frequency assignment requirements  
for the  
land mobile service

Amendment history

| Date | Comments |
| --- | --- |
| [insert date when update finalised] | Updates to remove arrangements for the legacy 800 MHz band (820-825/865-870 MHz) and to include additional criteria and guidance for coordination with spectrum licensed services. |
| 1 July 2020 | Update to arrangements for 800 MHz band trunking. See [IFC 12/2020](https://www.acma.gov.au/consultations/2020-05/803-960-mhz-band-implementation-arrangements-support-milestone-3-consultation-122020). |
| 21 October 2019 | Introduction of new arrangements for enclosed and short-range digital low power services. See [IFC 35/2018](https://www.acma.gov.au/theACMA/land-mobile-services-new-small-service-area-models). |
| 11 July 2016 | Simplified and clarified the process for Harmonised Government Spectrum Area licensing |
| 1 July 2016 | Sections 6.9 and 6.10 added to accommodate Harmonised Government Spectrum Area licensing arrangements. |
| September 2015 | Arrangements for supplementary transmitter (section 5.3) , height/power restriction base stations (5.6), intermodulation (section 6.5) and local environment (section 6.8) updated as part of completion of IFC42/2014 process. |
| 11 June 2015 | Annex C: Frequency-distance constraints update following public consultation. See [IFC 42/2014](http://acma.gov.au/theACMA/Consultations/Consultations/Current/proposed-updates-to-rali-lm8-land-mobile-service-frequency-assignment-requirements). |
| 4 December 2000 | Updated to clarify existing policy on assignment of high power (83 W EIRP) and low power (8.3 W EIRP) single frequency land mobile radio systems. |
| 6 April 1998 | Updated to incorporate requirements for 400 MHz land mobile radio systems including low powered land mobile radio systems. |
| 3 July 1997 | Updated to incorporate requirements for 800 MHz trunked land mobile radio systems and digitally modulated land mobile radio systems. |
| 2 April 1997 | New RALI |

Suggestions for improvements to Radiocommunications Assignment and Licensing Instruction LM 8 may be addressed to The Manager, Spectrum Planning, ACMA at PO Box 78, Belconnen, ACT, 2616, or by e-mail to [freqplan@acma.gov.au](mailto:freqplan@acma.gov.au). It would be appreciated if notification to the ACMA of any inaccuracy or ambiguity found be made without delay in order that the matter may be investigated, and appropriate action taken.

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## Frequency Assignment Requirements for the Land Mobile Service

### 1.0 Purpose

The purpose of this Radiocommunications Assignment and Licensing Instruction (RALI) is to provide advice on frequency assignment policy and coordination procedures for single and two frequency land mobile systems employing angle and digital modulation methods.

This RALI replaces RALI LM 8, dated 21 October 2019.

The information in this document reflects the Australian Communications and Media Authority’s statement of current policy in relation to frequency assignment requirements for the land mobile service. In making decisions, the Australian Communications and Media Authority (ACMA) and accredited frequency assigners should take all relevant factors into account and decide each case on its merits. If an issue related to this document appears to fall outside the enunciated policy, please consult the Manager, Spectrum Planning Section[[1]](#footnote-2).

### 2.0 Current Applicability

This RALI currently applies to angle and digital modulated:

* single and two frequency systems in the 400 MHz band[[2]](#footnote-3) and the VHF Mid and High bands[[3]](#footnote-4) using 6.25[[4]](#footnote-5), 12.5 and 25 kHz[[5]](#footnote-6) channelling; and
* 800 MHz trunked systems[[6]](#footnote-7) using 12.5 and 25 kHz channelling.

### 3.0 Service Description

Radiocommunications systems operating in the land-mobile service (LMS) are typically used to communicate information between a controlling station and vehicular mobile or personal stations often for, but not limited to, the purposes of dispatch activities related to the performance of a business or other organisational activity.

In the case of two frequency systems, communication usually occurs between a remote control station (RCS) and mobile stations via a centrally located land station (often referred to as a ‘base’ station or repeater) which is located at a high site in order to serve the surrounding area. The base station receives transmissions on its ‘base receive’ frequency from the RCS or any mobile within the notional service area and subsequently repeats those transmissions on its ‘base transmit’ frequency for reception by any other mobile (or the RCS) within the notional service area.

In single frequency systems, the controlling station typically is the ‘base’ station and is at the centre of the notional service area, although in some cases the controlling station is linked (sometimes by land line) to a ‘base’ station at a high site. All communications occur on the one frequency.

Trunked land mobile systems (TLMS) are functionally similar to the two frequency non-trunked systems described above. However, in a trunked system, a group of channels at the base station site is time-shared between a large number of users so that the channels can be used more efficiently.

Low-power land mobile radio systems (LPMRS) are functionally similar to the systems described above but have a much smaller coverage area. They are located primarily in high‑density areas and have greater frequency re-use. LPMRS are typically used to service small areas and can also be used in crane assistance and ambulatory applications.

Enclosed and short-range digital land mobile systems utilise low powers and are intended for use within either an enclosed site (such as a stadium or building) or use digital radio technology to cover a very localised area. They have greater frequency reuse than LPMRS due to their lower maximum EIRP, shielding provided by the enclosed environment they operate within or the additional interference protection provided by a digital system. However, interference protection is not provided to the same base station sensitivity level as LMRS and LPMRS due to the variability of site shielding, local clutter impacts and antenna limitations.

From an interference management perspective, an LMS has the following characteristics:

* it has a central fixed land station (generally referred to as a base station); in practice this is the controlling station in a single frequency system and the repeater in a two frequency system, and is commonly located at a high site;
* the base station serves a number of mobile/personal mobile stations, distributed randomly throughout the service area;
* in the case of a two frequency system, the controlling station (RCS) is treated as a ‘fixed mobile’ in the service area; and
* communication occurs mostly between mobiles and the controlling station (via a repeater in a two frequency system) although, in some cases, direct mobile-to-mobile or personal mobile-to-personal mobile communication may occur.

### 4.0 Service Model

The purpose of the service model is to define a set of characteristics for the LMS that will result in a specified ‘target’ grade of service for land mobile systems. There are three service models defined; one for large coverage applications (LMRS), one for small coverage applications (LPMRS) and one for localised coverage applications (enclosed and short-range digital).

The target grade of service (TGS) is defined as a signal quality of 12 dB SINAD[[7]](#footnote-8) for voice systems or a bit error rate of 10-2 for data systems at the receiver output for a 5 dB ratio of wanted to unwanted signals at the receiver RF input terminal. The model defines values for a set of parameters (at the inter-system, intra‑system and equipment levels) that, when satisfied, will on average achieve the TGS for LMS receivers at 90% of locations within the notional service area of a land mobile system. The TGS is consider aspirational as LM 8 is based on a generic model and that whilst it references these performance parameters, due to simplification made to cater for the different technologies, availability parameters of 50% are used (in determining path loss in frequency distance constraints).

Sections 5 and 6 of this RALI detail the frequency assignment policy and coordination procedures for land mobile systems which use, as their basis, the service model as described in this section.

#### 4.1 LMRS Service Model Description



**Figure 1 - LMRS Service Model**

Key features of the service model are:

* the radiated power is limited to an equivalent isotropically radiated power (EIRP) for all stations as follows;

1. 83 watts (W) for base stations (e.g. 50 W into a 2.15 dBi dipole antenna);
2. 41 W for mobile stations (e.g. 25 W into a 2.15 dBi λ/4 monopole antenna);
3. 41 W for supplementary transmitters (e.g. 25 W into a 2.15 dBi λ/4 monopole antenna);
4. 20 W for RCSs (e.g. 1 W into a 13 dBi yagi antenna);
5. 8.3 W for personal mobile stations (e.g. 5 W into a 2.15 dBi λ/4 monopole antenna);

* an assumed base station effective antenna height of 200 metres above surrounding terrain and a mobile antenna height of 1.5 metres above ground level[[8]](#footnote-9);
* assumed receiver usable sensitivity levels (refer to Annex D, Table D4, of this RALI);
* the use of a modified Longley-Rice model (base-to-base) and the modified Hata model (base-to-mobile) for propagation loss calculations associated with frequency-distance constraints (refer to Annex A of this RALI);
* the use of free space loss plus 10 dB for intermodulation propagation loss calculations associated with cull distances for intermodulation checks;
* a notional service area radius of 40 km;
* a notional antenna for base station receivers, assumed to be a vertically polarised dipole array with a maximum antenna gain in any direction of 2 dBi at VHF and 6 dBi at UHF (Note that these figures include cable and combiner loss, but exclude cavity filter loss);
* a co-channel re-use distance of 140 km between VHF single frequency base stations, 120 km between UHF single frequency base stations and 100 km between two-frequency base stations;
* frequency coordination that is performed for base and supplementary stations only (specific levels of protection for mobiles and RCSs are intrinsic to the service model);
* assumed maximum levels of spurious emissions, including broadband noise radiated from a transmitter;
* an assumed receiver blocking performance of 90 dB above the receiver usable sensitivity levels specified in Annex D, Table D3, of this RALI;
* anassumption that additional RF selectivity, equivalent to that achieved by two 6-inch cavity filters, is installed on base station receivers, to reduce their susceptibility to interference from site-based intermodulation products (refer to Annex D, Table D3, of this RALI)[[9]](#footnote-10);
* a limit on RCS transmitter output power to a maximum of 1 watt, which requires that a directional antenna be used to achieve the EIRP limit referred to above. The model presumes that the EIRP is limited to the minimum necessary to achieve a signal level 15 dB above the base station receiver’s minimum usable sensitivity level at its input terminal. These limits minimise the potential for interference between the RCS and adjacent services;
* specific requirements for RCSs to minimise their potential for causing intermodulation interference in areas having a relatively high concentration of transmitters and receivers. The model presumes the following requirements for RCSs located in central business districts:

1. the height of an RCS antenna does not exceed 30 metres above ground level; and
2. a 20 dB in-line attenuator[[10]](#footnote-11) is fitted between the output of an RCS transmitter and its associated antenna;

* the assumption that services are co-sited when they are located within 200 metres of each other;
* the inclusion of co-channelled transmitters (supplementary transmitters) to improve the service reliability within, but not outside, the notional service area; and
* the assumption that 800 MHz trunked equipment is approved to Federal Communications Commission (FCC) Rules Part 90.

Note that during an interference investigation, one of the factors the ACMA may take into account is whether equipment is being operated in accordance with these parameters. Services that are not consistent with these models may not be afforded protection from interference from licenced radiocommunications and might be required to take interference remediation measures (for example adjust antenna height). See Annex C for more details.

#### 4.2 LPMRS Service Model Description

  
**Figure 2 - LPMRS Service Model**

Key features of the LPMRS service model are:

* the radiated power is limited to an EIRP for all stations as follows;

1. 8.3 W for base stations (e.g. 5 W into a 2.15 dBi dipole antenna);
2. 8.3 W for mobile stations (e.g. 5 W into a 2.15 dBi λ/4 monopole antenna);
3. 8.3 W for personal mobile stations (e.g. 5 W into a 2.15 dBi λ/4 monopole antenna);

* base station effective antenna height of 10 metres above surrounding terrain (includes any building height) and a mobile antenna height of 1.5 metres above ground level. Interference protection cannot be provided for systems deviating significantly from this effective height assumption;
* assumed receiver usable sensitivity levels (refer to Annex D, Table D4, of this RALI);
* the use of the modified Hata model for base-to-base and base-to-mobile propagation loss calculations associated with frequency-distance constraints (refer to Annex A of this RALI);
* the use of free space loss plus 10 dB for intermodulation propagation loss calculations associated with cull distances for intermodulation checks;
* a notional service area radius of 2 km;
* a notional antenna for base station receivers, assumed to be a vertically polarised dipole array with a maximum antenna gain in any direction of 2 dBi at VHF or 6 dBi at UHF (Note that these figures include cable and combiner loss, but exclude cavity filter loss);
* a co-channel re-use distance of 10 km between base stations;
* frequency coordination that is performed for base stations only (specific levels of protection for mobiles and RCSs are intrinsic to the service model);
* assumed maximum levels of spurious emissions, including broadband noise radiated from a transmitter;
* an assumed receiver blocking performance of 90 dB above the receiver sensitivity levels specified in Annex D, Table D3, of this RALI;
* anassumption that additional RF selectivity, equivalent to that achieved by two 6 inch cavity filters, is installed on base station receivers to reduce their susceptibility to interference from site-based intermodulation products;
* the assumption that services are co-sited when they are located within 200 metres of each other; and
* specific requirements for tower crane control applications using LPMRS. The transmitter output power is assumed to be a maximum of 1 watt. The crane antenna is assumed to have a maximum beam width of 80 degrees with down tilt.

Note that during an interference investigation, one of the factors the ACMA may take into account is whether equipment is being operated in accordance with these parameters. Services that are not consistent with these models may not be afforded protection from interference from licenced radiocommunications and might be required to take interference remediation measures (for example adjust antenna height). See Annex C for more details.

#### 4.3 Enclosed and Short-range Digital Service Model Description

The enclosed and short-range digital low power models have characteristics that are common to both applications and characteristics that are unique to each model.

Common features of the enclosed and short-range digital low power model are:

* the radiated power is limited to a maximum EIRP for all stations as follows;

1. 1.7 W for base stations (e.g. 1 W into a 2.15 dBi dipole antenna)
2. 1.7 W for personal mobile stations (e.g. 1 W into a 2.15 dBi λ/4 monopole antenna);

* base station effective antenna height of 10 metres above surrounding terrain (includes any building height) and a mobile antenna height of 1.5 metres above ground level. Interference protection cannot be provided for systems deviating significantly from this effective height assumption;
* intermodulation checks are not carried out;
* frequency coordination is limited to co-channel base station minimum separation distances (specific levels of protection are not provided);
* assumed maximum levels of spurious emissions, including broadband noise radiated from a transmitter;
* an assumed receiver blocking performance of 90 dB above the receiver sensitivity levels specified in Annex D, Table D4, of this RALI;
* these services are not suitable for crane use due to their tight geographical frequency re-use; and
* the assumption that services are co-sited when they are located within 200 metres of each other.

**Enclosed specific features**

* the base station antenna must be located indoors or within the roof line of an enclosure with walls all around and no higher than 10 m above ground level (eg. within a building, warehouse or fully enclosed stadium - roof optional) or leaky feeders at any height including above 10m (eg. High rise building);
* assumed building penetration loss is 7 dB or more;
* assumed interference threshold is -96 dBm;
* a notional service area radius of 0.2 km about the station coordinates;
* a co-channel reuse distance of 0.5 km applies between base stations;
* Analog systems should deploy Continuous Tone Controlled Signalling System (CTCSS), Digitally Coded Squelch Signalling (DCSS) or similar in-band signalling.
* The following special condition is to be applied to the licence:
* LM06: This service is to be coordinated as an enclosed service



**Figure 3 – Enclosed Service Model**

Note that during an interference investigation, one of the factors the ACMA may take into account is whether equipment is being operated in accordance with these parameters. Services that are not consistent with these parameters may not be afforded protection from interference from licenced radiocommunications and might be required to take interference remediation measures (for example adjust antenna height). See Annex C for more details.

**Short-range Digital specific features**

* Intend to support digital mobile radio systems such as ETSI TETRA, APCO P25, ETSI DMR or other similar digital standards;
* a notional service area radius of 200 m about the station coordinates;
* a co-channel reuse distance of 2 km applies between base stations;
* assumed interference threshold is -112 dBm;
* The following special condition is to be applied to the licence:
  + LM05: This service is to be coordinated as a Short-range Digital service



**Figure 4 - Short-range Digital Service Model**

Note that during an interference investigation, one of the factors the ACMA may take into account is whether equipment is being operated in accordance with these parameters. Services that are not consistent with these parameters may not be afforded protection from interference from licenced radiocommunications and might be required to take interference remediation measures (for example adjust antenna height). See Annex C for more details.

#### 4.4 Sited Ambulatory Service Model Description



**Figure 4 – Sited Ambulatory Service Model**

Key features of the sited ambulatory service model are:

* for enclosed and short-range digital systems, the radiated power is limited to an EIRP of 1.7 W for personal mobile stations (e.g. 1 W into a 2.15 dBi λ/4monopole antenna)
* for a low power system the radiated power is limited to an EIRP of 8.3 W for personal mobile stations (e.g. 5 W into a 2.15 dBi λ/4 monopole antenna)
* for a high power system the radiated power is limited to an EIRP of 41 Watts EIRP for mobile stations (e.g. 25 W into a 2.15 dBi λ/4 monopole antenna);
* stations are assumed to be operating at or close to ground level: i.e. the effective antenna height is 1.5 metres above ground level (interference protection cannot be provided for systems deviating significantly from this effective height assumption);
* assumed receiver usable sensitivity levels (refer to Annex D, Table D4, of this RALI);
* intermodulation checks are not carried out;
* a notional service area radius of 0.2 km centred on the notional service area centre for an enclosed and short-range digital system;
* a notional service area radius of 2 km centred on the notional service area centre for a low power system;
* a notional service area radius of 40 km centred on the notional service area centre for a high power system;
* a co-channel re-use distance of 0.5 km between service areas for enclosed systems;
* a co-channel re-use distance of 2 km between service areas for short-range digital systems;
* a co-channel re-use distance of 10 km between service areas for low power systems;
* a co-channel re-use distance of 120 or 140 km (for UHF and VHF respectively) between service areas for high power systems;
* assumed maximum levels of spurious emissions, including broadband noise radiated from a transmitter;
* an assumed receiver blocking performance of 90 dB above the receiver sensitivity levels specified in Annex D, Table D3, of this RALI;

Note that during an interference investigation, one of the factors the ACMA may take into account is whether equipment is being operated in accordance with these parameters. Services that are not consistent with these models may not be afforded protection from interference from licenced radiocommunications and might be required to take interference remediation measures (for example adjust antenna height). See Annex C for more details.

### 5.0 Frequency Assignment Policy

Frequency assignment must take into consideration both *inter-service* and *intra-service* requirements consistent with the application of good engineering practice. Consideration should be given also to the issue of spectrum denial at and around popular (prime) radiocommunications sites[[11]](#footnote-12).

Successful management of interference in the LMS requires that all stations operating in the service (mobile, base and RCS) comply with specific technical constraints.

Intra-service constraints form an essential element of the service model upon which frequency assignment requirements are based, and are detailed in the following paragraphs. The intra‑service frequency coordination procedure is also part of this policy framework and is outlined in section 6 of this RALI.

Inter-service coordination of land-mobile services with other radiocommunications services are addressed, in some cases, by specific RALIs. Annex E lists inter-service coordination requirements prepared by the ACMA. In other cases, ITU-R Recommendations may exist. However, because of the diversity and complexity of sharing situations which may arise, it is not possible to provide rigorous and explicit procedures covering all inter-service coordination requirements. In these cases, coordination should be performed in accordance with good engineering practice based on fundamental interference mitigation principles.

For additional information on assigning services in harmonised government spectrum in the 400 MHz, please refer to Frequency assignment practice, Guideline No. 4 — assigning harmonised government spectrum (HGS) in the 400 MHz band.

#### 5.1 Spectrum and Channelling Arrangements

Spectrum and channelling arrangements are specified in the band plans referenced at section 2 of this RALI. Trunked systems may operate in ‘non-trunked’ two-frequency spectrum; however spectrum allocated in the relevant band plans for trunking should not be assigned to non‑trunked systems.

