RADIO SPECTRUM MANAGEMENT

Assignment of the 3340-3460 MHz Radio Spectrum

Discussion document

1 July 2026

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

New Zealand Government

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ISBN: 978-1-997308-52-2 (Online)

Invitation for submissions

This document sets out proposed options for the use of radio spectrum between 3340 - 3460 MHz in New Zealand and considers relevant technical rules and allocation methods.

Interested parties are invited to comment on the content of this document, in particular the questions posed, and on any related issues. Comments should be submitted in writing, no later than **5pm** on **26 August 2026** to:

By email *(preferred):*

Radio.Spectrum@mbie.govt.nz

Subject line: "Allocation of 3340 - 3460 MHz radio spectrum"

Or

By post:

Allocation of 3340 - 3460 MHz radio spectrum
Radio Spectrum Management Policy and Planning
Ministry of Business, Innovation and Employment
PO Box 2847
WELLINGTON 6140

Any party wishing to discuss the proposals with Ministry officials should, in the first instance, email Radio.Spectrum@mbie.govt.nz

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Except for material that may be defamatory or out of scope, the Ministry of Business, Innovation and Employment (the Ministry) will post all written submissions on the Radio Spectrum Management website at www.rsm.govt.nz. The Ministry will consider you to have consented to posting by making a submission, unless you clearly specify otherwise in your submission.

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Contents

Glossary

Abbreviation / Term	Meaning
3GPP	Third Generation Partnership Project
4G	Fourth generation cellular technology
5G	Fifth generation cellular technology
AI	Artificial Intelligence
BEL	Building Entry Loss
BS	Base Station
BTS	Base Transceiver Station
DbM	Decibel-milliwatt
DEM	Digital Elevation Model
DSM	Digital Spectrum Modulation
ECC	Electronic Communications Committee
FR	Frequency range
FWA	Fixed wireless access
GHz	Gigahertz
GURL	General User Radio Licence
IMT	International Mobile Telecommunications (generic cellular connectivity)
I/N	Interference-to-noise ratio
ITU	International Telecommunications Union
LTE	Long term evolution (4G technology)
MAN	Metropolitan area networks
MNO	Mobile network operator
NF	Near Field
NR	New Radio (the radio terminology for 5G)
RF	Radio frequency
RR	ITU Radio Regulations
RRF	RSM Register of Radio Frequencies
RSM	Radio Spectrum Management (MBIE)
TDD	Time Division Duplex
The Act	Radiocommunications Act 1989
The Crown	The Crown in right of New Zealand, acting through the MBIE Chief Executive
The Ministry	The Ministry of Business, Innovation and Employment (MBIE)
The Regulations	Radiocommunications Regulations 2001
TLA	Territorial local authority
TRP	Total Radiated Power
UE	User Equipment
WAN	Wide area networks
WISP	Wireless internet service provider

Executive Summary

This document seeks your feedback on proposed approaches to make the 3340 - 3460 MHz frequency band available for potential use by regional broadband/fixed wireless access, private mobile networks and mobile services.

The 3340 - 3460 MHz frequency band is the last portion of unassigned spectrum sitting in the wider 3300 - 3800 MHz range, which Government has been considering since 2017. In 2023, assignments were made to:

- regional broadband through spectrum licensing in the 3300 - 3340 MHz band under Crown management rights (expiring 30 June 2033); and
- national mobile networks and Māori, through management rights in the 3460 - 3800 MHz band (expiring June 2043).

Although spectrum was also intended to be assigned for private mobile networks in this process, this use case has not yet been accommodated in the band.

RSM are now looking at appropriate mechanisms and rules to assign portions of the 3340 - 3460 MHz frequency band to private mobile networks, regional broadband/fixed wireless access and potentially mobile services. These use cases would need to be balanced to ensure efficient spectrum use.

Private mobile networks: A private mobile network is a terrestrial wireless network, that likely uses International Mobile Telecommunications (IMT) technology, that is built for a specific location's dedicated use, providing secure, high-performance connectivity for its local area operations. Private mobile networks provide localised coverage of a facility or campus, using dedicated spectrum and network equipment, like antennas and base stations to a range of mobile and fixed devices that could be in indoor and/or outdoor areas. Unlike public networks, they are customised for specific operational requirements, like low latency, high reliability, and robust security, and are often used for critical applications such as industrial IoT, automation, and private data management in areas like factories, ports, logistics hubs, processing plants, transport hubs, stadiums and campuses. Private mobile networks do not include regional broadband, fixed wireless access, or any other macro, metropolitan or wide area networks. Many countries have made spectrum available for private mobile networks under various frameworks. Up to 60 MHz of spectrum would meet nearly all use cases with some outlying use cases needing 80 to 100 MHz.

Regional broadband: Currently 14 licensees with around 300 licences for regional broadband in the 3300 - 3340 MHz range. Over the course of the last year or so the number of licences held in this spectrum range has reduced as some licensees have not met implementation requirements or decided not to retain their licences. RSM propose to use the same assignment process and ruleset that it used in 2023 with some minor improvements. RSM will look to ensure that there is a transparent market-based approach and that regional broadband remains targeted for providing service to end customers with a focus on rural areas.

Mobile: RSM has put forward the possibility of providing additional spectrum for national mobile use. If this were to be provided, the assignment would be on a national basis through management right(s). Questions of acquisition limits, fair assignment and use or lose conditions would need to be considered.

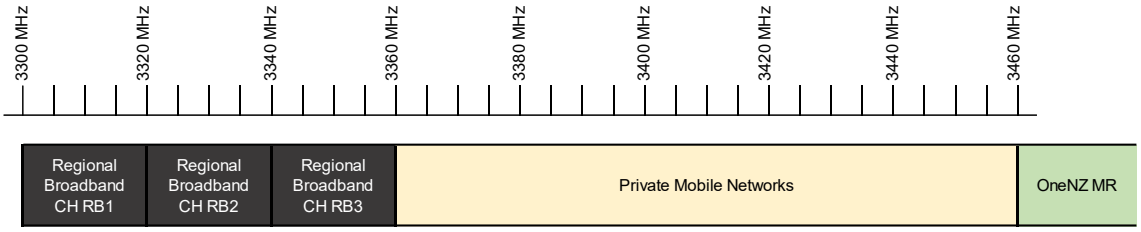
Next steps

After the conclusion of this consultation, RSM expects to publish submissions then begin the assignment process in early 2027.

Our approach - Options and proposals, in brief

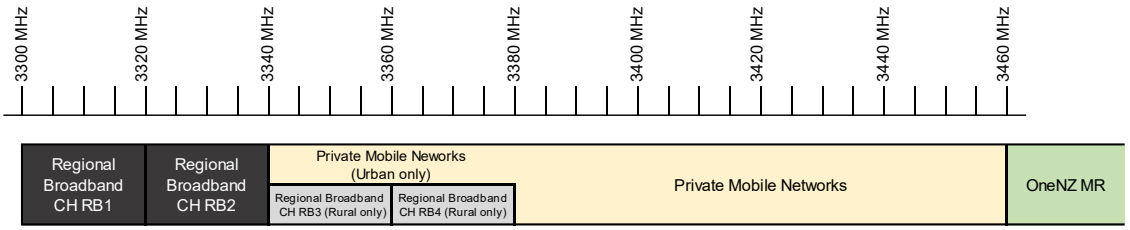
RSM puts forward three options for assigning the 3340 - 3460 MHz frequency range. These options would all make spectrum available to private mobile networks and to make additional spectrum available to regional broadband. Option 3 would also make additional spectrum available to national mobile networks (or another user). Two options include shared use of spectrum between regional broadband and private mobile networks on a geographic basis (urban and rural).

<u>Option One:</u> Nationwide access for regional broadband and private mobile networks



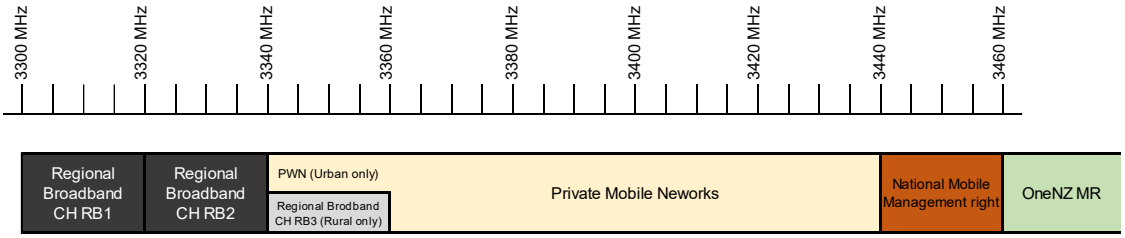
This option provides for an additional 20 MHz for regional broadband nationwide (totalling 60 MHz of spectrum for wireless internet service providers (WISPs) in this band), up to 100 MHz for private mobile networks to use nationwide, and no additional spectrum for national mobile networks.

<u>Option Two (MBIE preferred):</u> Rural access for WISPs, nationwide access for private mobile networks



This option provides for an additional 40 MHz of spectrum for regional broadband in rural areas and up to 120 MHz of spectrum available for private mobile networks (80 MHz nationwide and with an additional 40 MHz in urban areas). No additional spectrum to be made available to national mobile networks.

<u>Option Three:</u> Rural access for WISPs, nationwide access for private and mobile networks



This option provides for an additional 20 MHz of spectrum for regional broadband which would only be available in rural areas, up to 100 MHz of spectrum available for private mobile networks (80 MHz nationwide and with an additional 20 MHz in urban areas), and an additional 20 MHz of spectrum for national mobile networks in a management right.

New spectrum that is made available to the three use cases in the options would have the following apply:

Regional broadband:

RSM propose that the assignment process for regional broadband would follow largely the process undertaken for assigning spectrum to regional broadband in 2023. This process would retain the requirement to provide broadband to end customers. We propose that other connectivity types are not permitted.

For new regional broadband spectrum, minimum spectral efficiency and efficient network planning proposals are being considered.

For options that contain a shared approach, regional broadband would not be permitted to operate in urban areas. Base stations and customer premises equipment (CPS) would need to meet technical limits at the urban boundary to preserve this for private mobile networks.

The existing technical framework set out for 3300-3800 MHz and in PIB 39 will apply for all other aspects.

Private mobile networks:

A new assignment process is proposed in section 8.1 and this would be administrative on a first in first served basis. Strict rules would apply to ensure that the available spectrum is maximised and the utility is maximised while preventing use of the spectrum for other purposes (e.g. uses other than private mobile networks) and spectrum speculation.

Licensing rules include licence categories and classifications, channel plans, bandwidth assignment and spectrum rationing rules, equipment requirements, tuning ranges, power limitations, being bound to land area parcels and licenced to the landowner/lease holder/site manager.

Technical rules would apply including signal strength limits at the licence boundary and define separation distances between networks.

For options that contained a shared approach, private mobile networks would only be permitted to operate in urban areas in that portion of shared spectrum (40 or 20 MHz depending on the option).

