**PIB 38**
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# RADIO LICENCE CERTIFICATION RULES

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## Engineering Rules and Information

**For**

## Approved Radio Certifiers
## &
## Approved Radio Engineers

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## Disclaimer

This document reflects the current policies and practices of the Radio Spectrum Management (RSM) group of the Ministry of Economic Development (MED) in regard to the engineering of radio licences to meet the requirements of regulation 12(b) of the Radiocommunications Regulations 2001. All such licences must also meet the requirements of the Radiocommunications Act 1989 ("The Act").

Approved Persons, being Approved Radio Engineers and Approved Radio Certifiers, are required to comply with these rules when issuing engineering certificates relating to radio licence applications. These rules, however, do not represent the entirety of the knowledge and expertise that an Approved Person must use for determining the engineering technical compatibility of a proposed radio licence with existing licences.

These rules are amended from time to time to reflect evolving technologies and services. It is the responsibility of Approved Persons to ensure that they are familiar with the latest provisions as published on the RSM website. (www.rsm.govt.nz)

No liability is or will be accepted by the Ministry, or its officers, servants or agents for any loss suffered, whether arising directly or indirectly, from sole reliance on the accuracy or contents of these rules.

## Document amendment history

| Amendment history | | |
|---|---|---|
| **Date of effect** | **Issue** | **Description of amendment** |
| 23 September, 2004 | 1 | First Public Release |
| May 2005 | 2 | First amendment |
| August 2005 | 3 | Simplex clarification |
| December | 4 | UHF parameter clarification, new antenna criteria and minor editorial changes |
| December 2008 | 5 | Update to Land mobile Trunk Despatch 800 MHz Only |
| June 2009 | 6 | Updated for the addition of the 80GHz band, corrections to Fixed service band table, Appendix D and Editorial amendments. |
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## Contents

# 1 Section One - General

## 1.1 Introduction

An application for a *radio licence* made under regulation 7 of the New Zealand Radiocommunications Regulations (2001) must, in accordance with regulation 12(b), be technically compatible with existing *radio licences* and *spectrum licences* recorded in the *Register of Radio Frequencies (RRF).*

> PIB 22 (Fixed Service Bands in New Zealand) and PIB 23 (VHF and UHF Mobile Service Bands in New Zealand) list the frequency bands within which an Approved Person, being an *Approved Radio Engineer* (ARE) or *Approved Radio Certifier* (ARC)[1] may certify licences to assign frequencies. The licensing procedure is described under "scope" below.

PIB 21 (Table of Radio Spectrum Usage in New Zealand) also lists these bands along with other frequency bands for other services. For services other than fixed or mobile, (such as radiodetermination, meteorological etc), an Approved Person may also undertake the engineering analysis to certify the technical compatibility of licence applications, but must submit the licence applications to the Manager Licensing Services, RSM for the assignment of frequencies.

The principle of *technical compatibility* is embodied in Article 3.3 of the International Radio Regulations:

> "Transmitting and receiving equipment intended to be used in a given part of the frequency spectrum should be designed to take into account the technical characteristics of transmitting and receiving equipment likely to be employed in neighbouring and other parts of the spectrum, provided that all technically and economically justifiable measures have been taken to reduce the level of unwanted emissions from the latter transmitting equipment and to reduce the susceptibility to interference of the latter receiving equipment." [2]

In certifying a radio licence, an Approved Person must, in acting as an agent of the chief executive of the MED, comply with clauses 12(c) and (d) of the New Zealand Radiocommunications Regulations (2001):

> "*...take account of -*
> *(c) the public interest in achieving the maximum benefit from radiocommunications: and*
> *(d) any general policy of the Government...* "

## 1.2 Purpose

This document (RLCR) prescribes technical rules, makes recommendations, and provides other information relevant to Approved Persons when issuing a *radio licence certificate (RLC)* for a radio licence application. The document is intended to promote technically efficient spectrum use and to enable Approved Persons to avoid harmful interference between services.

Approved Persons must comply with the New Zealand legislation for use of the radio spectrum:

- The Radiocommunications Act (1989), including subsequent amendments
- The Radiocommunications Regulations (2001)

Approved Persons must also be aware of relevant information contained in sources such as:

- The International Radio Regulations; and
- The ITU-R Reports and Recommendations; and
- Annex 10 to the convention on International Civil Aviation; and
- The International Convention for the Safety of Life at Sea.

[1] Refer to MED publication PIB 34 – "Approved Radio Engineers and Approved Radio Certifiers"
[2] The phrase "likely to be employed" relates to ITU allocations and radio licence planning processes.

These rules should also be considered alongside other RSM documentation published on the RSM website, including: -

• Operational Policy Documents (POLDOCs)
• Public Information Brochures (PIBs)

Should there appear to be a conflict between publications, the manger, licensing should be contacted for a clarification..

The RLCR will be reviewed to reflect changing technologies and service requirements. It is the responsibility of Approved Persons to ensure they are familiar with the current version of this document published on the RSM website at http://www.rsm.govt.nz.

Points to note

1. Suggestions to improve the scope and content of the RLCR rules are welcome and should be made to the Group Manager RSM. It would be appreciated if any inaccuracy or ambiguity found, is notified to RSM without delay.

2. Applications for exemptions to the RLCR should be made to the Manager RSM Licensing Services. A copy of any exemption granted must be included with the licence application.

3. This document does not address the certification of *spectrum licences* by Approved Radio Engineers.

4. The frequencies applicable for use by Approved Persons are referred to in Appendix A (fixed services) and Appendix B (land mobile). These can be found in the engineering resources section of the Engineering Certification page at http://www.rsm.govt.nz.

## 1.3 Scope

The scope of the RLCR is generally limited to that of providing the essential engineering information necessary to assist Approved Persons to undertake technical compatibility analysis for land mobile and terrestrial near line-of-sight fixed services.

Although the RLCR specifies a number of important rules that must be adhered to as part of a radio system planning process, the RLCR is not intended to serve as a system design or planning guide. The RLCR is limited to the matters considered necessary for the technically effective and efficient use of the radio spectrum, avoidance of potential interference mechanisms, and compliance with recognised national and international standards, rules, recommendations, and procedures.

Note that the engineering requirements described in RLCR are a minimum. In many cases, such as links forming part of a high capacity network with specific service targets, more detailed engineering analysis will be required. The relevant ITU-R Recommendations usually provide the basis for such detailed analysis.

This document is intended to cover the majority of commonly deployed radiocommunication services that can usually be defined by operational application, and that typically fall under the following categories.

**Fixed services**

- Local network access linking – usually small to medium capacity, typically used for serving regional, rural and remote areas. Typically 2 Mbit/s.
- Thin route fixed networks – typically small to medium capacity and often used by public and private utility operators and mobile Telecommunication network operators.
- Customer fixed links – typically small capacity to medium capacity, mainly in-house voice and data communication, and usually over relatively short distances.
- Studio to transmitter and outside broadcast links – as typically used by broadcasters.
- High capacity trunking fixed links - as used for long haul fixed telecommunications networks.

While many of the above services are currently analogue, an increasing proportion are migrating to digital technologies, with data rates from a few hundred kilobits per second for some local access and telemetry systems and customer links, to high capacity links of Gigabits per second that supports broadband applications. Approved Persons must give particular consideration to analogue / digital compatibility issues.

**Mobile services**

- VHF and UHF despatch and trunked land mobile

**Satellite services**

Licence applications for Satellite services, such as for FSS receive-only and for satellite uplink circuits, may be engineered and have a certificate issued by an Approved Person for the applicant.

**Radiodetermination**

Approved Persons may provide the engineering analysis for radiodetermination systems. However although there are bands allocated to the radiodetermination service in New Zealand in PIB 21, there are no New Zealand channel plans for radiodetermination systems. Hence, licence applications for radiodetermination systems must be referred to the Manager Licensing Services, RSM for the assignment of frequencies.

**Other services**

Licence applications for other services, such as Radionavigation, Radiolocation and Meteorological Aids etc, must be submitted to the MED for technical compatibility certification by the Ministry, although the applicant may submit a proposed engineering design for a licence.

This document is not applicable to services operating under general user licences.

## 1.4 International allocations, band planning and channel arrangements

In New Zealand the national allocation plan for the radio frequency spectrum is specified in the PIB 21 *"Table of Radio Spectrum Usage in New Zealand"* and conforms to the Table of Frequency Allocations for Region 3 in the ITU-R Radio Regulations.

The ITU-R Radio Regulations, including their Table of Frequency Allocations under Article 5, have the status of an international treaty, to which the New Zealand government is a signatory. The obligation of the Ministry, as the administration on behalf of the government, to comply with these international regulations, is further underlined by clause 12 (a) of the New Zealand Radiocommunications Regulations (2001), which requires that the Chief Executive of the Ministry of Economic Development -

> "*in determining whether to grant a radio licence... ...must take account of -*
> *(a) any agreement between New Zealand and any other country or countries relating to radiocommunications;..."*

In certifying a radio licence, an Approved Person must also comply with all such agreements. PIB 21 in conforming with the ITU-R Radio Regulations, fulfils the majority of international obligations. Any other international agreements will be accommodated by the Policy Documents and standards referred to in the right hand column of the tables in PIB 21 ("References and Policies".)

A majority of the spectrum bands in the ITU-R Radio Regulations are allocated to more than one service. (See column 2 of PIB 21.) Many of these ITU allocations are technically incompatible, hence individual countries select particular services for their national allocations in each band to meet their individual needs. Not all national allocations are the same for all countries, nor can it be expected that they will all be implemented in the same manner.

In New Zealand, government policy and broad public interest criteria generally determine how particular bands will be used. Some frequency bands are reserved for exclusive use of one service,

whilst others may be available on a shared basis with other ITU allocated services. The specific national allocation plan for bands in New Zealand is the result of historical circumstances, including the intra-service and inter-service sharing and co-ordination considerations prevailing when the original allocations were made.

The channel plans for fixed microwave service bands are defined in PIB 22 - "Fixed Service Bands in New Zealand". These channel plans are generally implemented and aligned very closely with ITU-R Recommendations, supplemented by national arrangements to accommodate readily available local product.

The channel plans in PIB 23 - "VHF and UHF Mobile Service Bands in New Zealand", closely follow generic ITU-R Recommendations within frequency bands internationally identified with mobile services.

### 1.5 Licence agency recommendation

Some frequencies and frequency bands are allocated to radiocommunication services for which a range of government agencies or organisations have statutory or policy responsibilities, or other bodies have a recognised spectrum management advisory role. The key agencies are detailed in the following table. An agency recommendation for the licence application is automatically provided by SMART.

Notwithstanding these agency roles, the Ministry of Economic Development retains ultimate responsibility for the grant of any radio licence.

| Band | General Frequency Range | Comments | Agency |
|---|---|---|---|
| | All ITU Region 3 bands allocated to 'Aeronautical Radionavigation' or 'Aeronautical Mobile' – except "OR" bands below 30 MHz | All land-based transmitters | CAA |
| | All ITU Region 3 bands allocated to 'Maritime Radionavigation' or 'Maritime Mobile' | All land-based transmitters | MSA |
| | All Amateur bands (Note 1) (refer Amateur licence schedule) | All repeaters and beacons | NZART |
| ESA | 75 – 80 MHz | All | PSRFMG |
| ESB | 138 – 144 MHz | All | PSRFMG |
| ESC | 494 – 502 MHz | All | PSRFMG |
| ESD | 812 – 813 MHz<br>857 – 858 MHz | All | PSRFMG |
| MMVHF | Maritime bands below 30 MHz, and 156 – 162 MHz (MMVHF band) | All land-based maritime service transmitters (incl. maritime coast stations and repeaters) | MNZ<br>RNZCF |
| DEF | Aeronautical Mobile (OR) < 30 MHz<br>230 – 328.6 MHz<br>335.4 – 399.9 MHz | All | NZDF |

CAA Civil Aviation Authority
MSA Maritime Safety Authority
NZART New Zealand Association of Radio Transmitters
NZDF New Zealand Defence Force
PSRFMG Public Safety Radio Frequency Management Group

### 1.6 Determine the type of service

To decide on an appropriate band for a proposed licence, it is necessary to know what type of service is proposed. PIB 21 shows the types of service allocated to each band in New Zealand. (Refer to the 3rd column of each frequency table.)

If the proposed service has unusual characteristics and it is not obvious what service type it is, it may be helpful to refer to the ITU-Radio Regulations - Article 1, Section III - Radio Services. This gives definitions of all of the types of service that appear in the Table of Frequency Allocations.

### 1.7 Find a suitable band

If the proposed licence is for a Fixed service or Mobile service, PIB 22 and PIB 23 respectively give the available bands and channel plans for these two types of service in New Zealand.

Bands for other types of service should be found in PIB 21. Channel plans can be found for some bands under the references given in the right hand column "References and Policies". If a channel plan is not available for a particular band, you should discuss the matter with MED RSM. It is possible that you may be directed to other bands, or you may find appropriate channel plans for the band in the ITU-R Recommendations.

If a new channel plan is being proposed there are many factors that you and the Ministry will need to take into account, including the need for minimal interaction to or from services in neighbouring bands, the availability of equipment in New Zealand for the proposed channel plan, and the efficient integration of the plan with the bands in PIB 21.

### 1.8 Find a band with appropriate characteristics and suitable channel plans

Where you have a choice of a possible band, one important factor is spectrum efficiency. Generally, higher frequency bands are preferred because they can be re-used more readily than lower bands, due to higher antenna discrimination and greater geographical shielding.

Although factors such as rain-fade become progressively more significant at higher frequencies, systems with short paths should generally use higher bands.

The order in which available channels in a particular band are to be used is not prescribed. Approved Persons are expected to apply the spectrum efficiency principles in the choice of bands and frequencies.

Another factor to respect is the level of investment committed to particular bands by organisations with significant networks. Some bands such as for example L-band and the upper 4.7 GHz band are used by Telecom and Kordia respectively for major infrastructure systems. L-band for rural wireless access networks, and the 4.7 GHz and T-bands are for N + 1 long haul high capacity linking. Other bands similarly have major infrastructure commitment by particular licensees. If your proposed system would obstruct the future use of channels where expansion of the service is likely to be required, this may impact severely on the incumbent, so that instead of simply installing another transmit/receive module into the multiplexer, they would be obliged to install additional antennas, diplexers etc for another band, including the possible need for a separate protection channel in the new band. It is better that the new user avoid such bands at locations where they impact on major existing systems.