As well as complying with the channelling arrangements specified in the relevant band plans, assignments to a TLMS at any given site should be in accordance with the Block and Group arrangements tabulated at Annex B of this RALI. These arrangements have been established to minimise the occurrence of site-based intermodulation interference.

##### 5.1.1 Implementation of the 803–960 MHz review

In November 2015, the ACMA completed its review of arrangements in the 803–960 MHz band (the Review) and released the decision paper: *The ACMA’s long-term strategy for the 803–960 MHz band* (the 803–960 MHz review decision paper). The decision paper outlines the implementation of new arrangements in the band which will be completed by June 2024.

With regard to TLMS services, the legacy allocation (820–825/865–870 MHz) was removed on 30 June 2023[[12]](#footnote-13) and has been replaced by a new allocation at 806–809/851–854 MHz.

#### 5.2 Assignment Strategy

The procedure for assigning land mobile base station frequencies is based on a strategy of horizontal loading and maximum isolation between assigned services. Under this strategy, frequencies that pass interference checks by the greatest margin are assigned. This approach maximises the isolation between systems which typically achieve a grade of service well in excess of the TGS; the actual grade of service and reliability will reduce, over time, towards the TGS as the spectrum becomes more congested.

#### 5.3 Supplementary Transmitters

A supplementary transmitter is a transmitter intended to improve the service reliability within a 40 km radius of the ‘parent’ base station. A supplementary transmitter does not require frequency coordination and as such no protection is provided to the supplementary receiver. Like mobile receivers, an inherent level of protection is provided through coordination of the parent base station.

It is recommended that checks to identify and mitigate against intermodulation issues should be carried out.

Conditions of operation of supplementary base stations are contained in the *Radiocommunications Licence Conditions (Land Mobile Licence) Determination* and include that the operator:

(a) must not operate the station if its operation causes harmful interference to a service provided by another station;

(b must only operate the station to transmit using the transmit frequencies specified in the licence for the system’s base station;

(c) must only operate the station to improve the service reliability within a radius of 40 kilometres of the system’s base station;

(d) must not operate the station to extend the service area of the system’s base station beyond 40 kilometres from the base station;

The material below is intended to provide advice about how to assess whether the service area has been extended beyond 40 km from the base station. It is not intended to be a mandatory requirement. Note that the LM 8 planning model (as used in derivation of the frequency distance constraints) assumes that the requirement has been meet.

There are two approaches that can be used to determine whether coverage has been extended beyond 40 km. One is to use the tables provided below, and the other is to use ITU-R P.526 to determine received level at and beyond 40 km service area (as in section 6.8). Under this approach, the level received by a mobile at the edge of the 40 km service area should be compared to that achieved using the methodology used for frequency distance constraints[[13]](#footnote-14).

Distance/height/power tables for supplementary transmitters

|  |  |
| --- | --- |
| **Distance (d) from Base:** | **EIRP** |
| 0 ≤ *d* < 10 km | 41 W |
| 10 ≤ *d* < 20 km | 20.5 W |
| 20 ≤ *d* < 30 km | 10 W |
| *d* ≥ 30 km | Supplementary transmitters not permitted |

**Table 1 – Supplementary transmitter power restrictions.**

|  |  |
| --- | --- |
| **Height above average terrain:** | **EIRP Adjustment** |
| ≥ 250m | -3 dB |
| ≥ 350 m | -6 dB |
| ≥ 650 m | -10 dB |

**Table 2 – Height vs. power restrictions for supplementary transmitters.**

For example, a supplementary transmitter located 21 km from its base station and at a height of 300 metres would be permitted a maximum EIRP of 5 Watts (10 Watts minus 3 dB is 5 Watts)[[14]](#footnote-15).

#### 5.4 Bi-directional Amplifiers

Bi-directional amplifiers are used as part of a land mobile system to provide coverage within an enclosed area, within the service area of the ‘parent’ base station. Bi-directional amplifiers operate on a no protection/no interference basis. As defined in the *Radiocommunications Licence Conditions (Land Mobile Licence) Determination* a bi-directional amplifier system can be used with leaky feeder cable and consists of:

* one or more transmitters that transmit on frequencies used by the base station and mobile stations in the land mobile system; or
* one or more receivers that receive on frequencies used by the base station and mobile stations in the land mobile system.

Under the Radiocommunications Act all transmitters are required to be licensed[[15]](#footnote-16). A bi-directional amplifier is authorised to amplify and retransmit the ‘parent’ land mobile system’s frequencies and bandwidth.  For wideband amplifiers this could include the intended channel(s), i.e. the licensed channel of the ‘parent’ system to be to amplified and adjacent channels as well.  In such cases additional filtering might be required to remove unauthorised transmissions, or third party authorisation from the relevant adjacent channel licensee[[16]](#footnote-17).

**Bi-directional amplifiers and class licensing**

Underground bi-directional amplifier systems that meet the conditions for ‘underground transmitters’ in the Radiocommunications (Low Interference Potential Devices) Class Licence are authorised to operate under that class licence and the requirements of this RALI do not apply. Wideband amplifiers can be used for underground applications provided they meet the requirements of the Radiocommunications (Low Interference Potential Devices) Class Licence.

##### 5.4.1 Technical requirements of bi-directional amplifiers

The following general technical requirement applies to a bi-directional amplifiers:

1. The bi-directional amplifiers system must be located within the service area of the associated ‘parent’ base station;
2. Bi-directional amplifiers can be used within the internal sub-system as part of the signal distribution provided the signals do not radiate externally from the target area. For example they can be used as ‘power boosters’ along the length of the leaky feeder to maintain RF signal level, provided such amplifiers are not connected to an antenna that radiates externally to the enclosure;
3. An operator must not operate a bi-directional amplifier system, or a transmitter that is externally linked to the bi-directional amplifier system, using a power exceeding 1 watt pY;
4. For a transmitter that is externally linked to a bi-directional amplifier system:
5. If the transmitter is located in a central business district of a city or town – an operator must fit a device between the transmitter and the antenna to the ‘parent’ base station that provides intermodulation performance equivalent to, or better than, the intermodulation performance achieved by a 20 dB in-line attenuator;
6. If the transmitter is used for communicating with the base station of the land mobile system – the antenna of the transmitter must be a directional antenna with a minimum gain equivalent to that of a 6 element Yagi antenna.
7. Performance of a bi-directional amplifier connecting to the parent’ base station must meet the same performance standards of a supplementary base station including all discrete spurious components must be below -30 dBm.

In additional to the above requirements, good engineering practices must be used in regard to the radiation of intermodulation products and noise, such that interference to licensed communications systems is avoided. In the event of harmful interference caused by any given deployment, the ACMA may require additional attenuation or filtering of the emissions and/or noise from bi-directional amplifier, as necessary to eliminate the interference or that the bi-directional amplifier cease operating. While the ACMA does not mandate equipment standards for bi-directional amplifiers, guidance on expected performance can be found in North American and European performance requirement. For example, FCC Rules and Regulations for private land mobile services on use of signal boosters (United States Code of Federal Regulations, Title 47 §90.219) includes deployment rules and device certification requirements.

In Europe, Tetra system BDA’s are required to comply with ETSI TS 101 789-1 V1.1.2:2007-04 and utilise wideband amplifiers. BDA’s utilising wideband amplifiers must ensure appropriate licences covering the full transmit bandwidth.

##### 5.4.2 Bi-directional Amplifier Licensing Requirements

Operation of a bi-directional amplifier system that meets the requirements specified in this RALI is authorised under the licence for the land mobile system of which it is a part.

The following Special Condition should be applied to the associated ‘parent’ base station licence:

LT: Bi-directional amplifiers authorised to operate under this licence must not cause interference to the operation of radiocommunications services and will not be afforded protection from interference cause by other radiocommunications services.

#### 5.5 Trunked Systems

##### 5.5.1 VHF High Band Trunking Groups and Sub-segments

The basic trunking assignment unit is the group, which consists of five channels (refer to Annex B1 of this RALI). The 120 channels in each sub-segment are arranged into 12 blocks, each consisting of two groups of five channels. Channels should be assigned at any given site in groups of five, as shown at Annex B1 of this RALI, wherever possible.

Note that the VHF High Band trunking segments are divided into two equal sub-segments, A and B (refer to Annex B1 of this RALI), in order to minimise the potential for site-based interference due to 3rd and 5th order intermodulation products. At any one site, assignments may be made from either sub-segment, A or B, but not both. Sites at which frequencies from different sub‑segments are used must be separated by at least 200 metres.

##### 5.5.2 400 MHz Trunking Groups

The basic trunking assignment unit is the group, which consists of five channels (refer to Annex B3 of this RALI). Four groups comprise a block. The 200 channels are arranged into 10 blocks, each consisting of four groups of five channels. Channels should be assigned at any given site in sets of five, as shown at Annex B3 of this RALI, wherever possible.

##### 5.5.3 800 MHz Trunking Groups

The 800 MHz band TLMS frequency segment is 806–809/851–854 MHz.[[17]](#footnote-18) The arrangements in this segment permit both 12.5 kHz and 25 kHz channel spacing. For 12.5 kHz channel spacing, 240 channels are arranged so as to comprise of twelve blocks, each consisting of four groups of five channels as shown in Table B4.1 at Annex B. Table B4.2 in Annex B4 lists the applicable 12.5 kHz channels (1-240).

For 25 kHz channel spacing, the 120 channels are arranged into 6 blocks, each consisting of four groups of five channels. Table B5.2 lists the 25 kHz channels, with channels numbered 1–120.

Channels should be assigned at any given site in groups of five, as shown in Tables B4.1 and B5.1 in Annex B of this RALI, wherever possible.

Note: for assignments in the 800 MHz trunking band, the minimum assignment size is one five-channel group, however it is not mandatory to assign only full groups (i.e. assignments are not confined to multiples of five channels) as was the case under previous arrangements.

#### 5.6 Single Frequency Systems

Segments for single frequency assignments are specified in the band plans referenced at section 2 of this RALI.

As noted in the 400 MHz plan (RALI MS22), single frequency segments in the 400 MHz band are intended primarily for the assignment of low power, while not specifically stated in MS22 this includes LPMRS (8.3W EIRP), enclosed and short-range digital (1.7 W EIRP) land mobile services[[18]](#footnote-19). Assignments to single frequency high power land mobile services may, however, be made in these segments as per RALI MS22.

#### 5.7 Height / Power Restrictions for High Power Services

In order to limit interference to adjacent services, power restrictions shall apply for high power base stations located in high spectrum density areas with heights above average terrain above 450 metres:

|  |  |
| --- | --- |
| **Height above average terrain:** | **EIRP** |
| ≥ 450m | 41 Watts |
| ≥ 550 m | 20.5 Watts |
| ≥ 650 m | 10 Watts |

**Table 3 – Height vs. power restrictions for high power services in high density areas.**

Height above average terrain shall be determined by the procedure defined in ITU Recommendation ITU-R P.1546 14. Note that services located at heights above average terrain above 450 metres or more are still considered to be high power services for the purposes of licensing and coordination, even though EIRP is reduced.

As an alternative to this approach the procedure and levels outlined in section 6.8 can be used to determine whether the interference threshold (as specified in section 6.8) would be exceeded, in single frequency systems the base station receiver might also require consideration.

### 6.0 Frequency Coordination Procedure

Frequency coordination is performed only for base stations and supplementary transmitters in the LMS; interference protection for mobiles and RCSs is intrinsic to the service model described in section 4 of this RALI. Ambulatory systems requiring coordination are coordinated as per the requirements of the applicable model, i.e. the LMRS, LPMRS, Enclosed or short-range digital model. short-range

The following sections detail a coordination procedure that may be applied for frequency assignment of LMS base stations.

Alternative frequency coordination procedures may be used provided that they produce equivalent results, that is, the target grade of service is achieved at 90% of locations within the notional service area (refer to section 4 of this RALI).

Note that automation of the coordination procedure (by means of an appropriate software application) is highly desirable, particularly when coordinating services in areas of high spectrum occupancy.

#### 6.1 Overview

The general procedure for frequency coordination and assignment of land mobile base stations takes the following form:

* site selection;
* application of frequency-distance constraint checks;
* initial frequency selection;
* intermodulation checks; and
* the frequency assignment.

The following sections describe the above steps in more detail.

#### 6.2 Site Selection

Initial site selection is likely to be based on the client’s needs, but may need to be altered dependent on the outcome of the frequency coordination process outlined below.

#### 6.3 Frequency-Distance Constraints

##### 6.3.1 Cull for Frequency-Distance Constraints

Perform a cull (i.e. produce a list) of existing systems which due to their frequency and distance separation from the proposed system have the potential to cause or receive interference through co-channel emissions, out-of-band emissions, and transmitter broadband noise. The minimum radius and frequency range for this cull are specified at Annex C, Table C1 of this RALI.

##### 6.3.2 Application of Frequency-Distance Constraints

Apply the frequency-distance constraints to assess the potential for interference between the proposed assignment and the systems yielded by the cull. The frequency-distance constraints for single frequency and two frequency services are detailed at Annex C of this RALI.

#### 6.4 Initial Frequency Selection

Any channel passing the frequency-distance constraints and satisfying any particular needs of the client should be selected for subsequent intermodulation checks. Note that for two‑frequency systems this will involve selection of a pair of frequencies (base transmit and base receive) that each satisfy the frequency-distance constraints.

#### 6.5 Intermodulation Checks

The intermodulation checks listed in LM 8 are just one aspect of site management issues that should be considered as part of site management design, installation & commissioning and maintenance processes. While broader site management issues are important, they are not considered in the frequency assignment process and the licensee/site manager need to consider such matters separately. Intermodulation checks are not carried out for enclosed, short-range digital and Ambulatory systems.

##### 6.5.1 Introduction

Intermodulation checks are performed as per below:

*Transmitter Intermodulation*

The proposed transmitter must be evaluated for the potential for its emissions to mix with emissions from other transmitters at the site, to produce 3rd or 5th order intermodulation products that have the potential to cause interference to the proposed or existing receivers. Mixing of transmitter emissions can occur in passive components (eg, site hardware such as couplers, isolators or mechanical/structural joints) as well as in non-linear transmitter output stages, and can result in intermodulation products that are co-channel with the proposed or existing receivers. As the characteristics of the components in which the mixing occurs cannot be known under these circumstances, the criterion for harmful interference caused by transmitter intermodulation is simply the occurrence of a ‘hit’ between co-sited systems, unless other evidence can be cited to demonstrate that the intermodulation interference is acceptable or is unlikely to cause interference.

*Receiver Intermodulation*

The proposed receiver, and existing receivers within specified frequency ranges and distances of the proposed system, must also be evaluated for their potential to receive interference due to intermodulation products caused by the mixing of transmitter emissions in proposed and existing receivers. Intermodulation products can be generated in the RF input stages of receivers if sufficient signal power is applied to drive a stage into a non-linear condition. Because of this input level dependency, the ‘quality’ of a hit can be quantified and either noted as having the potential to cause harmful interference, or discarded because it does not have a sufficient level to cause harmful interference.

##### 6.5.2 Cull for Intermodulation Checks

Perform a cull of existing systems for which the potential for intermodulation interference must be considered. The cull identifies all such systems within defined frequency and distance limits from the proposed system. The radius and frequency range for each required cull is specified in Annex D, Table D1, of this RALI. Ambulatory services are excluded from consideration when performing intermodulation checks.

##### 6.5.3 Performance of Intermodulation Checks

Perform checks for intermodulation interference between the selected assignment frequency (both transmit and receive, if they are different) and existing systems yielded by the cull, in the manner described below.

*Transmitter Intermodulation*

If the operating frequencies of any two co-sited transmitters (including the proposed transmitter) are contained in the relevant frequency range (See Annex D Table D1) and can be algebraically combined in the form shown in Table 4 to produce a 3rd or 5th order intermodulation product within the ‘hit’ range of a co-sited receiver (as defined in Annex D, Table D2, of this RALI) the proposed frequency should not be assigned, unless other evidence can be cited to demonstrate that the level of intermodulation interference is acceptable.

|  |  |
| --- | --- |
| **Frequencies of 3rd Order Products** | **Frequencies of 5th Order Products** |
| 2f1 − f2 | 3f1 − 2f2 |
| 2f2 − f1 | 3f2 − 2f1 |

f1 = centre frequency of first co-sited transmitter

f2 = centre frequency of second co-sited transmitter

**Table 4 - Algebraic expressions for 3rd and 5th order intermodulation  
product frequencies**

*Receiver Intermodulation*

All systems falling within the cull limits specified in Annex D, Table D1, of this RALI are first evaluated for the occurrence of 3rd and 5th order intermodulation product ‘hits’ as per Table 4. A ‘hit’ is deemed to occur when an intermodulation product falls within the frequency ranges from a receiver specified in Annex D, Table D2, of this RALI.

Once the existence of a ‘hit’ has been confirmed, mathematical expressions (1) and (2) shown at Annex D3 of this RALI are evaluated to determine whether unacceptable interference would be caused due to receiver intermodulation by assignment of the proposed frequency.

When equations (1) and (2) at Annex D3 of this RALI are satisfied, the level of intermodulation interference is permissible; conversely, when the equations are not satisfied the level of interference is considered harmful, and the proposed frequency should not be assigned, unless appropriate justification can be provided to indicate that the level of intermodulation interference is acceptable.

If either receiver or transmitter intermodulation checks fail against the selected frequency, select another frequency that passed the frequency-distance constraints and perform intermodulation checks on that frequency.

Continue to perform intermodulation checks on frequencies passing the frequency-distance constraints until an acceptable frequency is found.

In cases where the prospective licensee of the new assignment is also the only victim of any harmful intermodulation products, the licensee may elect to accept any interference and proceed with the assignment.

##### 6.5.4 Inter-Service Intermodulation Checks

Intermodulation resulting from interaction with other radiocommunication services such as television and FM radio broadcasting and paging systems may need to be considered at some sites, e.g. sites occupied by broadcasting transmitters. If inter-service intermodulation checks fail, find another acceptable frequency as per the procedure in section 6.5.3 in this RALI and perform inter-service intermodulation checks on that frequency until an acceptable frequency is found.

#### 6.6 The Frequency Assignment

Assign to the proposed system the channel that passes the intermodulation checks and satisfies the frequency-distance constraints, consistent with meeting the client’s operating frequency requirements as far as practicable.

#### 6.7 Frequency Assignment Procedure - Trunked Systems

The procedure for frequency coordination and assignment of trunked systems is identical to that for conventional two frequency systems; however frequency-distance constraints and intermodulation requirements must be met for all frequencies in the proposed trunking block or group at the proposed site (refer to Annex B of this RALI).

Note that intra-service intermodulation checks are not required for 800 MHz trunking assignments due to the homogeneous nature of the trunking segment and the 45 MHz base transmit/receive split.

#### 6.8 Local Environment

There may be circumstances where the channel selected using the above mentioned procedure is not the optimal channel to be assigned due to the local environment. Examples are: a large mountain range offering additional propagation loss to/from a service in an adjacent area; a transmitter located on a site at a height much greater or lower than the planning model assumes; or an anomalous propagation mode occurring due to a path over water.