National mobile use (or other national user):

The assignment process for additional spectrum for national mobile networks would be done through management right(s) and awarded through a market-based approach (i.e. auction). The existing frameworks would apply. If national mobile networks are allocated additional spectrum, RSM would need to consider requirements on fair assignment so that the placement of this management right does not disproportionately benefit the adjacent management right holder.

Spectrum charging

RSM propose a new spectrum charge for private mobile networks. The proposed framework will calculate spectrum charges using bandwidth, geographic area, and Statistics NZ population density category. Spectrum charges are a product of the characteristics of a license application and will vary between licenses.

RSM also propose two options for charging regional broadband providers for spectrum in 3340 – 3460 MHz:

- Option One: retain all current settings (status quo)
- Option Two: reduce the per-capita rate to $0.06 (RSM preferred).

Should Government agree with Option Two, the changes will apply to all WISP licences in 3.3GHz, including the 2023 allocation, from the financial year beginning July 2027. Before this time only new licences in 3340 - 3460 MHz will be eligible for the new spectrum charge.

Introduction: An efficient assignment of unused spectrum

1. Scope

This paper presents RSM's further review of the 3340 - 3460 MHz band to support regional broadband (e.g. WISPs) and private mobile networks. It also considers providing more spectrum to national mobile networks. The aim is to assign spectrum efficiently for private mobile networks and regional broadband (e.g. WISPs) whilst being technically compatible with other uses, and while ensuring settings are suitable for future technologies and the effective use of the band.

Other frequency bands are not in scope of this consultation. This includes the 3800 - 4200 MHz frequency band which is listed in RSM's indicative work program in its Spectrum Outlook and will be considered in a separate process in due course. Submissions received on other frequency bands (or containing elements on other frequency bands) will be deemed 'out of scope' and will not be considered and returned to the submitter.

2. Previous consultations and decisions

There have been numerous reviews, workshops and consultations, public and targeted, informing the proposals in this consultation document. This process has been in progress since 2017 when RSM began mapping out potential frequency bands for use by 5G technologies within New Zealand, including the 3.5 GHz band under the "Preparing for 5G in New Zealand" work program. In 2019, the Government announced that further development of 5G networks would be enabled by making appropriate spectrum available in the 3.5 GHz band. Public consultation on the proposal for the 3300 - 3400 MHz band to be assigned for broadband services by way of long-term, regional or local rights subsequently occurred in RSM's 2021 discussion document *3.3 GHz Regional & non-national use in New Zealand.*

That consultation proposed that 3300 - 3400 MHz be made available for regional and non-national use (e.g. licenced to different users in different areas of the country). At that time, the 3400 - 3410 MHz frequency range was proposed to be made available for national use as part of the 3400 - 3800 MHz assignment. The two new uses envisaged for 3300 - 3400 MHz in the consultation were regional broadband and private mobile networks.

In March 2022, the Government agreed to include the expand the band from 3410 - 3800 MHz to 3400 - 3800 MHz for national mobile networks (e.g. 5G). Of this, the Government also allocated 3300 - 3400 MHz non a non-national basis for regional broadband and private mobile networks. A process was then run to make spectrum available by July 2023 through spectrum licensing for regional broadband (fixed wireless access that may be used by WISPs).

3300 - 3340 MHz assignment process

In 2023, RSM made two 20 MHz channels and one overlapping 40 MHz channel available in the 3300 - 3340 MHz frequency range to respond needs for Regional Broadband that could be used by WISPs. This reflects that at the time, RSM was told there was a preference for 4G LTE (or LTE-like) equipment, which supports a maximum 20 MHz channel, and that multiple users might seek spectrum in the same area.

The assignment of this spectrum was made available in two stages:

> Stage 1: Initial expression of interest process. For areas with two or more interested parties, auctions were held for with winners receiving a 6-month exclusive right period to licence stations within a specific TLA (ending December 2023).
>
> Stage 2: First in first served licensing anywhere in the country (provided they are compatible with existing licenced stations) which opened on 13 May 2024. This continues to open today for licensing.

3460 - 3800 MHz assignment process

The 3300 - 3800 MHz frequency range is under the management right regime where different portions of the frequency band are held by different managers[1]. In 2023, spectrum awards were made in management rights in the 3460 - 3800 MHz frequency range.

In the 3460 - 3700 MHz frequency range, 80 MHz each was awarded to Spark, 2Degrees, and One New Zealand, requiring them to speed up 5G deployment in small towns to enhance rural connectivity. This involved obligations on each mobile network operator (MNO) to:

- Accelerate the roll out of 5G to small towns across New Zealand.
- Pay the government $24 million between 2023 and 2025. This funded the Rural Connectivity Group to expand mobile coverage into areas of rural New Zealand which would not otherwise have been provided with coverage commercially (for example, rural areas where there are mobile black spots).

These obligations have now been met.

The 3700 - 3800 MHz range (100 MHz of spectrum) was awarded to the Interim Māori Spectrum Commission (now Tū Ātea). Tū Ātea manage this spectrum, on behalf of all Māori.

The 3400 - 3460 MHz band was initially meant for national mobile network use under management rights. Of this 60 MHz, 40 MHz was considered for potential use by Dense Air New Zealand. However, Dense Air, which held the interim 3500 MHz management rights until 30 June 2023, withdrew from the process and negotiations with the government.

The 3300 - 3400 MHz and 3400 - 3460 MHz frequency bands are currently held by the Crown. Management Right 514, which covers the 3300 - 3400 MHz range expires in 2033. Management Right 587 covers 3400 - 3460 MHz and expires on 1 July 2027, this follows Management Right 515 which expired on 30 June 2026. These management rights and periods are largely for administrative purposes while consultation and decision making on the band is underway.

3. Objectives of this assignment

In exploring options for the assignment of the 3340 - 3460 MHz spectrum range, the Crown needs to balance technical considerations with long-term economic and social outcomes and broader policy objectives.

Typically, RSM's approach to radio spectrum management seeks to ensure:

- New Zealanders can choose and use the best wireless technologies for their needs

[1] Management rights can be viewed in the Register of Radio Frequencies.

- Radio spectrum is made available to service providers in a way that is technically optimal and in line with our national interest – including economic and social benefit.

On this basis, Government has agreed to following objectives for the 3340 - 3460 MHz assignment:

1. New Zealand users can choose and use the best wireless technologies for their needs.
2. Spectrum is allocated in a way that enables efficient use of the spectrum – from both a technical and economic perspective.
3. Spectrum-related industries are competitive and enables innovation and growth that supports New Zealand's economic development.

4. Technical framework and conditions

Overall technical framework for 3300 - 3800 MHz

The technical framework for the 3300 - 3800 MHz frequency band was set in 2023 and is technology flexible but has been planned based on particular assumptions. When planning the 3300 -3800 MHz frequency band, it was assumed that technology was 5G NR compliant with 3GPP band n78 and 3GPP Technical Specifications 38.104 and 38.101. This incorporates a number of assumptions including:

- Frequency arrangements, band plans and channelling.
- Minimum spectral efficiency which also drives spectrum needs.
- Spectrum reuse between base stations where reuse can be achieved to maximise spectrum reuse.
- RF performance characteristics in adjacent frequencies including unwanted emissions and receiver selectivity and blocking. It is assumed that mobile stations in the same area (both Base stations and User equipment) can coexist with each other on directly adjacent frequencies (where they are synchronised and using the same default frame structure).
- Synchronisation and frame structure(s).

5G NR technology compliant with 3GPP band n78 and 3GPP Technical Specifications 38.104 and 38.101 is not mandatory and other technologies can be used (e.g. 4G LTE and other proprietary fixed wireless access). However, for the purpose of spectrum planning, technology is assumed to meet these requirements.

Technical conditions have been placed on management rights which also reflect onto spectrum licences created in those management rights. These can be found in the in the RRF and also Appendix 10 of PIB 39). Technical conditions include:

1. Synchronisation Requirement
    a. Primary / Default Synchronisation Frame Structure.
    b. Common phase clock reference and accuracy requirement.
2. AFEL, Unwanted Emission Limits, Protection Limits and Power Floor
    a. Adjacent Frequency Emission Limits
    b. Unwanted Emissions Limits in the Spurious Domain
    c. Protection Limit
    d. Power Floor

Regarding the synchronisation and frame structure requirement, flexibility has been provided for all management rights including both Crown and private management rights through the following condition:

> *"Licenses in management rights that do not conform to the synchronisation requirement must not interfere with licenses in other management rights that are conforming with the described*

synchronisation requirements in this section, and therefore cannot claim protection from interference from such licenses."

This flexibility is utilised in both Crown and private management rights. In practice, this means that if there is an interference issue between two stations where one is not meeting the synchronisation requirement then the onus will be on that licensee to rectify the issue (e.g. through mitigations including reducing power, changing antenna characteristics/pointing, using semi-synchronised or the default frame structure or ceasing transmission/reception). Licensees must cooperate to manage and minimise interference issues with all adjacent licensees. Licensees and their Approved Radio Engineers (AREs) should look to prevent issues before they occur.

RSM expects where licensees choose to use a frame structure other than the default frame structure, they will coordinate and cooperate among themselves to manage this (i.e. self-coordination) and RSM is not involved in this process. RSM's overall assumption is that networks are synchronised the default frame structure is used.

RSM have heard misconceptions that stations not meeting the frame structure requirements have an overall secondary priority status (even for interference issues not related to synchronisation and frame structure). RSM want to clarify that this is not the case. In essence, where licensees choose not to operate on the default frame structure, they take on the risks associated with that specific aspect, which are manageable by the licensee.

The default frame structure approach that New Zealand has set is comparable to other regulatory frameworks which have similar non-mandatory approaches such as recommended or default frame structures. This technical framework is set and is unlikely to be updated anytime soon as it would require consultation and agreement from management right holders and parties within the 3300 – 3800 MHz band (i.e. won't be changed as a result of this consultation). A technical review is planned ahead of the expiry of the management rights in 2033 commencing 30 months beforehand. Any changes will take effect after 30 June 2033.

Specific technical rules for assignment of regional broadband spectrum licences in 3300 – 3340 MHz

For the 3300 – 3340 MHz frequency band the overall technical framework of 3300 – 3800 MHz applies with some additional specific rules for regional broadband/FWA. At the time the rule set was being developed RSM was told that these users did not want to use 5G NR equipment and wished to use LTE like equipment or alternative equipment for a number of reasons but may want to transition at a future point.

For the spectrum licensing of regional broadband/FWA in the 3300 – 3340 MHz frequency band specific rules and technical conditions apply. These are outlined in licensing in section 4.7 of PIB 39.

