licence. However, these levels may be varied through negotiated agreement with affected adjacent licensees. The form of agreement described above also applies to these agreements with spectrally adjacent licensees. A licensee or accredited person must work out the radiated power of the device within bandwidths outside the frequency band of the licence using good engineering practice to establish whether the operation of a device will cause 'unacceptable interference' by breaching these emission limits. If the power so calculated is greater than a figure specified in the relevant licence condition, two things follow:

- if the device is not yet registered - the ACA will generally refuse to register it, because the interference that it would cause will be 'unacceptable interference' within the meaning of s.145 of the Act, (unless, for example, all relevant licensees agree alternative arrangements);
- if the device is already registered - there will be a breach of the core licence condition, unless, once again, all relevant licensees have agreed to the alternative arrangements.

Out-of-band emission limits have been expressed in the form of absolute levels rather than levels relative to the transmitter output power to allow licensees to operate transmitters with an optimized balance between power and out of band emission suppression.

The limits for out of band emissions have been chosen to enable adjacent STU operation beyond the licensee 200m interference management zone.

Other Licence Conditions

Whilst core conditions go some way to limit interference to adjacent services their primary purpose is to define the asset of the spectrum licence. Some additional protection from interference is required beyond that provided indirectly through the core conditions. One method of implementing this protection is through the inclusion of other conditions in the licence. In particular, a number of conditions have been added to protect space services.

Protection for space services

As can be seen from the Table of Allocations in the ITU Radio Regulations, the 27 GHz band is shared with the inter-satellite service (ISS) and the earth-exploration-satellite service (ESS)(space to earth). The 27 GHz band is also shared with the fixed-satellite service (FSS)(Earth-to-space). Due to these international allocations the ACA is including a number of conditions to protect these services.

Firstly there are a number of general requirements specified in ITU Radio Regulations Chapter SVI, Article S21 *Terrestrial and Space Services sharing Frequency Bands above 1 GHz*.

- The maximum true mean power of a transmitter must not exceed 40 dBm.
- The maximum radiated true mean power radiated from the antenna of a transmitter must not exceed 85 dBm.

Further to these general limits, in 1997 international agreement was reached on technical limits for fixed services in the band 25.25-27.5 GHz to enable sharing with the ISS. Recommendation ITU-R F.1249 *Maximum Equivalent Isotropically Radiated Power of Transmitting Stations in the Fixed Service Operating in the Frequency band 25.25-27.5 GHz Shared with the Inter-Satellite Service* specifies EIRP limits in the direction of the Geostationary Orbit (GSO) for all fixed services in the band. The following additional limits exist in the direction of the specific GSO locations (see following table) and all other GSO locations.

- A narrow beamwidth transmitter must not radiate a maximum true mean power above the horizontal plane exceeding 54 dBm/MHz in the direction of the specified GSO locations.
- An exception is made that where automatic power control is implemented, a transmitter may increase its power by an amount not exceeding the attenuation due to precipitation up to a maximum of 63 dBm/MHz.
- In the direction of all other GSO locations the limit is 63 dBm/MHz.
- The ACA may allow levels greater than these limits on a case by case basis if the licensee shows that the recommendations of ITU-R F.1249 have been met.

Specified Geostationary Orbit Locations

16.4° E, 21.5° E, 47° E, 59° E, 85° E, 90° E, 95° E, 113° E, 121° E, 160° E, 177.5° E, 174° W, 171° W, 170° W, 160° W, 139° W, 62° W, 49° W, 46° W, 44° W, 41° W, 32° W, 16° W
--

NOTE: These are the GSO locations identified in ITU-R SA.Doc.7/97 and ITU-R SA.1276 as referred to in Recommendation ITU-R F.1249 (1997) and Draft New Recommendation ITU-R F.[PMP]. Copies are available from the ACA.

[Note the Draft New Recommendation ITU-R F.[PMP] has been replaced by ITU-R F.1509 (2001)]

Subsequent ITU-R work made it clear that Recommendation F.1249 which was developed from technical considerations of point-to-point systems was not suitable to address sharing between the ISS and the hubs (wide beamwidth transmitters) of point-to-multipoint systems.

Accordingly, ITU-R Joint Rapporteur Group 7D/9D has recently developed Draft New Recommendation (DNR) ITU-R F.[PMP] *Technical and Operational Requirements that Facilitate Sharing between Point-to-Multipoint Systems in the Fixed Service and the Inter-Satellite Service in the Band 25.25-27.5 GHz* for accelerated approval. The ACA has added the following limits in the direction of the specific GSO locations and in all other directions to implement the recommendations of the DNR.

- A wide beamwidth transmitter must not radiate a maximum true mean power at angles above the horizontal plane in the direction of the specified GSO locations at angle less than or equal to 20 degrees exceeding 38 dBm/MHz. Above 20 degrees up to 90 degrees above the horizontal plane the level decreases with increasing angle down to 31.4 dBm/MHz at 90 degrees.

[These limits have been relaxed in ITU-R F.1509 (2001) for Time Division Duplex transmitters by $7\text{Log}(1/\delta)$ dB up to a maximum of 3 dB where δ is the proportion of time when the wide beamwidth transmitter is emitting signals.]

- A wide beamwidth transmitter must not radiate a maximum true mean power at angles above the horizontal plane in any other direction at angles less than or equal to 5 degrees exceeding 44 dBm/MHz. Above 5 degrees up to 90 degrees the level decreases with increasing angle down to 31.4 dBm/MHz at 90 degrees.
- Once again Automatic power control may be used up to a radiated maximum true mean power of 47 dBm/MHz.
- The ACA may allow levels greater than these limits on a case by case basis if the licensee shows that the recommendations of the DNR have been met.
- Should the DNR be changed during its progression to becoming a recommendation the ACA may reflect these changes in changes to the licence conditions.

Interference management at sites

Also included in the licence are conditions requiring the licensee to manage interference within 200m of a device operated under this licence. These conditions have been included due to the difficulty in specifying emission limits to prevent interference

between a large range of services that may operate in close proximity at prime radiocommunications sites.

To manage out-of-band interference, spectrum licensees may have to utilise guard bands between licensees to install filters at the edges of their spectrum and/or negotiate with the adjacent licensee either to employ transmit filtering, or to avoid placing transmitters near the frequency boundary at certain locations.

These examples of how the interference management regime might affect proposed services and spectrum utility are not intended to be exhaustive. Potential spectrum licensees are reminded to take such expert technical and other advice as they consider necessary, to inform themselves of the possible effects on their proposed services.

Determination of Unacceptable Interference

Before a transmitter can be operated under a spectrum licence its details must be recorded in the register. The ACA may refuse to register a device if the licensee or accredited person cannot show that the requirements deemed to prevent unacceptable interference are met in accordance with the relevant determination made by the ACA under s.145 of the Act - see **Attachment 9 Radiocommunications (Unacceptable Levels of Interference – 27 GHz Band) Determination**.

The Radiocommunications (Unacceptable Levels of Interference – 27 GHz Band) Determination sets out 4 basic requirements to prevent unacceptable levels of interference:

- that the core conditions of the licence are met;
- that other conditions of the licence are met;
- that full details of the transmitter are provided for the register;
- that the transmitter is not attached to a balloon higher than 100m above the ground.

The determination also sets out the definition of a group of transmitters and a group of receivers for the purpose of simplifying registration of those devices and how the registration details for a group of transmitters and receivers must be calculated.

ACA will, generally speaking, refuse to register the device because the levels of emission outside the licence that it would cause will be ‘unacceptable interference’ within the meaning of s.145 of the Act. An exception to this general rule can be made where there is an agreement in the form prescribed in the *Radiocommunications Spectrum Marketing Plan (27 GHz Bands) 2000 (Attachment 3)*.

In these circumstances, the agreement provides that emissions of a device may exceed the core conditions of a licensee license because the adjacent licensee has specifically agreed to that, and accepts any interference caused to its use of the spectrum space. Potential spectrum licensees should take such expert technical and other advice as they consider necessary to inform themselves of this aspect of the technical framework.

The corollary of this aspect of interference management is that spectrum licensees must expect that certain levels of emission will legitimately cross their geographic boundaries from points within other spectrum licensed areas. Accordingly, when considering what services they might establish within their own geographic areas, spectrum licensees will have to take into account the fact that transmitters may be located at certain points within other spectrum licensed areas. And, that those transmitters may radiate power into the spectrum licensee's area at any level up to that allowed under the relevant s.145 determination of unacceptable interference or levels otherwise negotiated with the relevant spectrum licensees.

Radiocommunications Advisory Guidelines

There are three Radiocommunications Advisory Guidelines made under s.262 of the Act issued by the ACA associated with spectrum licensing of the 27 GHz band. They are:

- Radiocommunications Advisory Guidelines (Managing Interference from Non-spectrum-licensed Transmitters-27 GHz band) 2000; and
- Radiocommunications Advisory Guidelines (Protection of Non-spectrum-licensed Receivers-27 GHz band) 2000; and
 - Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz and 28 GHz Spectrum Licensed Services) 2000.