Under such circumstances, modified frequency/distance constraints may be applied provided that interference to adjacent services is maintained to levels prescribed in the service model, and that service areas do not overlap (i.e. a minimum of 80 km separation is maintained for high power services). Mobile receivers in at least 90% of the area of any adjacent cells using the same frequency shall be protected (on channel) to a level as given in Table 5. In single frequency systems the base station receiver might also need consideration depending on terrain topography.

|  |  |  |
| --- | --- | --- |
|  | **6.25 kHz bandwidth** | **12.5 / 25 kHz bandwidth** |
| 400 MHz Band | −124 dBm | −121 dBm |
| VHF Band | −115 dBm | −112 dBm |

**Table 5 – Required on-channel protection levels for mobile receivers**

Propagation path loss may be determined by use of any appropriate method described in section 4 of ITU-R P.526 (versions 4 through 9). Other methods for determining the propagation path loss may also be used pending ACMA agreement. A 9 second digital elevation model or better should be used.

#### 6.9 Additional requirements for use of Harmonised Government Spectrum and coordination against Harmonised Government Spectrum Area licenses

The coordination methodology in this section applies to all Harmonised Government Spectrum (HGS) use, including when such use is authorised by a Harmonised Government Spectrum Area (HGSA) licence. The HGS frequency bands are listed in RALI MS22 – 400 MHz Plan (i.e. they exclude the rail segments and parts of 420-430 MHz used for defence purposes).

Area wide systems operating under HGSA arrangements have no coordination requirements and operate on a no interference – no protection basis.

##### 6.9.1 Geographic boundary power spectral density (PSD) limitations

For proposed sited transmitters located within 120 km of a neighbouring jurisdiction, the PSD thresholds specified in Table 5 apply at any point within the geographical area of any neighbouring jurisdiction(s), unless otherwise agreed between HGSA licensee(s) of the affected jurisdiction(s).

|  |  |
| --- | --- |
| Emission Bandwidth | In-Band interference Threshold |
| 6.25 kHz | -124 dBm |
| 12.5 kHz | -121 dBm |
| 25 kHz | -121 dBm |

**Table 5 – In-band PSD threshold value at a jurisdictional boundary**

The following procedure should be used to determine if a transmitter meets the in-band jurisdictional PSD threshold described above:

Step 1: Calculate the coverage area of the proposed station using:

|  |  |
| --- | --- |
|  |  |

*Where;*

*: Interfering power (dBm)*

*: Equivalent Isotropically Radiated Power of interfering transmitter (dBm)*

*: Receiver Antenna Gain (6 dBi)*

*: Propagation path loss (dB) is calculated using the most recent revision of propagation model ITU-R P.526[[19]](#footnote-21)*

Step 2: Using the resultant coverage area plot of the interfering signal, ensure that the interference power does not exceed the maximum acceptable interference level (values in Table 5) anywhere within a neighbouring jurisdiction[[20]](#footnote-22).

#### 6.10 Additional provisions for HGSA licensees

The purpose of this section is to provide additional advice on frequency assignment policy for single and two frequency land mobile systems that will operate in Harmonised Government Spectrum (HGS) segments within the 400 MHz band. The HGS comprises frequency segments that are designated for use exclusively for Commonwealth, State and Territory Government purposes. The 400 MHz plan (RALI MS22) details allocation and channelling arrangements for HGS and non-HGS segments. Note the spectrum set aside for rail use and parts of 420 – 430 MHz used for defence purposes are not included in the HGSA licence frequency ranges.

The document *Harmonised government spectrum area licences in the 400 MHz band* outlines the licensee requirements and application process for HGSA licences. HGSA licensees will be responsible for coordinating frequency access to HGS segments inside their jurisdictional geographical area. This will include coordination between users within their own jurisdiction as well as coordination with neighbouring jurisdictions and non-HGS users operating within their jurisdiction boundaries.

The intent is to afford a degree of flexibility to HGSA licensees in such a way that they are not (in all cases) constrained by the frequency reuse distances prescribed in this RALI. This will allow ‘denser’ network topologies to be deployed to better service areas where demand for channels is high. Conversely, there is an expectation that coordinator rights are used to ensure that networks are deployed in a spectrally efficient manner so as to make the best use of the spectrum available for exclusive government use.

While this means that the constraints of RALI LM8 will largely be relaxed for services operating under the same HGSA licence, there remain some components of the RALI where the service model and coordination procedures must necessarily continue to apply to HGS users. These include Section 4, which defines a service model for LMRS and LPMRS systems and gives operational characteristics of Land Mobile Systems (LMS) that are used to achieve a target grade of service; and Sections 5 and 6, which detail the frequency assignment policy and coordination procedures for LMS including the methodology behind intermodulation checks which are still applicable to the HGS.

The provisions listed in this Section may be invoked by an entity that holds an HGSA licence. The interference protection methodologies and coordination criteria detailed in this section are based on those detailed in the service models described in this RALI.

##### 6.10.1 Buffer Zone

A “buffer zone” has been defined in both the geographical and frequency domain. HGSA licensees will be required to observe this buffer zone in order to avoid interference into non-HGS frequency segments (adjacent band operation) and into adjacent jurisdictions (co-frequency operation). Within these buffer zones, the provisions listed below in Section 6.10.2 cannot be invoked.

The geographic and frequency limits of the buffer zone are as follows:

* Within 120 km of the geographical limit of a jurisdictional boundary; and
* Within 200 kHz of the edge of an HGSA frequency segment that borders a segment not covered by the HGSA licence.

HGS services proposed to operate within a buffer zone are subject to all LM08 coordination requirements and power restrictions.

##### 6.10.2 Larger service areas in regional and remote areas

Some deployments in Low and Remote density area[[21]](#footnote-23) in the HGS may operate with a higher EIRP than is permitted in Section 4.0 of the RALI, in order to achieve larger service areas. In these areas, the transmitter power and EIRP of base stations operating under an HGSA licence is specified as follows:

* Transmitter power (at the antenna input) not to exceed 125W; and
* EIRP not to exceed 400W in any direction.

However, the EIRP limit for mobile stations has not changed.

Operations under the above conditions are limited by:

* Geographic and frequency range radiated power spectral density limitations (as specified in 6.9.1 and 6.10.3 respectively) must be adhered to; and
* Base station location, i.e. power is limited to the ordinary conditions of Section 4 of this RALI within a buffer zone;
* Equipment standards: equipment must adhere to applicable standards specified in the RALI. Equipment meeting the Australian radiocommunications equipment standard(s) relevant to operation in the Land Mobile Service (LMS) will also meet those stated in the LMRS and LPMRS service model for adjacent channel isolation, receiver sensitivity, and transmitter spurious and out-of-band emissions;
* Intermodulation requirements described in Section 6.10.4 of this RALI must be adhered to.

Deployment of LMS systems (LMRS and LPMRS) in the 400 MHz band in High and Medium density areas, or within a buffer zone, is required to comply with all coordination criteria and all ordinary service model parameters specified in Section 4 of the RALI.

##### 6.10.3 Frequency boundary power spectral density (PSD) limitations

The power spectral density (PSD) of the *maximum* radiated power (i.e. the EIRP) limits that must be achieved at the segment boundary frequency (HGSA/non-HGSA) are shown in Table 6[[22]](#footnote-24).

|  |  |
| --- | --- |
| Emission Bandwidth | Out-of-Band Interference Threshold |
| 6.25 kHz | -16 dBm |
| 12.5 kHz | -20 dBm |
| 25 kHz | -13 dBm |

**Table 6 – Out-of-band radiated power limits (into varying channel bandwidths)**

##### 6.10.4 Coordination Methodologies

The provisions listed in this RALI afford HGSA licensees the requisite flexibility to manage access to HGS segments. The geographic area and frequency band-edge constraints specified are intended to help coordinate with other jurisdictions (in-band) and between HGS segments and non-HGS segments (out-of-band).

**6.10.4.1 Intra-Jurisdictional Coordination**

Coordination between users within segments in a jurisdiction covered by an HGSA licence is a matter for the HGSA licensee. The coordination methodologies set out in RALI LM8 may be used to guide this process.

Coordination between users in a segment in a jurisdiction covered by an HGSA licence and users in a segment not covered by the licence, is to follow the coordination methodologies set out in RALI LM8.

**6.10.4.2 Inter-Jurisdictional Coordination**

Assignments within HGS must meet the coordination requirements detailed in this RALI with respect to HGS registrations in adjacent jurisdictions. Additionally, the in-band PSD thresholds shown in Table 5 in this RALI must be met within neighbouring jurisdictions. If cross-jurisdiction coordination cannot be achieved and/or the above mentioned boundary PSD thresholds cannot be met, an assignment can only be made if an agreement can be reached between the respective HGSA licensees. If one of the affected jurisdictions does not have an HGSA licence, agreement must be reached with the jurisdiction’s National Coordinating Committee for Government Radiocommunications (NCCGR) representative.

**6.10.4.3 Coordination between HGS users and non-HGS users**

Assignments within the HGS must meet the coordination requirements detailed in this RALI with respect to non-HGS services, operating in adjacent non-HGS segments. Additionally, the out-of-band radiated PSD limits into adjacent non-HGS segments as shown in Table 6 in this RALI must be met.

**6.10.4.4 Intermodulation checks**

The coordination requirements detailed above are intended to ensure that no harmful interference is caused to licensed services outside the jurisdiction (frequency or geography-wise) of the band coordinator. This also extends to interference that might arise from intermodulation. In all cases, the intermodulation requirements specified in Section 6.5 of RALI LM8 must be adhered to when making an assignment in the HGS. This extends to operation under the provisions of 6.10.2 of this RALI (use of higher EIRP to achieve larger coverage areas in Low and Remote density areas).

Furthermore, given the provisions of 6.10.2, there are further conditions placed on HGS assignments operating under these provisions with respect to intermodulation checks with future non-HGS assignment requests within the intermodulation cull radius of the HGS station. That is, if a prospective non-HGS assignment cannot be made due to intermodulation interference resulting from a station currently operating in the HGS as a result of the additional EIRP, the HGS operator has obligations to work through the process set out below to assist with accommodating the prospective non-HGS assignee (this does not apply when the HGS user is operating in accordance with the normal power limits set out in Section 4 of this RALI). This process is as follows:

* When assessing a prospective non-HGS assignment against a high EIRP station operating in HGS and within the intermodulation cull radius, checks should be carried out using both the actual (higher) EIRP of the HGS station (check 1) and an EIRP of 83W (check 2).
* If both check 1 and check 2 fail, then the prospective assignment cannot be made, as the intermodulation check would have failed regardless of whether or not the HGS assignment was operating under the provisions of 6.10.2.
* If check 1 fails, but check 2 passes, and it can be shown that an alternative channel is not available for the non-HGS user in the requested location, then it is the responsibility of the HGS assignee to accommodate the new proposed assignment. The prospective assignment can proceed as long as the HGS assignee has been contacted in writing to:
  + Reduce EIRP to be compliant with Section 4 of this RALI; or
  + Move to a different HGS channel for which intermodulation checks would pass for the higher EIRP limit.
* Once initial contact has been made by the prospective non-HGS assignee, the HGS assignee has 20 business days to comply with the request.

While this means that the usual “first in time” provisions for frequency assignments only apply to HGS assignments that comply with normal EIRP limits, it is expected to be mitigated by the (usually) high availability of alternative channels (both HGS and non-HGS) in the Low and Remote density areas where the provisions of 6.10.2 may be invoked.

### RALI Authorisation

Approved [insert date when approved]

Chris Worley

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### Annex A - Propagation Loss Models

#### A1. Modified Longley-Rice Model

A modified version of the Longley-Rice propagation loss model [11] has been used in the calculation of propagation loss for the determination of frequency-distance constraints appearing in Annex C when the interference path is between two high sites having effective antenna heights of 200 metres above surrounding terrain. The model has also been used for the determination of intermodulation parameters appearing in Annex  D. For information, parameter values used in the model are detailed in Table A1 below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Band** | **Frequency Limits**  **(MHz)** | **Distance**  **(km)** | **Path Loss**  **(dB)** |
| VHF  Mid and High Bands | 70 to 87.5  148 to 174 | 0 < distance <= 0.006  0.006 < distance <= 40  distance > 40 | 41  FSL + 10  96 + (0.55 x distance) |
| 400 MHz  Band | 403 to 520 | 0 < distance <= 0.003  0.003 < distance <= 40  distance > 40 | 45  FSL + 10  104 + (0.55 x distance) |
| 800 MHz Trunking Band | 806 to 854 | 0 < distance <= 0.003  0.003 < distance <= 55  distance > 55 | 50  FSL + 10  107 + (0.55 x distance) |

**Table A1 - Parameter Values used in the Modified Longley-Rice Propagation Loss Model**

Notes: 1. distance = spatial separation between antennas

2. FSL = Free Space Loss [in dB]

= 32.5 + 20 log (distance [in km] ) + 20 log (frequency [in MHz] )

3. The model estimates propagation loss to a 90 % confidence level and assumes a terrain irregularity factor of 90 metres [11].

#### A2. Modified Hata Model

The modified Hata propagation loss model [7] for suburban environment has been used in the calculation of propagation loss for the determination of frequency-distance constraints appearing in Annex C for two frequency LMRS systems, when the interference path is between a high site and a low site (base to mobile). The modified Hata urban model has been used in the calculations for all cases involving enclosed, digital short-range and LPMRS systems, including coordination of LMRS with LPMRS.

The modified Hata model estimates mean propagation loss (50% of locations for 50% of the time).

The modified Hata equations are as follows:

where:

=

= median path loss (dB)

=

=

*d* = distance (km)

*f* = frequency (MHz)

= base and mobile antenna heights respectively (m)

**Modified Hata Model for LPMRS**

The modified Hata propagation loss model for urban environment used for LPMRS has been adjusted for the base station antenna height lower than 30 m, based on ERC Report 68 [12] as follows:

where:

*L* = median path loss (dB)

*d* = distance (km)

*f* = frequency (MHz)

= base and mobile antenna heights respectively (m)

L = 32.4 + 20log(f) + 10log( d2 + ( )2 /106 )

When L is below the free space attenuation for the same distance, the free space attenuation should be used instead.

### Annex B - Block, Group and Channel Allocations for Trunking Channels

#### B1. Block and Group Allocations for VHF High Band Trunking Channels

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **BLOCK** | **GROUP** | **CHANNEL NUMBER\*** | | | | | |
| 1 | 1 | **1** | **13** | **25** | **37** | **49** |
|  | 2 | **61** | **73** | **85** | **97** | **109** |
| 2 | 1 | **2** | **14** | **26** | **38** | **50** |
|  | 2 | **62** | **74** | **86** | **98** | **110** |
| 3 | 1 | **3** | **15** | **27** | **39** | **51** |
|  | 2 | **63** | **75** | **87** | **99** | **111** |
| 4 | 1 | **4** | **16** | **28** | **40** | **52** |
|  | 2 | **64** | **76** | **88** | **100** | **112** |
| 5 | 1 | **5** | **17** | **29** | **41** | **53** |
|  |  |  |  |  |  |  |
|  | 2 | **65** | **77** | **89** | **101** | **113** |
| 6 | 1 | **6** | **18** | **30** | **42** | **54** |
|  | 2 | **66** | **78** | **90** | **102** | **114** |
| 7 | 1 | **7** | **19** | **31** | **43** | **55** |
|  | 2 | **67** | **79** | **91** | **103** | **115** |
| 8 | 1 | **8** | **20** | **32** | **44** | **56** |
|  | 2 | **68** | **80** | **92** | **104** | **116** |
| 9 | 1 | **9** | **21** | **33** | **45** | **57** |
|  | 2 | **69** | **81** | **93** | **105** | **117** |
| 10 | 1 | **10** | **22** | **34** | **46** | **58** |
|  | 2 | **70** | **82** | **94** | **106** | **118** |
| 11 | 1 | **11** | **23** | **35** | **47** | **59** |
|  | 2 | **71** | **83** | **95** | **107** | **119** |
| 12 | 1 | **12** | **24** | **36** | **48** | **60** |
|  | 2 | **72** | **84** | **96** | **108** | **120** |

**Table B1.1 - VHF High Band Subsegment A**

\* For allocations of channel numbers to frequencies, see Table B2.1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **BLOCK** | **GROUP** | **CHANNEL NUMBER\*** | | | | |
| 1 | 1 | **121** | **133** | **145** | **157** | **169** |
|  | 2 | **181** | **193** | **205** | **217** | **229** |
| 2 | 1 | **122** | **134** | **146** | **158** | **170** |
|  | 2 | **182** | **194** | **206** | **218** | **230** |
| 3 | 1 | **123** | **135** | **147** | **159** | **171** |
|  | 2 | **183** | **195** | **207** | **219** | **231** |
| 4 | 1 | **124** | **136** | **148** | **160** | **172** |
|  | 2 | **184** | **196** | **208** | **220** | **232** |
| 5 | 1 | **125** | **137** | **149** | **161** | **173** |
|  | 2 | **185** | **197** | **209** | **221** | **233** |
| 6 | 1 | **126** | **138** | **150** | **162** | **174** |
|  | 2 | **186** | **198** | **210** | **222** | **234** |
| 7 | 1 | **127** | **139** | **151** | **163** | **175** |
|  | 2 | **187** | **199** | **211** | **223** | **235** |
| 8 | 1 | **128** | **140** | **152** | **164** | **176** |
|  | 2 | **188** | **200** | **212** | **224** | **236** |
| 9 | 1 | **129** | **141** | **153** | **165** | **177** |
|  | 2 | **189** | **201** | **213** | **225** | **237** |
| 10 | 1 | **130** | **142** | **154** | **166** | **178** |
|  | 2 | **190** | **202** | **214** | **226** | **238** |
| 11 | 1 | **131** | **143** | **155** | **167** | **179** |
|  | 2 | **191** | **203** | **215** | **227** | **239** |
| 12 | 1 | **132** | **144** | **156** | **168** | **180** |
|  | 2 | **192** | **204** | **216** | **228** | **240** |