When 3300–3340 MHz was made available for regional broadband/FWA, RSM understood that some prospective licensees' equipment could not meet the synchronisation and frame structure requirement (the default frame structure). Most proposed using LTE-like Configuration Type 2 frame structure, while some sought semi synchronised or fully unsynchronised operation and any frame structure. RSM therefore recognised LTE-like Configuration Type 2 as a secondary frame structure (to the default frame structure) in the framework and licence conditions[2] noting that there was frequency separation between this use and mobile use. After the rules were set and spectrum was made available, RSM was advised that some procured equipment could operate using the default frame

[2] See section 4.7 'Regional Broadband Use in 3.3 GHz' of the Spectrum Licence Certification Rules for Crown Management Rights (PIB 39)

structure, or a broadly similar downlink and uplink pattern. A longer guard interval is often used to support maximum distances of up to 30 km.

5. Existing spectrum uses in 3300 - 3800 MHz

5.1. Regional Broadband

Regional broadband operators (including WISPs) have access to a range of frequencies and licence types to deliver regional broadband services. These include:

- Regional broadband licences in 'non-national spectrum' such as the 3300 - 3340 MHz band[3]. RSM holds information on 3300 MHz licences, and other licensed bands, in the Register of Radio Frequencies. Further information is provided in section 5.1.1. below.
- General User Licences, such as 2400 - 2483.5 MHz, 5150 - 5250 MHz, 5470 - 5850 MHz and 57 - 71 GHz, along with other shared bands[4]. These bands provide more than 14.6 GHz of spectrum at no cost, but RSM does not hold records on use because individual licences are not required.
- Other licensed bands, including fixed point-to-point links for backhaul or dedicated customer links, such as the fixed 7G, 11G, 13G, 18G, 23G and 80G bands (see PIB 22[5]). RSM holds information on this use in the Register of Radio Frequencies.
- The 2600 MHz Managed Spectrum Park[6]. Access to this frequency range was put on hold in 2021 and is now part of the 2300/2600 MHz management right review process[7].

There are also future opportunities for fixed wireless access in the 24.25–28.35 GHz range following decisions on the 24–30 GHz range[8]. This will make additional spectrum available for non-national networks, although no submissions were received from WISPs in that process.

Use under General User Licences is on a shared basis and users must tolerate interference to reception. To ensure fair sharing, General User licences have power limitations to limit the area of interference, and most technologies use politeness/contention-based protocols (e.g. Wi-Fi's Adaptivity, listen before talk etc) to access the spectrum although some technologies may not use these protocols. An advantage of General User Licences use is flexible and there are no associated licencing fees. Users of General User Licences can operate anywhere in New Zealand without the need to obtain a licence provided that the rules and conditions of the General User Licences are met. A disadvantage is that there is limited scope for management (other than through the technical limits, restrictions, politeness protocols and self-management) so it is possible that WISPs will be using these bands and some may have saturated in some areas. There may be ways that these users can optimise existing use and there will be the ability to expand use in some areas.

Licensed spectrum such as the 3300 MHz band enables managed use and interference protection, supporting more reliable connectivity and quality of service. Access is subject to licensing requirements and, where demand exceeds supply, market-based allocation such as auctions and spectrum charges.

[3] Regional broadband licences | Radio Spectrum Management New Zealand
[4] Short Range Devices GURL | Radio Spectrum Management New Zealand and Fixed Radio Link Devices GURL | Radio Spectrum Management New Zealand
[5] Fixed Service Bands in New Zealand (PIB 22)
[6] Managed spectrum park licences | Radio Spectrum Management New Zealand
[7] https://www.rsm.govt.nz/projects-and-auctions/current-projects/future-allocations-of-2300-mhz-and-2600-mhz-spectrum
[8] https://www.rsm.govt.nz/projects-and-auctions/current-projects/future-use-of-the-24-30-ghz-spectrum

Current regional broadband use

In 2023, RSM made two 20 MHz channels or one 40 MHz channel available in the 3300 - 3340 MHz frequency range to respond to needs for regional broadband that could be provided by WISPs. This reflects that at the time, RSM was told there was a preference for 4G LTE (or LTE-like) equipment. LTE is standardised to support a maximum 20 MHz channel. Two 20 MHz channels were made available to address the possibility that multiple users might seek spectrum in the same area.

RSM hold information in the Register of Radio Frequencies on the current licenced used for the 3300 - 3340 MHz frequency band and the available channels. As of June 2026, there are currently 14 licensees with around 300 licences across the country. It should be noted that this is a simplified count where there are two licences (a pair) per base station (i.e. one for the base station and one for the CPE).

The channels available for licensing contained in PIB 39 are:

- 3300 - 3320 MHz (Channel RB1)
- 3320 - 3340 MHz (Channel RB2)
- 3300 - 3340 MHz (Channel RB12)

Most licensees use 3300 MHz as separate 20 MHz channels across different sectors of a base station or across different sites, rather than using a full 40 MHz channel across all sectors and sites where that is available.

The currently available spectrum is not fully used across the country. Spectrum remains available in many rural and provincial areas where 3300 MHz is not yet licensed, including East Cape, much of the West Coast of the South Island, South Westland and Southland. In some areas, 20 MHz channels are still available for licensing.

Further, in the implementation phase of the 3300 - 3340 MHz regional broadband licences, several licensees have not been able to meet implementation and have cancelled licences. RSM has received a range of feedback on reasons why licensees are cancelling, including:

- Not enough spectrum
- Competition from other broadband providers such as other fixed wireless access providers, fibre providers and satellite operators
- Lack of profitability, operating expenditure and capital
- Difficulty getting equipment. There is plenty of equipment that is available in this frequency band, and we understand that major mobile base station vendors and user equipment supports it. However, WISPs generally seek lower cost equipment that is for the fixed wireless access market, which likely provides a constrained range of choices
- Meeting the minimum end user requirements
- Restrictions on needing to serve end users and not provide other connectivity solutions
- Spectrum charging and fees

Equipment

There is a wide range of equipment that can support 3GPP band n78 from major vendors (i.e. equipment supporting 5G NR). There are different tiers of vendors offering equipment with different price points, features and performance. The equipment that is recorded against licences in the RRF is the following:

- BTI, CPX80P
- CABLE FREE, CF-EMERALD-SC-2X2
- CAMBIUM., 3 GHZ PMP 450M
- CAMBIUM, 450B SM
- CAMBIUM, MEDUSA
- CAMBIUM, 3 GHZ PMP 450I

- CAMBIUM, C035045A003A
- KUHNE KU PA 330360-40 LIN-994
- TELRAD, BREEZE COMPACT
- TELRAD, LTE/5G BASE STATION

This is mostly proprietary Fixed Wireless Access equipment rather than 5G NR equipment. Licensees have generally preferred this equipment as it meets their needs and is lower cost compared to 5G NR equipment. Many of these operators are small businesses, who need to be financially viable and are often building on/complementing existing networks using spectrum under General User Licences (e.g. 5 GHz). RSM understands from operators that there is currently limited equipment in this tier available for the 3300 MHz frequency band at a lower cost.

5.2. Mobile Networks

Mobile networks generally operate across large areas of the country with some frequency bands being used on a near national basis. Traditionally MNOs hold Management Rights which provide the exclusive right to create spectrum licences that cover base stations and user equipment.

MNOs now have widespread deployment of 3500 MHz base stations and a maturing network across the country, so far mostly focused on built up areas. Continued growth in base stations and licences is expected. As of June 2026, the current licenced use is the following:

- **One New Zealand:** 1172 licences (see licence schedule for MR516)
- **Spark New Zealand:** 881 licences (see licence schedule for MR518)
- **Two degrees networks limited:** 673 licences (see licence schedule for MR517)

5.3. Amateur Radio

The 2021 consultation identified existing amateur radio use in the 3300 - 3410 MHz band where users could operate, on a non-interference basis, under the General User Radio licence for Amateur Radio Operators and there was one licenced Amateur station at that time. RSM proposed continued use on a non-interference basis in the short to medium term. RSM received feedback from Amateurs through the consultation[9].

RSM decided to allow to allow continued Amateur radio use in the band under certain conditions. This was enabled by through two General User Spectrum Licences.

- **404591** Licence Summary
- **404593** Licence Summary

Among the conditions on the general user licences, we draw attention to the following:

> Special Conditions 1. These frequencies are used by mobile base stations and user equipment for providing mobile network services. These frequencies may also be used for, or may be, allocated for use by other services. Amateur operators must accept interference from, and must not cause interference to, such services. In addition to 6. General conditions applying to all transmissions under this licence, condition 10, the Crown acting by and through the chief executive reserves the right to cancel this licence at any time.

A more detailed explanation of our decision want sent to NZART at the time and is also available at RSM letter on amateur radio use of 3400 -3410 MHz.

[9] https://www.rsm.govt.nz/assets/Uploads/documents/consultations/2021-3-3ghz/nzart-3.3-ghz-use-in-new-zealand-discussion-document-submission.pdf

In this consultation we are not proposing any changes to this arrangement. Radio Amateurs need to hold a General Amateur Operator's Certificate of Competency (GAOC) and should have the skills to ensure that they avoid interference with mobile systems/FWA systems. RSM continue to encourage amateur operators to take steps to ensure that there is no impact on co or adjacent frequency mobile systems/FWA systems in the area before commencing transmission. RSM will keep a watching brief as mobile, private networks and FWA use increases in the 3300-3410 MHz frequency range.

Proposed spectrum uses for 3340 - 3460 MHz

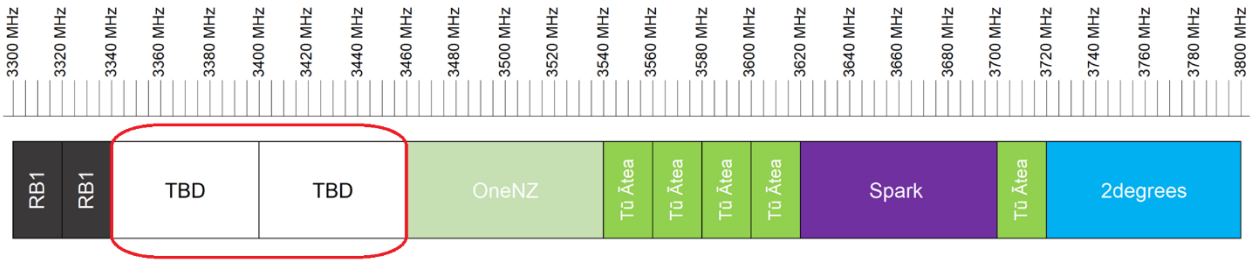


Figure 1: Current usage of the 3300 – 3800 MHz frequency range showing the 3340 - 3460 MHz is still to be determined

RSM have identified possible uses for the 3340 – 3460 MHz range, along with a preferred option. Listed below are the three primary use cases being considered:

1. Private mobile networks
2. Further regional broadband
3. Further national mobile network use.

6. New use: Private mobile networks

Private mobile networks may be used to support the so called “Industry 4.0”, as the phase of digitisation and enhanced technologies used by the industrial sector, supported by the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics. These technologies are to enhance productivity and efficiency, improve quality and also worker safety. An overview of private mobile networks is given in Annex 1.