The guidelines are not binding either on licensees or the ACA, and the ACA has adopted this approach in order to provide the maximum flexibility for both spectrum and apparatus licensees in how they arrange their affairs so as to avoid interference with each other's services. Once again, the ACA is prepared to consider alternative interference management arrangements agreed between spectrum licensees and, where relevant, apparatus licensees. Spectrum licensees should, however, note that the ACA will not give effect to alternative arrangements unless all affected and potentially affected licensees have agreed to the arrangements, and that subsequent trading of spectrum will impact on any agreements reached.

The ACA also recommends that radiocommunications devices be registered at the system design stage. This will enable apparatus licensees, if they wish, to re-check the coordination and if an obvious error is detected, negotiate directly with the spectrum licensee before further costs are incurred when transmitters cannot be operated due to interference. However, the registration of devices that are never intended to be operated or have entrepreneurial objectives as their primary purpose should not occur because they have the potential to inhibit the operation of devices by adjacent licensees through the coordination requirements.

The Radiocommunications Advisory Guidelines (Managing Interference from Non-spectrum-licensed Transmitters-27 GHz band) 2000 contains information for spectrum licensees on managing interference from non-spectrum-licensed services.

There are no services licensed in Australia to operate in the 27 GHz band however applicants should be aware that there are levels of emissions from international satellite services which must be considered in planning services.

Only registered receivers will receive protection in the planning of services by the ACA. For the case of managing interference from out-of-band services the ACA has in this guideline set out a minimum performance level for receivers in the 27 GHz band and a compatibility requirement for transmitters of non-spectrum-licensed services. These criteria form a model on the basis of which, spectrum and apparatus licensees are expected to develop co-ordination procedures for the management of interference to each other's services, using good engineering practice. Licensees who cannot resolve interference problems between themselves may expect the ACA to have regard to the guidelines in dealing with such disputes.

The Radiocommunications Advisory Guidelines (Protection of Non-spectrum-licensed Receivers-27 GHz band) 2000 contains information for spectrum licensees regarding protection they should provide to non-spectrum-licensed receivers. There are currently no services licensed in Australia to operate in the 27 GHz band however applicants should be aware that there are a number of international space services which must be considered. Most of the requirements to protect these space services have been included as conditions of the licence however applicants should be aware that because of technical change these guidelines and licence conditions may change over the 15 year period of the spectrum licence.

Licensees are also requested to support the introduction of earth stations for the Earth-exploration satellite service in the future. There are no known standards for equipment operating in and around the 27 GHz band and licensees should be aware that changes may develop over the 15 year period of the licence.

The Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz and 28 GHz Spectrum Licensed Services) 2000 sets out the relationship between spectrum licensed services in the abutting 27 GHz and 28 GHz bands. Built on similar technical frameworks the relationship between licensees in these two bands is a simple one. Namely, the relationship between licensees in the 27 GHz and 28 GHz band is the same as the relationship between licensees within the bands.

Receiver Performance

As mentioned above, licensees will need to take account of the emission limits permitted under the technical framework when deciding the level of performance they require for their receivers. Receivers will cope with emission levels with differing degrees of success depending on their interference susceptibility. For example, a receiver with poor performance would normally deny large amounts of spectrum space for transmitters in order to protect it from interference. The ACA does not intend to

enforce receiver standards. It is for each licensee to balance the cost of receiver performance against the cost of spectrum space denied to his or her transmitters.

Poor receiver performance is only a problem when a licensee uses spectrum space belonging to an adjacent licensee. The framework provides for the operation of receivers that have an interference susceptibility commensurate with that achieved by current technology and intends for this level of performance to guide the interference settlement process. Receivers with poor interference susceptibility performance can be used, but in those cases, a licensee may have to use part of their own spectrum space as guard space. For example, interference that results from a receiver having an RF or IF bandwidth that is larger than the frequency band of the licence, will be the licensee's responsibility. It is the licensee's responsibility to use receivers in a manner that is both consistent with good engineering practice and effectively copes with the levels permitted under the technical framework.

Deployment Considerations

Whilst the two core conditions aimed at emission levels provide some measure of protection from intermodulation effects, the ACA considers it will be necessary to provide further means of protection against this interference mechanism. The ACA has placed no constraints on the deployment of transmitters under the 27 GHz technical framework. Likewise the ACA does not intend to impose deployment constraints on receivers. This means that the onus will lie on spectrum licensees to determine the best siting for their receivers, having regard to the overall technical framework.

It is important to note that the technical framework does not provide any protection from intermodulation effects where transmitters are sited within 200 metres of each other. Consequently, the ACA proposes to include a condition on the spectrum licences that will have the effect of requiring spectrum licensees to come to an arrangement with neighbours in relation to interference in such cases.

Interference That The Technical Framework Does Not Prevent

No matter how rigorous the engineering analysis of a device, there is always a possibility of actual interference when devices are deployed in the field. This is because the technical framework is designed according to certain levels of acceptable interference probability. Under the framework described in this Chapter, it is anticipated that interference between spectrum licensed devices will occur at about the same rate as between apparatus licensed devices, that is, interference will arise in less than one percent of cases. Such interference may be caused by emissions at frequencies either inside or outside licensees' spectrum space.

Licensees are strongly advised before making an interference complaint to attempt to locate the source of any interference by checking the Register of Radiocommunications Licences. This investigation may reveal the cause of the interference and it may be possible to settle the problem without the ACA's intervention. If the ACA becomes involved, licensees may be charged for any work undertaken.

Registering Groups of Transmitters

Unless exempted, transmitters must always be registered as either an individual transmitter or as part of a group of transmitters. If two or more transmitters are operated for the purpose of communicating with the same receiver or same group of receivers and they have identical emission characteristics, then those transmitters may be treated as a group in order to simplify the registration process. A transmitter may belong to more than one group. Groups are defined to help minimise the work associated with the registration process of similar transmitters, for example, subscriber transmitters and multiple transmitters at a hub. Subscriber transmitters may be registered as a group. A group of device may have location details consisting of a centre and an associated effective radius that can take into account the distribution of subscriber transmitters. Mobile and indoor transmitters are exempted from device registration requirements. Licensees may decide whether to register receivers based on a risk assessment of the benefits achieved through coordination to manage out-of-band interference.

International Co-ordination

The ITU Radio Regulations have international treaty status and are binding on Australia. Transmitters operated under a spectrum licence, other than in accordance with ITU Radio Regulations, must not cause interference to any services of any other country (for example, Papua New Guinea or Indonesia) which are operating in accordance with ITU Radio Regulations. If operation of a transmitter does cause harmful interference to overseas services operating in accordance with ITU Radio Regulations, the transmission must cease. Spectrum licensees must also accept interference from any overseas service operating in accordance with ITU regulations. Potential spectrum licensees should note that the ACA will impose such additional licence conditions on spectrum licences as may be necessary to meet its international obligations.

Health and Safety

Every spectrum licensee will need to take into account occupational health and safety requirements for radiofrequency devices. Occupational health and safety requirements that concern use of radiofrequency devices are currently the responsibility of the relevant State or Territory Governments.

In addition, licensees will be required to comply with any health exposure standards that may be made by the ACA for the health and safety of persons who operate, work on or use radiocommunications transmitters and receivers.

Environmental and Other Considerations

Antenna siting, height and construction may be regulated by State, Territory or local government legislation. Before planning for a device to operate in a certain location, licensees should investigate the local rules pertaining to the erection of towers and antennas.

Obtaining a Permit to Operate Non-standard Devices

A licensee who wishes to operate standard devices under a spectrum licence (that is, equipment that conforms to mandatory ACA standards) will not have to apply to the ACA for permission to do so. However, a permit will be required to operate non-standard devices. These permits may be issued by the ACA under s.167 of the *Radiocommunications Act 1992*, and will only be issued during the term of the licence.

Permits to supply non-standard devices for operation under a spectrum licence may also be issued by the ACA under s.174 of the Act.