### 1.9 Check the availability of spectrum in a candidate band

It is necessary to check for available spectrum in your candidate band in the vicinity of your proposed service. The Register of Radio frequencies is accessible on-line at the following location: http://www.rsm.govt.nz/smart-web/smart/page/-smart/WelcomePage.wdk. It includes both radio licences and spectrum licences, and is updated daily.

The Register lists transmitters, which is important when you are analysing potential interference to your proposed service. Naturally, you must also consider potential interference to existing services, for which you need to know the location of receivers. It can be more difficult to locate receivers of

licensed services. In the case of bi-directional services, the location of the return transmitter is given on the licence. This will correspond to the receive location of the outgoing path. However to find the services with receivers at or near a particular site, you need to search for licences of services whose transmitters are some distance away, and whose receivers may be at or near your proposed site. You therefore need to have some knowledge of the expected path length from transmitter to receiver for the types of service in and adjacent to the band under consideration, in order to know how far to "cast your net" when looking for relevant licences.

Because the Register is continually changing, with new licences being added, and some existing ones discontinued, Approved Persons need to keep a record of the licences they considered when checking for available spectrum and compatibility with existing licences for later possible audit by RSM.

### 1.10 Site sense

A method of determining the site sense is necessary to ensure both business continuity for existing users, and an expansion capability for new and existing users.

The majority of radio communications are bi-directional and, as a consequence, microwave fixed services radio frequency channels are defined in paired blocks of "go" and "return" channels separated in frequency by a fixed transmit/receive duplex spacing. These channel pairs are usually numbered 1/1#, 2/2#, etc, or sometimes 1/1', 2/2' etc. Recommendation ITU-R F.746 'Radio-Frequency Channel Arrangements for Radio-Relays Systems' defines channel plans conforming with these principles for Fixed Service bands in the range 1.35 GHz to 15.35 GHz.

To maximise the isolation between co-located transmitters and receivers operating in the same band at any given site, transmit frequencies are assigned from either the lower frequency block (site sense "low"), or the higher frequency block (site sense "high"), and the corresponding paired duplex receive frequencies in the other block.

For those bands that have a slight frequency overlap, or are contiguous (such as R, T, V, U, W and Y bands), the "high-low" issue becomes more complex. For example, channels in the V "high" frequency block could be co-sited with channels in the U and T "low" block, or the W "high" block frequency ranges.

This concept also applies to other services such as VHF/UHF land mobile services, especially when co-siting with fixed linking services in bands that are adjacent to land mobile base station services. The co-location of transmitters and receivers using the same frequency block should be avoided, since the high levels of adjacent channel energy are highly likely to cause receiver desensitisation. The extent of desensitisation depends upon the absolute frequency separation between a transmitter and the characteristics of victim receiver. The effect may range from a small reduction in available system fade margins, or increasing base-band noise, through to severe blocking where receivers essentially become inoperative.

Incorrectly applied site sense may lead to extensive and unreasonable spectrum denial to future services, particularly at high demand radiocommunication sites which are often shared between a number of operators. Accordingly, appropriate consideration at the route/network planning stage is essential to ensure that potential problems of this nature are avoided.

If a mixed site sense is proposed at a multi-user / shared radiocommunication facility (or adjacent facilities), it is the licence applicant's responsibility to advise and negotiate with any potentially affected parties, including the site owner(s) or their designated representative(s).

At multiple use sites, or sites where a number of users operate separate facilities situated in close proximity to each other, the formation of a site co-ordination committee or site co-ordinator should be considered to manage "site sense" and other relevant issues.

Where existing site sense is potentially being compromised, Approved Persons must first discuss the implications with current site users. The results of such discussions must be recorded and held with the other documentation relating to the certification.

Sources of useful information concerning site engineering matters are found in the siting standard AS 3516, published by Standards Australia International (www.standards.com.au), and in a similar ETSI standard:

| | |
|---|---|
| AS 3516 | Siting Standard general |
| AS 3516.1 | Siting of radiocommunications facilities<br>LF/MF/HF transmitting and HF receiving facilities siting standard |
| AS 3516.2 | Siting of radiocommunications facilities -<br>Guidelines for fixed, mobile and broadcast services operating at frequencies above 30 MHz VHF/UHF siting standard |
| AS 3516.3 | Siting of radio communications facilities, Part 3:<br>Guidelines for Fixed location satellite earth stations" |
| ETS 300 086 | Radio Equipment and Systems - Land mobile services - Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech. |

## 1.11 Examine compatibility with existing licences

Having found a potential band and channel with compatible site sense for the proposed licence, an Approved Person, before certifying that licence, must determine that a service operating in accordance with that licence would be technically compatible with existing radio and spectrum licences. To determine whether the proposed licence is technically compatible with existing licences, the Approved Person must determine whether the total level of unwanted signals is acceptable, or would amount to harmful interference.

At least two potential interference cases must be considered for each existing licence.

| Case | Culprit | Victim |
|---|---|---|
| 1 | Proposed licence | Existing licence |
| 2 | Existing licence | Proposed licence |

Case 1 considers potential interference to existing licences, and case 2 considers potential interference to your proposed service.

If the proposed service is bi-directional, both cases must be considered for each direction of the proposed service, i.e. a total of four potential interference cases.

Section 4 of this document describes the mechanisms for potential interference, and briefly describes how to analyse the level of unwanted signals in a victim receiver, and to determine whether the total level of unwanted signals is acceptable, or would amount to harmful interference.

## 1.12 Emissions - compliance

Recommendations: ITU-R SM.328-10 “Spectra and bandwidth of emissions” and ITU-R SM.329-10 “Spurious emissions”, specify the levels for unwanted emissions (being out-of-band emissions and spurious emissions). These are particularly applicable to assessing potential interference at established telecommunication sites – both to and from new services.

These recommendations also apply for the purposes to determine the reference bandwidth of unwanted emissions.

In regard to wanted emissions, the mean power (in dBW e.i.r.p.) integrated across the emission bandwidth applies for the purposes of the definition of “Maximum power of emissions” specified on a licence..

### 1.13 Equipment standards

The RSM website < http://www.rsm.govt.nz/cms/compliance/product-compliance > lists radio equipment standards applying in New Zealand. In addition, all radio transmitters must:

- comply with generic EMC standards; and
- comply with recognised EMR standards.
- operate in conformity with the technical parameters and conditions specified on the relevant radio licence.
- be manufactured to conform to the requirements of the International Radio Regulations, relevant ITU-R Recommendations and /or other recognised worldwide or regional standards.

### 1.14 Check the technical compatibility with existing licences

Check the technical compatibility of the chosen service with existing licences...Section 4 of this document gives guidelines.

### 1.15 Efficiency of use of the spectrum resource

Approved Persons have an important responsibility in ensuring the efficient use of the valuable radio spectrum resource. Some of the factors influencing the efficiency of spectrum use include:

Path length versus frequency band
Antenna beam width and discrimination
Maximum power
Modulation mode
Channel bandwidth
Transmitter out-of-band emissions - ACLR
Receiver out-of-band reception - ACS
Receiver noise figure
Fade margin allowance

To ensure the efficient spectrum reuse, when engineering, a radio link the engineer should be engineering to an appropriate receive level. The receive level for any service should be sufficient to support effective communications.

### 1.16 Record of technical compatibility analysis

Approved Persons must, for audit purposes, keep documentation of their technical compatibility analysis for each radio licence that they certify. They should keep this for at least the lesser of:

(a) the life of the radio licence, or
(b) the life of any spectrum licences that may be affected by the radio licence.

Spectrum licences may be valid up to the expiry of the management right in which they are registered. Management rights usually have a 20 year life.

The Approved Person must use the Spectrum Management and Registration Technology (SMART) http://www.rsm.govt.nz/smart-web/smart/page/-smart/WelcomePage.wdk system to craft the radio licence and certify its technical compatibility. Note: A Certificate is required and generated by SMART for each licence.

### 1.17 Other policy issues

In addition to POLDOCs and PIB documents, Approved Persons should be aware of General User Radio Licence notices that may be relevant to the band or proposed service. These can be found on:
< http://www.rsm.govt.nz/cms/resource-library/gazette-notices/general-user-licences/ >

Policy issues relevant to certifying radio licences are on the “Licensing and Certification” page of the RSM web site: < http://www.rsm.govt.nz/cms/licensing/engineering-certification >

These include: How to obtain a licence; Licence exemptions; Ministerial directives; SMART; Engineering certification.

Other policy issues are found on the Spectrum Policy and Planning page of the RSM site:
< http://www.rsm.govt.nz/cms/policy-and-planning >
These include: Government policy directives, Public policy spectrum reservations, Public safety and security, etc.

If in doubt about any policy issues, please contact the licensing Manager.

## 1.18 Licensing

Notwithstanding the role of Approved Persons in issuing radio licence certificates, the MED remains responsible for considering the granting of licences in accordance with the provisions of regulation 12(a) and 12(c).

An annual fee, as prescribed in the regulations, is payable in regard to each application. The applicable fees payable to the chief executive are specified in Schedule 6 of the Radiocommunications Regulations (2001):
<http://www.rsm.govt.nz/cms/licensing/licence-fees >

## 1.19 Geographic co-ordinates

The co-ordination of radio services is predicated on the accurate determination of the relative spatial (distance and azimuth) relationships between potential victim and interfering services.

Since the geographic co-ordinates used affect the reliability of predicted signal levels, it is important that fixed-point location co-ordinates are accurately derived. In the context of radiocommunication services the location means the co-ordinates at the centre or main axis of the antenna support structure (i.e. pole or tower). Geographic co-ordinates for radiocommunications sites are to be derived using the Topographic Map 260 series 1:50 000 (New Zealand Map Grid projection on the New Zealand Geodetic datum 1949).

For example, an application location should be recorded on the licence application as either:

Short reference (Map number and "5+5 digit" grid reference), or
Long reference (Map number and "7 + 7 digit" grid reference.)

To illustrate, the Pencarrow Historic Lighthouse could be recorded as either:

| | | | |
|---|---|---|---|
| (Short reference) | R27 | 648.50 | 815.00 or |
| (Long reference) | 2 664 750E | | 5 981 500N |

Note the rounding up that is necessary in this example for the Easting part of the short reference, which is only accurate to 100 metres.

## 1.20 Site Naming Convention

In general the site names in the New Zealand Register of Radio Frequencies should use the following convention:

if the site is named on a NZMS 260 series map, i.e., its LINZ name, that name should be used, the addition of a north south, east or west designation can be added to indicate more closely the part of the named feature used.

if the site is on a named street the street number should be used followed by a street name, or in the case of a rural address, its road distance reference, i.e., the distance from the start of the road in meters. (This is reference is used by the fire service to locate rural properties.) Also, because of the propensity to use the same road names in different town/areas, a street number and name should also be followed by a town or area name.

For large named site, such as used for airports and oil refineries, etc, the site name should be followed by a building name or reference number. Generic names for large sites such as a Marae, park, factory, hospital name, etc not on a map can also be used.
Where a site owner has a unique numbering/naming system for sites e.g.,
AB142 LUMSDEN ROAD, these should be converted to name followed by a number,
LUMSDEN ROAD (AB142).

Please do not use a customer's name unless it can be absolutely guaranteed to be unique for one site, i.e., Disney World Bldg DW98.

## 1.21 Abbreviations

| | |
|---|---|
| ACLR | Adjacent Channel Leakage Ratio (of a transmitter) |
| ACS | Adjacent Channel Selectivity (of a receiver) |
| AM | Amplitude Modulation |
| APC/ATPC | Adaptive Transmitter Power Control (APC) |
| APCO | Association of Public- Safety Communication Officials |
| AS | Australia Standard |
| AS/NZS | Joint Australia and New Zealand Standard |
| ARC | Approved Radio Certifier |
| ARE | Approved Radio Engineer |
| CAA | Civil Aviation Authority |
| CCI | Co-channel Interference |
| CTCSS | Continuous Tone Coded Squelch System |
| ECD | Engineering Consideration Document |
| e.i.r.p. | Equivalent isotropic radiated power |
| EMC | Electromagnetic Compatibility |
| EMR | Electromagnetic Radiation |
| FM | Frequency Modulation |
| FSS | Fixed Satellite Service |
| GURL | General User Radio Licence |
| GUSL | General User Spectrum Licence |
| IRR | International Radio Regulations (of the ITU-R) |
| ITU-R | International Telecommunications Union - Radiocommunications Sector |
| MAR | Multi Access Radio |
| MCH | Ministry for Culture and Heritage |
| MMD | Ministry of Maori Development (Te Puni Kokiri – TPK) |
| MMSI | Maritime Mobile Service Identity |
| MED | Ministry of Economic Development |
| MMSI | Maritime Mobile Service Identity |
| MNZ | Maritime New Zealand |
| NZART | NZ Association of Radio Transmitters |
| NZDF | NZ Defence Force |
| PIB | Public Information Brochure |
| POLDOC | Operational Policy Document |
| PSRFMG | Public Safety Radio Frequency Management Group |
| RLC | Radio Licence Certificate |
| RLER | Radio Licence Engineering Rules |
| RPE | Radiation Pattern Envelope |

| | |
|---|---|
| RR | Radio Regulations (of NZ. See also IRR) |
| RRF | Register of Radio Frequencies |
| RSM | Radio Spectrum Management |
| SINAD | The radio of (signal + noise + distortion) to (signal + distortion) |
| STL | Studio-To-Transmitter link |
| SMART | Spectrum Management and Registration Technology |
| TETRA | Terrestrial Trunked Radio |
| TPK | Te Puni Kokiri (Ministry of Maori Development – MMD) |
| TVOB | Television Outside Broadcast |
| VHF | Very High Frequency (30 - 300 MHz) |
| UHF | Ultra High Frequency (300 - 3 000 MHz) |
| SHF | Super High Frequency (3 - 30 GHz) |
| WRC | World Radio Conference (of the ITU-R) |

## 1.22 Reference documents

PIB 21 "Table of Radio Spectrum Usage in New Zealand"

PIB 22 "Fixed Service Bands in New Zealand"

PIB 23 "VHF and UHF Mobile Service Bands in New Zealand"

PIB 34 "Approved Radio Engineers & Approved Certifiers"

PIB 37 "Linking for Television Outside Broadcast"

PIB 40 "Audit Procedures for Engineering Certificates"

ITU-R International Radio Regulations

Radiocommunications Act (1989)

Radiocommunications Regulations (2001)

Technical Frequency Assignment Criteria for fixed point-to-point radio services with digital modulation operating in the range 5 925 MHz to 6 425 MHz, June 2003 RA 374. Radio Authority UK.