**Table B1.2 - VHF High Band Sub-segment B**

\* For allocations of channel numbers to frequencies, see Table B2.2

#### B2. Channel Allocations for VHF High Band Trunking Channels

| **CHAN** | **BASE TX** | **BASE RX** | **CHAN** | **BASE TX** | **BASE RX** | **CHAN** | **BASE TX** | **BASE RX** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | 165.20000 | 169.80000 | **41** | 165.70000 | 170.30000 | **81** | 166.20000 | 170.80000 |
| **2** | 165.21250 | 169.81250 | **42** | 165.71250 | 170.31250 | **82** | 166.21250 | 170.81250 |
| **3** | 165.22500 | 169.82500 | **43** | 165.72500 | 170.32500 | **83** | 166.22500 | 170.82500 |
| **4** | 165.23750 | 169.83750 | **44** | 165.73750 | 170.33750 | **84** | 166.23750 | 170.83750 |
| **5** | 165.25000 | 169.85000 | **45** | 165.75000 | 170.35000 | **85** | 166.25000 | 170.85000 |
| **6** | 165.26250 | 169.86250 | **46** | 165.76250 | 170.36250 | **86** | 166.26250 | 170.86250 |
| **7** | 165.27500 | 169.87500 | **47** | 165.77500 | 170.37500 | **87** | 166.27500 | 170.87500 |
| **8** | 165.28750 | 169.88750 | **48** | 165.78750 | 170.38750 | **88** | 166.28750 | 170.88750 |
| **9** | 165.30000 | 169.90000 | **49** | 165.80000 | 170.40000 | **89** | 166.30000 | 170.90000 |
| **10** | 165.31250 | 169.91250 | **50** | 165.81250 | 170.41250 | **90** | 166.31250 | 170.91250 |
| **11** | 165.32500 | 169.92500 | **51** | 165.82500 | 170.42500 | **91** | 166.32500 | 170.92500 |
| **12** | 165.33750 | 169.93750 | **52** | 165.83750 | 170.43750 | **92** | 166.33750 | 170.93750 |
| **13** | 165.35000 | 169.95000 | **53** | 165.85000 | 170.45000 | **93** | 166.35000 | 170.95000 |
| **14** | 165.36250 | 169.96250 | **54** | 165.86250 | 170.46250 | **94** | 166.36250 | 170.96250 |
| **15** | 165.37500 | 169.97500 | **55** | 165.87500 | 170.47500 | **95** | 166.37500 | 170.97500 |
| **16** | 165.38750 | 169.98750 | **56** | 165.88750 | 170.48750 | **96** | 166.38750 | 170.98750 |
| **17** | 165.40000 | 170.00000 | **57** | 165.90000 | 170.50000 | **97** | 166.40000 | 171.00000 |
| **18** | 165.41250 | 170.01250 | **58** | 165.91250 | 170.51250 | **98** | 166.41250 | 171.01250 |
| **19** | 165.42500 | 170.02500 | **59** | 165.92500 | 170.52500 | **99** | 166.42500 | 171.02500 |
| **20** | 165.43750 | 170.03750 | **60** | 165.93750 | 170.53750 | **100** | 166.43750 | 171.03750 |
| **21** | 165.45000 | 170.05000 | **61** | 165.95000 | 170.55000 | **101** | 166.45000 | 171.05000 |
| **22** | 165.46250 | 170.06250 | **62** | 165.96250 | 170.56250 | **102** | 166.46250 | 171.06250 |
| **23** | 165.47500 | 170.07500 | **63** | 165.97500 | 170.57500 | **103** | 166.47500 | 171.07500 |
| **24** | 165.48750 | 170.08750 | **64** | 165.98750 | 170.58750 | **104** | 166.48750 | 171.08750 |
| **25** | 165.50000 | 170.10000 | **65** | 166.00000 | 170.60000 | **105** | 166.50000 | 171.10000 |
| **26** | 165.51250 | 170.11250 | **66** | 166.01250 | 170.61250 | **106** | 166.51250 | 171.11250 |
| **27** | 165.52500 | 170.12500 | **67** | 166.02500 | 170.62500 | **107** | 166.52500 | 171.12500 |
| **28** | 165.53750 | 170.13750 | **68** | 166.03750 | 170.63750 | **108** | 166.53750 | 171.13750 |
| **29** | 165.55000 | 170.15000 | **69** | 166.05000 | 170.65000 | **109** | 166.55000 | 171.15000 |
| **30** | 165.56250 | 170.16250 | **70** | 166.06250 | 170.66250 | **110** | 166.56250 | 171.16250 |
| **31** | 165.57500 | 170.17500 | **71** | 166.07500 | 170.67500 | **111** | 166.57500 | 171.17500 |
| **32** | 165.58750 | 170.18750 | **72** | 166.08750 | 170.68750 | **112** | 166.58750 | 171.18750 |
| **33** | 165.60000 | 170.20000 | **73** | 166.10000 | 170.70000 | **113** | 166.60000 | 171.20000 |
| **34** | 165.61250 | 170.21250 | **74** | 166.11250 | 170.71250 | **114** | 166.61250 | 171.21250 |
| **35** | 165.62500 | 170.22500 | **75** | 166.12500 | 170.72500 | **115** | 166.62500 | 171.22500 |
| **36** | 165.63750 | 170.23750 | **76** | 166.13750 | 170.73750 | **116** | 166.63750 | 171.23750 |
| **37** | 165.65000 | 170.25000 | **77** | 166.15000 | 170.75000 | **117** | 166.65000 | 171.25000 |
| **38** | 165.66250 | 170.26250 | **78** | 166.16250 | 170.76250 | **118** | 166.66250 | 171.26250 |
| **39** | 165.67500 | 170.27500 | **79** | 166.17500 | 170.77500 | **119** | 166.67500 | 171.27500 |
| **40** | 165.68750 | 170.28750 | **80** | 166.18750 | 170.78750 | **120** | 166.68750 | 171.28750 |

**Table B2.1 - VHF High Band Sub-segment A**

| **CHAN** | **BASE TX** | **BASE RX** | **CHAN** | **BASE TX** | **BASE RX** | **CHAN** | **BASE TX** | **BASE RX** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **121** | 166.70000 | 171.30000 | **161** | 167.20000 | 171.80000 | **201** | 167.70000 | 172.30000 |
| **122** | 166.71250 | 171.31250 | **162** | 167.21250 | 171.81250 | **202** | 167.71250 | 172.31250 |
| **123** | 166.72500 | 171.32500 | **163** | 167.22500 | 171.82500 | **203** | 167.72500 | 172.32500 |
| **124** | 166.73750 | 171.33750 | **164** | 167.23750 | 171.83750 | **204** | 167.73750 | 172.33750 |
| **125** | 166.75000 | 171.35000 | **165** | 167.25000 | 171.85000 | **205** | 167.75000 | 172.35000 |
| **126** | 166.76250 | 171.36250 | **166** | 167.26250 | 171.86250 | **206** | 167.76250 | 172.36250 |
| **127** | 166.77500 | 171.37500 | **167** | 167.27500 | 171.87500 | **207** | 167.77500 | 172.37500 |
| **128** | 166.78750 | 171.38750 | **168** | 167.28750 | 171.88750 | **208** | 167.78750 | 172.38750 |
| **129** | 166.80000 | 171.40000 | **169** | 167.30000 | 171.90000 | **209** | 167.80000 | 172.40000 |
| **130** | 166.81250 | 171.41250 | **170** | 167.31250 | 171.91250 | **210** | 167.81250 | 172.41250 |
| **131** | 166.82500 | 171.42500 | **171** | 167.32500 | 171.92500 | **211** | 167.82500 | 172.42500 |
| **132** | 166.83750 | 171.43750 | **172** | 167.33750 | 171.93750 | **212** | 167.83750 | 172.43750 |
| **133** | 166.85000 | 171.45000 | **173** | 167.35000 | 171.95000 | **213** | 167.85000 | 172.45000 |
| **134** | 166.86250 | 171.46250 | **174** | 167.36250 | 171.96250 | **214** | 167.86250 | 172.46250 |
| **135** | 166.87500 | 171.47500 | **175** | 167.37500 | 171.97500 | **215** | 167.87500 | 172.47500 |
| **136** | 166.88750 | 171.48750 | **176** | 167.38750 | 171.98750 | **216** | 167.88750 | 172.48750 |
| **137** | 166.90000 | 171.50000 | **177** | 167.40000 | 172.00000 | **217** | 167.90000 | 172.50000 |
| **138** | 166.91250 | 171.51250 | **178** | 167.41250 | 172.01250 | **218** | 167.91250 | 172.51250 |
| **139** | 166.92500 | 171.52500 | **179** | 167.42500 | 172.02500 | **219** | 167.92500 | 172.52500 |
| **140** | 166.93750 | 171.53750 | **180** | 167.43750 | 172.03750 | **220** | 167.93750 | 172.53750 |
| **141** | 166.95000 | 171.55000 | **181** | 167.45000 | 172.05000 | **221** | 167.95000 | 172.55000 |
| **142** | 166.96250 | 171.56250 | **182** | 167.46250 | 172.06250 | **222** | 167.96250 | 172.56250 |
| **143** | 166.97500 | 171.57500 | **183** | 167.47500 | 172.07500 | **223** | 167.97500 | 172.57500 |
| **144** | 166.98750 | 171.58750 | **184** | 167.48750 | 172.08750 | **224** | 167.98750 | 172.58750 |
| **145** | 167.00000 | 171.60000 | **185** | 167.50000 | 172.10000 | **225** | 168.00000 | 172.60000 |
| **146** | 167.01250 | 171.61250 | **186** | 167.51250 | 172.11250 | **226** | 168.01250 | 172.61250 |
| **147** | 167.02500 | 171.62500 | **187** | 167.52500 | 172.12500 | **227** | 168.02500 | 172.62500 |
| **148** | 167.03750 | 171.63750 | **188** | 167.53750 | 172.13750 | **228** | 168.03750 | 172.63750 |
| **149** | 167.05000 | 171.65000 | **189** | 167.55000 | 172.15000 | **229** | 168.05000 | 172.65000 |
| **150** | 167.06250 | 171.66250 | **190** | 167.56250 | 172.16250 | **230** | 168.06250 | 172.66250 |
| **151** | 167.07500 | 171.67500 | **191** | 167.57500 | 172.17500 | **231** | 168.07500 | 172.67500 |
| **152** | 167.08750 | 171.68750 | **192** | 167.58750 | 172.18750 | **232** | 168.08750 | 172.68750 |
| **153** | 167.10000 | 171.70000 | **193** | 167.60000 | 172.20000 | **233** | 168.10000 | 172.70000 |
| **154** | 167.11250 | 171.71250 | **194** | 167.61250 | 172.21250 | **234** | 168.11250 | 172.71250 |
| **155** | 167.12500 | 171.72500 | **195** | 167.62500 | 172.22500 | **235** | 168.12500 | 172.72500 |
| **156** | 167.13750 | 171.73750 | **196** | 167.63750 | 172.23750 | **236** | 168.13750 | 172.73750 |
| **157** | 167.15000 | 171.75000 | **197** | 167.65000 | 172.25000 | **237** | 168.15000 | 172.75000 |
| **158** | 167.16250 | 171.76250 | **198** | 167.66250 | 172.26250 | **238** | 168.16250 | 172.76250 |
| **159** | 167.17500 | 171.77500 | **199** | 167.67500 | 172.27500 | **239** | 168.17500 | 172.77500 |
| **160** | 167.18750 | 171.78750 | **200** | 167.68750 | 172.28750 | **240** | 168.18750 | 172.78750 |

**Table B2.2 - VHF High Band Sub-segment B**

#### B3. Block, Group and Channel Structure for the 400 MHz Trunking Band

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **BLOCK** | **GROUP** | **CHANNEL NUMBER\*** | | | | |
| 1 | 1 | **1** | **41** | **81** | **121** | **161** |
|  | 2 | **21** | **61** | **101** | **141** | **181** |
|  | 3 | **11** | **51** | **91** | **131** | **171** |
|  | 4 | **31** | **71** | **111** | **151** | **191** |
| 2 | 1 | **2** | **42** | **82** | **122** | **162** |
|  | 2 | **22** | **62** | **102** | **142** | **182** |
|  | 3 | **12** | **52** | **92** | **132** | **172** |
|  | 4 | **32** | **72** | **112** | **152** | **192** |
| 3 | 1 | **3** | **43** | **83** | **123** | **163** |
|  | 2 | **23** | **63** | **103** | **143** | **183** |
|  | 3 | **13** | **53** | **93** | **133** | **173** |
|  | 4 | **33** | **73** | **113** | **153** | **193** |
| 4 | 1 | **4** | **44** | **84** | **124** | **164** |
|  | 2 | **24** | **64** | **104** | **144** | **184** |
|  | 3 | **14** | **54** | **94** | **134** | **174** |
|  | 4 | **34** | **74** | **114** | **154** | **194** |
| 5 | 1 | **5** | **45** | **85** | **125** | **165** |
|  | 2 | **25** | **65** | **105** | **145** | **185** |
|  | 3 | **15** | **55** | **95** | **135** | **175** |
|  | 4 | **35** | **75** | **115** | **155** | **195** |
| 6 | 1 | **6** | **46** | **86** | **126** | **166** |
|  | 2 | **26** | **66** | **106** | **146** | **186** |
|  | 3 | **16** | **56** | **96** | **136** | **176** |
|  | 4 | **36** | **76** | **116** | **156** | **196** |
| 7 | 1 | **7** | **47** | **87** | **127** | **167** |
|  | 2 | **27** | **67** | **107** | **147** | **187** |
|  | 3 | **17** | **57** | **97** | **137** | **177** |
|  | 4 | **37** | **77** | **117** | **157** | **197** |
| 8 | 1 | **8** | **48** | **88** | **128** | **168** |
|  | 2 | **28** | **68** | **108** | **148** | **188** |
|  | 3 | **18** | **58** | **98** | **138** | **178** |
|  | 4 | **38** | **78** | **118** | **158** | **198** |
| 9 | 1 | **9** | **49** | **89** | **129** | **169** |
|  | 2 | **29** | **69** | **109** | **149** | **189** |
|  | 3 | **19** | **59** | **99** | **139** | **179** |
|  | 4 | **39** | **79** | **119** | **159** | **199** |
| 10 | 1 | **10** | **50** | **90** | **130** | **170** |
|  | 2 | **30** | **70** | **110** | **150** | **190** |
|  | 3 | **20** | **60** | **100** | **140** | **180** |
|  | 4 | **40** | **80** | **120** | **160** | **200** |

**Table B3.1 - Block and Group Structure for the 400 MHz Trunking Band**

\* For allocations of channel numbers to frequencies, see Table B3.2

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CH #** | **BASE TX** | **BASE RX** | **CH #** | **BASE TX** | **BASE RX** | **CH #** | **BASE TX** | **BASE RX** | **CH #** | **BASE TX** | **BASE RX** |
| **1** | 415.5750 | 406.1250 | **51** | 416.2000 | 406.7500 | **101** | 416.8250 | 407.3750 | **151** | 417.4500 | 408.0000 |
| **2** | 415.5875 | 406.1375 | **52** | 416.2125 | 406.7625 | **102** | 416.8375 | 407.3875 | **152** | 417.4625 | 408.0125 |
| **3** | 415.6000 | 406.1500 | **53** | 416.2250 | 406.7750 | **103** | 416.8500 | 407.4000 | **153** | 417.4750 | 408.0250 |
| **4** | 415.6125 | 406.1625 | **54** | 416.2375 | 406.7875 | **104** | 416.8625 | 407.4125 | **154** | 417.4875 | 408.0375 |
| **5** | 415.6250 | 406.1750 | **55** | 416.2500 | 406.8000 | **105** | 416.8750 | 407.4250 | **155** | 417.5000 | 408.0500 |
| **6** | 415.6375 | 406.1875 | **56** | 416.2625 | 406.8125 | **106** | 416.8875 | 407.4375 | **156** | 417.5125 | 408.0625 |
| **7** | 415.6500 | 406.2000 | **57** | 416.2750 | 406.8250 | **107** | 416.9000 | 407.4500 | **157** | 417.5250 | 408.0750 |
| **8** | 415.6625 | 406.2125 | **58** | 416.2875 | 406.8375 | **108** | 416.9125 | 407.4625 | **158** | 417.5375 | 408.0875 |
| **9** | 415.6750 | 406.2250 | **59** | 416.3000 | 406.8500 | **109** | 416.9250 | 407.4750 | **159** | 417.5500 | 408.1000 |
| **10** | 415.6875 | 406.2375 | **60** | 416.3125 | 406.8625 | **110** | 416.9375 | 407.4875 | **160** | 417.5625 | 408.1125 |
| **11** | 415.7000 | 406.2500 | **61** | 416.3250 | 406.8750 | **111** | 416.9500 | 407.5000 | **161** | 417.5750 | 408.1250 |
| **12** | 415.7125 | 406.2625 | **62** | 416.3375 | 406.8875 | **112** | 416.9625 | 407.5125 | **162** | 417.5875 | 408.1375 |
| **13** | 415.7250 | 406.2750 | **63** | 416.3500 | 406.9000 | **113** | 416.9750 | 407.5250 | **163** | 417.6000 | 408.1500 |
| **14** | 415.7375 | 406.2875 | **64** | 416.3625 | 406.9125 | **114** | 416.9875 | 407.5375 | **164** | 417.6125 | 408.1625 |
| **15** | 415.7500 | 406.3000 | **65** | 416.3750 | 406.9250 | **115** | 417.0000 | 407.5500 | **165** | 417.6250 | 408.1750 |
| **16** | 415.7625 | 406.3125 | **66** | 416.3875 | 406.9375 | **116** | 417.0125 | 407.5625 | **166** | 417.6375 | 408.1875 |
| **17** | 415.7750 | 406.3250 | **67** | 416.4000 | 406.9500 | **117** | 417.0250 | 407.5750 | **167** | 417.6500 | 408.2000 |
| **18** | 415.7875 | 406.3375 | **68** | 416.4125 | 406.9625 | **118** | 417.0375 | 407.5875 | **168** | 417.6625 | 408.2125 |
| **19** | 415.8000 | 406.3500 | **69** | 416.4250 | 406.9750 | **119** | 417.0500 | 407.6000 | **169** | 417.6750 | 408.2250 |
| **20** | 415.8125 | 406.3625 | **70** | 416.4375 | 406.9875 | **120** | 417.0625 | 407.6125 | **170** | 417.6875 | 408.2375 |
| **21** | 415.8250 | 406.3750 | **71** | 416.4500 | 407.0000 | **121** | 417.0750 | 407.6250 | **171** | 417.7000 | 408.2500 |
| **22** | 415.8375 | 406.3875 | **72** | 416.4625 | 407.0125 | **122** | 417.0875 | 407.6375 | **172** | 417.7125 | 408.2625 |
| **23** | 415.8500 | 406.4000 | **73** | 416.4750 | 407.0250 | **123** | 417.1000 | 407.6500 | **173** | 417.7250 | 408.2750 |
| **24** | 415.8625 | 406.4125 | **74** | 416.4875 | 407.0375 | **124** | 417.1125 | 407.6625 | **174** | 417.7375 | 408.2875 |
| **25** | 415.8750 | 406.4250 | **75** | 416.5000 | 407.0500 | **125** | 417.1250 | 407.6750 | **175** | 417.7500 | 408.3000 |
| **26** | 415.8875 | 406.4375 | **76** | 416.5125 | 407.0625 | **126** | 417.1375 | 407.6875 | **176** | 417.7625 | 408.3125 |
| **27** | 415.9000 | 406.4500 | **77** | 416.5250 | 407.0750 | **127** | 417.1500 | 407.7000 | **177** | 417.7750 | 408.3250 |
| **28** | 415.9125 | 406.4625 | **78** | 416.5375 | 407.0875 | **128** | 417.1625 | 407.7125 | **178** | 417.7875 | 408.3375 |
| **29** | 415.9250 | 406.4750 | **79** | 416.5500 | 407.1000 | **129** | 417.1750 | 407.7250 | **179** | 417.8000 | 408.3500 |
| **30** | 415.9375 | 406.4875 | **80** | 416.5625 | 407.1125 | **130** | 417.1875 | 407.7375 | **180** | 417.8125 | 408.3625 |
| **31** | 415.9500 | 406.5000 | **81** | 416.5750 | 407.1250 | **131** | 417.2000 | 407.7500 | **181** | 417.8250 | 408.3750 |
| **32** | 415.9625 | 406.5125 | **82** | 416.5875 | 407.1375 | **132** | 417.2125 | 407.7625 | **182** | 417.8375 | 408.3875 |
| **33** | 415.9750 | 406.5250 | **83** | 416.6000 | 407.1500 | **133** | 417.2250 | 407.7750 | **183** | 417.8500 | 408.4000 |
| **34** | 415.9875 | 406.5375 | **84** | 416.6125 | 407.1625 | **134** | 417.2375 | 407.7875 | **184** | 417.8625 | 408.4125 |
| **35** | 416.0000 | 406.5500 | **85** | 416.6250 | 407.1750 | **135** | 417.2500 | 407.8000 | **185** | 417.8750 | 408.4250 |
| **36** | 416.0125 | 406.5625 | **86** | 416.6375 | 407.1875 | **136** | 417.2625 | 407.8125 | **186** | 417.8875 | 408.4375 |
| **37** | 416.0250 | 406.5750 | **87** | 416.6500 | 407.2000 | **137** | 417.2750 | 407.8250 | **187** | 417.9000 | 408.4500 |
| **38** | 416.0375 | 406.5875 | **88** | 416.6625 | 407.2125 | **138** | 417.2875 | 407.8375 | **188** | 417.9125 | 408.4625 |
| **39** | 416.0500 | 406.6000 | **89** | 416.6750 | 407.2250 | **139** | 417.3000 | 407.8500 | **189** | 417.9250 | 408.4750 |
| **40** | 416.0625 | 406.6125 | **90** | 416.6875 | 407.2375 | **140** | 417.3125 | 407.8625 | **190** | 417.9375 | 408.4875 |
| **41** | 416.0750 | 406.6250 | **91** | 416.7000 | 407.2500 | **141** | 417.3250 | 407.8750 | **191** | 417.9500 | 408.5000 |
| **42** | 416.0875 | 406.6375 | **92** | 416.7125 | 407.2625 | **142** | 417.3375 | 407.8875 | **192** | 417.9625 | 408.5125 |
| **43** | 416.1000 | 406.6500 | **93** | 416.7250 | 407.2750 | **143** | 417.3500 | 407.9000 | **193** | 417.9750 | 408.5250 |
| **44** | 416.1125 | 406.6625 | **94** | 416.7375 | 407.2875 | **144** | 417.3625 | 407.9125 | **194** | 417.9875 | 408.5375 |
| **45** | 416.1250 | 406.6750 | **95** | 416.7500 | 407.3000 | **145** | 417.3750 | 407.9250 | **195** | 418.0000 | 408.5500 |
| **46** | 416.1375 | 406.6875 | **96** | 416.7625 | 407.3125 | **146** | 417.3875 | 407.9375 | **196** | 418.0125 | 408.5625 |
| **47** | 416.1500 | 406.7000 | **97** | 416.7750 | 407.3250 | **147** | 417.4000 | 407.9500 | **197** | 418.0250 | 408.5750 |
| **48** | 416.1625 | 406.7125 | **98** | 416.7875 | 407.3375 | **148** | 417.4125 | 407.9625 | **198** | 418.0375 | 408.5875 |
| **49** | 416.1750 | 406.7250 | **99** | 416.8000 | 407.3500 | **149** | 417.4250 | 407.9750 | **199** | 418.0500 | 408.6000 |
| **50** | 416.1875 | 406.7375 | **100** | 416.8125 | 407.3625 | **150** | 417.4375 | 407.9875 | **200** | 418.0625 | 408.6125 |