**11. Appendix C – Sample Licence Schedules
(Schedule 3 Marketing Plan)**

SCHEDULE 3

Clause 2.10

SAMPLE LICENCE SCHEDULES

This Schedule sets out a sample spectrum licence, and the conditions that may be included in a spectrum licence, issued in the parts of the spectrum that are subject to a notice of designation or re-allocation declaration:

LICENCE SCHEDULE 1**LICENCE AND TECHNICAL DETAILS*****Part 1 - Licence Details***

Item	Licensee Details
1	<i>Name of Licensee</i> <i>Address of Licensee</i>
2	Client Number
3	<i>Band Release</i>

Item	Licence Details
4	<i>Date of Licence Effect</i>
5	<i>Date of Licence Expiry</i>
6	<i>Licence Number</i>
7	<i>Date of Licence Issue</i>
8	<i>Issuing Officer</i>

Part 2 - Technical Details

Item	Core Condition – Frequency Band of Licence
9	<i>Upper limit of frequency band</i>
10	Lower limit of frequency band

Item	Core Condition – Emission Limits Outside the Area
11	<i>Radiated Power limit for core condition 3(a)</i> 79 dBm/MHz
12	<i>Radiated Power limit for core condition 3(b)</i> 65 dBm/MHz

Item	Core Condition – Emission Limits Outside the Band
Broadband Emissions from Wide Beamwidth Transmitters	
13	<i>Range of offsets for core condition 4(a)</i> 0 MHz to 50 MHz
14	<i>Maximum true mean power for core condition 4(a)</i> -22 dBm/MHz
15	<i>Range of offsets for core condition 4(b)</i> Greater than 50 MHz
16	<i>Maximum true mean power for core condition 4(b)</i> -36 dBm/MHz
17	<i>Range of offsets for core condition 4(c)</i> 49 to 50 MHz
18	<i>Peak power for core condition 4(c)</i> -22 dBm/MHz

SCHEDULE 3 *continued*
LICENCE SCHEDULE 1 Part 2 *continued*

Item	Core Condition – Emission Limits Outside the Band	
	Broadband Emissions from Narrow Beamwidth Transmitters	
19	<i>Range of offsets for core condition 5(a)</i>	0 MHz to 50 MHz
20	<i>Maximum true mean power for core condition 5(a)</i>	-1 dBm/MHz
21	<i>Range of offsets for core condition 5(b)</i>	Greater than 50 MHz
22	<i>Maximum true mean power for core condition 5(b)</i>	-15 dBm/MHz
23	<i>Range of offsets for core condition 5(c)</i>	49 to 50 MHz
24	<i>Peak power for core condition 5(c)</i>	-1 dBm/MHz
Item	Core Condition – Emission Limits Outside the Band	
	Narrowband Emissions from Wide Beamwidth Transmitters	
25	<i>Mean power for core condition 6(a)</i>	-36 dBm/100 kHz
26	<i>Band for condition 6(a)</i>	9 kHz to 1 GHz
27	<i>Mean power for core condition 6(b)</i>	-30 dBm/MHz
28	<i>Band for condition 6(b)</i>	1 GHz to 18 GHz
29	<i>Mean power for core condition 6(c)</i>	-7 dBm/MHz
30	<i>Band for condition 6(c)</i>	18 GHz to 37 GHz
Item	Core Condition – Emission Limits Outside the Band	
	Narrowband Emissions from Narrow Beamwidth Transmitters	
31	<i>Mean power for core condition 7(a)</i>	-36 dBm/100 kHz
32	<i>Band for condition 7(a)</i>	9 kHz to 1 GHz
33	<i>Mean power for core condition 7(b)</i>	-30 dBm/MHz
34	<i>Band for core condition 7(b)</i>	1 GHz to 18 GHz
35	<i>Mean power for core condition 7(c)</i>	14 dBm/MHz
36	<i>Band for core condition 7(c)</i>	18 GHz to 37 GHz
Item	Core Condition – Emission Limits Outside the Band	
	Emissions from Wide Beamwidth Receivers	
37	<i>Mean power for core condition 8(a)</i>	-57 dBm/100 kHz
38	<i>Band for condition 8(a)</i>	9 kHz to 1 GHz
39	<i>Mean power for core condition 8(b)</i>	-47 dBm/MHz
40	<i>Band for core condition 8(b)</i>	1 GHz to 18 GHz
41	<i>Mean power for core condition 8(c)</i>	-17 dBm/MHz
42	<i>Band for core condition 8(c)</i>	18 GHz to 37 GHz
Item	Core Condition – Emission Limits Outside the Band	
	Emissions from Narrow Beamwidth Receivers	
43	<i>Mean power for core condition 9(a)</i>	-57 dBm/100 kHz
44	<i>Band for condition 9(a)</i>	9 kHz to 1 GHz
45	<i>Mean power for core condition 9(b)</i>	-47 dBm/MHz
46	<i>Band for core condition 9(b)</i>	1 GHz to 18 GHz
47	<i>Mean power for core condition 9(c)</i>	4 dBm/MHz
48	<i>Band for core condition 9(c)</i>	18 GHz to 37 GHz

SCHEDULE 3 *continued*
LICENCE SCHEDULE 1 Part 2 continued

Item *Device Registration*

- 49 *Section 145 Determination for registration of transmitters* *Radiocommunications (Unacceptable Levels of Interference – 27 GHz Band) Determination 2000*

Part 3 - Geographic Area

Core Condition - Geographic area of licence

The area within which operation of radiocommunication devices is authorised by this licence is as follows:

- (a) the total area included within an aggregation of the Specified Areas:

[Description of Included Specified Areas]

- (b) but excluding the Specified Areas:

[Description of Excluded Specified Areas].

In this part, a ‘Specified Area’, in relation to each of the areas mentioned in a table below:

[Description of Tables for each Specified Area],

is the area of land described in the table, bounded by a line starting at the intersection of the first set of latitude and longitude coordinates specified in degrees, minutes, seconds and set out as item 1 of the relevant table and passing through the intersection of each consecutive set of coordinates listed for that table and then returning to the first intersection.

SCHEDULE 3 *continued*
LICENCE SCHEDULE 2

CORE CONDITIONS

Frequency Band

1. This licence authorises the operation of radiocommunications devices in the frequency bands that consist of the contiguous range of frequencies between the upper and lower frequency limits set out in Items 9 and 10 of Part 2 of Schedule 1, respectively.

Geographic Area

2. This licence authorises the operation of radiocommunications devices in the geographic area set out at Part 3 of Schedule 1.

Emission Limits Outside the Area

3. The emission limits outside the geographic area set out at Part 3 of Schedule 1 are:
(a) for a narrow beamwidth transmitter is the radiated power set out in item 11 of Part 2 of Schedule 1; and
(b) for a wide beamwidth transmitter is the radiated power set out in item 12 of Part 2 of Schedule 1.

Emission Limits Outside the Band

Broadband Emissions from Wide Beamwidth Transmitters

4. For radio emission that is broadband emission from wide beamwidth transmitters at frequencies outside the frequency band of the licence, the emission limits outside the band are:
(a) for frequency bands only containing frequencies that are removed from the upper and lower frequency limits of the frequency band of the licence by offsets within the range set out at item 13 of Part 2 of Schedule 1 - the radiated maximum true mean power set out at Item 14 of Part 2 of Schedule 1 of this licence; 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 set out at item 15 of Part 2 of Schedule 1 - the radiated maximum true mean power set out at Item 16 of Part 2 of Schedule 1; and
(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 set out at item 17 of Part 2 of Schedule 1 of this licence - the radiated peak power set out at item 18 of Part 2 of Schedule 1.

SCHEDULE 3 *continued*
LICENCE SCHEDULE 2 continued

Broadband Emissions from Narrow Beamwidth Transmitters

5. For radio emission that is broadband emission from narrow beamwidth transmitters at frequencies outside the frequency band of the licence, the emission limits outside the band are:
- (a) for frequency bands only containing frequencies that are removed from the upper and lower frequency limits of the frequency band of the licence by offsets within the range set out at item 19 of Part 2 of Schedule 1 - the radiated maximum true mean power set out at Item 20 of Part 2 of Schedule 1 of this licence; 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 set out at item 21 of Part 2 of Schedule 1 - the radiated maximum true mean power set out at Item 22 of Part 2 of Schedule 1; and
 - (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 set out at item 23 of Part 2 of Schedule 1 of this licence - the radiated peak power set out at item 24 of Part 2 of Schedule 1.

Narrowband Emissions from Wide Beamwidth Transmitters

6. For radio emission that is narrowband emission from wide beamwidth transmitters at frequencies outside the frequency band of the licence, the emission limits outside the band are:
- (a) a radiated mean power set out at item 25 of Part 2 of Schedule 1 and measured within a 100 kHz rectangular bandwidth that is within the band set out at item 26 of Part 2 of Schedule 1; and
 - (b) a radiated mean power set out at item 27 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 28 of Part 2 of Schedule 1; and
 - (c) a radiated mean power set out at item 29 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 30 of Part 2 of Schedule 1.

Narrowband Emissions from Narrow Beamwidth Transmitters

7. For radio emission that is narrowband emission from narrow beamwidth transmitters at frequencies outside the frequency band of the licence, the emission limits outside the band are:
- (a) a radiated mean power set out at item 31 of Part 2 of Schedule 1 and measured within a 100 kHz rectangular bandwidth that is within the band set out at item 32 of Part 2 of Schedule 1; and
 - (b) a radiated mean power set out at item 33 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 34 of Part 2 of Schedule 1; and
 - (c) a radiated mean power set out at item 35 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 36 of Part 2 of Schedule 1.

SCHEDULE 3 continued
LICENCE SCHEDULE 2 continued

Emissions from Wide Beamwidth Receivers

8. For radio emission from wide beamwidth receivers, the emission limits outside the band are:

- (a) a radiated mean power set out at item 37 of Part 2 of Schedule 1 and measured within a 100 kHz rectangular bandwidth that is within the band set out at item 38 of Part 2 of Schedule 1; and
- (b) a radiated mean power set out at item 39 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 40 of Part 2 of Schedule 1; and
- (c) a radiated mean power set out at item 41 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 42 of Part 2 of Schedule 1.