Fixed Terrestrial and Satellite Links Unit Licensing Procedures Manual for Fixed Terrestrial (point to point) Link application. Radio Authority UK.

Microwave Fixed Services Frequency Co-ordination. Radiocommunications Assignment Licensing Instruction: FX 3. Australian Communications and Media Authority.

Microwave Licensing Policy Framework. RP-022 June 2001 Industry Canada.

Application Procedures for Planned Radio Stations above 960 MHz in the Fixed Service. RSP-113 November 08, 2002 Industry Canada.

Revisions to Microwave Spectrum Utilisation Policies in the Range 1 - 20 GHz. SP1-20, January 1995 Industry Canada.

ITU-R Handbook - "Digital Radio-Relays Systems", ITU-R, Geneva 1996

Radio Spectrum Management Discussion Document: - Re-planning the Band 406.1 to 449 MHz

AS/NZS 4295 Analogue (angle modulated) mobile and fixed services bands in the 29.7 MHz to 1 GHz.

ETSI 300 086 Radio Equipment and Systems - Land mobile service - Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech.

ITU-R SM.328-10 "Spectra and bandwidth of emissions"

ITU-R SM.329-10 "Spurious emissions"

# 2 Section Two - Fixed service bands

## 2.1 Table of Frequency Bands for fixed services in New Zealand

| Band | Band GHz | Frequency Range | Alternative Antenna Methodology [4] | | | Typical Use | Notional Antenna Diameter (metres) | Minimum Path Length (kilometres) | RF Channel ITU-R Recommendation [2] |
|---|---|---|---|---|---|---|---|---|---|
| | | | XPD (min) dB | Grade C [5] F/B (min) dB | Grade B [5] F/B (min) dB | | | | |
| EE | | 162.2 – 170.31 MHz | | | | | | | POLDOC Spectrum Band Plan 007 |
| I | | 420 – 430 MHz | | | | | | | |
| JL [1] | | 440 – 449 MHz | | | | | | | POLDOC Spectrum Band Plan 003 |
| J | | 450 – 470 MHz | | | | | | | |
| KK | | 806 – 812 MHz 851 – 857 MHz | | | | | | 5 | |
| K | | 915 - 921 MHz 929 – 935 MHz | | | | Studio-to-transmitter links | | 3 | POLDOC 001 |
| L | | 1429-1530 MHz | | | | Point-to-multi-point | | | |
| LL | 1.5 | 1 427-1 525 MHz 1.8 m dia Aerial at (high sites) | 25 | 25 | 30 | Point-to-point | 1.8m (high site) | | POLDOC Spectrum Band Plan 004 |
| OX | 2.7 | 2 700-2 900 MHz | | | | Itinerant linking (TV) | | | POLDOC Spectrum Band Plan 008 |
| P [3] | 3.8 | 3600-4200 MHz | 30 | 60 | 60 | High capacity N+1 systems | 1.8 | 20 | ITU-R Rec.F.635 |
| 5 GHz | 4.7 | 4 400-5 000 MHz | 30 | 60 | 60 | High capacity N+1 systems | 3.0 | 30 | ITU-R Rec.F.1099 POLDOC Fixed 02 |
| R | 6 | 5 925-6 420 MHz | 30 | 60 | 60 | Med – high capacity | 1.8 | 20 | ITU-R Rec.F.383 |
| T | 6.7 | 6 430-7 100 MHz | 30 | 60 | 60 | High capacity N+1 systems | 1.8 | 20 | ITU-R Rec.F.384 |
| V | 7.2 | 7 100-7 425 MHz | 30 | 60 | 60 | Medium capacity | 1.2 | 20 | ITU-R Rec.F.384 |
| U | 7.5 | 7 425-7 730 MHz | 30 | 60 | 60 | Low - medium capacity | 1.2 | 20 | ITU-R Rec.F.385 |
| W | 8 | 7 730-8 275 MHz | 30 | 60 | 60 | Medium capacity | 1.2 | 20 | ITU-R Rec.F.386 |
| Y | 8.3 | 8 290-8 500 MHz | 30 | 60 | 60 | | 1.2 | 20 | |
| H | 10 | 10 500-10 680 MHz | 30 | 45 | 55 | Low- medium capacity | 0.6 | 5 | ITU-R Rec.F.747 POLDOC Spectrum Band Plan 001 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Z | 11 | 10 700-<br>11 700 MHz | 30 | 45 | 55 | High capacity | 1.2 | 5 | ITU-R Rec.F.387<br>POLDOC Spectrum Band Plan 0041 |
| X | 13 | 12.75-<br>13.25 GHz | 30 | 45 | 55 | | 0.6 | 5 | ITU-R Rec.F.497<br>POLDOC Spectrum Band Plan 001 |
| G | 14 | 14.5-<br>15.35 GHz | 30 | 45 | 55 | Low – medium capacity | 0.6 | 5 | ITU-R Rec.F.636<br>POLDOC Spectrum Band Plan 001 |
| 18 GHz | 18 | 17.7-19.7 GHz<br>(Plan A) | 30 | 45 | 55 | Low – medium capacity | 0.3 | 2 | ITU-R Rec.F.595<br>POLDOC Spectrum Band Plan 006 |
| 23 GHz | 22 | 21.2-23.6 GHz | 30 | 45 | 55 | Low – medium capacity | 0.3 | - | ITU-R Rec.F.637 |
| 38 GHz | 38 | 37.0-40.0 GHz | 30 | 45 | 55 | Low – medium capacity | 0.3 | - | ITU-R Rec.F.749 |
| 50 GHz | 50 | 50.4-<br>51.15 GHz | 30 | 45 | 55 | Low capacity | 0.3 | - | |
| 80 GHz(6) | 80 | 71 – 86 GHz | 30 | 43 | 50 | High capacity | 0.3 | - | - |

*(1)* JL Band is restricted for digital services only with a minimum spectral efficiency of 2 bits per second per Hertz (STL only channels are not subject to digital criteria)

*(2)* The International Telecommunication Union (ITU) Recommendation is cited as a reference. Band-plans for Fixed Service bands used in New Zealand are published in MED's Public Information Brochure 22 (PIB 22).

*(3)* This Band must be coordinated with Satellite C Band downlink.

*(4)* An explanation of the antenna performance grades is given in Appendix D.

*(5)* Radio paths within or transiting Auckland, Hamilton, Tauranga, Palmerston North, Wellington, Christchurch, Dunedin, shall be treated as HSDAs where High performance antenna are required.

*(6)* The minimum antenna gain must be 43dBi. The maximum permitted eirp is 55dBW. The maximum transmitter power is 3W with a maximum spectral density of 150mW / 100MHz.

## 2.2 Introduction

This section encompasses the majority of bands used in New Zealand for fixed services. A "fixed service" is defined in the International Radio Regulations as a "radiocommunication service between specified fixed points". This definition can encompass a wide range of point-to-point and point-to-multi-point radio-communication applications. The term "microwave" is generally used to identify the frequencies between 1 GHz and 90 GHz. This also distinguishes between "wide-band systems" above 1 GHz and "narrow-band systems" below 1 GHz. Another term, "radio-relay systems" is also commonly used to denote particular sub-types of microwave fixed systems with multiple hops.

These rules encompass analogue and digital fixed services as follows: -

- Narrow band single channels systems in the VHF and UHF bands (< 1000 MHz).
- Long haul radio – relay systems (< 10 GHz)
- Short haul – local access network (> 10 GHz)

Frequencies above 10 GHz are subject to increased attenuation, and link reliability problems caused by rain intensity outages often result in reduced hop lengths. These frequencies are also characterised, however, by high frequency re-use potential. Frequency re-use on the same path is also achievable using polarisation discrimination. The choice of frequency band is influenced by a number of factors, not the least being that the required capacity should be commensurate with the band channelling and propagation characteristics of the band concerned.

Digital services operating are required to comply with a minimum spectrum efficiency criteria of 1 bit per second per Hertz (1 bps/Hz)

For general link planning purposes, reference should be made to relevant publications such as the ITU-R Handbook - "Digital Radio-Relay Systems", Geneva 1996, which provides detailed guidance on most aspects of fixed service planning.

Important Note: Any variation from the notional minimum antenna diameters and path lengths specified in the above table-2.1, or variation to existing site sense arrangements, must granted by the Manager, licensing RSM and be justified in the context of the principles of Article 3.3 of the International Radio Regulations (see section 1.0), and documented by the Approved Person. The Approved Person must keep this documentation for use in certificate audits.

The antenna selection criteria must not be compromised within high radio spectrum usage areas, such as Auckland, (within 50 km radius of Sky Tower), or at existing fixed service installation sites.

## 2.3 Channel priority

The order in which available channels in a particular band are to be used is not prescribed. Approved Persons are expected to apply spectrum efficiency principles in the choice of fixed bands and frequencies.

## 2.4 Minimum / maximum path length

The minimum path length defines the shortest end-to-end distance for a single-hop link which may be supported in a particular frequency band. It is only applicable to fixed radio services that operate in the microwave region, typically above 1000 MHz. For the purpose of this document, minimum path lengths apply to those services in the KK-band and above (> 800 MHz). The table at the front of this section gives the typical minimum path lengths and antenna requirements for each fixed band. In the interests of efficient use of the spectrum resource, you need avoid bands for which the minimum path length is shorter than the physical path. This usually means implementing the link in a higher band.

A maximum path length of 100 kilometres generally applies to those fixed services operating in the fixed VHF and UHF bands below 800 MHz.

In selecting a frequency, an Approved Person will bear in mind that line-of-sight losses increase with frequency. The path length achievable is a function of the system gain, and the link performance objectives. Accordingly, the lower fixed microwave frequency bands should be assigned to long-haul paths where fade margins are often critical. Conversely, for shorter paths, higher frequency bands should be used in the interests of preserving the spectrum resource of the lower frequencies preferred for longer paths.

## 2.5 Antenna performance

Antennas are a critical component within the overall interference management framework and their characteristics play a large part in determining overall frequency re-use. Appendix D outlines the antenna performance requirement summarised in the above table.

It is essential that Approved Persons work with detailed radiation pattern envelope (RPE) data, both in the case of discrete antennas and systems with integrated antenna and equipment. Approved Persons should keep a record of parameters used in frequency co-ordination for future audit, including: an antenna's physical diameter, on-axis gain, 3 dB beam-width, as well as the antenna's $360^{o}$ radiation pattern envelope.

When using SMART to register licences, these parameters should also be entered for use in detailed frequency co-ordination and sharing studies, especially the type, make and model of antenna. This information is necessary not only for the engineering of an initial radio licence, but also for the co-ordination of on-going later licensing applications. This provides some balance between cost to the service operator and the ability to re-use the radio spectrum.

Appendix A provides minimum notional antenna performance for specific fixed service bands. This will enable Approved Persons to engineer radiocommunication services in the absence of detailed antenna characteristics parameters being available in the RRF.

The performance of antennas in the VHF/ UHF bands below 1 GHz is addressed in section 2.14. Associated with the above table-2.1 is a notional antenna performance concept, with a view to optimising system costs against spectrum productivity. As a general guide:

- Grid parabolic antennas must not be used above 3 GHz; and
- As a minimum high performance solid parabolic antennas must be used in the 3.8/4.0/6.7/11/18 GHz bands; and
- Standard solid parabolic dishes must be used in all other bands above 3 GHz as a minimum.

## 2.6 Notional antennas

Notional antennas have been included in these rules to indicate the minimum allowable antenna performance in the band, (Appendix A). Where there is antenna information associated with the licensing record in SMART (Spectrum Management and Registration Technology), this is to be used for co-ordination and interference calculations. In the absence of antenna details, Approved Persons must make all reasonable efforts to ascertain the necessary information for technical compatibility analysis.

## 2.7 Passive reflectors

A number of fixed links use passive reflectors as repeaters in their system configuration. These contain no active frequency translation devices. Approved Persons should include the parameters of any passive reflectors used in systems being registered through SMART to ensure that such systems are able to be protected from subsequent systems. The recording of passive reflectors in SMART should be discussed with RSM.

Systems using passive repeaters or single frequency (active) repeaters have constraints of high overall path loss, or low system gain and consequently operate with characteristically low margins. Passive reflectors may appear to cause problems in regard to “site sense” but in pratice they can be ignored at sites. This is especially so for established networks when co-located with other radiocommunication services operating within the same band.

## 2.8 Link diversity

Several diversity methods are used to improve system performance, typically to combat the effects of multi-path fading and to achieve performance objectives over hops with difficult propagation conditions.

Space diversity is usually implemented using multiple receiver antennas with a vertical separation large enough to provide separate signal paths in which the effects due to multi-path fading are sufficiently un-correlated.

Frequency diversity employs two or more frequencies transmitting identical information over the same path. The frequency separation between transmitters must be large enough to ensure that the effects of multi-path fading on the two discrete signals are sufficiently un-correlated.

The use of frequency diversity can represent an inefficient use of spectrum; hence the application of space diversity techniques should be used in preference to frequency diversity. Frequency diversity systems must be approved by the Manager Licensing, RSM prior to submission of licence applications.

Multiple bearer systems, transmitting different information on a number of channels, usually share a single protection channel. Such “n + 1” protection systems are more spectrally efficient than simple frequency diversity systems, which could be described as “1 + 1” protection systems.

## 2.9 Transmit power and Adaptive Power Control (ATPC)

Systems using Adaptive Power Control (ATPC) must operate in accordance with the International Radio Regulations and ITU-R Recommendations. In general, the provisions of IRR Article 3 apply in the context that no more than the minimum necessary power, commensurate with reasonable guarantee of service levels, should be used.

In those fixed service bands where terrestrial services share with satellite services, e.i.r.p. limits apply to protect the geo-stationary orbit. The International Radio Regulations Article 5, Table of Frequency Allocations has footnotes defining the technical limits for services likely to impact satellite services.

## 2.10 Co-ordination area

No universal co-ordination area model exists which can be confidently used under all circumstances. Variations in approach will be necessary to account for local factors such as band specific equipment, terrain and climatic variables. The majority of fixed service links are bi-directional, using separate go and return channels as specified in the relevant band plan. Accordingly, the interference scenario will be different for each direction of transmission, and frequency co-ordination for each of the proposed service's terminal ends needs to be separately evaluated.