**Table B3.2 - Channel Allocations for the 400 MHz Trunking Band**



\* For allocations of channel numbers to frequencies, see Table B4.2



#### B4 Block, Group and Channel Structure for the 800 MHz Trunking Band (12.5 kHz channel spacing)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **BLOCK** | **GROUP** | **CHANNEL NUMBER\*** | | | | |
| 1 | 1 | 1 | 49 | 97 | 145 | 193 |
|  | 2 | 25 | 73 | 121 | 169 | 217 |
|  | 3 | 13 | 61 | 109 | 157 | 205 |
|  | 4 | 37 | 85 | 133 | 181 | 229 |
| 2 | 1 | 2 | 50 | 98 | 146 | 194 |
|  | 2 | 26 | 74 | 122 | 170 | 218 |
|  | 3 | 14 | 62 | 110 | 158 | 206 |
|  | 4 | 38 | 86 | 134 | 182 | 230 |
| 3 | 1 | 3 | 51 | 99 | 147 | 195 |
|  | 2 | 27 | 75 | 123 | 171 | 219 |
|  | 3 | 15 | 63 | 111 | 159 | 207 |
|  | 4 | 39 | 87 | 135 | 183 | 231 |
| 4 | 1 | 4 | 52 | 100 | 148 | 196 |
|  | 2 | 28 | 76 | 124 | 172 | 220 |
|  | 3 | 16 | 64 | 112 | 160 | 208 |
|  | 4 | 40 | 88 | 136 | 184 | 232 |
| 5 | 1 | 5 | 53 | 101 | 149 | 197 |
|  | 2 | 29 | 77 | 125 | 173 | 221 |
|  | 3 | 17 | 65 | 113 | 161 | 209 |
|  | 4 | 41 | 89 | 137 | 185 | 233 |
| 6 | 1 | 6 | 54 | 102 | 150 | 198 |
|  | 2 | 30 | 78 | 126 | 174 | 222 |
|  | 3 | 18 | 66 | 114 | 162 | 210 |
|  | 4 | 42 | 90 | 138 | 186 | 234 |
| 7 | 1 | 7 | 55 | 103 | 151 | 199 |
|  | 2 | 31 | 79 | 127 | 175 | 223 |
|  | 3 | 19 | 67 | 115 | 163 | 211 |
|  | 4 | 43 | 91 | 139 | 187 | 235 |
| 8 | 1 | 8 | 56 | 104 | 152 | 200 |
|  | 2 | 32 | 80 | 128 | 176 | 224 |
|  | 3 | 20 | 68 | 116 | 164 | 212 |
|  | 4 | 44 | 92 | 140 | 188 | 236 |
| 9 | 1 | 9 | 57 | 105 | 153 | 201 |
|  | 2 | 33 | 81 | 129 | 177 | 225 |
|  | 3 | 21 | 69 | 117 | 165 | 213 |
|  | 4 | 45 | 93 | 141 | 189 | 237 |
| 10 | 1 | 10 | 58 | 106 | 154 | 202 |
|  | 2 | 34 | 82 | 130 | 178 | 226 |
|  | 3 | 22 | 70 | 118 | 166 | 214 |
|  | 4 | 46 | 94 | 142 | 190 | 238 |
| 11 | 1 | 11 | 59 | 107 | 155 | 203 |
|  | 2 | 35 | 83 | 131 | 179 | 227 |
|  | 3 | 23 | 71 | 119 | 167 | 215 |
|  | 4 | 47 | 95 | 143 | 191 | 239 |
| 12 | 1 | 12 | 60 | 108 | 156 | 204 |
|  | 2 | 36 | 84 | 132 | 180 | 228 |
|  | 3 | 24 | 72 | 120 | 168 | 216 |
|  | 4 | 48 | 96 | 144 | 192 | 240 |

**Table B4.1 - Block and Group Structure for the new 800 MHz Trunking Band (12.5 kHz channel spacing)**

\* For allocations of channel numbers to frequencies, see Table B4.2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CH #** | **BASE TX** | **BASE RX** | **CH #** | **BASE TX** | **BASE RX** | **CH #** | **BASE TX** | **BASE RX** |
| 1 | 851.00625 | 806.00625 | 81 | 852.00625 | 807.00625 | 161 | 853.00625 | 808.00625 |
| 2 | 851.01875 | 806.01875 | 82 | 852.01875 | 807.01875 | 162 | 853.01875 | 808.01875 |
| 3 | 851.03125 | 806.03125 | 83 | 852.03125 | 807.03125 | 163 | 853.03125 | 808.03125 |
| 4 | 851.04375 | 806.04375 | 84 | 852.04375 | 807.04375 | 164 | 853.04375 | 808.04375 |
| 5 | 851.05625 | 806.05625 | 85 | 852.05625 | 807.05625 | 165 | 853.05625 | 808.05625 |
| 6 | 851.06875 | 806.06875 | 86 | 852.06875 | 807.06875 | 166 | 853.06875 | 808.06875 |
| 7 | 851.08125 | 806.08125 | 87 | 852.08125 | 807.08125 | 167 | 853.08125 | 808.08125 |
| 8 | 851.09375 | 806.09375 | 88 | 852.09375 | 807.09375 | 168 | 853.09375 | 808.09375 |
| 9 | 851.10625 | 806.10625 | 89 | 852.10625 | 807.10625 | 169 | 853.10625 | 808.10625 |
| 10 | 851.11875 | 806.11875 | 90 | 852.11875 | 807.11875 | 170 | 853.11875 | 808.11875 |
| 11 | 851.13125 | 806.13125 | 91 | 852.13125 | 807.13125 | 171 | 853.13125 | 808.13125 |
| 12 | 851.14375 | 806.14375 | 92 | 852.14375 | 807.14375 | 172 | 853.14375 | 808.14375 |
| 13 | 851.15625 | 806.15625 | 93 | 852.15625 | 807.15625 | 173 | 853.15625 | 808.15625 |
| 14 | 851.16875 | 806.16875 | 94 | 852.16875 | 807.16875 | 174 | 853.16875 | 808.16875 |
| 15 | 851.18125 | 806.18125 | 95 | 852.18125 | 807.18125 | 175 | 853.18125 | 808.18125 |
| 16 | 851.19375 | 806.19375 | 96 | 852.19375 | 807.19375 | 176 | 853.19375 | 808.19375 |
| 17 | 851.20625 | 806.20625 | 97 | 852.20625 | 807.20625 | 177 | 853.20625 | 808.20625 |
| 18 | 851.21875 | 806.21875 | 98 | 852.21875 | 807.21875 | 178 | 853.21875 | 808.21875 |
| 19 | 851.23125 | 806.23125 | 99 | 852.23125 | 807.23125 | 179 | 853.23125 | 808.23125 |
| 20 | 851.24375 | 806.24375 | 100 | 852.24375 | 807.24375 | 180 | 853.24375 | 808.24375 |
| 21 | 851.25625 | 806.25625 | 101 | 852.25625 | 807.25625 | 181 | 853.25625 | 808.25625 |
| 22 | 851.26875 | 806.26875 | 102 | 852.26875 | 807.26875 | 182 | 853.26875 | 808.26875 |
| 23 | 851.28125 | 806.28125 | 103 | 852.28125 | 807.28125 | 183 | 853.28125 | 808.28125 |
| 24 | 851.29375 | 806.29375 | 104 | 852.29375 | 807.29375 | 184 | 853.29375 | 808.29375 |
| 25 | 851.30625 | 806.30625 | 105 | 852.30625 | 807.30625 | 185 | 853.30625 | 808.30625 |
| 26 | 851.31875 | 806.31875 | 106 | 852.31875 | 807.31875 | 186 | 853.31875 | 808.31875 |
| 27 | 851.33125 | 806.33125 | 107 | 852.33125 | 807.33125 | 187 | 853.33125 | 808.33125 |
| 28 | 851.34375 | 806.34375 | 108 | 852.34375 | 807.34375 | 188 | 853.34375 | 808.34375 |
| 29 | 851.35625 | 806.35625 | 109 | 852.35625 | 807.35625 | 189 | 853.35625 | 808.35625 |
| 30 | 851.36875 | 806.36875 | 110 | 852.36875 | 807.36875 | 190 | 853.36875 | 808.36875 |
| 31 | 851.38125 | 806.38125 | 111 | 852.38125 | 807.38125 | 191 | 853.38125 | 808.38125 |
| 32 | 851.39375 | 806.39375 | 112 | 852.39375 | 807.39375 | 192 | 853.39375 | 808.39375 |
| 33 | 851.40625 | 806.40625 | 113 | 852.40625 | 807.40625 | 193 | 853.40625 | 808.40625 |
| 34 | 851.41875 | 806.41875 | 114 | 852.41875 | 807.41875 | 194 | 853.41875 | 808.41875 |
| 35 | 851.43125 | 806.43125 | 115 | 852.43125 | 807.43125 | 195 | 853.43125 | 808.43125 |
| 36 | 851.44375 | 806.44375 | 116 | 852.44375 | 807.44375 | 196 | 853.44375 | 808.44375 |
| 37 | 851.45625 | 806.45625 | 117 | 852.45625 | 807.45625 | 197 | 853.45625 | 808.45625 |
| 38 | 851.46875 | 806.46875 | 118 | 852.46875 | 807.46875 | 198 | 853.46875 | 808.46875 |
| 39 | 851.48125 | 806.48125 | 119 | 852.48125 | 807.48125 | 199 | 853.48125 | 808.48125 |
| 40 | 851.49375 | 806.49375 | 120 | 852.49375 | 807.49375 | 200 | 853.49375 | 808.49375 |
| 41 | 851.50625 | 806.50625 | 121 | 852.50625 | 807.50625 | 201 | 853.50625 | 808.50625 |
| 42 | 851.51875 | 806.51875 | 122 | 852.51875 | 807.51875 | 202 | 853.51875 | 808.51875 |
| 43 | 851.53125 | 806.53125 | 123 | 852.53125 | 807.53125 | 203 | 853.53125 | 808.53125 |
| 44 | 851.54375 | 806.54375 | 124 | 852.54375 | 807.54375 | 204 | 853.54375 | 808.54375 |
| 45 | 851.55625 | 806.55625 | 125 | 852.55625 | 807.55625 | 205 | 853.55625 | 808.55625 |
| 46 | 851.56875 | 806.56875 | 126 | 852.56875 | 807.56875 | 206 | 853.56875 | 808.56875 |
| 47 | 851.58125 | 806.58125 | 127 | 852.58125 | 807.58125 | 207 | 853.58125 | 808.58125 |
| 48 | 851.59375 | 806.59375 | 128 | 852.59375 | 807.59375 | 208 | 853.59375 | 808.59375 |
| 49 | 851.60625 | 806.60625 | 129 | 852.60625 | 807.60625 | 209 | 853.60625 | 808.60625 |
| 50 | 851.61875 | 806.61875 | 130 | 852.61875 | 807.61875 | 210 | 853.61875 | 808.61875 |
| 51 | 851.63125 | 806.63125 | 131 | 852.63125 | 807.63125 | 211 | 853.63125 | 808.63125 |
| 52 | 851.64375 | 806.64375 | 132 | 852.64375 | 807.64375 | 212 | 853.64375 | 808.64375 |
| 53 | 851.65625 | 806.65625 | 133 | 852.65625 | 807.65625 | 213 | 853.65625 | 808.65625 |
| 54 | 851.66875 | 806.66875 | 134 | 852.66875 | 807.66875 | 214 | 853.66875 | 808.66875 |
| 55 | 851.68125 | 806.68125 | 135 | 852.68125 | 807.68125 | 215 | 853.68125 | 808.68125 |
| 56 | 851.69375 | 806.69375 | 136 | 852.69375 | 807.69375 | 216 | 853.69375 | 808.69375 |
| 57 | 851.70625 | 806.70625 | 137 | 852.70625 | 807.70625 | 217 | 853.70625 | 808.70625 |
| 58 | 851.71875 | 806.71875 | 138 | 852.71875 | 807.71875 | 218 | 853.71875 | 808.71875 |
| 59 | 851.73125 | 806.73125 | 139 | 852.73125 | 807.73125 | 219 | 853.73125 | 808.73125 |
| 60 | 851.74375 | 806.74375 | 140 | 852.74375 | 807.74375 | 220 | 853.74375 | 808.74375 |
| 61 | 851.75625 | 806.75625 | 141 | 852.75625 | 807.75625 | 221 | 853.75625 | 808.75625 |
| 62 | 851.76875 | 806.76875 | 142 | 852.76875 | 807.76875 | 222 | 853.76875 | 808.76875 |
| 63 | 851.78125 | 806.78125 | 143 | 852.78125 | 807.78125 | 223 | 853.78125 | 808.78125 |
| 64 | 851.79375 | 806.79375 | 144 | 852.79375 | 807.79375 | 224 | 853.79375 | 808.79375 |
| 65 | 851.80625 | 806.80625 | 145 | 852.80625 | 807.80625 | 225 | 853.80625 | 808.80625 |
| 66 | 851.81875 | 806.81875 | 146 | 852.81875 | 807.81875 | 226 | 853.81875 | 808.81875 |
| 67 | 851.83125 | 806.83125 | 147 | 852.83125 | 807.83125 | 227 | 853.83125 | 808.83125 |
| 68 | 851.84375 | 806.84375 | 148 | 852.84375 | 807.84375 | 228 | 853.84375 | 808.84375 |
| 69 | 851.85625 | 806.85625 | 149 | 852.85625 | 807.85625 | 229 | 853.85625 | 808.85625 |
| 70 | 851.86875 | 806.86875 | 150 | 852.86875 | 807.86875 | 230 | 853.86875 | 808.86875 |
| 71 | 851.88125 | 806.88125 | 151 | 852.88125 | 807.88125 | 231 | 853.88125 | 808.88125 |
| 72 | 851.89375 | 806.89375 | 152 | 852.89375 | 807.89375 | 232 | 853.89375 | 808.89375 |
| 73 | 851.90625 | 806.90625 | 153 | 852.90625 | 807.90625 | 233 | 853.90625 | 808.90625 |
| 74 | 851.91875 | 806.91875 | 154 | 852.91875 | 807.91875 | 234 | 853.91875 | 808.91875 |
| 75 | 851.93125 | 806.93125 | 155 | 852.93125 | 807.93125 | 235 | 853.93125 | 808.93125 |
| 76 | 851.94375 | 806.94375 | 156 | 852.94375 | 807.94375 | 236 | 853.94375 | 808.94375 |
| 77 | 851.95625 | 806.95625 | 157 | 852.95625 | 807.95625 | 237 | 853.95625 | 808.95625 |
| 78 | 851.96875 | 806.96875 | 158 | 852.96875 | 807.96875 | 238 | 853.96875 | 808.96875 |
| 79 | 851.98125 | 806.98125 | 159 | 852.98125 | 807.98125 | 239 | 853.98125 | 808.98125 |
| 80 | 851.99375 | 806.99375 | 160 | 852.99375 | 807.99375 | 240 | 853.99375 | 808.99375 |

**Table B4.2 - Channel Allocations for the 800 MHz Trunking Band (12.5 kHz channel spacing)**

#### 

#### B5 Block, Group and Channel Structure for the 800 MHz Trunking Band (25 kHz channel spacing)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **BLOCK** | **GROUP** | **CHANNEL NUMBER\*** | | | | |
| 1 | 1 | **1** | **25** | **49** | **73** | **97** |
|  | 2 | **13** | **37** | **61** | **85** | **109** |
|  | 3 | **7** | **31** | **55** | **79** | **103** |
|  | 4 | **19** | **43** | **67** | **91** | **115** |
| 2 | 1 | **2** | **26** | **50** | **74** | **98** |
|  | 2 | **14** | **38** | **62** | **86** | **110** |
|  | 3 | **8** | **32** | **56** | **80** | **104** |
|  | 4 | **20** | **44** | **68** | **92** | **116** |
| 3 | 1 | **3** | **27** | **51** | **75** | **99** |
|  | 2 | **15** | **39** | **63** | **87** | **111** |
|  | 3 | **9** | **33** | **57** | **81** | **105** |
|  | 4 | **21** | **45** | **69** | **93** | **117** |
| 4 | 1 | **4** | **28** | **52** | **76** | **100** |
|  | 2 | **16** | **40** | **64** | **88** | **112** |
|  | 3 | **10** | **34** | **58** | **82** | **106** |
|  | 4 | **22** | **46** | **70** | **94** | **118** |
| 5 | 1 | **5** | **29** | **53** | **77** | **101** |
|  | 2 | **17** | **41** | **65** | **89** | **113** |
|  | 3 | **11** | **35** | **59** | **83** | **107** |
|  | 4 | **23** | **47** | **71** | **95** | **119** |
| 6 | 1 | **6** | **30** | **54** | **78** | **102** |
|  | 2 | **18** | **42** | **66** | **90** | **114** |
|  | 3 | **12** | **36** | **60** | **84** | **108** |
|  | 4 | **24** | **48** | **72** | **96** | **120** |