Emissions from Narrow Beamwidth Receivers

9. For radio emission from narrow beamwidth receivers, the emission limits outside the band are:

- (a) a radiated mean power set out at item 43 of Part 2 of Schedule 1 and measured within a 100 kHz rectangular bandwidth that is within the band set out at item 44 of Part 2 of Schedule 1; and
- (b) a radiated mean power set out at item 45 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 46 of Part 2 of Schedule 1; and
- (c) a radiated mean power set out at item 47 of Part 2 of Schedule 1 and measured within a 1 MHz rectangular bandwidth that is within the band set out at item 48 of Part 2 of Schedule 1.

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 section 294 of the Act and subsection 53 (1) of the *Australian Communications Authority Act 1997*.

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 subsection 68(3) of the Act.

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

Transmitter registration requirements

- 3 The licensee must not operate a transmitter under this licence unless:
- (a) the transmitter has been exempted from the registration requirements under clause 4, or
 - (b) both:
 - (i) the requirements of the ACA under Part 3.5 of the Act relating to registration of the transmitter have been met; and
 - (ii) 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; or
 - (b) an indoor fixed transmitter; or
 - (c) a receiver that is also a transmitter because it radiates narrowband emission.

[NOTES: 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 persons under s. 145(3) of the Act is set out at Item 49 of Part 2 of Schedule 1 of this licence.

2. Although not mandatory, the registration of receivers is advised because one of the matters the ACA will take into account in settling interference is the time of registration of the receiver involved in the interference.]

SCHEDULE 3 *continued*
LICENCE SCHEDULE 4

CONDITIONS INCLUDED BY THE ACA

Additional emission limits

1. The true mean power into the antenna of a transmitter operated under this licence must not exceed 40 dBm.

2. The radiated true mean power of a transmitter operated under this licence must not exceed 85 dBm.

3. A narrow beamwidth transmitter operated under this licence must not radiate a maximum true mean power above the horizontal plane exceeding:
 - (a) 54 dBm/MHz in the direction of the Geostationary Orbit (GSO) locations specified in Table 1, except as set out in clause 4.; and
 - (b) 63 dBm/MHz in the direction of all other GSO locations.

4. When precipitation attenuation is experienced between the transmitter and the intended receiver, the transmitter may increase its power by an amount not exceeding the precipitation attenuation up to a maximum of 63 dBm/MHz

[NOTES: 1. These emission limits have been included to reflect the protection requirements in Recommendation ITU-R F.1249 (1997). The ACA may authorise maximum true mean powers greater than these limits on a case by case basis if the licensee shows that the recommendations of ITU-R F.1249 (1997) have been met. However, the ACA will not authorise an increase in maximum true mean power if this might cause interference to other radiocommunications services.
 2. Copies of ITU-R F 1249 (1997) are available from the ACA.]

5. A wide beamwidth transmitter operated under this licence must not radiate a maximum true mean power at angles above the horizontal plane:
 - (a) in the direction of the GSO locations specified in Table 1:
 - (i) at angles less than or equal to 20°, exceeding 38 dBm/MHz; and
 - (ii) at angles greater than 20° and less than or equal to 90°, exceeding 44 – 10 log(angle/5) dBm/MHz; and
 - (b) in any other direction:
 - (i) at angles less than or equal to 5°, exceeding 44 dBm/MHz; and
 - (ii) at angles greater than 5° and less than or equal to 90°, exceeding 44 – 10 log(angle/5) dBm/MHz;
 except when precipitation attenuation is experienced between the transmitter and the intended receiver. In this case, the transmitter may increase its power by an amount not exceeding the precipitation attenuation up to a maximum of 47 dBm/MHz.

SCHEDULE 3 *continued*
LICENCE SCHEDULE 4 *continued*

[NOTES: 1 These emission limits have been included to reflect the requirements of Draft New Recommendation ITU-R F [PMP]. The ACA may authorise maximum true mean powers greater than these limits on a case by case basis if the licensee shows that the recommendations of Draft New Recommendation ITU-R F.[PMP] have been met. This draft new recommendation may be amended before it becomes an approved Recommendation, and the ACA will modify this condition to reflect the amendments.

2. The ACA will not authorise any increase in maximum true mean if this might cause interference to other radiocommunications services.]

TABLE 1

Geostationary Orbit Locations

16.4° E, 21.5° E, 47° E, 59° E, 85° E, 90° E, 95° E, 113° E, 121° E, 160° E, 177.5° E, 174° W, 171° W, 170° W, 160° W, 139° W, 62° W, 49° W, 46° W, 44° W, 41° W, 32° W, 16° W
--

NOTE: These are the GSO locations identified in ITU-R SA.Doc.7/97 and ITU-R SA.1276 as referred to in Recommendation ITU-R F.1249 (1997) and Draft New Recommendation ITU-R F.[PMP]. Copies are available from the ACA.

Interference management

6. In this licence:
 “manage interference” includes investigation of the possible causes of the interference, taking all steps reasonably necessary to resolve disputes concerning interference where more than 1 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

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

Co-sited devices

8. If:
 (a) interference occurs between a radiocommunications device operated under this licence and a radiocommunications device operated under any other spectrum licence or any other licence that is located within 200 metres of the first device and measured with respect to the location of the phase centre of the antenna used with each device; and

SCHEDULE 3 *continued*
LICENCE SCHEDULE 4 *continued*

- (b) that interference is not the result of operation of a radiocommunications device in a manner that does not comply with the conditions of the relevant licence; and
 - (c) either the licensee or the holder (or third party authorisee) 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

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

International coordination

10. If operation of a transmitter under this licence causes harmful interference to a receiver that operates in accordance with International Telecommunication Union Radio Regulations and is located in a country other than Australia, the transmission must cease.

SCHEDULE 3 *continued***LICENCE NOTES****Variation to licence conditions**

1. The ACA may, with the written agreement of the licensee, vary this licence by including 1 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.
2. The ACA may, by written notice given to the licensee, vary a licence by including 1 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

3. The ACA has issued written Advisory Guidelines under section 262 of the Act about:
 - (a) co-ordinating the operation of transmitters under this licence for non-spectrum-licensed receivers:
 - Radiocommunications Advisory Guidelines (Protection of Non-spectrum-licensed Receivers - 27 GHz Band) 2000; and
 - (b) co-ordinating the operation of non-spectrum licensed transmitters with receivers operated under spectrum licences:
 - Radiocommunications Advisory Guidelines (Managing Interference from Non-spectrum-licensed Transmitters - 27 GHz Band) 2000.
4. The guidelines should be read in conjunction with the relevant Determination made under s. 145(4) 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 ACA intends to afford protection to receivers in accordance with the guidelines in the settlement of interference disputes. Copies of the guidelines are available from the ACA.

The suspension and cancellation of spectrum licences

5. The ACA may by written notice given to a licensee suspend or cancel a spectrum licence where the ACA 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.

SCHEDULE 3 *continued*
LICENCE NOTES *continued*

Re issue

6. A spectrum licence may not be reissued to the same licensee without a price-based allocation procedure unless:
- the ACA is satisfied under subsection 82(1) of the Act that special circumstances exist as a result of which it would be 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 subsection 82(3) of the Act for which reissuing licences to the same licensees would be in the public interest.

Trading

7. 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 ACA under section 88 of the Act.

An assignment under section 85 of the Act of the whole or any part of a licence that involves any change to a licence does not take effect until the ACA has been advised of the changes and the Register of Radiocommunications Licences in respect of spectrum licences has been altered accordingly.

Appeals

8. An application may be made to the ACA 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 ACA under subsection 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.

Labelling of Transmitters

9. Transmitters operated under this licence are to be labelled in accordance with the Radiocommunications (Labelling) Determination 1997.
-

SCHEDULE 4

Clause 2.14(1)

Emission limits outside the area

1. The emission limits outside the area, for frequency bands only containing in-band frequencies, are a radiated power of:
 - (a) for a wide beamwidth transmitter, 65 dBm/MHz ; and
 - (b) for a narrow beamwidth transmitter, 79 dBm/MHz.

 2. For this Schedule, the level of emission outside the area is to be estimated with a level of confidence not less than 95 percent that the true level of emission remains below the relevant emission limit.

 3. For the purposes of paragraph 2, the level of emission is to be estimated after taking into account:
 - (a) the kind of antenna; and
 - (b) the kind of equipment used with the antenna; and
 - (c) the location and immediate physical environment in which the antenna operates.
-

SCHEDULE 5

Clause 2.14(2)

Emission limits outside the band

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

- (a) modulation and intermodulation products outside the frequency band of the licence associated with:
 - (i) the transmitted information; and
 - (ii) switching transient emissions (carrier rise times) from transmitters that include multicarrier transmitters; and
- (b) transmitter broadband noise; and
- (c) transmitter narrowband signals from frequency combining processes, including multicoupling of transmitters into an antenna; and
- (d) any receiver emissions.]