The site owner may also require the assignee to undertake engineering analysis to confirm the compatibility of a proposed frequency with existing services at the site or location. The method and degree of engineering analysis applied is at the discretion of the Approved Person.

## 2.11 On-site co-ordination – suppressed records

In accordance with s28 of the Act, some Government records are suppressed in the interests of national security. Approved Radio Certifiers / Engineers must take into account suppressed records in their Engineering analysis and keep a record of this.

## 2.12 Calculation of receive signal levels

This section is provided for information only. For the purpose of a co-ordination exercise the received (wanted or unwanted) signal power can be expressed as:

$$Pr = Pt + Gt - Lt - Lb + Gr - Lr$$

Where:

| | |
|---|---|
| Pr | RF signal power at the input to the receiver (dBm or dBW) |
| Pt | RF signal base power, i.e. at the output of the transmitter (dBm or dBW) |
| Gt | gain of transmitting antenna in the azimuth towards the receiver, relative to a hypothetical isotropic radiator (dBi) |
| Lt | feeder/branching losses associated with the transmitter (dB) |
| Lb | total transmission path loss between transmit and receive antennas (dB) |
| Gr | gain of receiving antenna in the azimuth towards the transmitter (dBi) |
| Lr | feeder/branching losses associated with the receiver (dB) |

The above parameters are generally considered as the minimum requirement for determining the receive level.

## 2.13 Path profiles and co-channel interference calculation

Calculation of the transmission losses attributed to the interference path are necessary for the analysis of interference scenarios. Commercial software is available that uses algorithms to calculate the combined effects of the above elements. Path profile information must be retained for audit purposes.

In many cases where an initial assessment only marginally fails against the relevant co-ordination criteria, a number of interference counter measures could be implemented to mitigate the effect, such as using a different polarisation, or using higher performance antennas that give better off-axis discrimination.

An unfavourable comparison of the wanted-to-unwanted signal power ratio against the protection criteria would indicate that the co-ordination is not possible under a given set of circumstances. In such situations the only available course of action may be to attempt co-ordination within another channel.

## 2.14 Fixed services in VHF / UHF bands below 1 GHz

The following characteristics are to be used to define the engineering boundaries for fixed VHF/UHF services below 1 GHz. In the following table, the transmit power is expressed as a maximum Equivalent Isotropic Radiated Power (e.i.r.p.), thus the maximum allowable power already takes account of higher gain antennas.

Note: Fixed Point to Multi-point services are limited to only the, I, JL, J and L Bands.
Typical values for analogue simple modulation systems are:

| | |
|---|---|
| Nominal receive level: | -90 dBm (≤ than or equal to 50 kHz bandwidth)<br>-70 dBm (> than 50 kHz bandwidth) |
| Maximum unwanted co-channel signal level: | -110 dBm |
| Maximum assignable e.i.r.p.: | 23 dBW |
| Minimum assignable e.i.r.p.: | -3 dBW |
| Maximum path length: (for all channels below 1000 MHz) | 100 km |
| Antenna front-to-back ratio: | > 12 dB |
| Horizontal 3 dB beamwidth: | < 60 degrees |
| Notional antenna: | Not specified, as the above criteria effectively control the antenna characteristic. |

To assist in explaining how these typical values were derived, by way of clarification the following equation is given:

$$\text{Tx (e.i.r.p.) dBW} = L_P + F_M + L_R + RL_N - G_R + L_{EX} - 30$$

| | | |
|---|---|---|
| $RL_N$ | = | nominal receive level is that which has been determined to achieve 99.9% propagation availability. |
| $L_P$ | = | free space path loss between isotopic antennas. $L_P = 32.4 + 20 \log F + 20 \log D$ |
| $G_R$ | = | receive antenna gain. |
| $L_R$ | = | receive transmission line system losses |
| $L_{EX}$ | = | external loss factors that will attenuate the signal not included in $L_P$, e.g. Obstruction, vegetation, etc. |
| $F_M$ | = | Fade margin, the amount by which the received signal level may be reduced without causing system performance to fall below the specified threshold value, |

$$F_M = 10 \log FD.$$

where

F = frequency in GHz

D = distance in km

Analogue fixed point to point radio communication circuits in the VHF/UHF bands, are to be engineered so that nominal wanted signal strengths at the receiver are above -90 dBm ($RL_N$), for a single voice channel has 99.9% propagation availability. An availability of 80% may be used if path losses do not permit 99% without exceeding the EIRP requirements.

RSM imposes a Maximum and Minimum assignable e.i.r.p. regime for this service. The assignable power level shown on any fixed VHF / UHF licence will be in the range < 23 dBW (53dBm / 200 W), and > - 3.0 dBW (27 dBm / 500 mW). For example if a short radio path requires 20dBm (-10 dBw / 100 mW) e.i.r.p for reliable communications, it would be assigned - 3.0 dBW (27 dBm / 500 mW) and this is the valve that will be shown on the licence. Similarly if a proposed radio path requires 30 dBW (1.0 kW) for reliable communications the licensed power shall be 23 dBW (200W).

Digital modulation technology is beginning to be deployed in UHF bands. Digital technology offers considerable advantage in spectrum reuse, as digital services are less susceptible too adjacent channel and co-channel interference.

When engineering digital systems, special care must be taken to ensure that existing analogue systems are not degraded.

Assignments in K-band are restricted to studio-to-transmitter links (STLs) which should be longer than 3 km. K-band assignments should not be used for multi-hop links. In some circumstances, two-hop STLs may be approved by RSM.

## 2.15 Fixed services in VHF EE-band (162.2-170.3 MHz)

The number of channels available in the VHF fixed services EE-band is limited, they are only to be used for high data rate digital services operating over relatively obstructed paths, or other situations that require a similarly high level of link availability, and where it has been shown the UHF linking is unsuitable. High gain antennas must be used to help maximise re-use of the channels. Approved Persons must provide an explanatory note with the licence application, justifying the need for VHF.

## 2.16 Protection of satellite services from the fixed service in the UHF and SHF-bands

A significant number of the fixed bands above 1 GHz are also shared with satellite services. To facilitate spectrum sharing between fixed services and space services, and comply with New Zealand's obligations to the ITU, Approved Persons need to be aware of the applicable ITU-R Radio Regulations and Recommendations regarding protection of space services. These include maximum e.i.r.p. limits for radio relay system transmitters.

## 2.17 Services above 1 GHz

The e.i.r.p. is derived using, in part, methods described in the Recommendation ITU-R P.530. In regard to actual power versus the calculated link budget, a deviation of +/- 3 dB is permitted. For microwave systems operating in bands above 10 GHz (H-band), the maximum e.i.r.p. must be based on the requirements specified under Article 21 of International Radio Regulations

## 2.18 Performance Reliability

Within the scope of this document availability is to be taken as meaning propagation availability. A major factor contributing to unavailability will generally be from equipment failures, which is determined by equipment reliability and not propagation effects. RSM would expect operators wishing to use high propagation availabilities to also employ network resilience techniques to complement the required propagation availability.

a) Availability

The unavailability objectives for the radio hop should comply with standardised availability objectives such as those specified in ITU-R F.1703. The class of link, (e.g. Access, Short-haul, or Long-haul) and the hop availability allocation method should be specified.

A suitable portion of the unavailability budget should be applied to rain outages for links operating above about 6 GHz where this is the prime influencing factor. Link parameters should be such that the predicted rain availability is not substantially better than the rain availability unless this is required to meet the error performance objectives.

While clear-air propagation effects can also result in unavailable time for radio links, ITU-R F.1605 points out that there is currently no accepted method for the prediction of unavailability due to multipath propagation or other clear-air effects. Therefore, it is generally assumed that fades due to rain are only propagation effects that result in unavailable time.

b) Error Performance
The error performance objectives (ESR, SESR, and BBER) should comply with standardised error performance objectives such as those specified in ITU-R F.1668 with suitable specified allocation per radio hop. The class of link, (e.g. Access, Short-haul, or Long-haul) and the hop performance allocation method should be specified.

Link parameters should be such that the predicted error performance is not substantially better than the error performance objectives unless this is required to meet the rain availability objective.

In addressing its responsibility to ensure the optimum use of spectrum is met, the Ministry will continue to use relevant ITU recommendations in calculating fixed link propagation availability and error performance.

## 2.19 Television Outside Broadcast services

Of special consideration is the itinerant fixed linking use in support of Television Outside Broadcast (TVOB) services which are addressed in Engineering Consideration Document (ECD) 2003/3 and public information brochure (PIB 37) detailing engineering and co-ordination requirements. Access to these documents is available from the RSM website. http://www.rsm.govt.nz/cms

## 2.20 Interference levels

RSM procedures for evaluating a proposed fixed service licence against existing services (as the victim), use a methodology based on the ITU-R Handbook on Digital Radio-Relay Systems, which relates reduction in the fade margin to an increase in noise floor. When evaluating potential interference at a receiver for services above 1 GHz, the calculated aggregate of co-channel and adjacent channel interfering signals must be at least 6 dB below the receiver noise floor for terrestrial services, or 10 dB below the receiver noise floor for terrestrial to satellite co-ordination.

When an Approved Person encounters existing multiple co-channel and adjacent channel sources that may effect the proposed service (as the victim), their interference calculations should aggregate the total interference power of these individual interference sources. The calculated aggregate equivalent co-channel interfering level should be at least 6 dB below the receiver's noise floor. If it is necessary to plan for higher wanted receive power to overcome any excessive intersystem interference level above the -6 dB benchmark, Approved Persons should take care to avoid excessive power levels that may result in pollution of the valuable spectrum resource.

The effect of the aggregate power from multiple time variable interference sources is a matter currently under consideration.

# 3 Section Three - Land mobile services

## VHF (< 300 MHz) and UHF (300 MHz to 1 000 MHz)

### 3.1 Introduction

Land mobile is usually defined as a point-to-multi-point radiocommunication service where most outstations are mobile. Typically these are narrow band services supporting single channel voice and/or non continuous data communication on 12.5 kHz channels. Point-to-multipoint bi-directional non continuous data systems (for example water pump control polling) systems may also use land mobile channels provided coded squelch systems are incorporated. PIB 23 lists the bands and channel plans for land mobile services.

Most land mobile applications are duplex. The sub-set of the land mobile service known as "simplex" is a single frequency "press-to-talk" voice service. Simplex services are typically itinerant and discontinuous by nature. At least one end of simplex service will be mobile, that is, not operated from a fixed installation location, (i.e. a vehicle installation or handheld unit). Except as may be specifically provided for in Appendix B, simplex frequencies must not be used to provide "point-to-point" fixed services. Most simplex frequencies are shared, multiple users with no co-channel interference protection.

RSM plans to provide for a range of simplex channels in each band under a General User Radio Licence, and these will be excluded from the scope of these rules. The affected channels will be identified in Appendix B when the GURL is granted.

Requests for either of the following must be referred to the RSM Manager, Licensing for approval:

- exclusive simplex channels, whether local, regional or nationwide; or
- two-frequency or simplex channels at 25 kHz channel spacing in accordance with POLDOC Land Mobile Service 003

Because simplex is a shared service, ARE/ARC's when processing simplex applications, need to consider individual channel loading to optimise spectrum efficiency. Associated with this issue of channel congestion is the number of sets of mobile units each licensee has, as well as the licensee's area of business. For example it is not advisable for two companies in the same line of work to share the same channel.

Those people wishing to deploy a large number of sets (>10 – 20) solely on a simplex channel should look at alternative radio solutions such as two-frequency (duplex) land mobile channels.

These rules apply to the following analogue land mobile services: -

- Single and two-frequency systems in the VHF (< 300 MHz) band using 12.5 kHz channelling
- Single and two-frequency systems in the UHF (300 to 1 000 MHz) band using 12.5 kHz and 25 kHz channelling

### 3.2 EIRP

The power levels for land mobile services are to be recorded in e.i.r.p. and not base transmitter power. Also note that it is to be recorded as the total power within the channel (in $dBW_{e.i.r.p.}$) and not power spectral density.

The maximum permitted e.i.r.p. applicable to each land mobile band is included in Appendix B - Land mobile service RF channel arrangements, as derived from PIB 23.

### 3.3 Co-ordination requirements

In general, RSM does not define fixed-value co-ordination areas and it is the responsibility of Approved Persons to exercise their own judgement on this matter. RSM does, however, provide a range of web-based reports that are intended to provide support to Approved Persons undertaking such work. The site owner may require the Approved Persons to undertake some engineering analysis to confirm the compatibility of a proposed frequency with those of existing services at the site, or location. Third or fifth order intermodulation products have the greatest potential to cause on-site interference, however the method and degree of engineering analysis applied is at the discretion of the Approved Person.

### 3.4 Suppressed records

In accordance with s28 of the Act, some Government records are suppressed in the interests of national security. Approved Radio Certifiers / Engineers must take into account suppressed records in their Engineering analysis and keep a record of this.

### 3.5 Off-site co-ordination

Because of the general topography of New Zealand it is not possible to prescribe a single standard for preventing co-channel interference at all locations. Nevertheless, the following generic guidelines are provided to assist Approved Persons in making a professional judgement.

The potential for co-channel interference to the proposed licence can be minimised if some or all of the following measures are used:

- The grade of service for the land mobile service is defined in the context of a 12 dB SINAD for voice
- The mute gating level is assumed to be –109dBm (AM) and –117 dBm (FM)
- The minimum protected level is –106 dBm (at antenna)
- A coded squelch system is used

In considering potential interference to existing services, the following assumptions can be made:

- Antennas are assumed to be vertical polarised dipoles
- Adjacent channel separation is assumed to be 50 dB (a function of transmitter adjacent power)

### 3.6 Coded squelch systems

The use of coded squelch systems in the land mobile services bands is strongly recommended for all licences. The current licence condition regarding coded squelch is:

> "*A coded squelch system and/or CTCSS tone (group B) shall be used on all radio apparatus covered by the licence. Where CTCSS is not used due to a conflict with the operational requirements of the licensee there will be no protection from interference from other external sources. NOTE: for SCADA or data use, the repeater equipment is exempt from this requirement.*"

This requirement assists in maximising channel re-use as well as channel loading capability. It can also reduce the effects of co-channel interference, and offers a measure of privacy on multi-user channels.

For the purpose of this document a coded squelch system is defined as a system using a unique addressing system to activate one receiver (or more) in response to a specific radio transmission.