**Table B5.1 - Block and Group Structure for the 800 MHz Trunking Band (25 kHz channel spacing)**

\* For allocations of channel numbers to frequencies, see Table B5.2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CH #** | **BASE TX** | **BASE RX** | **CH #** | **BASE TX** | **BASE RX** |
| 1 | 851.0125 | 806.0125 | 61 | 852.5125 | 807.5125 |
| 2 | 851.0375 | 806.0375 | 62 | 852.5375 | 807.5375 |
| 3 | 851.0625 | 806.0625 | 63 | 852.5625 | 807.5625 |
| 4 | 851.0875 | 806.0875 | 64 | 852.5875 | 807.5875 |
| 5 | 851.1125 | 806.1125 | 65 | 852.6125 | 807.6125 |
| 6 | 851.1375 | 806.1375 | 66 | 852.6375 | 807.6375 |
| 7 | 851.1625 | 806.1625 | 67 | 852.6625 | 807.6625 |
| 8 | 851.1875 | 806.1875 | 68 | 852.6875 | 807.6875 |
| 9 | 851.2125 | 806.2125 | 69 | 852.7125 | 807.7125 |
| 10 | 851.2375 | 806.2375 | 70 | 852.7375 | 807.7375 |
| 11 | 851.2625 | 806.2625 | 71 | 852.7625 | 807.7625 |
| 12 | 851.2875 | 806.2875 | 72 | 852.7875 | 807.7875 |
| 13 | 851.3125 | 806.3125 | 73 | 852.8125 | 807.8125 |
| 14 | 851.3375 | 806.3375 | 74 | 852.8375 | 807.8375 |
| 15 | 851.3625 | 806.3625 | 75 | 852.8625 | 807.8625 |
| 16 | 851.3875 | 806.3875 | 76 | 852.8875 | 807.8875 |
| 17 | 851.4125 | 806.4125 | 77 | 852.9125 | 807.9125 |
| 18 | 851.4375 | 806.4375 | 78 | 852.9375 | 807.9375 |
| 19 | 851.4625 | 806.4625 | 79 | 852.9625 | 807.9625 |
| 20 | 851.4875 | 806.4875 | 80 | 852.9875 | 807.9875 |
| 21 | 851.5125 | 806.5125 | 81 | 853.0125 | 808.0125 |
| 22 | 851.5375 | 806.5375 | 82 | 853.0375 | 808.0375 |
| 23 | 851.5625 | 806.5625 | 83 | 853.0625 | 808.0625 |
| 24 | 851.5875 | 806.5875 | 84 | 853.0875 | 808.0875 |
| 25 | 851.6125 | 806.6125 | 85 | 853.1125 | 808.1125 |
| 26 | 851.6375 | 806.6375 | 86 | 853.1375 | 808.1375 |
| 27 | 851.6625 | 806.6625 | 87 | 853.1625 | 808.1625 |
| 28 | 851.6875 | 806.6875 | 88 | 853.1875 | 808.1875 |
| 29 | 851.7125 | 806.7125 | 89 | 853.2125 | 808.2125 |
| 30 | 851.7375 | 806.7375 | 90 | 853.2375 | 808.2375 |
| 31 | 851.7625 | 806.7625 | 91 | 853.2625 | 808.2625 |
| 32 | 851.7875 | 806.7875 | 92 | 853.2875 | 808.2875 |
| 33 | 851.8125 | 806.8125 | 93 | 853.3125 | 808.3125 |
| 34 | 851.8375 | 806.8375 | 94 | 853.3375 | 808.3375 |
| 35 | 851.8625 | 806.8625 | 95 | 853.3625 | 808.3625 |
| 36 | 851.8875 | 806.8875 | 96 | 853.3875 | 808.3875 |
| 37 | 851.9125 | 806.9125 | 97 | 853.4125 | 808.4125 |
| 38 | 851.9375 | 806.9375 | 98 | 853.4375 | 808.4375 |
| 39 | 851.9625 | 806.9625 | 99 | 853.4625 | 808.4625 |
| 40 | 851.9875 | 806.9875 | 100 | 853.4875 | 808.4875 |
| 41 | 852.0125 | 807.0125 | 101 | 853.5125 | 808.5125 |
| 42 | 852.0375 | 807.0375 | 102 | 853.5375 | 808.5375 |
| 43 | 852.0625 | 807.0625 | 103 | 853.5625 | 808.5625 |
| 44 | 852.0875 | 807.0875 | 104 | 853.5875 | 808.5875 |
| 45 | 852.1125 | 807.1125 | 105 | 853.6125 | 808.6125 |
| 46 | 852.1375 | 807.1375 | 106 | 853.6375 | 808.6375 |
| 47 | 852.1625 | 807.1625 | 107 | 853.6625 | 808.6625 |
| 48 | 852.1875 | 807.1875 | 108 | 853.6875 | 808.6875 |
| 49 | 852.2125 | 807.2125 | 109 | 853.7125 | 808.7125 |
| 50 | 852.2375 | 807.2375 | 110 | 853.7375 | 808.7375 |
| 51 | 852.2625 | 807.2625 | 111 | 853.7625 | 808.7625 |
| 52 | 852.2875 | 807.2875 | 112 | 853.7875 | 808.7875 |
| 53 | 852.3125 | 807.3125 | 113 | 853.8125 | 808.8125 |
| 54 | 852.3375 | 807.3375 | 114 | 853.8375 | 808.8375 |
| 55 | 852.3625 | 807.3625 | 115 | 853.8625 | 808.8625 |
| 56 | 852.3875 | 807.3875 | 116 | 853.8875 | 808.8875 |
| 57 | 852.4125 | 807.4125 | 117 | 853.9125 | 808.9125 |
| 58 | 852.4375 | 807.4375 | 118 | 853.9375 | 808.9375 |
| 59 | 852.4625 | 807.4625 | 119 | 853.9625 | 808.9625 |
| 60 | 852.4875 | 807.4875 | 120 | 853.9875 | 808.9875 |

**Table B5.2 - Channel Allocations for the 800 MHz Trunking Band (25 kHz channel spacing)**

### Annex C - Frequency-Distance Constraints

**Overview of frequency-distance constraints**

The frequency-distance constraints are intended to support technology flexible networks (that apply equally to both digital and analog systems) and provide a frequency coordination framework that balances the risk of interference with spectrum efficiency.

The frequency-distance constraints are based on a notional equipment configuration using statistical propagation models.

The methodology used for calculation of the frequency-distance constraints is outlined in Spectrum Planning Report SPP 08/14 ([Derivation of 400 MHz band land mobile frequency-distance constraints used in RALI LM8](https://www.acma.gov.au/-/media/Spectrum-Monitoring-and-Analysis/Information/Word-Document/The-spectrum-planning-report---Derivation-of-400MHz-band-land-mobile-frequency-distance-constraints-used-in-RALI-LM8-docx.docx?la=en))). This report was released in September 2014 in support of consultation on an update to LM8. Following industry consultation, changes were made to the resulting frequency-distance constraints when LM8 was finalised in June 2015 (see section below – “Modifications from Spectrum Planning Report SPP 08/14”). The planning report documents the key equipment performance assumptions that were used in that process.

In this regard the international standards considered (as documented in the 2014 spectrum planning report) in deriving the frequency-distance constraints in LM8 included:

* Part 90 of the FCC Rules; Rule 90.210 (Emission masks) and Rule 90.221 (Adjacent channel power limits) [13]
* ETSI EN 300 392-2 [14]
* ETSI EN 300 113-1 V1.7.1 (2011-11) [15]
* ETSI EN 300 086-1 V1.4.1 (2010-06) [16]

While not specifically mentioned, the Australian analog standard AS/NZS 4295 Analog speech (angle modulated) equipment operating in land mobile and fixed services bands in the range 29.7 MHz to 1 GHz [17] was considered as it is largely based on ETSI EN 300 086 [16] and its parameters are subsumed by those of standards referenced above.

Similarly, the parameters of the 2018 voluntary Australian digital standard AS/NZS 4768.3 Digital radio equipment operating in land mobile and fixed services bands in the range 29.7 MHz to 1 GHz [18], while it was not considered in the 2015 LM8 release, it’s parameters are also subsumed by those standards referenced above including ETSI EN 300 113 [15].

Both Australian Standards (AS/NZS 4295 and AS/NZS 4768.3) provide the Australian parameters to the ETSI standards they reference and are listed above. Two examples of Australian specific parameters include extending the frequencies used from 470 MHz to 520 MHz and maximum power limits.

Subject to the consideration of local factors and employing good engineering site practices equipment meeting the above-mentioned performance requirements (or similar requirements) should be compatible with the assumptions used in the calculation of the frequency-distance constraints.

**Relationship of frequency-distance constraints to interference management**

As outlined above the frequency-distance constraints for the various LM8 models are based around the notional models, their equipment configuration and equipment performance assumptions. During an interference investigation, one of the factors the ACMA may take into account is whether equipment is being operated in accordance with those parameters.

For example, a radiocommunications receiver that does not meet notional equipment configuration and the level of performance of the reference standards may not be afforded protection from interference from licenced radiocommunications transmitters operating in accordance with the conditions of the associated licence. Likewise, a transmitter whose adjacent channel emission do not meet the level of performance of the reference standards and causes interference to an adjacent channel service, whose equipment meets the referenced standards, would need to take interference remediation measures.

**Site management**

LM8 frequency-distance constraints do not consider all interference mechanisms that potentially arise when services are located in close proximity to one another. Consequently, it is important for the radiocommunications designer to consider local factors and employ good engineering practices to ensure their radiocommunications system operates satisfactorily. For example, for single frequency systems the LM8 frequency-distance constraints do not provide protection from blocking caused by services located in close proximity to one another with a frequency separation beyond 100 kHz.

To minimise the impacts of blocking, good engineering practice could include using vertical separation on the same tower and the use of appropriate filtering in circumstances where sites need to be located close to each other.

**Modifications from Spectrum Planning Report SPP 08/14**

Consideration was given to feedback received as part of the consultation process ([IFC 42/2014](https://www.acma.gov.au/theACMA/proposed-updates-to-rali-lm8-land-mobile-service-frequency-assignment-requirements)) and the following changes were made from the frequency-distance constraints as determined in the SPP 08/14:

* Frequency-distance constraints are symmetrical and based on worst case values. That is, values for new 6.25 kHz to existing 12.5 kHz are the same as new 12.5 kHz to existing 6.25 kHz with worst case values being used.
* For low powered systems, to address concerns about small separation distances in low powered systems when channel bandwidths overlap, in such circumstances distances have been set at 10 km.
* Adjusting 1st adjacent channel separation for 12.5 and 25 kHz high powered two frequency systems to be 0 km. Rationale being that either performance will be better than modelled and any degradation in adjacent channel performance will be limited to mobile receivers at edge of the 40km service area (i.e. 37-40 km) in close proximity to unwanted base station.
* Reference levels for 25/12.5 kHz systems are to be the same. For 6.25 kHz systems levels will be adjusted by 3 dB in recognition of smaller bandwidth.
* Calculating separation distances by determining a reference propagation loss at the co-channel separation distance and using the FDR values to determine what loss (and hence distances) are required at other frequency separations.

|  |  |
| --- | --- |
| [SPP 8/2014: Derivation of 400 MHz band land mobile frequency distance constraints used in RALI LM8](https://www.acma.gov.au/-/media/Spectrum-Monitoring-and-Analysis/Information/Word-Document/The-spectrum-planning-report---Derivation-of-400MHz-band-land-mobile-frequency-distance-constraints-used-in-RALI-LM8-docx.docx?la=en) |  |
| LM8 frequency-distance constraint tables before and after simplifications |  |

#### C1. Cull Limits Applicable to Frequency-Distance Constraints

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Cull Frequency Range | | |
| Band of Operation | Cull Radius | Single Frequency Segment | Two Frequency Segment | |
|  |  |  | Tx | Rx |
| VHF Mid Band | 140 km | ± 100 kHz | ± 100 kHz | ± 100 kHz |
| VHF High Band | 140 km | ± 100 kHz | ± 100 kHz | ± 100 kHz |
| 400 MHz  Band | 120 km | ± 100 kHz | ± 100 kHz | ± 100 kHz |
| 800 MHz Trunking Band | 200 km | N/A | ± 25 kHz | ± 25 kHz |

**Table C1 - Cull Limits Applicable to Frequency-Distance Constraints**

Note: These cull limits do not consider the impact of blocking.

#### C2. Frequency-Distance Constraints for Single Frequency LMRS in the VHF Mid and High Bands

The following frequency-distance constraints apply whenever two LMRS systems require coordination in the VHF Mid and High Bands, and where:

* both are single-frequency systems; or
* both are two-frequency systems and the transmit frequency of one system is with 100kHz of the receive frequency of the other; or
* one is a single-frequency system operating within 100kHz of the transmit or receive frequency of the other (two-frequency) system.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Distance Constraints for **Single Frequency** Services | | | |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **140** | **140** | **140** |
| **< 12.5** | **90** | **130** | **136** |
| **< 18.75** | **33** | **51** | **106** |
| **< 25** | **33** | **30** | **64** |
| **< 31.25** | **26** | **23** | **48** |
| **< 62.5** | **17** | **15** | **47** |
| **< 68.75** | **17** | **15** | **42** |
| **< 75** | **16** | **14** | **18** |
| **< 93.75** | **15** | **14** | **18** |
| **< 100** | **14** | **13** | **18** |
| **≥ 100** | **0** | **0** | **0** |

**Table C2.1 - Frequency-Distance Constraints for 6.25 kHz Single Frequency  
LMRS in the VHF High Band**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Distance Constraints for **Single Frequency** Services | | | |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **140** | **140** | **140** |
| **< 12.5** | **130** | **130** | **135** |
| **< 18.75** | **51** | **76** | **118** |
| **< 25** | **30** | **22** | **76** |
| **< 31.25** | **23** | **16** | **48** |
| **< 62.5** | **15** | **8.6** | **46** |
| **< 68.75** | **15** | **8.5** | **41** |
| **< 75** | **14** | **8** | **15** |
| **< 81.25** | **14** | **7.3** | **14** |
| **< 87.5** | **14** | **6.9** | **14** |
| **< 93.75** | **14** | **6.5** | **14** |
| **< 100** | **13** | **6.3** | **14** |
| **≥ 100** | **0** | **0** | **0** |

**Table C2.2 - Frequency-Distance Constraints for 12.5 kHz Single Frequency  
LMRS in the VHF Mid and High Bands**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Distance Constraints for **Single Frequency** Services | | | |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **140** | **140** | **140** |
| **< 12.5** | **136** | **135** | **135** |
| **< 18.75** | **106** | **118** | **118** |
| **< 25** | **64** | **76** | **82** |
| **< 31.25** | **48** | **48** | **56** |
| **< 56.25** | **47** | **46** | **51** |
| **< 62.5** | **47** | **46** | **50** |
| **< 68.75** | **42** | **41** | **46** |
| **< 75** | **18** | **15** | **27** |
| **< 81.25** | **18** | **14** | **19** |
| **< 100** | **18** | **14** | **18** |
| **≥ 100** | **0** | **0** | **0** |

**Table C2.3 - Frequency-Distance Constraints for 25 kHz Single Frequency  
LMRS in the VHF Mid and High Bands**

#### C3. Frequency-Distance Constraints for Single Frequency LMRS in the 400 MHz Band

The following frequency-distance constraints apply whenever two LMRS systems require coordination in the 400MHz Band, and where:

* both are single-frequency systems; or
* both are two-frequency systems and the transmit frequency of one system is with 100kHz of the receive frequency of the other; or
* one is a single-frequency system operating within 100kHz of the transmit or receive frequency of the other (two-frequency) system.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **120** | **120** | **120** |
| **< 12.5** | **70** | **110** | **116** |
| **< 18.75** | **8.1** | **19** | **86** |
| **< 25** | **8.1** | **7.5** | **44** |
| **< 31.25** | **6.4** | **5.7** | **12** |
| **< 37.5** | **4.1** | **3.6** | **5.1** |
| **< 93.75** | **4.1** | **3.6** | **4.7** |
| **< 100** | **4.1** | **3.6** | **4.5** |
| **≥ 100** | **0** | **0** | **0** |

**Table C3.1 - Frequency-Distance Constraints for 6.25 kHz Single  
Frequency LMRS in the 400 MHz Band**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz | |
| **< 6.25** | **120** | **120** | **120** | |
| **< 12.5** | **110** | **110** | **115** | |
| **< 18.75** | **19** | **57** | **98** | |
| **< 25** | **7.5** | **5.4** | **56** | |
| **< 31.25** | **5.7** | **4.1** | **13** | |
| **< 37.5** | **3.6** | **2.1** | **4.6** | |
| **< 43.75** | **3.6** | **2.1** | **3.6** | |
| **< 100** | **3.6** | **2.1** | **2.4** | |
| **≥ 100** | **0** | **0** | **0** | |

**Table C3.2 - Frequency-Distance Constraints for 12.5 kHz Single  
Frequency LMRS in the 400 MHz Band**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz | |
| **< 6.25** | **120** | **120** | **120** | |
| **< 12.5** | **116** | **115** | **115** | |
| **< 18.75** | **86** | **98** | **98** | |
| **< 25** | **44** | **56** | **62** | |
| **< 31.25** | **12** | **13** | **23** | |
| **< 37.5** | **5.1** | **4.6** | **7.9** | |
| **< 43.75** | **4.7** | **3.6** | **4.6** | |
| **< 50** | **4.7** | **2.4** | **2.8** | |
| **< 87.5** | **4.7** | **2.4** | **2.4** | |
| **< 93.75** | **4.7** | **2.4** | **2.1** | |
| **< 100** | **4.5** | **2.4** | **1.7** | |
| **≥ 100** | **0** | **0** | **0** | |

**Table C3.3 - Frequency-Distance Constraints for 25 kHz Single  
Frequency LMRS in the 400 MHz Band**

#### C4. Frequency-Distance Constraints for Single Frequency LPMRS in the VHF High Band and the 400 MHz Band

The following frequency-distance constraints apply whenever two LPMRS systems require coordination, and where:

* both are single-frequency systems; or
* both are two-frequency systems and the transmit frequency of one system is with 100kHz of the receive frequency of the other; or
* one is a single-frequency system operating within 100kHz of the transmit or receive frequency of the other (two-frequency) system.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz | |
| **< 6.25** | **10** | **10** | **10** | |
| **< 12.5** | **1.9** | **10** | **10** | |
| **< 18.75** | **0.3** | **0.5** | **10** | |
| **< 25** | **0.3** | **0.3** | **0.8** | |
| **< 31.25** | **0.3** | **0** | **0.4** | |
| **≥ 31.25** | **0** | **0** | **0** | |
| Proposed 12.5 kHz  from Existing |  |  |  | |
| **< 12.5** | **10** | **10** | **10** | |
| **< 18.75** | **0.5** | **1.2** | **10** | |
| **< 25** | **0.3** | **0** | **1.2** | |
| **< 31.25** | **0** | **0** | **0.4** | |
| **≥ 31.25** | **0** | **0** | **0** | |
| Proposed 25 kHz  from Existing |  |  |  | |
| **< 18.75** | **10** | **10** | **10** | |
| **< 25** | **0.8** | **1.2** | **10** | |
| **< 31.25** | **0.4** | **0.4** | **0.5** | |
| **< 37.5** | **0** | **0** | **0.3** | |
| **≥ 37.5** | **0** | **0** | **0** | |

**Table C4.1 - Frequency-Distance Constraints for Single  
Frequency LPMRS in the 400 MHz Band**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz | |
| **< 6.25** | **10** | **10** | **10** | |
| **< 12.5** | **1.9** | **10** | **10** | |
| **< 18.75** | **0.3** | **0.5** | **10** | |
| **< 25** | **0.3** | **0.3** | **0.8** | |
| **< 31.25** | **0.3** | **0** | **0.4** | |
| **< 62.5** | **0** | **0** | **0.4** | |
| **< 68.75** | **0** | **0** | **0.3** | |
| **≥ 68.75** | **0** | **0** | **0** | |
| Proposed 12.5 kHz  from Existing |  |  |  | |
| **< 12.5** | **10** | **10** | **10** | |
| **< 18.75** | **0.5** | **1.2** | **10** | |
| **< 25** | **0.3** | **0** | **1.2** | |
| **< 62.5** | **0** | **0** | **0.4** | |
| **< 68.75** | **0** | **0** | **0.3** | |
| **≥ 68.75** | **0** | **0** | **0** | |
| Proposed 25 kHz  from Existing |  |  |  | |
| **< 18.75** | **10** | **10** | **10** | |
| **< 25** | **0.8** | **1.2** | **10** | |
| **< 31.25** | **0.4** | **0.4** | **0.6** | |
| **< 62.5** | **0.4** | **0.4** | **0.5** | |
| **< 68.75** | **0.3** | **0.3** | **0.4** | |
| **< 75** | **0** | **0** | **0.3** | |
| **≥ 75** | **0** | **0** | **0** | |

**Table C4.2 - Frequency-Distance Constraints for Single  
Frequency LPMRS in the VHF High Band**

#### C5. Frequency-Distance Constraints for Single Frequency LMRS and LPMRS in the VHF High Band and the 400 MHz Band

The following frequency-distance constraints apply whenever an LMRS and LPMRS system require coordination, and where:

* both are single-frequency systems; or
* both are two-frequency systems and the transmit frequency of one system is with 100kHz of the receive frequency of the other; or
* one is a single-frequency system operating within 100kHz of the transmit or receive frequency of the other (two-frequency) system.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **116** | **111** | **111** |
| **< 12.5** | **35** | **91** | **103** |
| **< 18.75** | **4.5** | **8** | **54** |
| **< 25** | **4.5** | **4.3** | **14** |
| **< 31.25** | **3.9** | **3.5** | **7** |
| **< 62.5** | **2.9** | **2.6** | **6.7** |
| **< 68.75** | **2.9** | **2.6** | **5.4** |
| **< 75** | **2.8** | **2.6** | **3.7** |
| **< 87.5** | **2.7** | **2.5** | **3.7** |
| **< 100** | **2.6** | **2.5** | **3.6** |
| **≥ 100** | **0** | **0** | **0** |

**Table C5.1 - Frequency-Distance Constraints for 6.25 kHz Single Frequency LMRS vs LPMRS in the VHF High Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **111** | **105** | **111** |
| **< 12.5** | **91** | **92** | **102** |
| **< 18.75** | **8** | **23** | **70** |
| **< 25** | **4.3** | **3.4** | **23** |
| **< 31.25** | **3.5** | **2.8** | **7** |
| **< 62.5** | **2.6** | **1.8** | **6.4** |
| **< 68.75** | **2.6** | **1.8** | **5.2** |
| **< 75** | **2.6** | **1.7** | **3.5** |
| **< 87.5** | **2.5** | **1.6** | **3.5** |
| **< 100** | **2.5** | **1.5** | **3.5** |
| **≥ 100** | **0** | **0** | **0** |

**Table C5.2 - Frequency-Distance Constraints for 12.5 kHz Single Frequency LMRS vs LPMRS in the VHF High Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | Frequency Offset (kHz) | Distance Separation (km) |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **111** | **111** | **111** |
| **< 12.5** | **103** | **102** | **102** |
| **< 18.75** | **54** | **70** | **71** |
| **< 25** | **14** | **23** | **27** |
| **< 31.25** | **7** | **7** | **10** |
| **< 37.5** | **6.7** | **6.4** | **7.9** |
| **< 56.25** | **6.7** | **6.4** | **7.8** |
| **< 62.5** | **6.7** | **6.4** | **7.7** |
| **< 68.75** | **5.4** | **5.2** | **6.4** |
| **< 75** | **3.7** | **3.5** | **4** |
| **< 87.5** | **3.7** | **3.5** | **3.1** |
| **< 100** | **3.6** | **3.5** | **3.1** |
| **≥ 100** | **0** | **0** | **0** |

**Table C5.3 - Frequency-Distance Constraints for 25 kHz Single Frequency LMRS vs LPMRS in the VHF High Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **107** | **103** | **103** |
| **< 12.5** | **34** | **85** | **96** |
| **< 18.75** | **4.5** | **8** | **52** |
| **< 25** | **4.5** | **4.3** | **14** |
| **< 31.25** | **3.9** | **3.5** | **6** |
| **< 37.5** | **2.9** | **2.6** | **3.3** |
| **< 93.75** | **2.9** | **2.6** | **3.1** |
| **< 100** | **2.9** | **2.6** | **3** |
| **≥ 100** | **0** | **0** | **0** |

**Table C5.4 - Frequency-Distance Constraints for 6.25 kHz Single Frequency LMRS vs LPMRS in the 400 MHz band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **103** | **97** | **103** |
| **< 12.5** | **85** | **86** | **95** |
| **< 18.75** | **8** | **23** | **67** |
| **< 25** | **4.3** | **3.4** | **23** |
| **< 31.25** | **3.5** | **2.8** | **6.1** |
| **< 37.5** | **2.6** | **1.8** | **3.1** |
| **< 43.75** | **2.6** | **1.8** | **2.6** |
| **< 100** | **2.6** | **1.8** | **2** |
| **≥ 100** | **0** | **0** | **0** |

**Table C5.5 - Frequency-Distance Constraints for 12.5 kHz Single Frequency LMRS vs LPMRS in the 400 MHz band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | Frequency Offset (kHz) | Distance Separation (km) |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **103** | **103** | **103** |
| **< 12.5** | **96** | **95** | **95** |
| **< 18.75** | **52** | **67** | **68** |
| **< 25** | **14** | **23** | **27** |
| **< 31.25** | **6** | **6.1** | **9.2** |
| **< 37.5** | **3.3** | **3.1** | **4.4** |
| **< 43.75** | **3.1** | **2.6** | **3.1** |
| **< 50** | **3.1** | **2** | **2.2** |
| **< 87.5** | **3.1** | **2** | **2** |
| **< 93.75** | **3.1** | **2** | **1.8** |
| **< 100** | **3** | **2** | **1.6** |
| **≥ 100** | **0** | **0** | **0** |

**Table C5.6 - Frequency-Distance Constraints for 25 kHz Single Frequency LMRS vs LPMRS in the 400 MHz band.**

#### C6. Frequency-Distance Constraints for Two Frequency LMRS in the 400 MHz Band and the VHF Mid and High Bands

The following frequency-distance constraints apply whenever two systems requiring coordination are both two-frequency LMRS operating with the same frequency sense.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Distance Constraints for **Two Frequency** Services | | | |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **100** | **100** | **100** |
| **< 12.5** | **52\*** | **86** | **94** |
| **< 18.75** | **0** | **0** | **63** |
| **≥ 18.75** | **0** | **0** | **0** |

**Table C6.1 - Frequency-Distance Constraints for 6.25 kHz Two Frequency LMRS  
in the VHF High Bands**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Distance Constraints for **Two Frequency** Services | | | |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **100** | **100** | **100** |
| **< 12.5** | **86** | **87** | **94** |
| **< 18.75** | **0** | **0** | **74** |
| **< 25** | **0** | **0** | **47** |
| **≥ 25** | **0** | **0** | **0** |

**Table C6.2 - Frequency-Distance Constraints for 12.5 kHz Two Frequency LMRS  
in the VHF Mid and High Bands**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Distance Constraints for **Two Frequency** Services | | | |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **100** | **100** | **100** |
| **< 12.5** | **94** | **94** | **94** |
| **< 18.75** | **63** | **74** | **74** |
| **< 25** | **0** | **47** | **48** |
| **≥ 25** | **0** | **0** | **0** |

**Table C6.3 - Frequency-Distance Constraints for 25 kHz Two Frequency LMRS  
in the VHF Mid and High Bands**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  LMRS from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **100** | **100** | **100** |
| **< 12.5** | **54\*** | **87** | **95** |
| **< 18.75** | **0** | **0** | **65** |
| **≥ 18.75** | **0** | **0** | **0** |
| Proposed 12.5 kHz  LMRS from Existing |  |  |  |
| **< 6.25** | **100** | **100** | **100** |
| **< 12.5** | **87** | **88** | **94** |
| **< 18.75** | **0** | **0** | **75** |
| **< 25** | **0** | **0** | **47** |
| **≥ 25** | **0** | **0** | **0** |
| Proposed 25 kHz  LMRS from Existing |  |  |  |
| **< 6.25** | **100** | **100** | **100** |
| **< 12.5** | **95** | **94** | **94** |
| **< 18.75** | **65** | **75** | **75** |
| **< 25** | **0** | **47** | **49** |
| **≥ 25** | **0** | **0** | **0** |

**Table C6.4 - Frequency-Distance Constraints for Two Frequency LMRS in  
the 400 MHz Band**

\* This base-to-base distance separation is not required if the services are co-sited (i.e. within 200m). This is because for the co-sited services the propagation path for the wanted and interfering signals is always the same and the receiver filtering will provide wanted-to-unwanted signal discrimination greater than the required protection ratio.

#### 

#### C7. Frequency-Distance Constraints for Two Frequency LPMRS in the VHF High Band and the 400 MHz Band

The following frequency-distance constraints apply whenever two systems requiring coordination are both two-frequency LPMRS operating with the same frequency sense.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **10** | **10** | **10** |
| **< 12.5** | **3.5** | **10** | **10** |
| **< 18.75** | **0** | **2.4** | **10** |
| **< 25** | **0** | **0** | **2.6** |
| **< 31.25** | **0** | **0** | **2.3** |
| **≥ 31.25** | **0** | **0** | **0** |
| Proposed 12.5 kHz  from Existing |  |  |  |
| **< 12.5** | **10** | **10** | **10** |
| **< 18.75** | **2.4** | **2.9** | **10** |
| **< 25** | **0** | **0** | **2.9** |
| **< 31.25** | **0** | **0** | **2.3** |
| **≥ 31.25** | **0** | **0** | **0** |
| Proposed 25 kHz  from Existing |  |  |  |
| **< 18.75** | **10** | **10** | **10** |
| **< 25** | **2.6** | **2.9** | **10** |
| **< 31.25** | **2.3** | **2.3** | **2.4** |
| **≥ 31.25** | **0** | **0** | **0** |

**Table C7.1 - Frequency-Distance Constraints for Two Frequency LPMRS in the 400 MHz Band**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **10** | **10** | **10** |
| **< 12.5** | **3.5** | **10** | **10** |
| **< 18.75** | **0** | **2.4** | **10** |
| **< 25** | **0** | **0** | **2.6** |
| **≥ 25** | **0** | **0** | **0** |
| Proposed 12.5 kHz  from Existing |  |  |  |
| **< 12.5** | **10** | **10** | **10** |
| **< 18.75** | **2.4** | **2.9** | **10** |
| **< 25** | **0** | **0** | **2.9** |
| **≥ 25** | **0** | **0** | **0** |
| Proposed 25 kHz  from Existing |  |  |  |
| **< 18.75** | **10** | **10** | **10** |
| **< 25** | **2.6** | **2.9** | **10** |
| **< 31.25** | **0** | **0** | **2.5** |
| **≥ 31.25** | **0** | **0** | **0** |

**Table C7.2 - Frequency-Distance Constraints for Two Frequency LPMRS in the VHF High Band**

#### C8. Frequency-Distance Constraints for Two Frequency LMRS and LPMRS in the VHF High Band and the 400 MHz Band

The following frequency-distance constraints apply whenever an LMRS and an LPMRS system require coordination, and both are two-frequency systems operating with the same frequency sense.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **65** | **62** | **62** |
| **< 12.5** | **42** | **49** | **57** |
| **< 18.75** | **3.4** | **4.5** | **43** |
| **< 25** | **3.4** | **3.3** | **6.3** |
| **< 31.25** | **3.2** | **3.1** | **3.9** |
| **< 93.75** | **2.9** | **2.8** | **3** |
| **< 100** | **3** | **2.6** | **2.9** |
| **≥ 100** | **0** | **0** | **0** |

**Table C8.1 - Frequency-Distance Constraints for 6.25 kHz Two Frequency LMRS vs LPMRS in the 400 MHz Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **62** | **58** | **62** |
| **< 12.5** | **49** | **50** | **56** |
| **< 18.75** | **4.5** | **9.4** | **44** |
| **< 25** | **3.3** | **3.1** | **9.4** |
| **< 31.25** | **3.1** | **2.9** | **3.9** |
| **< 37.5** | **2.8** | **2.5** | **2.9** |
| **< 43.75** | **2.8** | **2.5** | **2.8** |
| **< 93.75** | **2.8** | **2.5** | **2.6** |
| **< 100** | **2.6** | **2.5** | **2.6** |
| **≥ 100** | **0** | **0** | **0** |

**Table C8.2 - Frequency-Distance Constraints for 12.5 kHz Two Frequency LMRS vs LPMRS in the 400 MHz Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **62** | **62** | **62** |
| **< 12.5** | **57** | **56** | **56** |
| **< 18.75** | **43** | **44** | **44** |
| **< 25** | **6.3** | **9.4** | **41** |
| **< 31.25** | **3.9** | **3.9** | **4.9** |
| **< 37.5** | **3** | **2.9** | **3.4** |
| **< 43.75** | **3** | **2.8** | **2.9** |
| **< 50** | **3** | **2.6** | **2.7** |
| **< 87.5** | **3** | **2.6** | **2.6** |
| **< 93.75** | **3** | **2.6** | **2.5** |
| **< 100** | **2.9** | **2.6** | **2.5** |
| **≥ 100** | **0** | **0** | **0** |

**Table C8.3 - Frequency-Distance Constraints for 25 kHz Two Frequency LMRS vs LPMRS in the 400 MHz Band.**

The following frequency-distance constraints apply whenever LMRS and LPMRS systems in the VHF High Band are to be coordinated (proposed and existing), use two frequency operation, and have the same frequency sense.

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 6.25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **65** | **62** | **62** |
| **< 12.5** | **42** | **48** | **56** |
| **< 18.75** | **3.3** | **4.3** | **43** |
| **< 25** | **3.3** | **3.2** | **5.9** |
| **< 31.25** | **3.1** | **3** | **4** |
| **< 62.5** | **2.8** | **2.7** | **3.9** |
| **< 68.75** | **2.8** | **2.7** | **3.6** |
| **< 100** | **2.8** | **2.7** | **2.9** |
| **≥ 100** | **0** | **0** | **0** |

**Table C8.4 - Frequency-Distance Constraints for 6.25 kHz Two Frequency LMRS vs LPMRS in the VHF High Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 12.5 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **62** | **58** | **62** |
| **< 12.5** | **48** | **49** | **56** |
| **< 18.75** | **4.3** | **8.9** | **44** |
| **< 25** | **3.2** | **3** | **8.8** |
| **< 31.25** | **3** | **2.8** | **4** |
| **< 62.5** | **2.7** | **2.5** | **3.8** |
| **< 68.75** | **2.7** | **2.5** | **3.5** |
| **< 100** | **2.7** | **2.5** | **2.7** |
| **≥ 100** | **0** | **0** | **0** |

**Table C8.5 - Frequency-Distance Constraints for 12.5 kHz Two Frequency LMRS vs LPMRS in the VHF High Band.**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Offset (kHz) | Distance Separation (km) | | |
| Proposed 25 kHz  from Existing | Existing  6.25 kHz | Existing  12.5 kHz | Existing  25 kHz |
| **< 6.25** | **62** | **62** | **62** |
| **< 12.5** | **56** | **56** | **56** |
| **< 18.75** | **43** | **44** | **44** |
| **< 25** | **5.9** | **8.8** | **41** |
| **< 31.25** | **4** | **4** | **4.9** |
| **< 56.25** | **3.9** | **3.8** | **4.3** |
| **< 62.5** | **3.9** | **3.8** | **4.2** |
| **< 68.75** | **3.6** | **3.5** | **3.8** |
| **< 75** | **2.9** | **2.7** | **3.1** |
| **< 100** | **2.9** | **2.7** | **2.9** |
| **≥ 100** | **0** | **0** | **0** |

**Table C8.6 - Frequency-Distance Constraints for 25 kHz Two Frequency LMRS vs LPMRS in the VHF High Band.**

#### C9. Frequency-Distance Constraints for Trunked Services in the 800 MHz Trunking Band

|  |  |  |
| --- | --- | --- |
| Frequency-Distance Constraints for Trunked Services in the 800 MHz Trunking Band | | |
| Frequency Offset (kHz) | Distance Separation (km) | |
| Proposed 12.5 kHz  from Existing | Existing  12.5 kHz | Existing  25 kHz |
| **< 12.5** | **100** | **100** |
| **< 25** | **0** | **100** |
| **≥ 25** | **0** | **0** |

**Table C9.1 - Frequency-Distance Constraints for 12.5 kHz Trunked Services  
in the 800 MHz Band**

|  |  |  |
| --- | --- | --- |
| Frequency-Distance Constraints for Trunked Services in the 800 MHz Trunking Band | | |
| Frequency Offset (kHz) | Distance Separation (km) | |
| Proposed 25 kHz  from Existing | Existing  12.5 kHz | Existing  25 kHz |
| **< 12.5** | **100** | **100** |
| **< 25** | **100** | **100** |
| **≥ 25** | **0** | **0** |

**Table C9.2 - Frequency-Distance Constraints for 25 kHz Trunked Services  
in the 800 MHz Band**

#### C10. Frequency-Distance Constraints for enclosed and short-range digital systems in the 400 MHz Band

The following frequency-distance constraints apply whenever enclosed or short-range digital system and a LMS require coordination, and both are operating with the same frequency sense.