1. Broadband emission

For radio emission that is:

- (a) broadband emission; and
- (b) caused by a transmitter operating under a spectrum licence issued for the 27GHz band; and
- (c) at frequencies outside the frequency band of the licence; and
- (d) offset from the upper and lower limits of the frequency band;

the emission limits outside the band are:

- (e) for wide beamwidth transmitters radiating emission in frequency bands containing frequencies that have offsets:
 - (i) within the range 0 MHz to 50 MHz—a radiated maximum true mean power of -22 dBm EIRP per 1 MHz; and
 - (ii) greater than 50 MHz—a radiated maximum true mean power of -36 dBm EIRP per 1 MHz; and
 - (iii) within the range 49 MHz to 50 MHz—a radiated peak power of -22 dBm EIRP measured within a 1 MHz rectangular bandwidth; and
- (f) for narrow beamwidth transmitters radiating emission in frequency bands containing frequencies that have offsets:
 - (i) within the range 0 MHz to 50 MHz—a radiated maximum true mean power of -1 dBm EIRP per 1 MHz; and
 - (ii) greater than 50 MHz—a radiated maximum true mean power of -15 dBm EIRP per 1 MHz; and
 - (iii) within the range 49 MHz to 50 MHz—a radiated peak power of -1 dBm EIRP measured within a 1 MHz rectangular bandwidth.

SCHEDULE 5 *continued*

2. Narrowband emission

For radio emission that is:

- (a) narrowband emission; and
- (b) caused by a transmitter operating under a spectrum licence issued for the 27 GHz band; and
- (c) at frequencies outside the frequency band of the licence;

the emission limit outside the band is a radiated mean power of:

- (d) -36 dBm EIRP measured within a 100 kHz rectangular bandwidth that is within the band 9 kHz to 1 GHz; and
- (e) -30 dBm EIRP measured within a 1 MHz rectangular bandwidth that is within the band 1 GHz to 18 GHz; and
- (f) for wide beamwidth transmitters— -7 dBm EIRP measured within a 1 MHz rectangular bandwidth that is within the band 18 GHz to 37 GHz; and
- (g) for narrow beamwidth transmitters— 14 dBm EIRP measured within a 1 MHz rectangular bandwidth that is within the band 18 GHz to 37 GHz.

3. Receivers

For radio emission that is:

- (a) caused by receivers operating under spectrum licences issued for the 27 GHz band; and
- (b) at frequencies outside the frequency band of the licence;

the emission limit outside the band is a radiated mean power of:

- (c) -57 dBm EIRP measured within a 100 kHz rectangular bandwidth that is within the band 9 kHz to 1 GHz; and
- (d) -47 dBm EIRP measured within a 1 MHz rectangular bandwidth that is within the band 1 GHz to 18 GHz; and
- (e) for wide beamwidth receivers— -17 dBm EIRP measured within a 1 MHz rectangular bandwidth that is within the band 18 GHz to 37 GHz; and
- (f) for narrow beamwidth receivers— 4 dBm EIRP measured within a 1 MHz rectangular bandwidth that is within the band 18 GHz to 37 GHz.

4. For this Schedule, a level of emission outside the band is to be estimated with a level of confidence not less than 95 percent that the true level of emission remains below the relevant emission limit.

5. For the purposes of paragraph 4, the level of emission is to be estimated after taking into account:

- (a) the kind of antenna; and
- (b) the kind of equipment used with the antenna; and
- (c) the location and immediate physical environment in which the antenna operates.

**12. Appendix D - Radiocommunications
(Unacceptable Levels of Interference - 27 GHz Band)
Determination 2000**

Radiocommunications (Unacceptable Levels of Interference - 27 GHz Band) Determination 2000

Commonwealth of Australia

Radiocommunications Act 1992

**Radiocommunications (Unacceptable Levels of Interference - 27 GHz Band)
Determination 2000**

THE AUSTRALIAN COMMUNICATIONS AUTHORITY determines the following unacceptable levels of interference under section 145 of the *Radiocommunications Act 1992*.

Dated 21 September 2000

A J Shaw
Chair

R Horton
Deputy Chair

Australian Communications Authority

CONTENTS

Clause	Title
1.	Title
2.	Commencement
3.	Purpose
4.	Interpretation
5.	Group of transmitters
6.	Group of receivers
7.	Unacceptable level of interference
8.	Emission designator
9.	Registration
Schedules	
Schedule 1	Centre location and effective radius of a transmitter
Schedule 2	Antenna height above ground

Radiocommunications (Unacceptable Levels of Interference - 27 GHz Band) Determination 2000

Title

1. This determination is the Radiocommunications (Unacceptable Levels of Interference - 27 GHz Band) Determination 2000.

Commencement

2. This determination commences on 2000.

Purpose

3. This determination sets out what is an unacceptable level of interference caused by a transmitter operating under a spectrum licence issued for the 27 GHz band. It ensures that high levels of emission from transmitters operated under the licence are kept within the geographic area and frequency band of the licence.

[NOTES:

1. The ACA may refuse to register a transmitter if the operation of the transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices - see s.145 of the Act.

2. The ACA has issued written advisory guidelines under s.262 of the Act about compatibility requirements in relation to the assignment of frequencies for transmitters operated under apparatus licences and the operation of transmitters under spectrum licences. The ACA will take these guidelines into account during the settlement of interference disputes. Each case will be assessed on its merits. The guidelines do not prevent a licensee negotiating other compatibility requirements with another licensee. The guidelines are:

- *Radiocommunications Advisory Guidelines (Managing Interference from Non-spectrum-licensed Transmitters - 27GHz Band) 2000*
- *Radiocommunications Advisory Guidelines (Protection of Non-spectrum-licensed Receivers - 27GHz Band) 2000*
- *Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz and 28 GHz Spectrum-Licensed Services) 2000.*

Copies are available from the ACA.]

Interpretation

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

Act means the *Radiocommunications Act 1992*.

Australian National Spheroid means the Australian National Spheroid published in the *Commonwealth of Australia Gazette* on 6 October 1966 and used with the Australian Geodetic Datum 1984.

effective occupied bandwidth, for a transmitter, means the minimum width of a frequency band having fixed upper and lower limits that is necessary to contain not less than 99% of the true mean power of the transmitter's emission at any time.

emission centre frequency, for a transmitter, means the frequency midway between the lower and upper frequency limits of the transmitter's effective occupied bandwidth.

emission designator has the meaning given by clause 8.

Radiocommunications (Unacceptable Levels of Interference - 27 GHz Band) Determination 2000

error means the uncertainty, relating to the estimated value of a specified parameter, that results in a 95% level of confidence that the true value of the parameter is within the range:

- (a) estimated value minus the uncertainty; to
- (b) estimated value plus the uncertainty.

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

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

geographic area, for a spectrum 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 7.

group of transmitters has the meaning given by clause 6.

indoor, for a fixed transmitter, means a transmitter having an antenna with its phase centre located within, and at least 5 metres from the external surface of, an enclosed space.

outdoor, for a fixed transmitter, means a transmitter that is not an indoor fixed transmitter.

publish includes publish electronically.

27 GHz band means the frequency band 26.5 GHz - 27.5 GHz.

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

frequency band	interference
ACA	spectrum licence
transmitter.]	

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

2000

Unacceptable levels of interference

5. (1) This clause sets out what are unacceptable levels of interference for the purposes of section 145 of the Act.

[NOTE: Under s.145, the ACA may refuse to register a transmitter if the operation of the transmitter could cause an unacceptable level of interference to the operation of other radiocommunications devices.]

(2) A level of interference caused by a transmitter or group of transmitters operated under a spectrum licence issued for the 27 GHz band is unacceptable if the operation results in a breach of a core condition of the licence about the maximum permitted level of radio emission from the transmitter or any transmitter within the group:

- (a) outside the parts of the spectrum the use of which is authorised by the licence; or
- (b) outside the geographic area of the licence.

[NOTE: S.66(1) of the Act deals with core conditions relating to maximum permitted levels of radio emissions.]

(3) A level of interference caused by a transmitter or group of transmitters operated under a spectrum licence issued for the 27 GHz band is unacceptable if the operation would result in a breach of any condition of the licence about protection limits for satellite services from a transmitter or any transmitter within a group.

[NOTE: Under s.71(1) of the Act the ACA may include other conditions in spectrum licences. The ACA proposes to include conditions setting additional emission limits.]

(4) If the centre location or effective radius cannot be calculated as set out in Schedule 1 for a transmitter or a group of transmitters, the transmitter or group is taken to cause unacceptable interference.

(5) If the antenna height above ground cannot be calculated as set out in Schedule 2 for a transmitter or a group of transmitters, the transmitter or group is taken to cause unacceptable interference.

(6) A level of interference caused by a transmitter or group of transmitters operated under a spectrum licence issued for the 27 GHz band is unacceptable if the maximum error in the antenna azimuth and mechanical antenna tilt is greater than:

- (a) 2 degrees for a transmitter; and
- (b) 180 degrees for a group of transmitters.

(7) A transmitter on an airship or on a balloon is taken to cause unacceptable interference when it is operated at a height greater than 100 metres above the ground.

Group of transmitters

6. (1) For the purpose of this determination, two or more fixed transmitters are a group of transmitters if a height can be calculated for the group and:

- (a) they have the same:
 - (i) emission centre frequency; and
 - (ii) emission designator; and

2000

- (b) each has an antenna of the same type, model and manufacturer; and
- (c) they are operated for the purpose of communicating with the same receiver or group of receivers.