The most commonly used coded squelch system is Continuous Tone Coded Squelch System (CTCSS). If CTCSS is used, the allocation of tone groups is based on a region / area distribution throughout New Zealand as listed in Appendix B, and the assignment of tones will be at the discretion of the operator.

In the case of data acquisition systems, unique receive data addresses are an acceptable alternative method to satisfy the coded squelch requirement.

### 3.7 Restricted channels

A number of channels in the bands listed in Appendix B of this document: "Land mobile service RF channel arrangements" are restricted. This means that these channels have been set aside for particular purposes and are not available other than for the specified purposes.

### 3.8 Trunk dispatch - Analouge

In the TD and TS-bands only trunking systems are permitted. Typically, to qualify as a trunking system there must be a minimum of 3 trunking channels at each site. Licence application for less than three channels can be directed to the Manager, Licensing RSM for consideration.

Simplex frequencies in the TD and TS-bands are restricted to those licensees also operating on two-frequency repeater trunking channels in these bands.

### 3.9 TD-band (406 – 420 MHz) Analogue only.

In the channel plan in PIB 23, each block has a numeric designator. The first eight channels are unavailable because of the satellite distress beacon band (406.0 – 406.1 MHz), and therefore the equivalent half-band (414.0 – 414.1 MHz) has been designated for simplex use. Due to the limited number of available simplex channels, the frequencies have been designated "restricted" and will be licensed by RSM. Where demand requires that two operators have to share a given block, channels should be chosen from opposite ends of that block.

It should be noted that a number of fixed links are still in service in this band, thus restricting the availability for trunking services. Approved Persons must include these fixed links in their technical compatibility analysis.

### 3.10 TS-band (813 – 819 MHz and 858 – 864 MHz). Analogue and digital.

In the channel plan in PIB 23, each block has a numeric designator. In any given block (band plans, TS 800 MHz), the first channel to be licensed will be taken from the group marked "First Allotment". Once all channels in this grouping have been licensed, use will be made of those in the "First Extension" grouping, followed by the "Second Extension" and "Third Extension" groupings.

However, there may be occasions when this pattern cannot be followed. For example, where demand requires that two licensees share a given block, one licensee will be given channels from the "Initial Allotment "and "First Extension" groupings, while the other licensee will make use of the "Second Extension" and "Third Extension" groupings.

#### 3.10.1 Digital Services, TS band

The following section provides for three alternative trunked dispatch technologies to co-exist compatibly within the TS-band. These are: analogue FM, TETRA and APCO P25.

Where there is a difference between this section and the text of PIB38 section 3.6 "Trunk Dispatch", this section takes priority.

**General**

a) To efficiently cater for the introduction of APCO P25 phase 1, a channelling plan with a 12.5 kHz raster is implemented in conjunction with the existing 25 kHz plan. 12.5 kHz channels will be named "TSN" for "narrow band". (Figure 4)

b) To preserve the current block and channel assignment scheme (band plans, TS 800 MHz), digital channels are overlaid on the existing analogue channel raster. The maximum EIRP limit of the band (21.8 dBW) remains unchanged.

c) To promote RF efficiency, a digital trunked dispatch system permitted to operate in the TS-band, must have a minimum number of digital voice channels equivalent to the current minimum number of analogue voice channels. In other words, a single TETRA 25 kHz channel assignment, or three APCO P25 (phase 1) 12.5 kHz channel assignments are considered equivalent to an analogue trunked system (with three RF channel assignments).

Later when it becomes available, two APCO P25 (phase 2) 12.5 kHz channel assignments will be considered as equivalent.

### 3.10.2 Engineering guidelines

a) **Coverage area**

The coverage area of a base station is the area of service within which the licensee has a reasonable expectation of protection from harmful interference. This is defined by a continuous contour equivalent to a signal level of -106 dBm or a theoretical coverage area with a radius of 58 km*, whichever is the smaller. (Figure 1.)

b) **Co-channel re-use distance**

The re-use distance is the distance required to ensure a suitable grade of service between co-channel services. Generally, the re-use distance is constrained by topographic obstructions. (Figure 2, Case A.)

In areas where the local topography may not provide sufficient levels of obstruction loss between co-channel services, the proposed service must protect existing services to a minimum C/I of 18 dB** at the edge of the existing coverage area. (Figure 2, Case B.)

c) **Protecting first adjacent channel services**

In non co-sited situations – with services sharing a substantial overlapping coverage area – it is recommended that between analogue FM, APCO and TETRA base stations, the new base station be spaced at least 5 km away from the edge of the coverage area of the existing service. In situations where the local terrain and clutter provide sufficient obstruction loss, this measure can be relaxed provided that an equivalent co-channel C/I of 18 dB is maintained by the proposed service at the edge of the coverage area of existing services. Where the new service is TETRA, and has an adjacent channel leakage ratio of -55 dB, the C/I for the first and second adjacent channel is -37 dB, and where the proposed service is APCO P25, with an ACLR of -60 dB, the first and second adjacent channel C/I is -42 dB. (Figure 3.)

Co-channel, first and second adjacent channels etc in this document refer to the 25 kHz raster, not the 12.5 kHz sub-channels.

d) **Protected C/I**

In some instances, the above guidelines may not be optimal when considering specific characteristics of the local topography, especially in large and flat terrains. In such cases, the above distances can be adapted, provided that the proposed service complies with the minimum C/I of 18 dB at the edge of the coverage area of the existing service. (Figure 2, case B.)

**Combined 25 kHz and 12.5 kHz channel plan**

Channels based on 12.5 kHz spacing must be licensed on the 12.5 kHz raster of frequencies that are 6.25 kHz displaced from the 25 kHz raster.

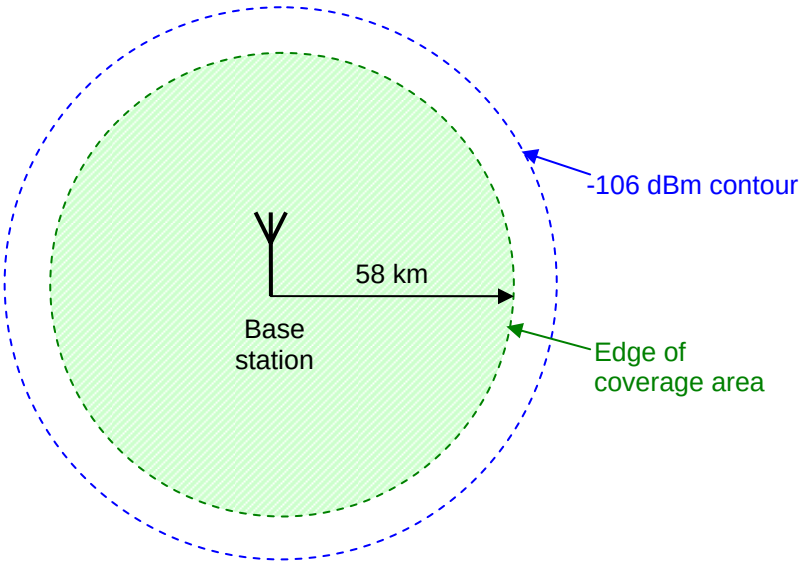
**Explanatory notes**

* The 58 km radius takes into account the inherent maximum cell size for TETRA TDMA systems due to path delay (ETSI EN 300 392-2 V3.2.1).

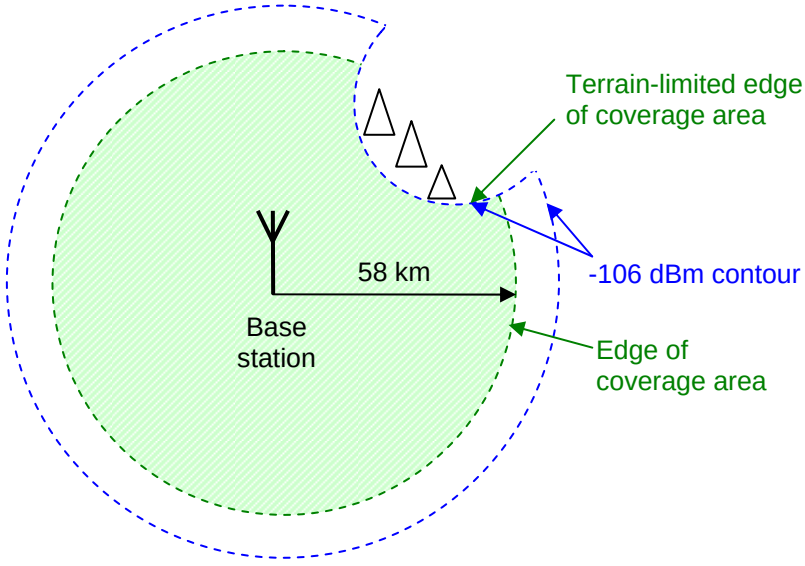
** The C/I level of 18 dB has been obtained considering dynamic conditions (fading) for analogue, APCO and TETRA systems. This figure takes into account the C/I requirements to maintain a Delivered Audio Quality (DAQ) grade of 3.4 (as specified in TSB88.1, table A-1). This value is also used in ITU-R SM.337-4 (table 1), where a calculation example is given for determining frequency and distance separation between land mobile services in the UHF band.

**Detail of C/I specifications (extract from TSB88, table A-1):**

| Modulation type | Channel spacing | Static | | DAQ 3.4 | |
|---|---|---|---|---|---|
| | | Reference | C/N | BER % | C/(I+N) |
| Analogue FM ± 5 kHz | 25 kHz | 12 dB SINAD | 4 dB | n/a | 20 dB |
| Analogue FM ± 4 kHz | 25 kHz | 12 dB SINAD | 5 dB | n/a | 22 dB |
| C4FM (IMBE) | 12.5 kHz | 5% | 7.6 dB | 2% | 17.7 dB |
| CQPSK (IMBE) | 12.5 kHz | 5% | 7.6 dB | 2% | 17.7 dB |
| CQPSK (IMBE) | 6.25 kHz | 5% | 7.6 dB | 2% | 17.7 dB |
| TETRA | 25 kHz | 5% | 8 dB | 2% | 16 dB |

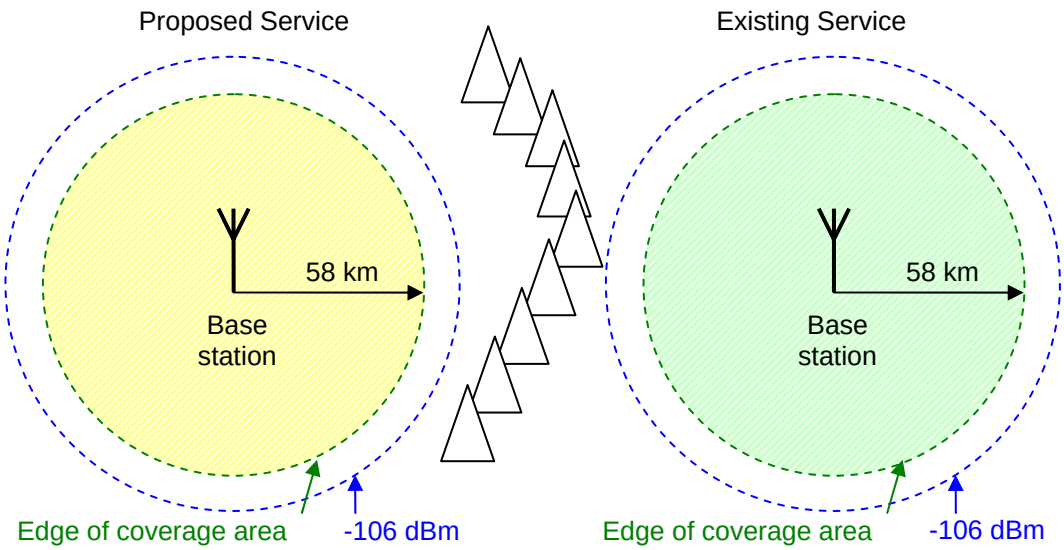



**Case A**

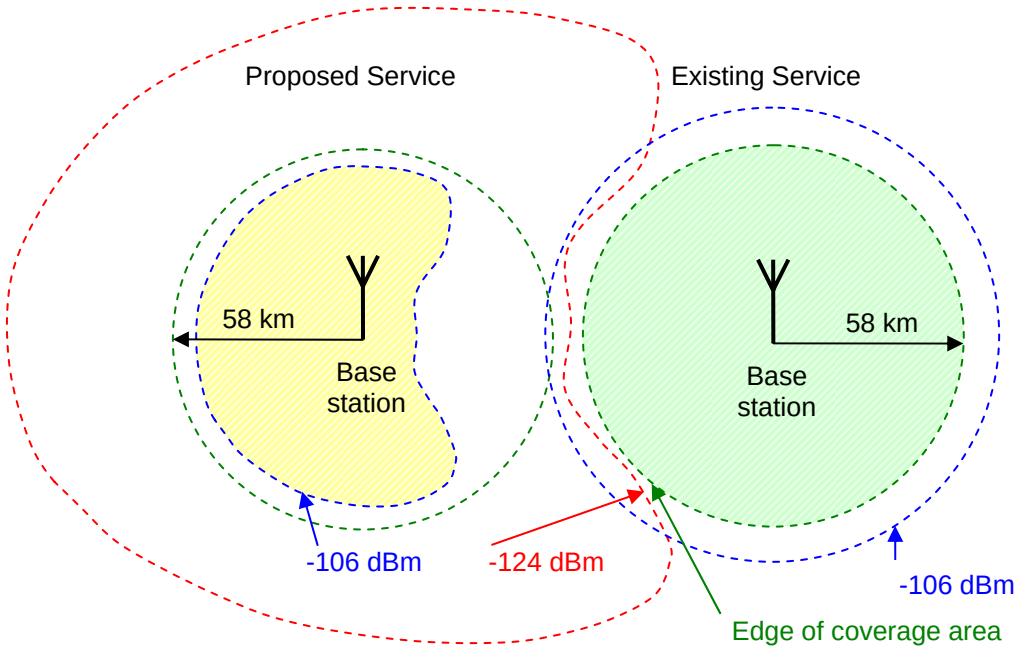



**Case B**

**Figure 1** Coverage area
Case A: Without terrain limitation, a 58 km radius applies.
Case B: With terrain limitation, the smaller -106 dBm area applies.