The modified Hata urban model has been used in the calculations for enclosed and short-range digital services co-channel separation distances.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| System 1 | System 2 | Distance Separation (km) | | | | | | | |
| Two Frequency | | | | Single Frequency | | | |
| Offset (kHz) | | Co-Ch | 1st Adj | 2nd Adj | <100 | Co-Ch | 1st Adj | 2nd Adj | <100 |
| **Short-range Digital** | **Short-range Digital** | **2** | **0** | **0** | **0** | **2** | **0.3** | **0** | **0** |
| **Short-range Digital** | **Enclosed** | **2** | **0** | **0** | **0** | **2** | **0. 2** | **0** | **0** |
| **Enclosed** | **Enclosed** | **0.5** | **0** | **0** | **0** | **0.5** | **0** | **0** | **0** |
| **LPMRS (Low Power)** | **Short-range Digital** | **5** | **0.3** | **0** | **0** | **7** | **0.3** | **0** | **0** |
| **LPMRS (Low Power)** | **Enclosed** | **5** | **0** | **0** | **0** | **5** | **0.2** | **0** | **0** |
| **LMRS (High Power)** | **Short-range Digital** | **45** | **0.6** | **0.4** | **0.3** | **50** | **1.7** | **0.7** | **0.4** |
| **LMRS (High Power)** | **Enclosed** | **45** | **0.5** | **0.3** | **0.3** | **45** | **0.8** | **0.4** | **0.2** |

**Table C10.1 – Frequency Distance constraints requirements for 12.5 kHz and 25 kHz Enclosed and Short-range Digital Services in the 400 MHz Band**

Coordination between Enclosed or Short-range Digital systems and LPMRS Crane systems (Special Condition AU) needs to be undertaken as LPMRS to LPMRS systems due to the elevated antenna height of the Crane system.

### Annex D - Intermodulation Checks

Receiver and transmitter intermodulation checks are required to be performed for two-signal 3rd order and two-signal 5th order products. These intermodulation products have the potential to cause interference as a result of:

1. Emissions from two existing transmitters mixing and falling within the ‘hit’ range of an existing (Scenario 1) or proposed receiver (Scenario 2); or
2. Emissions from the proposed transmitter mixing with emissions from an existing transmitter and falling within the ‘hit’ range of an existing (Scenario 3) or proposed receiver (Scenario 4).

Scenarios 2, 3 and 4 are required to be assessed using the applicable frequency-distance constraints detailed in Table D1.

#### D1. Cull Limits Applicable to Intermodulation Checks

|  |  |  |
| --- | --- | --- |
|  | Frequency - Distance Cull Range | |
| **Receiver Intermodulation** | | |
| Description | Third Order Intermodulation | Fifth Order Intermodulation |
| **Scenario 1** – *caused in existing receiver by existing transmitter* | Not applicable to assignment of new systems | |
| **Scenario 2** *- caused in proposed receiver by existing transmitters* | Transmitters within 2 km & 2.25 MHz of proposed receiver frequency | Transmitters within 0.2 km & 0.375 MHz of proposed receiver frequency |
| **Scenarios 3 and 4** *-caused in proposed or existing receiver by proposed transmitter as Outer* | Transmitters within 4 km & 1.125 MHz of proposed transmitter frequency  Receivers within 2 km & 2.25 MHz of proposed transmitter frequency | Transmitters within 0.4 km & 0.125 MHz of proposed transmitter frequency  Receivers within 0.2 km & 0.375 MHz of proposed transmitter frequency |
| **Scenarios 3 and 4***- caused in proposed or existing receiver by proposed transmitter as Inner* | Transmitters within 4 km & 1.125 MHz of proposed transmitter frequency  Receivers within 2 km & 1.125 MHz of proposed transmitter frequency | Transmitters within 0.4 km & 0.125 MHz of proposed transmitter frequency  Receivers within 0.2 km & 0.25 MHz of proposed transmitter frequency |
| **Transmitter Intermodulation** | | |
| **Scenarios 2, 3 and 4** *- caused by proposed or existing transmitters* | Transmitters and receivers within 0.2 km & within the band 20 MHz above and 20 MHz below the proposed transmitter frequency | |

**Table D1 - Cull Limits Applicable to Intermodulation Checks**

#### D2. Frequency Offset from Victim Receiver Within Which an Intermodulation ‘Hit’ is Deemed to Occur

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Frequency offset from receiver centre frequency (± kHz)** | | | | | | |
| Interferer channel width\* | Receiver channel width / Intermodulation Order | | | | | |
|  | 6.25 kHz | | 12.5 kHz | | 25 kHz | | |
|  | 3rd order | 5th order | 3rd order | 5th order | 3rd order | 5th order |
| 6.25 kHz | **9.375** | **12.5** | **12.25** | **15.5** | **18.5** | **22** |
| 12.5 kHz | **15.125** | **21.125** | **18** | **24** | **24.5** | **30.5** |
| 25 kHz | **28** | **40** | **30.5** | **43** | **37** | **49** |

**Table D2 - Frequency Offset from Victim Receiver within which an  
Intermodulation ‘Hit’ is Deemed to Occur**

\* The interferer channel width is taken as the wider of the two intermodulation-producing interferers

#### D3. Expressions for Evaluating Intermodulation Interference

The following equations should be used to evaluate receiver generated intermodulation interference. When the equations are satisfied, the level of the intermodulation product is not high enough[[23]](#footnote-25) to cause harmful interference.

The equation for two signal 3rd order receiver intermodulation is:

PR + 2\*(EIRPdBm - Lb inner + Lc - RFinner) + (EIRPdBm - Lb outer + Lc - RFouter) + ECR 2/3 < RS

The equation for two signal 5th order receiver intermodulation is:

PR + 3\*(EIRPdBm- Lb inner + Lc - RFinner) + 2\*(EIRPdBm- Lb outer + Lc - RFouter) + ECR 2/5 < RS

The parameter values applicable to the above equations above are specified in Table D3.

#### D4. Parameter Values Applicable to Intermodulation Checks

|  |  |
| --- | --- |
| **Parameter** | **Assumed Value** |
| RS (Base Receiver Usable Sensitivity[[24]](#footnote-26)) | -119 dBm (800 MHz Trunking Band)  -116 dBm (400 MHz Band)  -107 dBm (VHF High Band)  -101 dBm (VHF Mid Band) |
| PR (Protection Ratio) | 5 dB for 12 dB SINAD |
| EIRPdBm (Transmitter EIRP) | 30+ 10Log(EIRPWatts) (e.g. 49.2 dBm for LMRS @ 200m HAAT)  39.2 dBm (8.3 W for LPMRS) |
| Lb (propagation loss: from ‘inner’ or ‘outer’ transmitter to victim receiver) | Free Space Loss + 10 dB |
| Lc (antenna gain and feeder loss) | 2 dBi (VHF)  6 dBi (400 MHz & 800 MHz Bands) |
| RF (receiver front-end response: achieved by the RF selectivity of a receiver in conjunction with two cavity filters) | **For the VHF Mid and High Bands:**  **2 dB** for Freq Offset <= 0.06 MHz  **2 x [23.3 + 18.7\*log(Freq Offset)] dB**   for 0.06 < Freq Offset <= 1.5 MHz  **2 x [23.3 + 18.7\*log(Freq Offset) + (Freq Offset – 1.5)\*18/1.5]** dB for 1.5 MHz < Freq Offset <= 4.4 MHz  **140 dB** for Freq Offset > 4.4 MHz  **For the 400 MHz Band:**  **5 dB** for Freq Offset <=0.1 MHz  **5 + 60 log [1+ (2 × (Freq Offset - 0.1)/1.5)0.8 ]dB** for 0.1 < Freq Offset <= 15 MHz  **70 dB** for Freq Offset > 15 MHz  **For the 800 MHz Trunking Band:**  **2 + 60\*log[1 + (2\*Freq Offset/5)1.5] dB**  for Freq Offset <= 2.5 MHz  **2 + 60\*log[1 + (2\*Freq Offset/5)2] dB**  for 2.5 < Freq Offset <= 9 MHz  **70 dB** for Freq Offset > 9 MHz |
| ECR (effective conversion ratio of intermodulation products) | 2 Signal Third Order: ECR 2/3 = -9 dB  2 Signal Fifth Order: ECR 2/5 = -28 dB |

**Table D3 - Parameter Values Applicable to Intermodulation Checks**

### Annex E - Inter-service Coordination

The following inter-service coordination requirements have been prepared by the ACMA. Note that this list is not exhaustive. In some cases, specific ITU-R Recommendations may exist to address inter-service coordination. However, because of the diversity and complexity of sharing situations which may arise, it is not possible to provide rigorous and explicit procedures covering all inter-service coordination requirements. In these cases, coordination defaults to the identification of all non-homogeneous services in the band in question, followed by a manual assessment of their impact on the interference environment.

#### E1. VHF Mid and High Assignments Adjacent to Television Channels 6

In the absence of detailed coordination procedures, no assignments for new fixed or mobile services should be made in the frequency band 168–174 MHz within the frequency/distance limits specified in Table E1 from television services operating on channel 6 (177.5 MHz). These requirements are in addition to those of embargo 32.

|  |  |
| --- | --- |
| **Frequency Band** | **Distance Separation** |
| 168.0–172.8 MHz  172.8–173.3 MHz  173.3–174.0 MHz | 3 km  10 km  60 km |

**Table E1 – Frequency-Distance constraints for services operating near TV Ch6**

#### E2. 400 MHz Assignments in the Vicinity of Wideband Fixed Services

The frequency coordination requirements detailed in RALI FX01 [5] should be observed for 403 – 500 MHz assignments within 160 km of wideband fixed services.

For assignments within 400 km of wideband fixed services licensed to Telstra on 501.9, 504.3, 506.7, 509.1, 513.1, 515.5 and 517.9 MHz, additional coordination requirements may apply. Contact the Manager, Spectrum Engineering Section in these instances.

There are restrictions on the assignment of certain trunked channels in low demand areas to provide protection to wideband fixed services. These restrictions are detailed in Embargo 19 of RALI MS 3 [3].

#### E3. Coordination with spectrum licensed services

The 800 MHz TLMS band is in close frequency proximity to spectrum-licensed services.

The ‘[Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 700 MHz Band) 2023](https://www.legislation.gov.au/Series/F2023L00248)’, and ‘[Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 850/900 MHz Bands) 2021](https://www.legislation.gov.au/Details/F2021L01148)’ set out protection requirements for services operating frequency adjacent to spectrum licensed transmitters. In summary, these protection requirements are:

* Protection of TLMS radiocommunications receivers from spectrum licensed radiocommunications transmitters is on a first-in-time basis.
* Any existing TLMS base-station receiver licensed prior to the registration of a spectrum licensed transmitter in the Register[[25]](#footnote-27) is to be provided protection to protection ratio specified in this RALI. Initial assessment can be made using the applicable protection ratio and sensitivity level with the unwanted emissions from the spectrum licensed transmitter that fall within the passband of the receiver. Receiver blocking of TLMS should also be checked, using the blocking criteria of 90 dB above the receiver sensitivity level and additional RF selectivity (Table D3) with the in-band power of the spectrum licensed transmitter. Applicable protection ratios and sensitivity levels are:
* For coordination between 700 MHz spectrum licensed transmitters and PMP receivers licensed after 1 July 2024: a receiver sensitivity of -110 dBm with an 8 dB protection ratio[[26]](#footnote-28)
* In all other cases: a receiver sensitivity of -119 dBm with a 5 dB protection ratio (also see Table D4).

In some scenarios, an apparatus licensee may choose to accept a higher level of interference. In these scenarios, the below advisory note is to be included on their licence to ensure that existing licensees are not negatively impacted. For example, if future modifications are made to an existing spectrum licensed transmitter, from which the apparatus licensee has accepted a higher level of interference, the spectrum licensee will only need to re-coordinate to the level accepted by the apparatus licensee (not to the level in RALI LM8).

*‘The licensee agrees to accept a level of interference which is [xx] dB higher the provided by [the applicable RALI], with respect to a transmitter operated under device registration number(s) [yyyyyy].’* [where ‘xx’ is the amount in which the receiver fails the coordination criteria in the RALI LM8]

Unless otherwise stated, spectrum licensed transmitters that are exempt from registration are not required to be coordinated with PMP services. Although these transmitters have a low risk of causing interference, spectrum licensees should use judgement to identify cases where this risk might be higher than normal, e.g., for operation of high-sited stations. In the event that interference from unregistered spectrum licensed transmitters occurs, the 850/900 MHz spectrum licence contains a condition that registration exempt transmitters must not cause harmful interference to other radiocommunications devices operated under a different spectrum licence or an apparatus licence.[[27]](#footnote-29)

Out-of-band protection requirements for interference from PMP services operating in bands adjacent to spectrum-licensed services are outlined in the ‘*[Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 700 MHz band) 2023](https://www.legislation.gov.au/Series/F2023L00289)*’, and ‘*[Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 850/900 MHz Bands) 2021’](https://www.legislation.gov.au/Series/F2021L01149).*

Coordination of proposed TLMS transmitters with spectrum licensed receivers operating in the 703-748 MHz range or above 890 MHz is not required as the frequency separation is considered sufficient to enable coexistence.

**Additional guidance for coordination with 700 MHz spectrum licensed base transmitters**

The 806-809 MHz TLMS base-receive segment is 3 MHz separated from the upper frequency limit of the 700 MHz spectrum licensed segment which is optimised for the deployment of base station transmitters. For cases where an initial coordination assessment fails, the accredited person and/or licensee may wish to consider more detailed assessment and/or negotiation to achieve a satisfactory outcome. This may include:

* Coordination using actual unwanted emission levels from the spectrum licensed transmitter, which are likely to be less than the maximum limits specified on the licence.
* Consideration of additional filtering on the spectrum licensed transmitter to further reduce unwanted emission levels. This may be particularly relevant when a proposed spectrum licensed transmitter is attempting to coordinate with an existing apparatus licensed receiver.
* Use of actual antenna patterns, accounting the for effects of orientation and tilt.
* Undertaking on-site measurements to assess the actual level of interference coming from an existing spectrum licensed transmitter which may be impacted by higher path losses than anticipated (e.g. resulting from terrain and/or local clutter).
* Engagement with the affected apparatus licensee to ascertain whether they might accept a higher level of interference than the minimum level prescribed in this RALI. For example, where TLMS mobile stations will always be in close proximity to the base station. This may be particularly relevant when attempting to coordinate a proposed apparatus licensed TLMS receiver with an existing spectrum licensed transmitter.

Discussion and negotiation between licensees is encouraged where appropriate and may be necessary to implement some of the above suggestions.

1. E-mail [freqplan@acma.gov.au](mailto:freqplan@acma.gov.au) [↑](#footnote-ref-2)
2. The 400 MHz band (403 to 520 MHz) is defined in RALI MS 22 [4]. [↑](#footnote-ref-3)
3. These frequency bands are defined in RALI MS 42 “Frequency Plan for the VHF Bands (70-87.5 MHz and 148-174 MHz)”. [↑](#footnote-ref-4)
4. 6.25 kHz channelling is applicable in the 400 MHz and VHF High bands. [↑](#footnote-ref-5)
5. When assigning 25 kHz systems in the 400 MHz band all transitional arrangements and limitation set out in RALI MS 22 [4] must be adhered to. [↑](#footnote-ref-6)
6. The frequency band for the 800 MHz trunked land mobile service is defined in RALI MS 40 “Frequency Plan for Services in the 800 MHz Band (803–890 MHz)”. [↑](#footnote-ref-7)
7. SINAD - the ratio of (signal + noise + distortion) to (noise + distortion). [↑](#footnote-ref-8)
8. Base station antenna height is height above ground, which may include building height and tower height if the antenna is mounted atop a building. [↑](#footnote-ref-9)
9. Cavity loss is assumed to be 2 dB [↑](#footnote-ref-10)
10. The model allows for the use of other devices such as isolators or feed-forward amplifiers which give intermodulation performance equivalent to or better than that achieved by a 20 dB in-line attenuator. [↑](#footnote-ref-11)
11. Spectrum Planning report 25/92 “Furthering Productivity of Prime Sites – Advice to Site Managers” contains useful information that is relevant to the issue of spectrum denial at and around popular radiocommunications sites. [↑](#footnote-ref-12)
12. See section 3.3 of the decision paper for implementation timeframes. [↑](#footnote-ref-13)
13. That is, Hata suburban propagation loss, Tx 83 watts eirp, Gr = 0dBi, Hbase = 200m, Hmobile = 1.5m. Which is is -101.4 dBm at 450 MHz. [↑](#footnote-ref-14)
14. Height above average terrain shall be determined by the procedure defined in ITU Recommendation ITU-R P.1546. A minimum of eight equally spaced radials should be used in the calculation. The online tool at <http://www.itu.int/SRTM3/index.html> may be used to calculate EFFHGT. A Digital Elevation Model of 9 seconds of arc or better resolution is preferred. [↑](#footnote-ref-15)
15. Under s46 of the Radiocommunications Act it is an offence to operate a radiocommunications devices unless authorised by a spectrum, apparatus or class licence [↑](#footnote-ref-16)
16. See [Third-party authorisation](https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Apparatus-licences/third-party-authorisation-apparatus-licences-acma) information on the ACMA website. [↑](#footnote-ref-17)
17. As explained in section 5.1.1, the legacy 800 MHz TLMS frequency segment (820-825/865-870 MHz) has been removed to support the final stage of the 803–960 MHz review decision paper. [↑](#footnote-ref-18)
18. For background information see Spectrum Planning Report SP 2/00, “*Review of the ACA Policy on the Assignment of Single Frequency High Power and Low Power Mobile Services in the 400 MHz Band*”. [↑](#footnote-ref-19)
19. Propagation by diffraction, see <http://www.itu.int/rec/R-REC-P.526/en>. Assumptions: K factor 4/3, mobile height 1.5 metres, base antenna height 30m. [↑](#footnote-ref-21)
20. E.g. for an assignment in NSW near the Queensland border, if the threshold level is exceeded anywhere in Queensland the PSD test fails. [↑](#footnote-ref-22)
21. [http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma#schedule](http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma) [↑](#footnote-ref-23)
22. These figures have been derived from applicable standards that specify transmitter emission masks, as shown in Spectrum Planning Report SPP 08/14 (*Derivation of 400 MHz band land mobile frequency-distance constraints used in RALI LM8*). [↑](#footnote-ref-24)
23. It is assumed that harmful interference will occur if the level of the intermodulation product is greater than the usable sensitivity level (RS). [↑](#footnote-ref-25)
24. These are static usable sensitivity levels assumed by the service model for base receivers in built up areas and take into consideration man made noise levels. It is expected that receivers will have bench measured sensitivity levels at their rf input terminals better than those specified. [↑](#footnote-ref-26)
25. Register has the same meaning as in the *Radiocommunications Act 1992*. [↑](#footnote-ref-27)
26. This relaxed criterion is based on receiver performance requirements in ETSI EN 300 113 V2.2.1 (2016-12) and is intended to enhance coexistence between TLMS and 700 MHz spectrum licensed services. [↑](#footnote-ref-28)
27. [Radiocommunications Spectrum Marketing Plan (850/900 MHz Band) 2021](https://www.legislation.gov.au/Details/F2021L01150). [↑](#footnote-ref-29)