(2) A transmitter may belong to more than one group of transmitters.

Group of receivers

7. (1) For the purpose of this determination, two or more fixed receivers are a group of receivers if a height can be calculated for the group and:

- (a) each has an antenna of the same type, model and manufacturer; and
- (b) they are operated for the purpose of communicating with the same transmitter or group of transmitters.

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

[NOTE: The height of a group of receivers is calculated using the same method as that for a group of transmitters.]

Emission designator

8. (1) In this determination, a reference to an emission designator, for a transmitter, is a reference to the designation of the transmitter's emission worked out in accordance with Article 4 of the Radio Regulations published by the International Telecommunication Union as in force on the day this determination commences.

(2) To work out the designation of the transmitter's emission, the references in Article 4 to necessary bandwidth for a given class of emission are taken to be references to the effective occupied bandwidth of the transmitter.

[Note: Article 6 of the Radio Regulations contains examples of how the emission designator is worked out.]

2000

SCHEDULES

SCHEDULE 1

Clause 9(1)

Centre location and effective radius of a transmitter

1. The centre location of a transmitter is the centre of a circle lc with an effective radius re . This Schedule sets out the lc and re of particular transmitters.

[NOTE: For the purpose of registration and interference analysis the effective location of a transmitter or a group of transmitters is modelled using the circumference of the circle defined by the centre location and effective radius.]

2. Centre location and effective radius of a fixed transmitter

For a fixed transmitter, lc is the location (by latitude and longitude with reference to the Australian National Spheroid) of the phase centre of the transmitter's antenna and re is zero.

In measuring the latitude and longitude, the following errors are acceptable:

- (a) in a high radio-dense area, less than 10 metres, measured using a differential GPS unit;
- (b) in a medium radio-dense area, less than 100 metres, measured using a standard GPS unit;
- (c) in any other area, less than 1 kilometre, measured using a map.

[NOTE: The ACA issues site identifiers for established radiocommunications locations.]

3. Centre location and effective radius of a group of fixed transmitters operating on land and not covered in paragraph 4

For a group of fixed transmitters operating within the limits of a town specified in the towns mobile list, lc and re are taken to be those specified in the towns mobile list for that town.

4. Centre location and effective radius of a group of fixed transmitters located near a central point

For a group of fixed transmitters:

- (a) supported by the same structure; and
- (b) having the phase centre of each transmitter's antenna located within 10 metres of the same central point;

lc is the central point and re is zero.

[NOTE: The centre location, effective radius and antenna height above ground of a receiver are calculated as if the receiver is a transmitter.]

SCHEDULE 2

Clause 4(1)

Antenna Height Above Ground

1. The antenna height above ground is determined in accordance with its transmitter, as set out in this Schedule.

2. Antenna height above ground of an outdoor fixed transmitter

The antenna height above ground (“hg”) for an outdoor fixed transmitter, is the vertical height in metres of the phase centre of the fixed transmitter’s antenna measured with an error of less than 5 parts in 100 and relative to the point:

- (a) 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
- (b) having the lowest elevation on that line.

[NOTE: Indoor transmitters are exempt from registration.]

3. Antenna height above ground of a group of fixed transmitters

For a group of fixed transmitters where the antenna height above ground of the highest transmitter (hg_{max}), calculated in accordance with clause 2, is equal to or less than 20 metres, the antenna height above ground of the group is hg_{max} .

However, if a fixed transmitter in the group transmits for more than 5% of the time in any 1 hour period:

- (a) each transmitter in the group is to be treated as if it were a single fixed transmitter; and
- (b) the antenna height above ground of each fixed transmitter is to be worked out as for a single fixed transmitter.

4. Antenna height above ground of a group of fixed transmitters located near a central point

For a group of fixed transmitters:

- (a) all supported by the one structure; and
- (b) having the phase centre of each transmitter’s antenna located within 10 metres of the same central point;

the antenna height above ground of the group is calculated as if it is a single fixed transmitter located at the central point and with a hg, calculated in accordance with clause 2, equal to that calculated for the antenna with the largest hg.

**13. Appendix E - Radiocommunications Advisory Guidelines
(Managing Interference From Non-Spectrum-Licensed Transmitters – 27 GHz Band)
2000**

Commonwealth of Australia

Radiocommunications Act 1992

Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000

THE AUSTRALIAN COMMUNICATIONS AUTHORITY makes the following guidelines under section 262 of the *Radiocommunications Act 1992*

Dated 21 September 2000

A J Shaw
Chair

R Horton
Deputy Chair

Australian Communications Authority

BACKGROUND

Interference to a spectrum licensee's registered receiver is managed using a number of tools provided by the *Radiocommunications Act 1992*. These tools are:

- the core conditions in all spectrum licences (see s.66 of the Act), about:
 - emission limits outside the area; and
 - emission limits outside the band;
- other conditions of the spectrum licences (see s.71 of the Act);
- the determination under s.145 of the Act about what constitutes unacceptable interference;
- advisory guidelines made under s.262 of the Act, about managing interference in specific circumstances.

The following advisory guidelines under s.262 of the Act have been made for the management and settlement of interference to registered fixed receivers operated under 27 GHz spectrum licences and caused by non-spectrum-licensed transmitters.

Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000

CONTENTS

PART 1.–INTRODUCTION

- 1.1 Title
- 1.2 Commencement
- 1.3 Purpose of these guidelines
- 1.4 Interpretation

PART 2.–MANAGING INTERFERENCE FROM NON-SPECTRUM-LICENSED SERVICES

- 2.1 Recording Device Details in the Register
- 2.2 Space Services
- 2.3 Other Non-spectrum-licensed Services

PART 3.–MINIMUM RECEIVER PERFORMANCE LEVEL

- 3.1 Minimum Receiver Performance Level

PART 4.–COMPATIBILITY REQUIREMENT

- 4.1 Compatibility Requirement

Schedule 1 Minimum Receiver Performance Level

Schedule 2 Compatibility Requirement

Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000

PART 1.–INTRODUCTION

Title

1.1. These guidelines are the *Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000*.

Commencement

1.2. These guidelines commence on 2000.

Purpose of these guidelines

1.3. The purpose of these advisory guidelines is to manage interference by providing for the protection of registered fixed receivers under spectrum licences issued for the 27 GHz band from interference caused by non-spectrum-licensed transmitters.

Interpretation

1.4. In these guidelines, unless the contrary intention appears:

Act means the *Radiocommunications Act 1992*.

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

blocking means a measure of the ability of the receiver to receive a wanted signal without exceeding a specified degradation in output quality caused by the presence of a high level off-tune signal overloading the receiver's front-end.

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

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.

intermodulation immunity means a measure of the ability of a receiver to receive a wanted signal without exceeding a specified degradation in output quality caused by the presence of two or more unwanted signals with a specific amplitude and frequency relationship to the wanted signal frequency.

non-spectrum-licensed, for a transmitter or a service, means a transmitter or service operated in spectrum space by a person:

- (a) who does not hold a spectrum licence for that space; and
- (b) who is not authorised under section 68 of the Act to operate Radiocommunications in that space.

Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000

Register means the Register established under s.143 of the Act.

RF selectivity means a measure of the ability of a receiver to attenuate an unwanted out-of-band signal.

RF and IF selectivity means a measure of the ability of a receiver to attenuate an unwanted out-of-band signal including the attenuation of that signal after conversion to another frequency within the receiver.

s.145 determination means the *Radiocommunications (Unacceptable Levels of Interference.27 GHz Band) Determination 2000*.

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

spurious response immunity means a measure of the ability of the receiver to discriminate between the wanted signal at its nominal frequency and an unwanted signal at any frequency at which the receiver responds.

27 GHz band means the frequency band 26.5 GHz - 27.5 GHz.

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

(3) A term used in these guidelines that is defined in the s.145 determination has the same meaning as in that determination.

[NOTES: 1. The following terms, used in this determination, are defined in the *Radiocommunications Act 1992* and have the meanings given to them by that Act: frequency band, interference, ACA, spectrum licence, transmitter.]

PART 2.–MANAGING INTERFERENCE FROM NON-SPECTRUM-LICENSED SERVICES

Recording Device Details in the Register

2.1 A receiver will not be afforded protection unless details of the receiver are in the Register.

Space Services

2.2 Spectrum licensees must accept any in-band interference from the Inter-Satellite Service and Earth-Exploration-Satellite Service presenting power flux densities on the surface of the Earth not exceeding the levels set down by the ITU-R Radio Regulations S21.16 and presented in the following table.

TABLE

Limit (dB(W/m ²)) in 1 MHz bandwidth for angles of arrival above the horizontal plane

Radiocommunications Advisory Guidelines (Managing Interference from Non-

Spectrum-Licensed Transmitters.27 GHz Band) 2000

Angles	0° – 5°	5° – 25°	25° – 90°
Limit	-115	-115 + 0.5(angle-5)	-105

Other Non-Spectrum-Licensed Services

2.3 There are no incumbent devices licensed in Australia using in-band frequencies of the 27 GHz band. Interference can however be caused by frequency adjacent services through mechanisms that act directly (for example, out of band emissions) or indirectly (for example, receiver intermodulation) and usually occur between devices located close to each other at communal sites. The spectrum licensee is required under the licence to take reasonable steps to manage interference in the case of co-sited devices (that is, devices within 200m).