**Case A**




**Case B**

**Figure 2** Re-use distance to protect existing co-channel services
Case A shows co-channel services isolated by topography.
Case B does not have sufficient topographic obstruction. To comply with the minimum C/I of 18 dB at the edge of coverage of existing services, the proposed service must constrain the interfering impact of its transmission by other means. In this example, a modified horizontal radiation pattern (HRP) is used to achieve the required C/I.

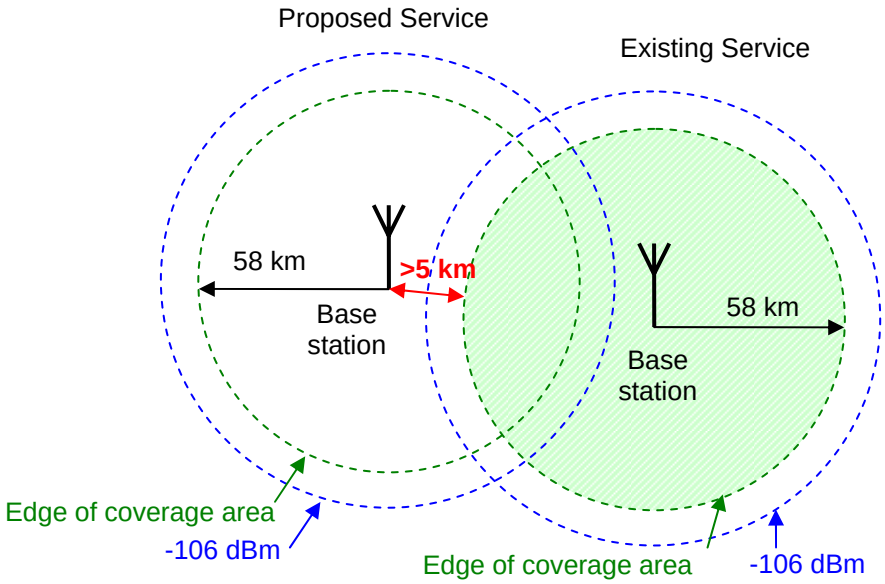



**Figure 3** Protecting existing first adjacent channel (±25 kHz) services.
The minimum unobstructed separation from edge of coverage is 5 km. With topographical obstruction, separation may be less, provided the net co-channel C/I exceeds 18 dB at the edge of coverage of the existing service when taking account of the proposed service's adjacent channel leakage ratio.

Channel rasters for 25 kHz and 12.5 kHz.

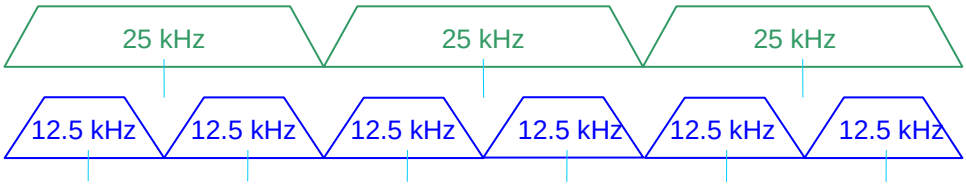



**Figure 4** The channel raster for 12.5 kHz ("TSN" channels) is offset 6.5 kHz from the 25 kHz TS raster in order to accommodate two 12.5 kHz channels within each 25 kHz channel.

### 3.11 Linear repeaters

On occasions it will be necessary to use and licence linear repeaters to provide coverage to relatively small areas within primary coverage service areas. Existing receive signal levels could be compromised by surrounding environmental factors, such as RF "shadowing" due to the need to operate close to tall buildings which may physically block the base station's direct line of sight radio signal path.

From a spectrum management perspective, linear repeaters exhibit several potentially undesirable characteristics. Such systems are susceptible to interference, intermodulation, and system overload from multiple locations and azimuths.

Given the constraints on system gain, linear repeaters operate with characteristically low margins. This necessitates significantly more stringent interference protection levels than other links. Linear repeaters must only be used to provide "in-fill" coverage and not to extend the primary coverage area of the land mobile service.

## 3.12 Other services

In determining whether to grant a radio licence or a General User Radio Licence, the Chief Executive must take into account public interest in achieving the maximum benefits from radiocommunications. In addressing this issue a number of services have been given unique consideration in the allocation of radio frequencies. In many cases these services are essential for the protection of life and property. Approved persons must take into account public interest in deciding whether to choose a band under GURL or use a radio licence for the particular application.

### 3.12.1 Crane Control and Bush Winch

Crane Control and Bush Winch services have dedicated channels allocated in several VHF and UHF simplex bands for the exclusive use of these services. Also a separate band has been established solely for Bush Winch services to provide addition channels. (See PIB-21 in the vicinity of 160 and 171 MHz.)

Each channel must be licensed for one specific location, for one type of service and for a fixed term period. These obligations must be re-enforced both to the end user of the equipment, and to the licensee, together with instructions that they must re-apply if the location of the crane or winching operations is to be changed.

Prior to 1999, these services predominantly used 25 kHz channel spacing. RSM now expects all new channel usage to be engineered to comply with 12.5 kHz channel spacing. In situations where 25 kHz channels are necessary to ensure service continuity and compatibility with existing equipment using 25 kHz channels, the Approved Person certifying the licence application must obtain an exemption from the Manager Licensing Services RSM. Documentation justifying an exemption must be retained for audit purposes.

Use of these licences shall be restricted to the licensee's nominated location area, which must be specified on the licence. A coded squelch system such as CTCSS must be used on all assignments associated with these services in order to provide an additional level of protection against co-channel interference. Allocation of CTCSS tones is undertaken on a regional basis, the tone groups allocated to each region are listed in Appendix B..

The maximum allowable power prescribed for this equipment is typically 14 $dBW_{(e.i.r.p.)}$ in any direction. However such power use can be excessive in some situations, e.g. small service areas, with the communication being only over short distances. Hence lower power should be used for the majority of situations, as the principle consideration in issuing licences for these services is Health and Safety. The associated co-channel and interleaved channel co-ordination is also influenced by the power.

The following tables are provided as a guide for Approved Persons. These are indicative and should not be seen as replacing the technical analysis an Approved Person should undertake when quantifying the level of interference.

**Crane Control / Bush Winch communication distance and minimum channel re-use distance**

Note: The tables are based on one Watt and zero gain antennas.

| Crane height (m) | Communication distance (km) | Min co-channel re-use (km) |
|---|---|---|
| 50 | 7 | 16 |
| 100 | 9 | 19 |
| 150 | 11 | 22 |
| 200 | 13 | 26 |

**The effect of obstruction height on minimum channel re-use distance**

| Obstruction height (m) | Min co-channel re-use (km) | Min co-channel re-use (km) |
|---|---|---|
| | A & E-bands | C & F-bands |
| 50 | 13 | 10 |
| 100 | 12 | 8 |
| 200 | 10 | 6 |
| 300 | 9 | 4 |

A number of F band simplex channels have been allocated for mobile cranes use, the same precautions apply to these as would any other bush winch or crane control channel.

### 3.12.2 Government agencies

A number of frequency bands within the New Zealand radio spectrum have been allocated nationally for the sole use of New Zealand government agencies, such as Ambulance, Fire, and Police etc. These agencies form the Public Safety Radio Frequency Management Group (PSRFMG).

Licence application for channels in bands controlled by the Public Safety Radio Frequency Management Group can only be engineered and processed if accompanied by the appropriate endorsement from the PSRFMG member agency. The PSRFMG has overall control of apportioning the radio channel resources among the individual members. The group must approve any amended use or allocation of additional resources by PSRFMG members. Such changes shall be advised to the Radio Spectrum Management group by the chairman of the PSRFMG.

Only those channels that have been allocated to the PSRFMG member can be assigned on the authority of the PSRFMG member.

### 3.12.3 Aeronautical and maritime mobile services

The procedure described here for Aeronautical and Maritime services applies only to licenses above 30 MHz (the only exception to this are Coastguard designated maritime two frequency repeater channels 80-88).

Frequencies below 30 MHz are more prone to propagate over international distances, and are subject to international agreements. In general, frequencies for both Aeronautical and Maritime have been identified by ITU-R WRCs and have the legal status of international treaties. The assignment, licensing, international registration and co-ordination of Aeronautical and Maritime services below 30 MHz must only be done by RSM in accordance with the band plans agreed in the treaties.

This document does not address the requirement for operators' certificates of competency necessary for users to transmit on these channels.

Applications for any of the following proposed uses are to be referred to the Manager Licensing Services, RSM:

- Channel use not in accordance with the Radiocommunications Regulations - General User Radio Licence (GURL) for Maritime purposes
- Reserve channels listed in the Radiocommunications Regulations - GURL for Maritime purposes
- Channel use not in accordance with the Radiocommunications Regulations - GURL for Aircraft
- Channel use in Aeronautical or Maritime mobile bands by airport or port authorities for non-Aeronautical or non-Maritime applications; or
- Interconnection with telecommunications networks

Up-to-date Aeronautical Notices and Maritime Notices can be found on the RSM website. < http://www.rsm.govt.nz/cms/resource-library/gazette-notices/general-user-licences >

### 3.12.4 Aeronautical services

Licence codes for radio licences for aeronautical services are specified in the New Zealand Regulations (Schedule 6) as follows:

| Type | Licence Code | Remarks |
|---|---|---|
| Aircraft | A1 | Authorised Frequencies between 118.0 – 135.975 MHz and specific HF frequencies |
| Aeronautical Land | A5 | Aeronautical Base – for control of Airspace at International, Domestic (served by scheduled Airlines) and Military Airports. |
| Aeronautical Land | A6 | Other aeronautical bases, such as aero clubs, companies, farm strips etc. |
| Repeater | A8 | |

**Route and off-route**

Frequencies allocated in the ITU-R Radio Regulations for aeronautical communications are separated into two groups:

1. **Route:** An aeronautical mobile service reserved for communications relating to safety and regularity of flight, primarily along national or international civil air routes.

2. **Off-route:** An aeronautical mobile service intended for communication, including those relating to flight co-ordination, primarily outside national civil air routes.

Frequency bands are identified within ITU-R Recommendations for these two groups within the ITU-R allocations for aeronautical services. Frequencies for specific purposes such as surface movements, repeaters, ballooning, fish spotting, etc, have national and international agreement and are listed in the Aeronautical Notices on the RSM web site: < http://www.rsm.govt.nz/cms/resource-library/gazette-notices/general-user-licences >

Approved Persons may provide the engineering analysis for licence applications for both route and off-route licences however all licence applications for aeronautical mobile services will be referred to CAA for approval via SMART.

### 3.12.5 Maritime services

**Vessels**

The majority of maritime services radio channels used by vessels in the international maritime mobile service band 156 to 174 MHz are covered by the Radiocommunications Regulations - General User Radio Licence (GURL) for Maritime Purposes and hence do not require individual licences.
< http://www.rsm.govt.nz/cms/resource-library/gazette-notices/general-user-licences >

All equipment used for transmitting under this GURL must comply with the equipment standard: Radiocommunications (Radio Standards) Notice.
< http://www.rsm.govt.nz/cms/compliance/product-compliance >

**Coast stations**

Remotely activated VHF land based coast stations, coast stations below 30MHz and all repeaters are not covered by the GURL, and must be individually licensed. They must also meet the above equipment standards.

In the case of licence applications for the use of duplex channels providing communications through a repeater which is licensed to a person other than the applicant, the Approved Person needs to have a formal document giving written permission from the licence holder for the new coast station licensee to use the repeater. This formal authority must be filed with the application, and a copy retained by the Approved Person with the analysis for the engineering certification. When the coast station licence is issued it shall include the following conditions:

> "*Use of channel MM… (channel number and repeater location)…is permitted only when authorised by the licensee of the repeater: (name of the licensee of the repeater).*"

Any application requesting a simplex channel (or channels), or more than one duplex channel, will be assigned channel MM16 and the licensee will be required to be equip the apparatus to operate on this channel for distress and safety purposes. Where the apparatus has Digital Selective Calling facilities, the applicant needs a Maritime Mobile Service Identity (MMSI) code to enable this facility. RSM will issue an appropriate code number.

**Repeaters**

Radio licence applications to establish duplex repeaters on any of channels MM84, 85, 86, 87, or 88 must be approved by the Royal NZ Coast Guard Federation. This happens automatically in SMART

## 3.13 Simplex procedures

### 3.13.1 General

The ITU-R IRR defines *simplex operation* as: "Operating method in which transmission is made possible alternately in each direction of a telecommunication channel, for example, by means of manual control. Simplex operation may use either one or two frequencies." These transmissions are discontinuous; the transmitter is only temporarily actively transmitting information. All general simplex channels are primarily for speech transmissions only, data transmissions of a reasonably brief and infrequent nature are allowed. Some channels are set aside for mobile data communications in EEX and FNX bands – see appendix B

The licensing of simplex services offers a reduced coverage option compared with a two-frequency repeater system using elevated sites. Communication is limited to the direct line-of-sight signal path between units. The service is generally used for short-range communication. A VHF/UHF land mobile simplex licence will authorise the use of the number of frequencies needed to meet the requirements of the service and an unlimited number of mobiles within a defined area.

See appendix C for further clarification of the licensing codes associated with simplex licensing.

The Approved Certifier or Approved Engineer who issues a Radio Licence certificate must document the requirements for each frequency that is to be licensed. Approved persons certifying simplex base stations at elevated sites, need to exercise discretion, as co-ordination with out of district services may be necessary due to the extended coverage. The use of simplex services at high elevation sites restricts the future availability of channels to operators in adjacent areas.

Simplex channels in some bands will be made available for use with a General User Radio Licence (GURL) and will have no fee associated with their use. They also will not require certification by an Approved Radio Engineers (ARE) or Approved Radio Certifiers (ARC).

### 3.13.2 Assignment for 12.5 kHz and 25 kHz channels

A Mobile policy document (POLDOC: land mobile 003, issue 2, 16 November 2000) was released to encourage applicants to apply for mobile licences on the basis 12.5 kHz channelling in order to cope with congestion arising from the continued use of 25 kHz plans. The policy was to only grant land mobile licences in accordance with 12.5 kHz channel plans

Approved persons can continue to assign 25 kHz simplex channels if use is in accordance with the above policy document. All other applications for 25 kHz assignments are to be forwarded to the Manager Licensing Services, RSM. Due to the differing licence types, it will not be possible to put a mix of 25 kHz and 12.5 kHz simplex channels on one licence.

The proposed GURL simplex assignments will be 12.5 kHz channels and comply with the above policy.