In the “3300 MHz non-national broadband use in New Zealand” consultation, private mobile networks were covered and anticipated to use spectrum within the 3300 MHz band. To date spectrum has not yet been made available and use cases for private mobile networks are beginning to mature, with multiple deployments internationally and interest increasing in New Zealand.

Between 2019 and 2026, a number of countries have made spectrum available for private Mobile Networks within different portions of the 3300 -4900 MHz frequency range, generally on a shared basis under specific, with different amounts of spectrum available on depending on their national circumstances as outlined in section A1-2.0, Annex 1. Where countries have made spectrum there has been industry adoption has steadily grown in the last few years as outlined in A1-3.0, Annex 1.

In this section of this consultation document RSM has investigated private mobile network technology and international trends including use cases, adoption, regulatory frameworks and their applicability to New Zealand. Section **Error! Reference source not found.** provides specific proposals for technical a ssignment and licensing mechanisms, it makes proposals to make spectrum available in New Zealand. In setting out the different elements and proposals relating to private mobile network, RSM is considering the following factors that inform the development of a framework:

1. **Providing sufficient spectrum** for private mobile networks to deliver their intended services.
2. **Ensuring that there is a range of available equipment**, leveraging global technology ecosystems.

3. **Making the best use of the available spectrum** and ensuring efficient and effective spectrum management.
4. **Maximising the utility of the spectrum** through maximising the number of locations that can get access to spectrum to deploy private mobile networks and allowing different private mobile networks in nearby locations to access spectrum.
5. **Preventing spectrum hoarding and speculation** where a licence is not using or effectively using the spectrum when it could be used by another party. This includes allowing private mobile networks to get sufficient spectrum without acquiring more spectrum than is needed to support their intended services.
6. **Providing fair simplified assignment / licensing approaches** to minimise the burden on applicants and flexibility within a locations / sites / campus as far as practicable.
7. **Ensuring licences are used for their intended purpose** of private mobile networks and having mechanisms to prevent licences being used for other purposes (e.g. FWA, Mobile Networks, Metropolitan and Wide Area Networks) which undermines the purpose of the spectrum.
8. **Minimising administrative and regulatory burdens** so that the regime can be run effectively by RSM within its available resource for the benefit of private mobile network users.

To provide a clear understanding on private mobile networks the definition for the purpose of this consultation is:

> **Private Mobile Network (PMN)** A private mobile network is a terrestrial wireless network, that likely uses IMT technology, that is built for a specific location's dedicated use, providing secure, high-performance connectivity for its local area operations. Private mobile networks provide localised coverage of a facility or campus, using dedicated spectrum and network equipment, like antennas and base stations to a range of mobile and fixed devices that could be in indoor and/or outdoor areas. Unlike public mobile networks, they are customised for specific operational requirements, like low latency, high reliability, and robust security, and are often used for critical applications such as industrial IoT, automation, and private data management in areas like factories, ports, logistics hubs, processing plants, transport hubs, stadiums and campuses. Private mobile networks do not include regional broadband, fixed wireless access, wide area mobile networks or any other macro, metropolitan or wide area networks.

Question 1: Do you agree that spectrum should be made available to private mobile networks and that there is demand for private mobile networks?

Question 2: Do you agree with the 8 factors RSM should consider when making spectrum available to private mobile networks in New Zealand? If not, what would you prefer and what would you suggest on the factors above?

Question 3: Do you agree with RSM's definition of a private mobile network? If not, please provide detail.

6.1. Private mobile network locations, industries and use cases

Based on global adoption and trends, RSM anticipate Private mobile networks to be applicable to a range of industry verticals and location/sites in New Zealand.

Potential private mobile network locations and categorisation

RSM has done a desktop review of potential industrial sites in New Zealand, from publicly available information and GIS / mapping sources and considering that provide localised coverage of a facility or

campus. Based on this review Table 1 provides some typical location categories by area and coverage requirements along with related potential private mobile network design characteristics for those sites.

Table 1: Potential private mobile network locations and network design characteristics

Location categories	Example Sites	Area to Cover (m2)	BTS density (per site)	BTS heights (m)	Device density (per BTS)	Device heights (m)
Outdoor rural	Agriculture fields, Forestry site, Mining open cast	100,000 - 1,000,000	<10	20 - 40	<50	1 - 40
Outdoor urban	Ports, Airport aprons, Logistics yards, Rail yards, Processing plants, Events	10,000 - 500,000	<25	8 – 30	~100	1 - 30
Indoor rural	Processing plants, Power stations	10,000 - 250,000	<50	5 - 15	~500+	1 - 15
Indoor urban	Stadiums, Factories, Warehousing	5,000 - 100,000	<100	3 – 6	~1,000+	1 – 5
Indoor high-rise	Hospitals, Universities	5,000 - 100,000	<100	3 – ≥24+	~1,000+	1 – ≥22

RSM consider that some of the possible locations could be in urban areas where there would be more demand for private mobile networks at more locations in a smaller area where networks could be closer together or have overlapping service areas (i.e. a higher density of networks). This means there may be demand of multiple networks in an area (number of adjacent channels required). Other private mobile networks may be outside the urban areas where the locations would be over a larger area and there would be greater spatial separation between networks and the service areas of these networks would be separated. RSM need to consider both the practical demand for bandwidth of a single network (channel sizes), and the demand of multiple networks in an area (number of adjacent channels required) to ensure there is sufficient spectrum for private mobile networks.

Private mobile networks can be characterised by outdoor (which would include a site with both indoor and outdoor areas) and indoor only deployments. Indoor networks will generally have a greater number of lower power base stations than outdoor networks. Indoor networks also inherently have 'building entry loss' which attenuates the radio signal strength present outside of the building and helps with inter network frequency re-use.

These locations and categorisation and areas are used to inform the proposed technical conditions and assignment rules in section **Error! Reference source not found.** 'Private mobile networks: proposed t echnical conditions, assignment and licensing mechanisms' of this consultation.

Question 4: Do you agree location categorisation, example sites, areas and network design characteristics? Are other private mobile network locations and categories that RSM should be considering?

Potential private industry use cases

A wide range of industry use cases can be expected, and these will continue to evolve with adoption of advanced technologies outlined in Annex 1. The use case technical requirements (e.g. latency, downlink and uplink throughput) are considered in the development the proposals in section **Error! Reference s ource not found.**. Examples of some typical use case requirements for private mobile networks are summarised below in Table 2.

***Table 2*: Private Mobile Network typical industry use case service minimum requirements[10]**

Use-case	2-Way end to end latency max (ms)	Throughput (Mbps)	
		DL	UL
Discrete Automation	10	1 - 10	1 - 10
Remote Control	50	1 - 10	1 - 100
Process Monitoring	50	1	1
Electricity - medium voltage	25	10	10
Electricity - high voltage	5	10	10
Medical Monitoring	100	<1	1
Robot - Sensor/Audio	5	<1	<1
Robot - Video	5	<1	1 - 100
Critical Coms - Voice & MCPTT	30	<1	<1
Critical Coms – MC Video	125	12	12
Critical Coms – MC Data	125	1	1
Live Broadcast Video Feed	150	10	100
Live video for AI 4k	100	1	25
AGV/drones 4x video	150	1	20
Video collab in HD	100	5	5
Video 8K; VR 2K@90fps	5	100	10
Video 4K 3D; VR 1K@60fps	5	50	10

[10] Source: Based on expert experience and on reference materials including 3GPP TS 22.261 Service requirements for the 5G system section 7, Performance Requirements; 5G Americas White Paper, "5G Vertical Use Cases"; NGMN White Paper "5G TDD Uplink")

Video 4K 2D	100	25	5
Video VR 720p@30fps	5	20	2

Question 5: Do you agree with the use cases, latency and throughput figures? Is there something else that RSM should be considering?

6.2. Private mobile networks frequency arrangements and equipment availability

Frequency arrangements and equipment availability

The 3340 - 3460 MHz band falls within the broader 3300-3800 MHz frequency band where the current framework and technical conditions as outlined in section 4 of this document. There is no proposal to change this framework in this consultation (and is highly unlikely to change any time soon). In planning this band, while noting the conditions allow technology flexibility, it was assumed that technology was 5G NR compliant with the following:

- 3GPP band n78
- 3GPP TS 38.104: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Base Station (BS) radio transmission and reception
- 3GPP TS 38.101: 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; User Equipment (UE) radio transmission and reception

At the time this framework was set, global equipment eco-systems, equipment availability and future technology trends were considered. New Zealand users benefit from spectrum band plans that align with international standards within available equipment ecosystems whilst taking a forward-looking view. RSM seeks to ensuring that there is a range of available equipment, leveraging global technology ecosystems.

When considering private mobile networks in the 3340 -3460 MHz band RSM has prepared an up-to-date overview of the relevant 4G LTE and 5G NR standardised frequency bands in Table 3, Table 4 and the related equipment availability and potential global eco-system for 3500 MHz in Table 5 below:

Table 3: 5G NR frequency bands overlapping 3340 -3460 MHz, 3GPP Technical Specification (TS) 38.101[11]

NR band	Duplex mode	Uplink (UL) BS RX / UE TX	Downlink (DL) BS TX / UE RX	Channel bandwidth options (MHz)
n77	TDD	3300 MHz – 4200 MHz		10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100
n78	TDD	3300 MHz – 3800 MHz		10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100

[11] The 5G NR/4G Band 48 (CBRS) is from 3550 MHz – 3700 MHz, outside the range of this consultation

Table 4: 4G LTE frequency bands overlapping 3340 -3460 MHz, 3GPP Technical Specification (TS) 36.101[12]

E UTRA Band	Duplex mode	Uplink (UL) BS Rx / UE Tx	Downlink (DL) BS Tx / UE Rx	Channel bandwidth options (MHz)
42	TDD	3400 MHz – 3600 MHz		5, 10, 15, 20
52	TDD	3300 MHz - 3400 MHz		5, 10, 15, 20

Table 5: Equipment availability - global eco-system for adoption of 3500 MHz 3GPP frequency bands[13]

3GPP Frequency Band	Countries in use	Carriers in use	Devices with support
5G Band n77	13	33	2,757
5G Band n78	57	157	3,257
4G Band B42	3	7	1,560
4G Band B52	0	0	0

RSM also undertook a desktop analysis of commercially available base station equipment and antennas suitable for 5G Band n78 with sub-band 3300 – 3460 MHz operation. A range of suppliers and models were found suitable for private mobile networks, including for outdoor and indoor deployment, integrated and external antenna options of different gain and beamwidths. Based on this analysis RSM consider there is range of readily available equipment that supports 3GPP 5G NR band n78, leveraging global technology ecosystems. RSM consider that equipment used for private mobile networks must be tuneable at least over the entire 3340 - 3460 MHz frequency range (see also section 0)

RSM consider that 'low power' and 'medium power' base station categories (i.e. with limits on effective isotropic radiated power - EIRP) are most appropriate to meet the objective of maximising the utility of the available spectrum. See section **Error! Reference source not found.** for further details a nd A1-2.1 of Annex 1 for some comparisons.