The following will be considered in managing interference:

- the characteristics of the registered receiver; and
- the minimum receiver performance characteristics in Part 3 and Schedule 1; and
- the compatibility requirement in Part 4.

PART 3.-MINIMUM RECEIVER PERFORMANCE LEVEL**Minimum Receiver Performance Level**

3.1 The level of interference caused by out-of-band emissions from a transmitter depends on the interference susceptibility of the receiver as well as the frequency offset and level of the emissions. A receiver's minimum level of performance should be such that its susceptibility to interference does not reduce the use of adjacent licensees' spectrum beyond what is reasonable.

An estimate of the interference susceptibility of a receiver would be based on its performance in relation to adjacent channel selectivity, blocking, intermodulation immunity and spurious response immunity. These characteristics of a receiver are influenced by the RF and IF selectivity of a receiver. A receiver operated under a 27 GHz spectrum licence should have a minimum level of combined RF and IF selectivity and minimum level of RF selectivity as set out in Schedule 1.

PART 4.–COMPATIBILITY REQUIREMENT**Compatibility Requirement**

4.1 A fixed transmitter must meet the compatibility requirement set out in Schedule 2 for a registered fixed receiver:

- (a) with a reasonable minimum level of performance; and
- (b) registered before the issue of the licence under which the transmitter operates; and

Radiocommunications Advisory Guidelines (Managing Interference from Non-

Spectrum-Licensed Transmitters.27 GHz Band) 2000

- (c) operated under a spectrum licence issued for the 27 GHz band.
-

Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000

SCHEDULE 1

Clause 3.1

MINIMUM RECEIVER PERFORMANCE LEVEL

1. RF and IF selectivity

Table 1 sets out the minimum selectivity caused by the sum of the RF and IF selectivities of a receiver operating under a spectrum licence issued for the 27 GHz band for interfering signals from a transmitter operated under a non-spectrum licence.

- Column 1 sets out the frequency offset by reference to the upper and lower limits of the frequency band of the spectrum space in which the receiver operates. A negative offset means that the frequency is inside the frequency band of the licence by the amount of that offset.
- Column 2 sets out the frequency offset by reference to the upper and lower absolute frequency limits of the effective occupied bandwidth of the transmitter that communicates with the receiver.

Column 1 Frequency Offset (MHz) - frequency band of licence	Column 2 Frequency Offset (MHz) - effective occupied bandwidth	Loss (dB)
-8	0	3
-3	5	10
2	10	20
7	15	40
32	40	60

Table 1 . Receiver RF+ IF filter characteristics.

2. RF selectivity

Table 2 sets out the minimum RF selectivity of a receiver between the antenna and the antenna connector of the equipment. The frequency offsets are specified with reference to the upper and lower limits of the frequency band of the spectrum licence under which the receiver operates. A negative offset means that the frequency is inside the frequency band of the licence by the amount of that offset.

Frequency Offset (MHz)	Loss (dB)
-8	0
-3 1.5	7 4.5
42 15	92 30

Table 2 . Receiver RF filter characteristics.

Radiocommunications Advisory Guidelines (Managing Interference from Non-Spectrum-Licensed Transmitters.27 GHz Band) 2000

SCHEDULE 2

Clause 4.1

COMPATIBILITY REQUIREMENT

The compatibility requirement for a fixed receiver operating under a 27 GHz spectrum licence to be provided by a fixed non-spectrum-licensed transmitter is:

- an output quality equivalent to a wanted to unwanted signal level ratio that is not less than 14 dB for more than 1% of the time in any 1 hour period; and
 - with the wanted signal never less than -92 dBm; and
 - when measured within a 1 MHz rectangular bandwidth that is within the frequency band of the spectrum licence.
-

**14. Appendix F - Radiocommunications Advisory Guidelines
(Protection of Non-Spectrum-Licensed Receivers – 27 GHz Band) 2000**

Commonwealth of Australia

Radiocommunications Act 1992

**Radiocommunications Advisory Guidelines (Protection of
Non-Spectrum-Licensed Receivers.27 GHz Band) 2000**

THE AUSTRALIAN COMMUNICATIONS AUTHORITY makes the following guidelines under section 262 of the *Radiocommunications Act 1992*.

Dated 21 September 2000

A J Shaw
Chair

R Horton
Deputy Chair

Australian Communications Authority

BACKGROUND

Interference resulting from operation of a transmitter under a spectrum licence is managed using a number of tools provided by the *Radiocommunications Act 1992*.

These tools are:

- the core conditions in all spectrum licences (see s.66 of the Act), about:
 - emission limits outside the area; and
 - emission limits outside the band;
- other conditions in the spectrum licence (see s.71 of the Act);
- the determination under s.145 of the Act about what constitutes unacceptable interference;
- advisory guidelines made under s.262 of the Act, about managing interference in specific circumstances.

The following advisory guidelines under s.262 of the Act have been made for the management and settlement of interference caused by transmitters operated under a 27 GHz spectrum licence to receivers operating otherwise than under a spectrum licence.

Receivers.27 GHz Band) 2000

CONTENTS

PART 1.–INTRODUCTION

- 1.1 Title
- 1.2 Commencement
- 1.3 Purpose of these guidelines
- 1.4 Principles of protection requirements
- 1.5 Interpretation

**PART 2.–NON-SPECTRUM-LICENSED RECEIVERS IN AND ADJACENT TO
THE 27 GHz BAND**

- Fixed Service Receivers
- 2.1 Background
- 2.2 Protection requirements
- Fixed-satellite Service Satellite Receivers
- 2.3 Background
- 2.4 Protection requirements
- Inter-satellite Service Satellite Receivers
- 2.5 Background
- 2.6 Protection requirements
- Mobile Service Receivers
- 2.7 Background
- 2.8 Protection requirements
- Earth-exploration-satellite Service Earth Station Receivers
- 2.9 Background
- 2.10 Protection requirements

Radiocommunications Advisory Guidelines (Protection of Non-Spectrum-Licensed Receivers.27 GHz Band) 2000

PART 1.–INTRODUCTION

Title

1.1 These guidelines are the *Radiocommunications Advisory Guidelines (Protection of Non-Spectrum-Licensed Receivers.27 GHz Band) 2000*.

Commencement

1.2 These guidelines commence on 2000.

Purpose of these guidelines

1.3 The purpose of these guidelines is to provide information on the protection requirements for receivers operated otherwise than under a spectrum licence from transmitters operating under a 27 GHz spectrum licence.

Principles of protection requirements

1.4 There is little technical information available on the protection requirements for services identified in this guideline because the services are not yet fully developed. When developed, the protection requirements are likely to relate to:

- maximum aggregate power spectral density levels;
- maximum equivalent isotropically radiated power density levels;
- protection ratios (co-channel, adjacent channel and image channel).

Interpretation

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

Act means the *Radiocommunications Act 1992*.

Spectrum Plan means the Australian Radiofrequency Spectrum Plan made on 17 December 1998, copies of which are available from the ACA.

non-spectrum-licensed, for a receiver or a service, means a receiver or service operated in spectrum space by a person:

- (a) who does not hold a spectrum licence for that space; and
- (b) who is not authorised under section 68 of the Act to operate radiocommunications in that space.

27 GHz band means the frequency band 26.5 GHz - 27.5 GHz.

(2) A term used in these Guidelines that is defined in the Spectrum Plan has the same meaning as in the Plan.

(3) In these guidelines, the range of numbers that identifies a frequency band includes the higher, but not the lower, number.

[Notes: 1. A number of expressions used in these Guidelines are defined in the Act, including: spectrum licence.

2. The following expressions used in these Guidelines are defined in the *Spectrum Plan*:

Earth-exploration-satellite service	fixed service
fixed-satellite service	inter-satellite service
Mobile service]	

PART 2.–NON-SPECTRUM-LICENSED RECEIVERS IN AND ADJACENT TO THE 27 GHz BAND

Fixed Service Receivers

Background

2.1 The Spectrum Plan allocates the 25.5 GHz to 26.5 GHz band to the fixed service on a primary basis. This band is adjacent to the 27 GHz band. The ACA has not yet developed protection requirements for non-spectrum-licensed fixed services in this band. It is the ACA's practice to develop protection requirements in consultation with industry. The requirements are usually based on internationally accepted ITU Recommendations.

Protection Requirements

2.2 In planning for the operation of any transmitters under a 27 GHz spectrum licence, spectrum licensees should pay regard to any protection requirements that the ACA may specify for receivers of any non-spectrum-licensed fixed services that are operating in the 25.5 to 26.5 GHz band.

[Note: The 27.5 to 28.35 GHz band, adjacent to the 27 GHz band, has been allocated using spectrum licensing as part of the 28-31 GHz spectrum licence allocation.]