### 3.13.3 Guidelines for Approved Persons in the assignment of simplex channels

These guidelines only cover VHF / UHF simplex services only. They do not cover High Frequency – Single Sideband (HF-SSB) simplex services, as these will continue to be engineered by RSM...

The VHF / UHF simplex frequencies will be assigned under the following conditions:

1. With the exception of frequencies that have been set aside on a nationwide basis for Emergency Services, Crane Control and Bush Winch simplex, simplex services are to be operated on a shared channel basis. No exclusive channels are available except as approved by Manager Licensing, Radio Spectrum Management.

2. **Simplex services will have no protection from interference by other users on the same channel.** Simplex is a shared service and with no exclusive channels, the assignor should be aware of the type(s) of service(s) already on assigned to a particular channel and that future applicants are likely to be assigned the same channel in area.
   **Co-channel interference can be expected and must be tolerated**.

3. As with any radio service there is no guarantee of privacy of communications.

4. Channel loading / demand is unregulated and affects service availability.

5. The use of a coded squelch system (or CTCSS tones) is to be strongly encouraged for simplex assignments. Tones are to be assigned in accordance with PIB 23. (Appendix B and of this document have extracts from PIB 23.)

6. Multiple Regional/Territorial Local Authority districts (R/TLA), may be used for defining the licence coverage area. The approved person issuing the Radio Licence Certificate must document the requirement for each frequency that is proposed and that the coverage area applied for is limited to the area that will meet the business requirements of the client.

7. An Approved Radio Certifier or Engineer issued Radio Licence Certificate is required for each simplex licence. (Multiple frequencies may be covered by one certificate, i.e. a schedule of the frequencies attached to a certificate.)

When selecting a frequency for assignment it is important to:

- Achieve, as far as possible, a uniform channel loading.
- Pay regard to any possible conflict of interest between users.
- Co-ordinate between other areas where nominated service areas overlap.

### 3.13.4 Simplex Channel Usage for Air to Ground and Ship to Shore Communications

General User Radio Licences are available for Aeronautical and Maritime purposes and use of Land Mobile Simplex services to supplement these licences is not permitted except as follows :-

1 Usage must be restricted to short infrequent messages that relate to;
   a) The safe and expeditious passage of aeronautical or maritime transportation;
   b) An emergency;
   c) Matters relating to a particular occupation, industry or activity in which an aircraft of maritime craft is engaged, such as search and rescue operations, fish spotting, crop spraying and top dressing.

2 Usage by aircraft is restricted to use within 500 metres of the local terrain, except in an emergency.

3 A licensee will enter into a written agreement with persons who need to communicate on the frequency or frequencies licensed by the Simplex licence before such use is required... New Zealand Radiocommunications Regulations (2001) Regulation 13, allows for such agreements.

4 Should interference occur to a radio licence or spectrum licence service, the Ministry reserves the right to require any simplex licence to reduce power or cease operation.

## 3.14 Miscellaneous Services

### 3.14.1 General

The miscellaneous type of services describe in this section, may use spectrum that is also covered by General User Radio Licensing (GURLs). A general licence has been used to licence radio operations where it is viewed the activity has wide public appeal or benefit, and would be more effective for the Ministry to hold the licence on behalf of all New Zealanders, rather that issuing a potentially large number of individual licences. However, associated with these GURL frequency bands, there are a number of additional radio services listed in PIB 23 which will not meet the conditions of the GURL. Those service that can be covered by the GURL but use the same frequency spectrum, require to be engineered by an approved person. Typically these services are limited to a maximum e.i.r.p. power of 5 watts (7dBW).

Except where detailed to the contra these service are to be engineering to same general conditions the Simplex service previously described.
Note: Single frequency, multiple users, shared services and therefore not protected from co-channel interference.

These miscellaneous services are:-

- Personal Radio Services
- Telecommand and Telemetry
- Radio Paging

### 3.11.2 Personal Radio Services

Personal Radio Services (UHF Citizen Band 476.425 – 477.400 MHz) has a number of Simplex and Repeater channel frequencies allocated. While the Simplex PRS operation is covered under a General User Radio Licence and require no additional licensing action. The two frequency repeater channels shall be engineered in accordance to rules applying for two frequency Land mobile repeater services as described earlier, as well as the licensing requirements outlined in PIB 20 available from the RSM website.

- A repeater station may be accessed by radio apparatus covered by the General User Radio Licence.
- The purpose of the repeater is for the re-transmit of voice telephony (speech) only, the re-transmission of selective calling tones sent between personal radio apparatus is permitted.
- Only one channel will be licensed at any transmitter site location, and with a minimum distance between adjacent transmitters of 20 kilometres.
- The minimum separation distance for co-channelled repeaters will be 100 kilometres.
- Repeater base receiver gating level setting is to be -95 dBm.

### 3.11.3 Telecommand and Telemetry Radio Services

Telecommand services are defined as the use of telecommunications for the transmission of signals to initiate, modify or terminate functions of equipment at a distance.

Telemetry services use telecommunications for automatically indicating or recording measurements at a distance from the measuring instrument.

While these services share the same radio spectrum short range devices that operate under the GURLs there are some situation in which more power is necessary. Approved person can familiarise themselves with the channelling and EIRP power requirement detailed in PIB 23, which is available on the RSM website.

Area Licences must not be issued for Telemetry use, this is a point to point or point to multi point band for fixed locations.

### 3.11.4 Local Radio Paging

These are effective a sub-set of the telecommand and Telemetry frequencies bands, and limited to localise locations. The frequency channelling is given in PIB23 on the RSM website.

In heavy loaded area Wide Area Radio Paging frequencies may also be used at the reduced power to provide service if technical possible. Typically used in Rest Homes and Hospital.

### 3.11.5 Wide Area Radio Paging / Radio Reporter Services (157.6 – 158.07 MHz)

Due to the potential interference issues for the International VHF Maritime Mobile Band operating in the same coverage area as wide area paging. RSM must be consulted and approval must be obtained before any wide area paging licences are certified.

# 4 Section Four - Interference analysis

## 4.1 Interference mechanisms

There are many possible frequency relationships between the culprit and victim. The case where the culprit and victim channels partly overlap illustrates the three main mechanisms for interference. The level of the total interference is the sum of all power due to each of the three interference mechanisms calculated in terms of the power entering the receive pass-band.

The first of the three interference mechanisms is *co-channel interference* (CCI). The other two are two separate mechanisms of *adjacent channel interference*, one due to the culprit transmitter adjacent channel leakage ratio (ACLR), and the other due to the victim receiver filter's adjacent channel selectivity (ACS). The three mechanisms are:

| | | |
|---|---|---|
| (a) | $I_{CCI}$ | Co-channel interference (CCI) |
| (b) | $I_{ACLR-Tx}$ | Interference from the adjacent channel leakage (ACLR) of the culprit transmitter |
| (c) | $I_{ACS-Rx}$ | Unwanted adjacent channel reception by the victim receiver, due to its adjacent channel selectivity (ACS) |

In cases where the culprit and victim channels overlap totally, CCI becomes dominant, and when their channels do not overlap, one or both of the two adjacent channel interference mechanisms become dominant. Note that in interference analysis, the term "adjacent channel interference" is not restricted to the immediately adjacent channel in the channel raster of the victim's system, but includes any range of spectrum which lies outside the victim's channel. Where the culprit and victim channels partly overlap, all three mechanisms may contribute similar levels of interference, and their aggregate will need to be analysed. The case of partly overlapping channels is illustrated in the following figure showing the areas of interference mechanisms: (a), (b) and (c).

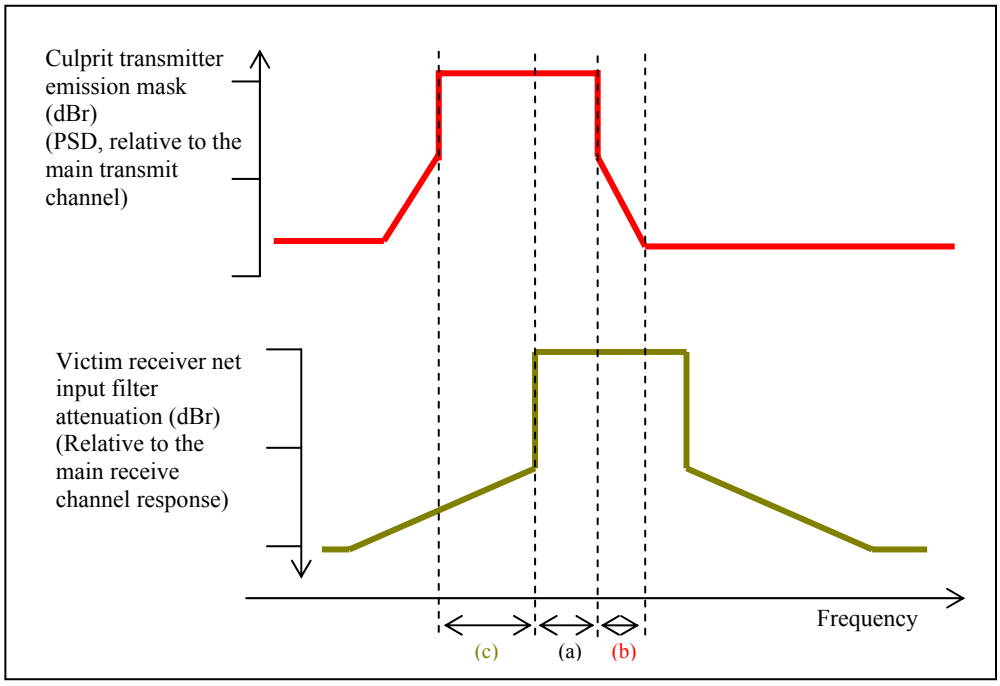



Figure: Example showing areas of three types of interference mechanism.

The first two interference mechanisms: (a) $I_{CCI}$ and (b) $I_{ACLR\text{-}Tx}$ clearly represent interference power within the pass-band of the victim receiver, however it may be less obvious that the interference power due to the third mechanism: (c) $I_{ACS\text{-}Rx}$ also represents unwanted power in the receive pass-band because it is power affecting the receiver demodulator. $I_{ACS\text{-}Rx}$ is calculated as the product of the received power of the unwanted signal in the unwanted channel, times the rejection ratio of the receiver's net filter response to that channel, known as adjacent channel selectivity (ACS). Because these interference powers all occur or are equivalent to power within the receive pass band, their net effect can be determined by addition in the linear domain.

## 4.2 Total interference

The total equivalent co-channel interference power in the victim receiver input is $I_{total}$ and this needs to be aggregated in the linear domain (i.e. Watts or micro Watts etc, not dBW, dBμW etc)

$$I_{total} = I_{CCI} + I_{ACLR\text{-}Tx} + I_{ACS\text{-}Rx}$$

Equations for addition of power in the linear domain, such as the following can be used:

$$P_{tot}(\text{dBW}) = 10 * \log_{10}\left( 10^{P1(\text{dBW})/10} + 10^{P2(\text{dBW})/10} + 10^{P3(\text{dBW})/10} \right)$$

To avoid such tiresome equations, Approved Persons are likely to use short cuts, such as taking account of the stronger signals and ignoring signals with powers more than 10 dB below the strongest. Summation of the stronger signals can then be estimated from relationships such as the following table (with the more familiar relationships in bold):

| Power of a weaker signal relative to the stronger one | Sum of the two signals |
|---|---|
| **0 dB** | **+3 dB** |
| -1 dB | +2.5 dB |
| -2 dB | +2.1 dB |
| **-3 dB** | **+1.8 dB** |
| -4 dB | +1.5 dB |
| -5 dB | +1.2 dB |
| **-6 dB** | **+1 dB** |
| -7 dB | +0.8 dB |
| -8 dB | +0.6 dB |
| -9 dB | +0.5 dB |
| **-10 dB** | **+0.4 dB** |

There is no single criterion for acceptable interference levels because this will depend on the nature of the victim service. However, commonly the total co-channel interference power calculated as above should cause no more than 1 dB degradation to the receiver noise floor at locations near the edge of coverage. From the above table, the total co-channel interference power should be 6 dB or more below the receiver noise floor.

At locations within the coverage of the victim service where the wanted signal of the victim is higher, the total co-channel interference power should respect the co-channel protection ratio of the victim service.

In addition, if either or both the victim wanted signal and interfering signal are high, then the mechanism of receiver blocking becomes important, and must be avoided.

Note that where the victim service will experience interference from a number of sources in addition to the proposed service under consideration, the total interference power of all of these interferers should meet the noise floor degradation criterion or the co-channel protection criterion or the blocking criterion as appropriate.

The receiver noise floor is the thermal noise power at the operating temperature, plus the noise figure (F) of the receiver.

$$\text{Noise floor} = 10*\log_{10}(KTB) + F \qquad \text{(dBW)}$$

Satellite systems typically have very low margins and the accepted interference criterion is usually 0.4 dB noise floor degradation, corresponding to the total co-channel interfering signal level of 10 dB below the noise floor.

## 4.3 Inter-service compatibility and co-ordination

### 4.3.1 Off-site compatibility

What is an appropriate co-ordination zone in a particular circumstance will depend on many factors, not the least being the expertise and judgement of Approved Persons. In practice the co-ordination zone radius must be sufficient to meet the *harmful interference*[3] test. Interference to, and from the proposed radiocommunication service is to be assessed taking into account the path profile between two stations, transmitting antenna radiation patterns, and receiver antenna gain in the direction of other transmitters within the zone.

Public safety and security services rely on radio waves for both communications and navigation. It is the responsibility of Approved Persons to give particular consideration to such services.

### 4.3.2 On-site compatibility

Detailed information in regard to "on-site" interference and compatibility issues (intermodulation, broadband noise etc) is outside the scope of this document, however the ITU-R provides significant guidance on such matters. While the potential for on-site interference problems can be minimised if all equipment meets "best practice" standards and is well maintained, unexpected interference mechanisms do occur from time to time. For complex sites involving multiple users and/or multiple installations in close proximity, the establishment of site co-ordination committees might be a useful approach to prevent and remedy interference problems.

Notwithstanding the above, Approved Persons have an obligation to mitigate the impact on existing radio services in the area, hence on-site co-ordination is strongly recommended.

## 4.4 Unwanted emissions

Unwanted emissions consist of *spurious emissions* and *out-of-band emissions*. The levels of these unwanted emissions of your proposed licence must comply with Rec. ITU-R SM.329-10.