Question 6: What equipment are you seeking to operate in the 3340 -3460 MHz band and do you do you agree with RSM's analysis that there is a range of readily available equipment that supports 3GPP 5G NR band n78 (3300 -3800 MHz)?

Private Mobile Network frame structures and the NZ default frame structure

For 5G NR TDD network deployments one key consideration is the balance of spectrum resources (in the time domain) for 'Downlink' (DL) compared with 'Uplink' (UL) data. This is configured in a semi-static way with the configuration of the TDD frame slot structure. There are a wide range of standardised numerology and frame configurations available in the 3GPP technical specifications (including TS 38.104). However, the eco-system of network and device equipment usually only supports limited common configurations, some common configurations are shown in Figure 2.

[12] The 4G LTE Band 42 only covers the upper 60 MHz of the frequency range of consultation. 4G LTE Band 52 only covers 60 MHz of the spectrum range of this consultation

[13] Source: Frequencycheck.com, Jan 2026

Description	SCS	Rep time	1ms				1ms				1ms		1ms		1ms		Flexible slot symbols														% time	
																															DL	UL
NZ Default 3.3-3.8 GHz (4+1)	30 kHz	2.5 ms	D	D	D	F	U	D	D	D	F	U	D	D	D	D	D	D	D	D	D	D	G	G	U	U					74%	23%
Common Int config (4+2+4)	30 kHz	5 ms	D	D	D	F	U	U	D	D	D	D	D	D	D	D	D	D	D	D	G	G	G	G	U	U	U	U			74%	23%
Uplink enhanced (4+4+2)	30 kHz	5 ms	D	D	D	F	U	U	U	U	D	D	D	D	D	D	D	D	D	D	G	G	G	G	U	U	U	U			54%	43%
Uplink prioritised (4+6)	30 kHz	5 ms	D	D	D	F	U	U	U	U	U	U	D	D	D	D	D	D	D	D	G	G	G	G	U	U	U	U			34%	63%

Figure 2: Common 5G NR TDD frame slot structures (Sources: 3GPP technical specification 38.211 and Appendix 10 of PIB 39 for NZ band default)

The synchronisation, frame structure and TDD slot arrangement utilised by private mobile networks have implications for co-existence between networks, with both co-channel private mobile networks and adjacent users including National Mobile Networks (MNOs) and Regional Broadband networks (e.g. Fixed Wireless Access providers such as WISPs) in the same 3300-3800 MHz band, which by default are assumed to be following the NZ Primary/Default Synchronisation and Frame Structure in figure above. This is outlined in section 4 (see also Appendix 10, PIB 39), where all users in this band (including Mobile Networks and Regional Broadband) operate under the same ruleset and have flexibility on the frame structure they operate (e.g. see the secondary frame structure secondary frame structure used by Regional broadband in section 4). However, if the default is not used the onus will be on that party to prevent and rectify interference issues.

For a range of private mobile network use cases, it is expected that flexibility in TDD frame structure is desired, but for certainty in band planning for co-existence with both co-channel and adjacent channel networks, a default configuration is assumed. Further details on the Proposed technical conditions and assignment licensing mechanisms can be found in section **Error! Reference source not found.**.

Question 7: What frame structures do you wish to operate for Private Mobile Networks and has RSM captured the main options in Figure 2? Would you choose to use a frame structure other than the default frame structure noting the onus will be on that party to prevent and rectify interference issues (see the technical framework in section 4 and section **Error! R eference source not found.** for further details)? Please provide reasons for your views, including any evidence where relevant. We also welcome any additional comments or information that RSM should consider in relation to synchronisation, frame structure, or the operation of Private mobile networks in this band.

Frequency planning for private mobile networks

Frequency planning and spectrum reuse (e.g. reusing the same frequencies) for every sector and base station in the Private Mobile network within the facility or campus are important for making the best use of the available spectrum. More sectors and base stations can be brought online/built (densifying the network) in lieu of obtaining additional spectrum, but this increases technical complexity and often comes at a higher cost than using or obtaining more spectrum (where feasible).

The baseline assumption is that available spectrum (carrier) is used at each base station and that full frequency reuse is achieved (frequency reuse n=1) with intercell interference managed, meaning that the entire available spectrum is used in every single cell, maximising capacity and spectral efficiency.

RSMs understanding is that this can be achieved by private mobile networks.

Question 8: Do you agree that private mobile networks can use available spectrum (carrier) at each base station and that full frequency reuse is achieved (frequency reuse n=1) within the facility or campus? If not, why?

6.3. Spectrum needs of private mobile networks

Private mobile network spectrum needs are driven by both the requirements of the use cases for the location, and the equipment capabilities and network design.

Use case impacts on throughput bandwidth:

- Single user throughput (minimum throughput required for application/service)
- User equipment density
- Application behaviour (QoS, latency, etc.) and aggregate traffic capacity

Network and equipment impact on channel bandwidth requirement:

- Equipment capabilities: bandwidth support, MIMO and antenna configuration, etc.
- Network base station density, sectorisation and optimisation
- TDD frame configuration, and allocation of downlink versus uplink resources (see section 6.2 on Private Mobile Network frame structures and the NZ default frame structure above)

A simplified spectrum needs assessment has been undertaken based on single user throughput (SUT), with a set of assumptions for a range of use cases. The use cases outlined in Annex 1: , show a wide range of single user throughput requirements from less than 1 Mbps to 100 Mbps for both Downlink and Uplink.

To assess the possible channel bandwidth throughput capacity the approach was to assume a reasonable coverage edge maximum data rate. For 5G NR, 3GPP (TS 38.101 and TS 38.104) defines a range of Modulation and Coding Scheme (MCS) indexes which the base station and user equipment will select depending on channel state and signal to noise and interference ratio (SNIR). While there are a range of 28 possible MCS, the selection is an equipment proprietary algorithm. Taking an engineering assumption of a typical coverage edge condition MCS of 7 out of 28 (modulation order 2, QPSK) the theoretical maximum rates can be calculated.[14]

Table 6: Maximum Data Rates for MCS 7 per Channel Size, TDD slot scheme matching current NZ band default

Maximum Physical Layer Throughput for MCS 7			**Bandwidth (MHz)**						
Direction	**MIMO Streams**	**TDD Resources**	**10**	**20**	**40**	**60**	**80**	**100**	
DOWNLINK	4	74%	21	45	93	142	191	240	Mbps
UPLINK	2	26%	4	8	17	27	36	45	Mbps

[14] https://5g-tools.com/5g-nr-throughput-calculator/. *Parameters: MCS 7, for the 5G NR configuration of FR1 (n78), SCS = 30 kHz, standard Cyclic prefix (CP), Downlink 4 MIMO Layers, Uplink 2 MIMO Layers.*

Table 7: Maximum Data Rates for MCS 7 per Channel Size, TDD slot scheme for more enhanced UL resources (see below table above row 3)

Maximum Physical Layer Throughput for MCS 7			Bandwidth (MHz)						
Direction	**MIMO Streams**	**TDD Resources**	**10**	**20**	**40**	**60**	**80**	**100**	**MHz**
DOWNLINK	4	54%	15	33	68	104	139	175	Mbps
UPLINK	2	46%	7	15	31	47	63	80	Mbps

Note these rates are maximums at the physical layer, actual service throughput available to applications could be lower by 5-10%, depending on overheads and the data protocols used.

Comparing these maximum channel data rates to the typical use case single user throughput requirements (Table 6**: Maximum Data Rates for MCS 7 per Channel Size, TDD slot scheme matching current NZ band default** and Table 7**: Maximum Data Rates for MCS 7 per Channel Size, TDD slot scheme for more enhanced UL resources (see below table above row 3)**above) the possible spectrum (channel) bandwidth requirements depending on the TDD slot resource configuration can be observed.

RSM consider, based on analysis above and the supplementary analysis in A1-4.0, Annex 1, that up to 60 MHz would meet nearly all use cases although RSM note that some use cases may need 80 MHz or up to 100 MHz[15]. RSM is also seeking to prevent spectrum speculation, to ensure that different users can access spectrum in nearby areas and that a single user has not taken up all of the available spectrum. RSM note that users may look to seek the maximum amount of spectrum they can, to provide flexibility for future business planning. However, when considering the wider range of spectrum this may be contrary to making the best use and utility of the available spectrum.

Question 9: Do you agree with the assessment of spectrum needs for private mobile networks and that up to 60 MHz would meet nearly all use cases with some use cases requiring more? If not, please provide technical analysis on your spectrum needs.

7. Further regional broadband use

Regional broadband providers (e.g. Fixed Wireless Access providers, WISPs) provide end user broadband services in specific areas around the country. These areas focus on rural areas which may not be served by fibre. Regional broadband providers currently have access to two 20 MHz channels or one 40 MHz in the 3300 - 3340 MHz frequency range and are seeking to expand the available spectrum (see section 5). The existing framework has been used to inform the proposals for technical conditions, assignment and licensing mechanisms in section 8.2.

RSM understands that many regional broadband providers consider that two 20 MHz channels (RB1 and RB2) or one 40 MHz (RB12) channels (40 MHz of total spectrum) is insufficient to deliver their desired services and ensure that their companies remain commercially viable. RSM understands that regional broadband providers are therefore seeking access to an additional two 20 MHz channels or one 40 MHz channels (i.e. additional 40 MHz of spectrum overall) to make 80 MHz total available to regional broadband. Some regional broadband providers have suggested that four 40 MHz channels total (160

[15] 100 MHz is the maximum bandwidth standardised for frequency range 1 in 3GPP specifications

MHz) be made available to regional broadband, which would be the entire 3300 - 3460 MHz frequency range.

Spectral efficiency and spectrum needs

Regional broadband providers will have different network configurations to achieve different real-world throughput and user outcomes. These differences can affect their spectrum needs. Providers will also balance equipment and infrastructure costs against their business models, existing licenced spectrum, and any other spectrum they use (e.g. general user licences).

While many regional broadband providers are using various proprietary technologies, the baseline assumptions on spectral efficiency for the 3300-3800 MHz frequency band are based on 3GPP compliant 5G NR technology as per the technical framework outlined in section 4. This shows a calculated baseline for the purpose of this consultation.

Throughput/Data rate

The baseline assumptions for regional broadband network base stations throughput / data rate are outlined in Table 8 using a simplified single user throughput (SUT) method and a basic online tool[16]. The assumptions are from Appendix 10, PIB 39 (see also section 4) and it is assumed that 4 Layers / streams will be achieved for the maximum rate where 1 Layer / streams will be achieved at the cell edge. This gives the calculated maximum rates. In practice, when considering real world conditions, overheads and multiple users the experienced rate is lower.