Fixed-Satellite Service Satellite Receivers

Background

2.3 The Spectrum Plan allocates the 27 GHz to 29.1 GHz band to the fixed-satellite (earth-to-space) service on a primary basis. This band overlaps the 27 GHz band. There are no known satellite receivers in the fixed-satellite (earth-to-space) services operating in this band. However, global fixed-satellite services may operate in this band in the future.

General requirements for the protection of fixed satellite services are specified in ITU Radio Regulations Chapter SVI, Article S21 *Terrestrial and Space Services sharing Frequency Bands above 1 GHz*. Additional protection requirements for satellite receivers in the fixed-satellite (earth-to-space) service are usually developed by the ITU and specified in ITU Recommendations.

Radiocommunications Advisory Guidelines (Protection of Non-Spectrum-Licensed Receivers.27 GHz Band) 2000

Protection Requirements

2.4 In planning for the operation of any transmitter under a spectrum licence, spectrum licensees should pay regard to protection requirements specified in ITU Recommendations, that have been prepared by the ITU, for satellite receivers of any fixed-satellite (earth-to-space) services that are operating in the 27 to 27.5 GHz band.

Inter-Satellite Service Satellite Receivers

Background

2.5 The Spectrum Plan allocates the 25.5 GHz to 27.5 GHz band to the inter-satellite service on a primary basis. This band overlaps the 27 GHz band. A number of space agencies are planning to operate inter-satellite services in this band in the future.

Protection Requirements

2.6 In planning for the operation of transmitters under a spectrum licence, spectrum licensees should pay regard to all protection requirements specified by the ITU for satellite receivers in the Inter-satellite service. Some protection requirements are set out in the following ITU Recommendations:

- ITU-R SA.609: Protection Criteria for Telecommunication Links for Manned and Unmanned near-Earth Research Satellites.
- ITU-R SA.1155: Protection Criteria Related to the Operation of Data Relay Satellite Systems.
- ITU-R F.1249: Maximum Equivalent Isotropically Radiated Power of Transmitting Stations in the Fixed Service Operating in the Frequency Band 25.25 – 27.5 GHz Shared with the Inter-Satellite Service.
- Draft New Recommendation ITU-R F.[PMP] Technical and operational Requirements that Facilitate Sharing Between Point to Multipoint Systems in the Fixed Service and the Inter-Satellite Service in the Band 25.25 – 27.5 GHz.

Mobile Service Receivers

Background

2.7 The Spectrum Plan allocates the 25.5 GHz to 26.5 GHz band to the mobile service on a primary basis. This band is adjacent to the 27 GHz band. There are no known mobile services operating in this band in Australia. The ACA has not yet developed protection requirements. However, mobile services may operate in this band in the future. It is the ACA's practice to develop protection requirements in consultation with industry. The requirements are usually based on internationally accepted ITU Recommendations.

Protection Requirements

Radiocommunications Advisory Guidelines (Protection of Non-Spectrum-Licensed Receivers.27 GHz Band) 2000

2.8 In planning for the operation of transmitters under a spectrum licence, spectrum licensees should pay regard to the protection requirements, when specified by the ACA, for receivers of any non-spectrum-licensed mobile services that are operating in the 25.5 to 26.5 GHz band.

Earth-exploration-satellite Service Earth Station Receivers

Background

2.9 The Spectrum Plan allocates the 25.5 GHz to 27 GHz band to the earth-exploration-satellite service (space to earth) on a primary basis. This band overlaps the 27 GHz band. There are no known earth station receivers in the earth-exploration-satellite service operating in this band. However, earth-exploration-satellite services may operate in this band in the future.

Earth-exploration-satellite earth stations may be established for scientific purposes. Protection requirements for earth-exploration-satellite earth stations operating in this band have not been developed. Protection requirements for the Earth-exploration-satellite service are usually developed by the ITU and specified in ITU Recommendations.

Protection Requirements

2.10 In planning for the operation of transmitters under a spectrum licence, spectrum licensees should pay regard to the protection requirements specified in ITU Recommendations, for receivers in the Earth-exploration-satellite service operating in the 25.5 to 27 GHz band.

Some background information can be found in ITU Recommendation ITU-R SA.1278 (1997) Feasibility of Sharing between the Earth-Exploration-Satellite service (space to Earth) and the Fixed, Inter-Satellite, and Mobile services in the band 25.5 – 27.0 GHz.

**15. Appendix G - Radiocommunications Advisory Guidelines
(Managing Interference between 27 GHz and 28 GHz Spectrum-Licensed
Services) 2000**

Commonwealth of Australia

Radiocommunications Act 1992

**Radiocommunications Advisory Guidelines (Managing Interference
between 27 GHz and 28 GHz Spectrum-Licensed Services) 2000**

THE AUSTRALIAN COMMUNICATIONS AUTHORITY makes the following
guidelines under section 262 of the *Radiocommunications Act 1992*

Dated 21 September 2000

A J Shaw
Chair

R Horton
Deputy Chair

Australian Communications Authority

BACKGROUND

Interference to a spectrum licensee's registered receiver is managed using a number of tools provided by the *Radiocommunications Act 1992*. These tools are:

- the core conditions in all spectrum licences (see s.66 of the Act), about:
 - emission limits outside the area; and
 - emission limits outside the band;
- other conditions of the spectrum licences (see s.71 of the Act);
- the determination under s.145 of the Act about what constitutes unacceptable interference;
- advisory guidelines made under s.262 of the Act, about managing interference in specific circumstances.

The following advisory guidelines under s.262 of the Act have been made for the management and settlement of:

- interference to registered fixed receivers operated under 27 GHz spectrum licences and caused by transmitters operated under 28 GHz spectrum licences; and
- interference to registered fixed receivers operated under 28 GHz spectrum licences and caused by transmitters operating under 27 GHz spectrum licences.

Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz and 28 GHz Spectrum-Licensed Services) 2000

CONTENTS

PART 1.–INTRODUCTION

- 1.1 Title
- 1.2 Commencement
- 1.3 Purpose of these guidelines
- 1.4 Interpretation

PART 2.–MANAGING INTERFERENCE FROM SPECTRUM-LICENSED SERVICES

- 2.1 Recording Device Details in the Register
- 2.2 Relationship between the 27 GHz and 28 GHz Spectrum Licences

Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz and 28 GHz Spectrum-Licensed Services) 2000

PART 1.—INTRODUCTION

Title

1.1. These guidelines are the *Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz and 28 GHz Spectrum-Licensed Services) 2000*.

Commencement

1.2. These guidelines commence on 2000.

Purpose of these guidelines

1.3. The purpose of these advisory guidelines is to manage interference by providing for the protection of:

- (a) registered fixed receivers operating under spectrum licences issued for the 27 GHz band from interference caused by transmitters operated under 28 GHz spectrum licences; and
- (b) registered fixed receivers operating under spectrum licences issued for the 28 GHz band from interference caused by transmitters operated under 27 GHz spectrum licences.

Interpretation

1.4. In these guidelines, unless the contrary intention appears:

Act means the *Radiocommunications Act 1992*.

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

Register means the Register established under s.143 of the Act.

s.145 determinations means the *Radiocommunications (Unacceptable Levels of Interference.27 GHz Band) Determination 2000* and the *Radiocommunications (Unacceptable Levels of Interference.28 GHz and 31 GHz Bands) Determination 1998*.

27 GHz band means the frequency band 26.5 GHz - 27.5 GHz.

28 GHz band means the frequency band 27.5 GHz - 28.35 GHz.

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

Radiocommunications Advisory Guidelines (Managing Interference between 27 GHz

and 28 GHz Spectrum-Licensed Services) 2000

(3) A term used in these guidelines that is defined in the s.145 determination has the same meaning as in that determination.

[NOTES: 1. The following terms, used in this determination, are defined in the *Radiocommunications Act 1992* and have the meanings given to them by that Act: frequency band, interference, spectrum licence, transmitter.]

PART 2.–MANAGING INTERFERENCE FROM SPECTRUM-LICENSED SERVICES

Recording Device Details in the Register

2.1 A receiver will not be afforded protection unless details of the receiver are in the Register.

Relationship between the 27 GHz and 28 GHz Spectrum Licences

2.2 Spectrum licences in the 27 GHz band and 28 GHz band are subject to the same core conditions and other conditions in relation to the management of interference. For registration of transmitters both licences are covered by similar s.145 determinations. The 27 GHz spectrum licences have some additional licence conditions to protect satellite receivers that may operate in the 27 GHz band. These do not affect the relationship between spectrum licensees.

2.3 This means that interference from transmitters operated under 28 GHz spectrum licences to receivers operated in spectrum covered by a 27 GHz spectrum licence should be managed in the same way as interference from transmitters operated under other spectrum licences in the 27 GHz band.

2.4 Similarly it also means that interference from transmitters operated under 27 GHz spectrum licences to receivers operated in spectrum covered by a 28 GHz spectrum licence should be managed in the same way as interference from transmitters operated under other spectrum licences in the 28 GHz band.

2.5 This interference is managed through the licence core conditions and the s.145 determinations.