Similarly, the levels of unwanted emissions from transmissions operating under existing licences which may be a source of potential interference to the proposed licence can be presumed to comply with Rec. ITU-R SM.329-10.

### 4.4.1 Out-of-band emissions

An *out-of-band emission* is defined in the ITU-R Radio Regulations to be:

> *An emission* on a frequency or frequencies immediately outside the *necessary bandwidth* which results from the modulation process, but excluding *spurious emissions*.

[3] The Radiocommunications Act (1998) definition:
"*harmful interference*"' means interference which endangers the functioning of a radionavigation service, or of other safety services, or seriously degrades, obstructs, or repeatedly interrupts radiocommunications.

Any unwanted emissions, excluding *spurious emissions*, that fall at frequencies separated from the centre frequency of the emission by less than 250% of the necessary bandwidth of the emission will generally be considered out-of-band emission. For multi-channel or multi-carrier transmitters/transponders, where several carriers may be transmitted simultaneously from a final output amplifier stage or an active antenna, the centre frequency of the emission is taken to be the centre of the –3 dB bandwidth of the transmitter or transponder.

### 4.4.2 Spurious emissions

A s*purious emission* is defined in the ITU-R Radio Regulations to be:

> *Emission* on a frequency or frequencies which are outside the *necessary bandwidth* and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic *emissions*, parasitic *emissions*, intermodulation products and frequency conversion products, but exclude *out-of-band emissions*.

For the purpose of these rules all emissions, including intermodulation products, conversion products and parasitic emissions, (but excluding *out-of-band emissions,* which fall at frequencies separated from the centre frequency of the emission by 250% or less of the necessary bandwidth of the emission), will generally be considered spurious emissions.

For multi-channel or multi-carrier transmitters and transponders, where several carriers may be transmitted simultaneously from a final output amplifier stage, or an active antenna, the centre frequency of the emission is taken to be the centre of the –3 dB bandwidth of the transmitter or transponder. Recommendation ITU-R SM.329 may provide some guidance in this matter.

Two additions to the ITU-R Radio Regulations resulting from WRC-2003 help clarify what are *out-of-band emissions* and what are *spurious emissions*, and in what parts of the spectrum these are likely to occur.

**Article 1.146A**

> *Out-of-band domain* (of an emission)*:* The frequency range, immediately outside the necessary bandwidth but excluding the *spurious domain*, in which *out-of-band emissions* generally predominate. *Out-of-band emissions*, defined based on their source, occur in the out-of-band domain and, to a lesser extent, in the spurious domain. *Spurious emissions* likewise may occur in the out-of-band domain as well as in the spurious domain. (WRC-03)

**Article 1.146B**

> *Spurious domain* (of an emission)*:* The frequency range beyond the *out-of-band domain* in which *spurious emissions* generally predominate. (WRC-03)

Note that these domains only give an indication of where one is likely to find these two types of unwanted emission. The domains do not define what are *out-of-band emissions* and *spurious emissions*. The definitions of these two types of emission are based on their source, i.e. on what causes them, not on where they occur in the spectrum relative to the position of the wanted channel. We have underlined text in the above to highlight this distinction.

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# Appendix C

## How to apply the simplex Class of Licence Codes LS1, LS2, LS3 and LS4 after 1 July 2005.

LS1: Multiple transmitters on a common frequency throughout New Zealand with a bandwidth 12.5 kHz or less.

LS2: Multiple transmitters on a common frequency throughout New Zealand with a bandwidth more than 12.5 kHz but less than or equal to 25.0 kHz.

LS3: Multiple transmitters on a common frequency throughout New Zealand with a bandwidth more than 25.0 kHz.

From 1 July 2005 these Licence Codes are only to be used for *frequencies that have been set aside on a nationwide basis for emergency services.*

Emergency Services are defined in Part H of the Statement of Government Policy and Directions to Chief Executive of Ministry of Economic Development dated the 22nd day of April 2002 and states;

*"That adequate provision should be made, in common frequency bands where practicable, for the licensing of services operated by Government departments and Crown agencies, where the primary objective of such services is the protection of life and property"*

Examples of such Government departments and Crown Agencies are; Police, Fire, Ambulance, Defence, Customs and Ministry of Civil Defence and Emergency Management.

Any licence applications for codes LS1, LS2 and LS3 that fall outside these parameters must be approved by the Manager, Licensing. A full business case justifying the proposed use must accompany any such application.

Note:

1. There are a small number of existing licences with Licence Code LS1, LS2 and LS3 that fall outside the above described licence parameters. These licences were issued under the previous licensing regime, to private firms that were granted a frequency for nationwide use and private firms that were granted a shared frequency licence to cover an unlimited number of mobiles nationwide. There are no immediate plans to bring these licences under the new licensing regime, but if the clients apply to correct their licence code the application will be processed.

LS4: Other transmitters (per licence)

All other simplex applications fall into this Class of Licence Code.

(per licence) means;

*A simplex licence will authorise the use of the number of frequencies needed to meet the requirements of the service and an unlimited number of mobiles within a defined area. PIB38 directs the Approved Radio Certifier and Approved Radio Engineer issuing the Radio Licence certificate to document the requirement for each frequency issued.*

**Notes:**

1. All Licence Code LS4 licence applications for less than 30.0 MHz must be engineered by RSM. This is to meet ITU coordination requirements for services that could be received outside New Zealand.

2. Clients that hold separate licences for the same location for 12.5 kHz channeled VHF (AX, ENX and EEX Bands) and UHF (CNX, DNX and FNX) bands may amalgamate these licences under one licence number.

3. Clients that hold separate licences for the same location for 25.0 kHz channeled VHF (EX) and UHF (CX, DX, and FX) bands may apply to amalgamate these licences under one licence number.

4. The amalgamation of 12.5 kHz and 25.0 kHz licence types on a single simplex licence will not be allowed because RSM is required to continue to collect information on the use of the two bandwidths.

5. Clients may apply to amalgamate licences that are currently individually licensed in separate areas of New Zealand. It should be pointed out to the client that this may degrade their service as simplex licences are engineered to provide an optimum loading of channels in an area. This local load spreading is compromised by the use of All New Zealand or All North Island locations, SMART allows multiple locations which means a single licence could have multiple locations to cover the licence requirements of a client who operates in separate but defined areas, but does not require service anywhere in New Zealand.

6. It should be emphasised to clients that simplex is a ***shared service*** and all simplex licences shall have a licence condition that states *"Simplex is a shared service and any co-channel interference suffered must be tolerated"*

7. Applications for All New Zealand shared use are covered by the Licence Code LS4. These All New Zealand shared use licences will only be issued to clients who have a business requirement for simplex communications on an ad hoc basis anywhere in New Zealand. Typical users are road marking companies and land surveyors.

**Additional Notes for Medium Frequency/High Frequency Licensing – RSM only.**

1. The licensing of a MF/HF simplex service is covered by the Licence codes LS1 or LS4. The detail of how these Licence codes are applied is outlined at the beginning of this document.

2. If all sets are portables/mobiles then the transmit location is All New Zealand and the receive location is All New Zealand.

3. The location of all fixed base station sites to be covered by the licence is to be recorded on the licence. A base station is defined as a station having a non-portable power supply and a permanently erected aerial. The receive location will be All New Zealand.

4. A receive location of South Pacific may be requested if the service is to be used to communicate with the South Pacific. Any transmissions from other countries must be authorised by the administrations of those countries.

5. Any modifications to the licence e.g. the addition of a new base station location or a request for additional frequencies will incur an engineering fee. Changes in the number of sets recorded on the licence and the associated allocation of extra callsigns does not attract a fee.

6. A 3.0 MHz and a 5.0 MHz frequency will be assigned to all new services. Additional frequencies may be requested and will be assigned where they meet RSM and ITU requirements.

7. Any requests for the licensing of MF/HF frequencies assigned to Search and Rescue, New Zealand Police and the Ministry of Civil Defence and Emergency Management must be accompanied by a letter from the relevant organisation supporting the use of that frequency by the applicant.

# Appendix D

## Antenna Compliance Requirements

**Table of Contents**



### 1. Introduction

This appendix details the compliance requirements for antennas used in point-to-point microwave fixed service frequency bands. The end result is to ensure antennas with the best performance are always used.

Antenna compliance is determined by reference, to the antenna front-to-back (F/B) ratio and antenna cross-polar discrimination (XPD) as stated by the respective product manufacturer. These values are then compared to Table 1 which provides the minimum acceptable antenna performance requirements based on F/B ratios and XPD for each band.

High Spectrum Demand Areas (HSDA's) are defined as Auckland, Hamilton, Tauranga, Palmerston North, Wellington, Christchurch and Dunedin metropolitan areas

### 2. Minimum Antenna Performance Requirements

Licensees are required to employ antennas with characteristics that meet or exceed those specified in Table 1. In some instances, in order to achieve coordination in a difficult area, RSM may require that antennas with performance exceeding that specified in Table 1 be used in order to facilitate coordination and maximise spectrum utilisation. The minimum requirements specified in Table 1 differ depending on the location of the fixed service:

- In High Spectrum Demand Areas (HSDAs) (i.e. within a metropolitan city, or operating from an exposed high site that would unduly constrain the reuse of the channel(s)), point-to-point fixed service antennas must meet the minimum XPD performance and the a minimum F/B ratio given in the Grade B column of Table 1.

- Outside HSDAs point-to-point microwave fixed service antennas must meet the minimum XPD performance and must satisfy the minimum F/B ratio given in the Grade C column of Table 1.

| NZ Band | Band GHz | XPD (min) dB | Grade C F/B (min) dB | Grade B F/B (min) dB | Grade A F/B (min) dB |
|---|---|---|---|---|---|
| LL | 1.5 | 25 | 25 | 30 | 40 |
| P | 3.8 | 30 | 60 | 60 | 65 |
| 5 GHz | 4.7 | 30 | 60 | 60 | 65 |
| R | 6.0 | 30 | 60 | 60 | 75 |
| T | 6.7 | 30 | 60 | 60 | 75 |
| V/U | 7.5 | 30 | 60 | 60 | 70 |
| W/Y | 8 | 30 | 60 | 60 | 75 |
| H | 10 | 30 | 45 | 55 | 65 |
| Z | 11 | 30 | 45 | 55 | 75 |
| X | 13 | 30 | 45 | 55 | 70 |
| G | 15 | 30 | 45 | 55 | 65 |
| 18 GHz | 18 | 30 | 45 | 55 | 65 |
| 23 GHz | 22 | 30 | 45 | 55 | 65 |
| 38 GHz | 38 | 30 | 45 | 55 | 65 |
| 50 GHz | 50 | 30 | 45 | 55 | 65 |
| 80 GHz | 80 | 30 | 43 | 43 | 50 |

Table 1: Minimum acceptable antenna performance requirements

Note 1: The three classes of antennas defined are differentiated on the basis of their F/B ratio. Essentially, standard (STD) antennas are Grade C, high performance (HP) antennas are Grade B and ultra high performance (UHP) antennas are Grade A. Whilst inclusion of the Higher Grade A antennas in this Table is not strictly necessary under these arrangements, it allows users to differentiate between HP and UHP antenna types and could provide a basis for future regulatory discrimination between antenna types.

## 3. Coordination Requirements

RSM requires that frequency coordination studies be performed using manufacturer's actual antenna radiation pattern envelope (RPE) data for both proposed and existing assignments.

As a consequence actual RPE data for all licensed services will need to be accessible for the life of these services for coordination purposes. In some cases manufacturer RPE data may not be available for assignments that were licensed prior to the introduction of these antenna regulatory compliance arrangements (i.e. prior to the SMART roll-out, or assignments were licensed using the notional antenna. In these cases the use of notional antenna RPEs provided in appendix A can be used in frequency coordination studies.

## 4. Provision of RPE data

Antenna RPE data for proposed new assignments must be provided to RSM as a condition of the proposed assignment being accepted, unless already held by RSM. To facilitate the process, RSM maintains a paper based file of antenna RPE data files and provides a searchable list on the SMART Database. This enables licensees and ARE/ARC's to verify if an antenna record is in SMART. ARE/ARC's only need to provide RSM Antenna data if it is not in the SMART database.

RPE data is readily available from most manufacturers and in the first instance users will be expected to contact the manufacturers to obtain the RPE data.

## 5. Trunk Bands

A geographic definition of trunk routes and prime sites is problematic due to the constant development of new sites and new trunk routes. However, as many trunk routes are located in non-HSDAs allowing the use of standard Grade C antennas would impact on the provision of trunk services. In order to maintain the spectrum efficiency for trunk services the front-to-back criteria in the trunk bands (5GHz & T Bands) for Grade C have been set to be the same as Grade B. This approach is administratively simple as it avoids a requirement to define trunk routes (and to update that definition as new trunk routes are developed). Also, specifying Grade B as a minimum for the trunk bands ensures that the spectrum efficiency in important trunk bands is not compromised by use of poorer performing antennas in those bands.

**6. Prime Sites**

A "prime sites" definition is also not necessary. Antennas used at sites within HSDAs are required to be Grade B or better so the spectrum utility is preserved. As mentioned above, the spectrum utility of sites that are used as part of a trunk route outside HSDAs will be subject to the tighter requirements that apply for trunk bands. For non-trunk bands spectrum availability is usually not critical at sites outside the HSDAs and so it was considered reasonable to set a less stringent compliance requirement in those cases.

**7. Links Crossing HSDA boundaries**

Fixed service point-to-point microwave links that simply traverse a HSDA (i.e. both ends of a link are outside the HSDA but the path partially crosses a HSDA) will not be considered to be within the HSDA. However, if one end of a link is located inside a HSDA and the other is outside, then both ends of the link will need to conform to the requirements for antennas within the HSDA for that band.

**8. Antenna Measurement Standards**

RSM does not intend mandating measurement standards. However, it would be expected that the RPE data provided would be in accordance with internationally recognised standards and methodologies. If it is found that an antenna differs markedly from the published data and is causing a problem then RSM may require that the antenna be replaced at the licensee's expense.

**9. Exemptions**

Any requests for an exemption from these requirements must be addressed to the Manager, licensing, RSM. Should an exemption be given it must be in writing and filed with engineering documentation.

The use of parabolic antennas was assumed in deriving the values included in Table 1, other types, such as 'patch' antennas, may be used as long as they conform to the requirement of having a single main axis of radiation and they meet the other relevant criteria specified for each band.