Table 8: Spectrum efficiency assumptions for regional broad band network base station throughput / data rate (Downlink)

Maximum and cell edge	20 MHz channel	40 MHz channel
Maximum throughput (assuming MCS 27 -28)	233 -243 Mbps	485 - 506 Mbps
Cell edge rate case for 20 MHz channel (assuming MCS 0 -5)	10 -32 Mbps	21 -67 Mbps

From reviewing some vendors specifications, it is understood that some equipment can achieve a maximum single user throughput of around 450 Mbps in a 20 MHz channel and 800 Mbps in a 40 MHz channel which is above the maximum throughput rates calculated above. RSM also understands that for some equipment, stakeholders may only able to achieve a peak single user throughput of 144 Mbps in a 40 MHz channel which is about what 4G LTE can achieve in a 20 MHz channel (i.e., can only achieve half the data rate). RSM note that it has have received mixed information and messages on what can be achieved by equipment, the actual rates may not be within a range that relates to the calculated values.

Frequency planning and spectrum reuse

Frequency planning and spectrum reuse (e.g. reusing the same frequencies) for every sector and base station in the network are important for maximising use of the available spectrum. More sectors and

[16] https://5g-tools.com/5g-nr-throughput-calculator/

base stations can be brought online/built (densifying the network) in lieu of obtaining additional spectrum, but this increases technical complexity and often comes at a higher cost than using or obtaining more spectrum (where feasible).

The baseline assumption in the technical framework is that a 20 or 40 MHz carrier is used at each base station and that full frequency reuse is achieved (frequency reuse n=1) with intercell interference managed, meaning that the entire available spectrum is used in every single cell, maximising capacity and spectral efficiency.

RSM's understanding is that this is largely not achieved by regional broadband providers and separate frequencies are used for different cells (see also section 5) and this is common for the preferred type of equipment in this band. RSM also understand that regional broadband licensees frequency reuse is n=2 reuse meaning that 40 MHz channel cannot support 360-degree coverage and separate 20 MHz channels need to be used for different sectors on a site. It is understood that most of the current equipment that is preferred by regional broadband operators cannot achieve full frequency reuse (frequency reuse n=1). Meaning that for each site / base station the equipment used by regional broadband providers may require up to twice as much spectrum to compared with site / base station using 5G NR mobile equipment to deliver comparable services.

RSM also understand that if more spectrum were to be made available (e.g. up to a total of 60 MHz or 80 MHz – see section 0) some equipment may not be able to support 60 or 80 MHz carriers.

Question 10: What throughput/Data rate(s) can be achieved by Regional Broadband networks? Can these networks use available spectrum (carrier) at each base station and that and can full frequency reuse is achieved (frequency reuse n=1)

8. Further mobile use

Further spectrum for national Mobile networks may be sought by the current mobile network operators or another party. Data demands are continuing to grow for mobile networks and additional spectrum can help meet this demand as well as reduce or delay the need to build additional base stations (densify the network). 5G NR can support up to 100 MHz carriers and in some cases in-band carrier aggregation could be used to make use of bandwidths greater than 100 MHz, although this comes with complexities. Additional spectrum will likely be sought when mobile network operators look to roll out 6G in the future.

RSM understands that there are discussions in 3GPP on the possibility of supporting up to 200 MHz carriers for 6G standards where it could be possible for MNOs to support 6G carrier bandwidths of 120 MHz or potentially 140 MHz in the 3500 MHz band. However, it is unlikely that these discussions will be concluded in the near future. A decision on 200 MHz carriers would then take further time to be included in normative standards (3GPP release), be incorporated into products and then be deployed by mobile network operators. 6G is expected to be standardised around 2028 with commercial networks expected in the 2030s.

Spectral efficiency and spectrum needs

Different MNOs will have different configurations and achieve different real-world throughput and user experiences. MNOs will also balance procurement costs and infrastructure build against their business models and available spectrum alongside other spectrum they are hold as well as carrier aggregation across multiple bands. It should also be noted that 3500 MHz is aggregated with other frequency bands (necessary in 5G non standalone). MNOs use 3GPP compliant equipment and the following shows a calculated baseline for the purpose of this consultation.

Throughput / Data rate

The baseline assumptions for mobile network base station throughput data rate our outlined in are outlined in Table 9 using a simplified single user throughput (SUT) method and a basic online tool[17]. The set of assumptions from Appendix 10, PIB 39 (see also section 4) and it is assumed that 4 layers / streams will be achieved for the maximum rate where 1 layer / stream will be achieved at the cell edge. This gives the calculated maximum rates. In practice, when considering real world conditions, overheads and multiple users the experienced rate is lower.

The baseline assumptions for regional broadband network base stations throughput / data rate our outlined in are outlined in Table 8 using a simplified single user throughput (SUT) method and a basic online tool[18]. The set of assumptions from Appendix 10, PIB 39 (see also section 4) and it is assumed that 4 Layers / streams will be achieved for the maximum rate where 1 Layer / streams will be achieved at the cell edge. This gives the calculated maximum rates. While mobile networks may not achieve these rates in all real-world conditions, the rates achieved are within a range that relates to the calculated values.

Table 9: Spectrum efficiency assumptions for mobile network base station throughput / data rate (Downlink)

Maximum and cell edge	80 MHz channel
Maximum throughput (assuming MCS 27 -28)	993 -1035 Mbps
Cell edge rate case for 20 MHz channel (assuming MCS 0 -5)	44 -138 Mbps

Frequency planning

As with regional broadband spectrum reuse (e.g. reusing the same) frequencies for every sector and base station in the network are important for maximising use to of the available spectrum. More sectors and base stations can be brought online/built (densifying the network) in lieu of obtaining additional spectrum, but this increases technical complexity and often comes at a higher cost than using or obtaining more spectrum (where feasible).

The baseline assumption is that an 80 MHz carrier is used at each base station and that full frequency reuse is achieved (frequency reuse n=1) with intercell interference managed, meaning that the entire available spectrum is used in every single cell, maximising capacity and spectral efficiency.

RSMs understanding is that this is achieved by mobile network operators.

Question 11: Do you agree with the throughput/Data rate(s) can be achieved by Mobile Networks? Do you agree that these networks use available spectrum (carrier) at each base station and that and full frequency reuse is achieved (frequency reuse n=1)?

[17] https://5g-tools.com/5g-nr-throughput-calculator/
[18] https://5g-tools.com/5g-nr-throughput-calculator/

Options on how the 3340 - 3460 MHz frequency band is made available

There are three proposed options for assigning the currently unused 3340 - 3460 MHz frequency band to Regional Broadband (fixed wireless access), private mobile networks and national mobile networks. The preferred option is Option Two as it provides the best balance between providing spectrum for regional broadband that is used to serve rural areas and providing sufficient spectrum to private mobile networks. For the definition of urban and rural in the context of this document, see A2-1.0, Annex 2 along with technical framework for sharing in A2-3.0, Annex 2.

Option One: Nationwide access for regional broadband and private mobile networks

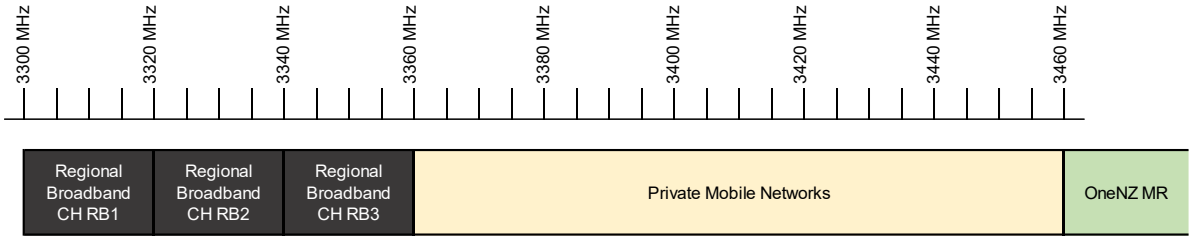


Figure 3: Option One provides an additional 20 MHz (60 MHz total) for regional broadband and 100 MHz for private mobile networks

This option is outlined in Figure 3 and provides:

- An additional 20 MHz of spectrum for regional broadband which means a total of 60 MHz available. Licensing would be available anywhere in the country and would be in accordance with the proposals in Section 8.2.
- Up to 100 MHz of spectrum available for private mobile networks. Licensing would be available anywhere in the country and would be in accordance with the proposals section 8.1.

Under this option, there is no additional spectrum that would be made available to national mobile networks. This option provides the greatest flexibly for regional broadband and private mobile network operators where they can seek licences anywhere in the country. This option will also minimise technical and administrative burden. This option does not maximise the spectrum that could be used for regional broadband and private mobile network, noting that regional broadband is targeted at rural areas and private mobile networks will likely have the highest demand in urban areas.

Option Two (RSM preferred): Rural access for regional broadband, nationwide access for private mobile networks

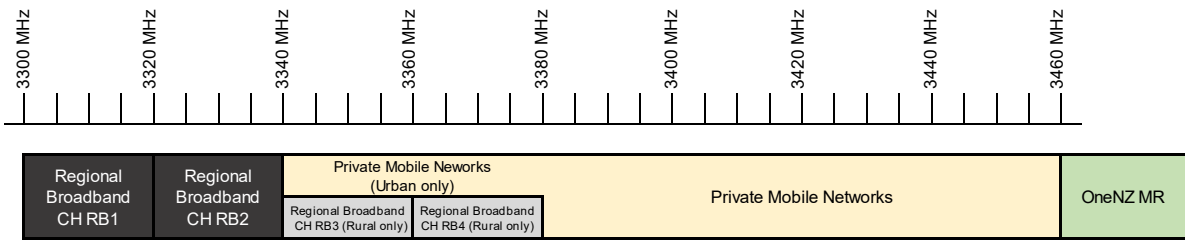


Figure 4: Option Two provides an additional 40 MHz for regional broadband in rural areas and 120 MHz for private mobile networks (of which 40 MHz would only be available in urban areas)

This option is outlined in Figure 4 and provides:

- An additional 40 MHz of spectrum for regional broadband which will only be available in rural areas. This will mean that a total 80 MHz available to regional broadband in rural areas. Licensing would be in accordance with the proposals in Section 8.2. The existing 40 MHz in 3300 -3340 MHz would remain available across New Zealand and the new 40 MHz in 3340 – 3480 MHz would only be available in rural areas in line with the definitions in A2-1.0, Annex 2 with technical restrictions applying, see framework in A2-3.0, Annex 2.
- Up to 120 MHz of spectrum available for private mobile networks. 40 MHz of this in 3340 – 3480 MHz would only be available in urban areas and the remaining 80 MHz in 3480 -3460 MHz would be available across the entire country. Licensing would be accordance with the proposals in section 8.1.

Under this option, there is no additional spectrum that would be made available to national mobile networks. This option maximises the spectrum that could be used for regional broadband and private mobile networks noting that regional broadband is targeted at rural areas and private mobile networks will have the highest demand in urban areas. This option provides the best balance between the different use cases.

Option Three: Rural access for regional broadband, nationwide access for private and mobile networks

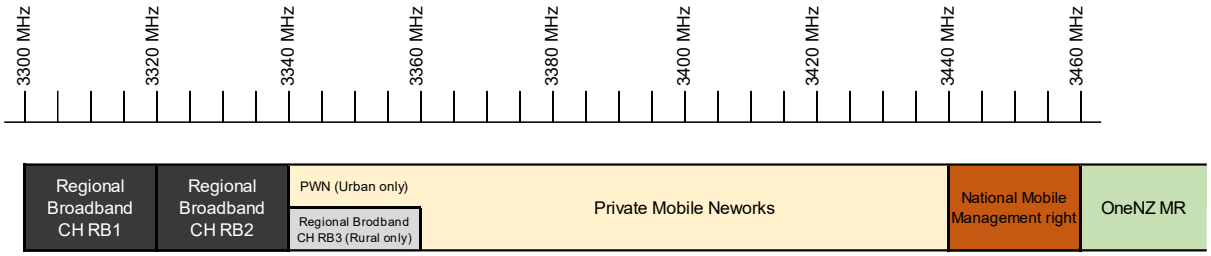


Figure 5: Option Three provides an additional 20 MHz for regional broadband in rural areas and 100 MHz for private mobile networks with 20 MHz of this being urban only. This option also provides an additional 20 MHz for national mobile networks

This option is outlined in Figure 5 and provides:

- An additional 20 MHz of spectrum for regional broadband which will only be available in rural areas. This will mean a total of 60 MHz available to regional broadband in rural areas. Licensing would be in accordance with the proposals in section 8.2. The existing 40 MHz in 3300 -3340 MHz will remain available across New Zealand and the new 20 MHz in 3340 – 3460 MHz would only be available in rural areas in line with the definitions in A2-1.0, Annex 2 with technical restrictions applying, see framework in A2-3.0, Annex 2..
- Up to 100 MHz of spectrum available for private mobile networks where 20 MHz in 3340 – 3460 MHz would only be available in urban areas in line with the definitions in A2-1.0, Annex 2 and the remaining 80 MHz in 3460 -3460 MHz would be available across the whole country. Licensing would be accordance with the proposals in section 8.1.
- An additional 20 MHz of spectrum would be provided for national mobile networks in a management right.

This option provides additional spectrum to mobile networks which could allow existing operators to enable the maximum 100 MHz channel in their networks or to allow a new entrant to access spectrum nationwide. This option would likely favour the immediate adjacent management right holder and consideration would need to be given on how a fair assignment process is run. Assignment would likely be through a market mechanism (e.g. auction), see proposals in section 8.3. This option provides

additional spectrum to regional broadband while balancing sufficient spectrum access for private mobile networks noting that regional broadband is targeted at rural areas and private mobile networks will have the highest demand in urban areas.

Question 12: What is your preferred option for making the 3340 – 3460 MHz band available? Please provide details on why.

Proposed technical conditions, assignment and licensing mechanisms

8.1. Private mobile networks: Proposed technical conditions, assignment and licensing mechanisms

RSM consider the that the appropriate assignment mechanism for private mobile networks is 'first-in-first-served' basis rather than a market mechanism approach, but to ensure that demand does not exceed supply (or is managed appropriately) as set of rules will need to be put in place to ensure there is sufficient spectrum for private mobile networks.

RSM need to consider both the practical demand for bandwidth of a single network (channel sizes), and the demand of multiple networks in an area where networks are nearby and frequency re-use cannot be achieved (number of adjacent channels required). Factors impacting spectrum demand include:

- Use case and services' throughput requirements and minimum channel bandwidth
- Demand for private mobile network sites and their location/density in an area
- Equipment specifications, performance and eco-system.

To maximise the utility of the available spectrum, RSM need to consider ways to ensure individual deployments meet their coverage requirements but minimise excessive emissions from the facility / campus and inter-network interference. Factors impacting spectrum utility (re-use) include:

1. Coverage requirements either outdoor or indoor and area size.
2. Equipment specifications and performance
3. Channel bandwidths sizes and plan
4. TDD synchronisation and frame structure
5. Power-levels of base stations and user equipment
6. Design limits on base station and user equipment heights
7. Boundary coverage level limits to ensure good design of base station placement and antenna selection

In developing the assignment proposals below, RSM consider these 7 factors as the basis for a licensing framework to meet the spectrum assignment objectives.

The framework needs to be set to minimise the administrative burden for both application and management.

Different options for making spectrum available are proposed in section 7 where between 100 -120 MHz in urban areas and 80 - 100 MHz in rural areas total spectrum is proposed to be made available to private mobile networks which may need to serve multiple users / networks.

RSM will look to implement new private mobile licencing frameworks to fit within its broader existing frameworks (e.g. licensing rule sets, licence certification regime etc) set out in the PIBs (with appropriate updates) and to work within the RRF. Although not widely implemented, some

frameworks of some countries have database or dynamic database approaches for 3500 MHz (e.g., CBRS in the US), these are complex to implement and solve specific national spectrum management issues for those countries (e.g. sharing between government and commercial users) that do not apply to New Zealand. RSM's approach is based on simple static licencing / administrative approaches and would not consider a database approach for 3500 MHz at this stage. Implementing database approaches for 3340 -3460 MHz in New Zealand would likely be bespoke and take considerable resource and time from industry and RSM.

Proposed low power and medium power limits and equipment power categories

RSM propose to set limits on the base station and user equipment effective isotropic radiated power (EIRP) are required to meet the objective of maximising the utility of the available spectrum. These limits are contained in Table 10**: Proposed power limits for 'low power' and 'medium power' base station and user equipment** as 'low power' and 'medium power' base station limitations along with user equipment EIRP limitations and would meet the majority of typical coverage requirements with a global equipment eco-system available. High power macro base stations would not be permitted as these have broad coverage and would limits the number of locations that can get access to spectrum for private mobile networks (spectrum sterilisation) and not maximise the utility of the available spectrum.

These limits would be implemented in a licensing framework. The limits are comparable to some other international licence constructs for private mobile networks where A1-2.1, Annex 1 gives a comparison, noting Annex 1: there are a range of power limits implemented.

Table 10: Proposed power limits for 'low power' and 'medium power' base station and user equipment

Equipment Category	Maximum Power Limit
Low Power Base station	≤ 27 dBm/channel for BW ≤ 20 MHz EIRP ≤ 24 dBm / 10 MHz for BW > 20 MHz EIRP
Medium Power Base station	44 dBm/channel for BW ≤ 20 MHz EIRP ≤ 41 dBm / 10 MHz for BW > 20 MHz EIRP
User equipment (all)	Mobile / Nomadic 28 dBm EIRP Fixed 28 dBm EIRP

Question 13: Do you agree with the proposed equipment (base station and user equipment) power categories in Table 10 providing a balance of coverage and frequency re-use? If not, please provide specific details, including the impact on spectrum reuse / sterilisation.

Proposed license attributes, location categories, area limitations and other limitations

Private mobile networks provide localised coverage of a facility or campus, for the required use case (see the definition in section 6) and must be designed to limit the coverage to those areas (also see section 8.1.1). Private mobile networks are not for macro, metropolitan or wide area networks and to ensuring licences are used for their intended purpose maximum area limits are proposed.

Specific attributes and licence categories are proposed to make the best use of the available spectrum and ensure efficient use and co-existence with other Private mobile networks. This also seeks to maximise the utility of the spectrum by providing a framework for multiple private mobile networks applicants to access spectrum. These attributes and proposed categories are contained in Table 11 and the resulting licence categories are in Table 12**: Proposed licence categorisation of private mobile network licences and technical conditions** based on urban or rural areas, outdoor or indoor deployments and ongoing or temporary durations.

Table 11: Private mobile network License attributes summary

Proposed PMN license categories Attribute	**Category**	**Area Description**	**Definition**	**Conditions**
Region	Urban	Places with likely more dense private mobile network demand	See A2-1.0, Annex 2 Note definition is aligned with other regional band users	Available 100 or 120 MHz shared bandwidth (see section 7) Smaller coverage areas
	Rural	Places with likely larger private mobile network coverage requirements, but shared demand with Regional Broadband	See A2-1.0, Annex 2 Note definition is aligned with other regional band users	Available 80 or 100 MHz shared bandwidth (see section 7) Larger coverage areas
Deployment	Outdoor	Outdoor deployments of irregular size, need more inter-network isolation considerations Includes outdoor and any indoor buildings	Polygon area definition linked to LINZ land parcel/s for the site/premise E ach BS individually licensed (section 8.1.1)	Medium or Low Power Base Stations Base Station and User Equipment height limits
	Indoor	Indoor only deployments benefit from building isolation for denser reuse	License point at centre of building/s within relevant LINZ land	Restricted to Low Power BS

			parcel (section 8.1.1) Unlimited BS	
Duration	On-going	Permanent network deployments need certainty of operations	On-going licenses (section 8.1.1)	Use or lose within 12 months
	Temporary	Event, incident or temporary operations need only short-term license	License up to 2 months (section 8.1.1)	No repetition within 6 months

Private mobile network locations in urban areas would typically be expected to have coverage areas that are smaller than in non-urban areas, although urban networks would be expected to be denser (closer together). Outside urban areas coverage requirements would typically be expected to be larger, with greater area separation this is outlined in section 6.1.

Private mobile networks can also be characterised as either outdoor (including a site with indoor and outdoor areas) or Indoor only deployments. Indoor only networks will generally have more lower power base stations than outdoor networks. They also have inherent building entry loss which attenuates the signal entering or exiting a building and helps with inter network frequency re-use.

Area limitations are needed to ensure that licences are being used for their intended purpose of private networks (see above). Restrictions will also be put in place to ensure that multiple areas are not aggregated together to form a sprawling network.

RSM consider that there needs to be limitations placed on both Base station and User Equipment maximum heights as this has an impact on spectrum reuse. Where base stations or user equipment at greater heights may require greater spatial separation between networks (e.g. may become line of sight to other nearby private networks)

RSM consider that categorisation of licences with specific technical conditions is important to maximising the utility of the spectrum and to help ensure licences are used for their intended purpose.

RSM proposed to use this categorisation and technical conditions in **Error! Reference source not f ound.** above, to inform the development of a licensing framework alongside other factors.

Table 12: Proposed licence categorisation of private mobile network licences and technical conditions

	Category		**Technical Conditions**		
	Area	**Deployment**	**Max Land Area (m^2)**	**Base station Category**	**Base station and User equipment maximum height (AGL)**
A	Urban	Outdoor	500,000	Medium or low power	20 m
B	Urban	Indoor	32,000	Low power	NA

C	Rural	Outdoor	1,000,000	Medium or low power	30 m
D	Rural	Indoor	100,000	Low power	NA

Question 14: Do you agree with the licence attribute and the proposed licence categories including associated technical conditions such as area, base station category and maximum height outlined Table 12? If not, are there other key private mobile network location coverage requirements you foresee for private mobile networks in New Zealand? Please provide details.

Proposed minimum spectral efficiency requirements

The 3340 - 3460 MHz spectrum range is a limited resource with competing demand from multiple use cases. Accordingly, we are considering the introduction of minimum spectral efficiency requirements for private mobile networks under the options outlined in section 7 in portions of the 3340 - 3460 MHz. These requirements would include:

- Equipment must be capable of supporting throughput / data rates that are comparable to 5G NR as outlined in Section 4 and 6.3
- Equipment must be capable of supporting the full bandwidth of the licence / assignment (see channel plan in section 8.1.1 depending on the option in section 7)
- Networks must be planned where the available spectrum is used in every single cell (n=1), maximising capacity and spectral efficiency.

It is anticipated that private mobile networks using 3GPP compliant 5G NR equipment would meet these requirements, but this would prevent use of less efficient equipment being used for private mobile networks.

Question 15: Do you support minimum spectral efficiency requirements in the 3340 - 3460 MHz band? Please provide reasons for your view, including any anticipated benefits, risks, or implementation challenges.

Proposed channel plan and assignment process

The channelling for the band n78 (3300 -3800) is outlined in section 6.2 is 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100. However, to maximise the utilisation of the band portion for private mobile networks in New Zealand, a subset of these channel options is considered. To reduce the risk of fragmentation / minimise inefficiency and to simplify channel assignment and compatibility between systems, channels of 10, 20, 40, 60 and 80 MHz are considered.

RSM propose a channel plan based on 10 MHz with 10, 20, 40, 60, 80 MHz channels available in **Error! R eference source not found.** below. Note that while other channels are available in n78 these have not been included as this risks fragmentation and could complicate spectrum management and frequency co-ordination.

RSM will also require that any equipment used must be tuneable at least over the entire 3340 - 3460 MHz frequency range given any channel may be assigned.

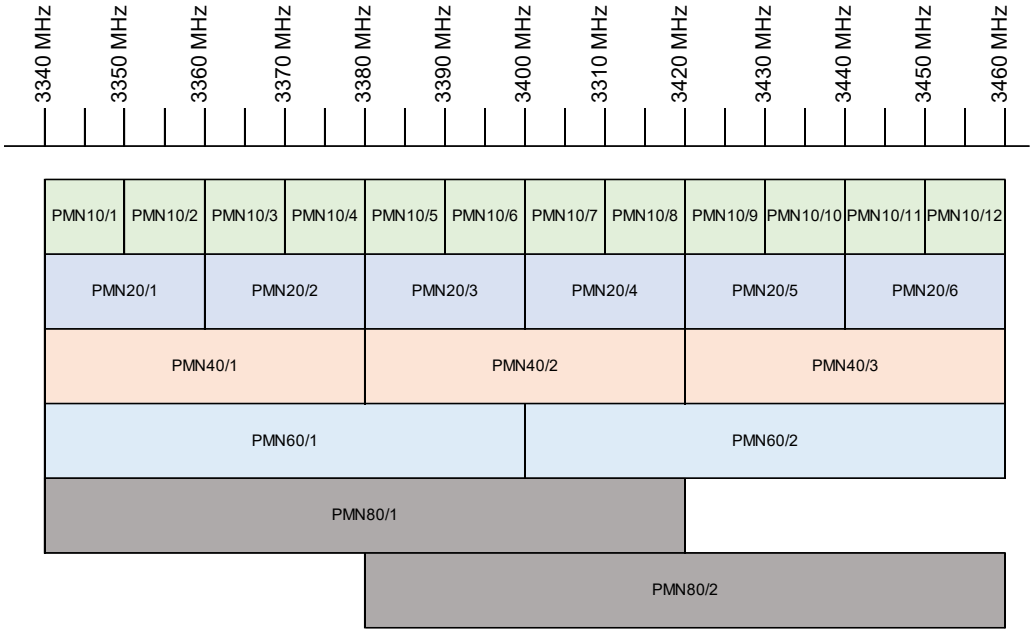


Figure 6: Proposed channel plan for Private mobile networks supporting10, 20, 40, 60, 80 MHz channel bandwidths

Proposed channel assignment and stacking

Channels will be assigned adjacent (no frequency separation) to neighbouring Private mobile networks and co-channel with geographically disperse Private mobile networks. Based on the location of the private mobile network different channel stacking order is proposed:

Table 13: Proposed Channel Stacking order

Private mobile network region	Potential adjacent band usage	PMN Channel stacking
Urban	Higher for Mobile lower for regional broadband	Bottom to top
Rural	Higher for Regional broadband lower for Mobile	Top to bottom

Question 16: Do you agree with the proposed channel plan and adopting a subset of the available channels to reduce the risk of fragmentation / minimise inefficiency and to simplify channel assignment? Do you agree that equipment will be required to have a tuning range covering 3340 -3460 MHz? Do you agree on the proposed channel stacking order? If not, what do you suggest, please provide details.

Proposals on managing channel bandwidth assignments to allow multiple nearby users

There is a limited amount of available spectrum that will need to be used by multiple users, potentially in nearby areas. The use-case-based spectrum needs and estimates are in Section 6.1, and new use cases will emerge over time. It is important to make the best use of the available spectrum to get the maximum utility as well as prevent spectrum hoarding and speculation. Based on the options in Section 7, the assignment of bandwidth (channel size) per license is to be determined in consideration of the following:

1. The details of service use-case requirements detailed in the application: Analysis of the preferred and minimum bandwidth requirements for site.
2. The region zone either Urban or Rural where total bandwidth available for private mobile networks varies:
    a. Urban areas have 100 - 120 MHz total bandwidth available (depending on the option)
    b. Rural areas have 80 – 100 MHz total bandwidth available (depending on the option).
3. The deployment either Outdoor or Indoors: Outdoor deployments have larger coverage and isolation area requirements reducing spatial frequency reuse. Indoor deployments can benefit from more frequency reuse and therefore larger bandwidth allocations.
4. Local geography and neighbouring current or potential Private mobile network sites: Each location will have different potential for co-channel contention for spectrum.
5. An assignment for potential temporary events or incidents: Ad-hoc Private mobile network demand which may be expected (like events) or un-foreseen (like urgent construction and repairs or disaster recovery)[19].

To reduce the risk of first movers getting an advantage over other potential nearby users (e.g. overlapping or nearby private mobile networks where spectrum reuse is not possible), RSM propose three options to address this:

Option A: Expression of interest process

Upon implementation or a licensing framework for private mobile networks and before opening it for licensing, RSM would undertake an expression of interest process and collect information on planned private mobile networks and their requested bandwidth to determine if there are potential nearby users (e.g. overlapping or nearby private mobile networks where spectrum reuse is not possible) requesting the same overlapping channels then undertake a process to resolve these conflicts. This process could take some time to work through, and it is would not address use cases that come at a later stage.

Option B: Spectrum rationing (preferred)

Spectrum rationing would allow prevent any one applicant to apply for a channel that uses most or all of the available spectrum and will instead be limited in an initial assignment, after a period of time, if there is no application from a potential nearby user (e.g. overlapping or nearby private mobile networks where spectrum reuse is not possible) then they may apply to increase the channel bandwidth.

- The spectrum rationing limits will apply to any new licence applicant for a location / site for 12 months from the commencement of the licence. This will apply regardless of when the application is made. This allows time for other users in adjacent sites to determine if they have an interest in operating a private mobile network who may apply

[19] It should be noted that RSM already has general rules (PIBs) and provision for nonconventional requests and special events.

- After 12 months from the commencement of the licence at the location, the licensee may apply to increase the bandwidth up to the maximum values set out in Table 14 provided that it is technically compatible with other use in the area.

This process would be the fastest way to make spectrum available to applicants, but they would need to wait until the end of the 12-month rationing period before seeking additional bandwidth, allowing time for other potential nearby users to express interest and apply for spectrum.

Table 14: Proposed Spectrum rationing approach to managing channel bandwidth assignments to allow multiple nearby users

	Category		Bandwidth / maximum channels	
	Area	**Deployment**	**Initial rationing among (first 12 months)**	**Maximum bandwidth allowed**
A	Urban	Outdoor	40 MHz	60 MHz
B	Urban	Indoor	60 MHz	80 MHz
C	Rural	Outdoor	60 MHz	80 MHz
D	Rural	Indoor	None	80 MHz

Option C: Technical approach

This approach would require the development of a technical approach based on considerations 1 -5 where this will likely require the identification of most potential current and future sites along with collection of detailed information from applicants to assess them. The distances defined for 'Inter-Private Mobile Network Protection and Isolation' in section 8.1.1 may also inform this. This could take time to develop and could be more administratively burdensome.

Question 17: Do you agree private mobile networks with the need to have measures to reduce the risk of first movers getting an advantage over other potential nearby users (e.g. overlapping or nearby private mobile networks where spectrum reuse is not possible) to maximum utility as well as prevent spectrum hoarding and speculation? If so, which option do you prefer and why?

Proposal to require that equipment is capable of synchronising and operating the default frame structure

Noting the technical framework for 3300-3800 MHz is set (see section 6.2.1), any new private mobile network users in the 3300-3800 MHz band operate under the same ruleset where the default restructure would apply. Where use case requirements prefer a non-default TDD frame structure, the network must be designed to ensure non-interference operation to other licenced stations using the default structure. In practice this the licensee will need to undertake analysis and possible coordination with adjacent users ahead of commencing transmission to ensure that there is sufficient isolation and interference is prevented, should interference occur they the licence must immediately implement mitigation measures. Further information is provided in section A2-3.4, Annex 2.

All users in the 3300-3800 MHz frequency band have this flexibility. RSM consider that this is the most efficient and flexible way to manage spectrum and provide spectrum access to users. The approach of assuming synchronisation (under the default frame structure) is comparable with the approach taken in other regulator frameworks including the 'shared access licences' by Ofcom UK[20].

[20] https://www.ofcom.org.uk/spectrum/frequencies/shared-access

RSM proposed to include a requirement that equipment used must be capable of operating the default frame structure (e.g. in the case the network needs to switch to the default as a mitigation).

Question 18: Noting that the overarching framework and technical conditions for the 3300–3800 MHz band are already established (see section 4), including a default frame structure and synchronisation approach, do you agree that equipment deployed for Private Mobile networks must be capable of operating using the default frame structure?

8.1.1. Proposals for assignment and licensing mechanisms

The specific assignment and licensing mechanisms proposed are considering the factors provided in section 6. These proposals are outlined in this section below.

Outdoor per base station area licensing proposal: Based on LINZ land parcel

For Outdoor licences (Category A and C – see Table 12**: Proposed licence categorisation of private mobile network licences and technical conditions**) licences are proposed to be based on LINZ land parcel[21] polygons. The following attributes are proposed:

- The area base stations are allowed to be placed is a polygon comprising of relevant land parcel(s)
    - No base stations will be permitted to operate outside this area
    - This polygon is recorded as a protection area recorded on licences and in the RRF
- Each base station within this area must be individual licenced for the protection area above, there is no limit on the number of base stations that can be licenced
- Base stations can be Medium or Low Power equipment category (see Table 10**: Proposed power limits for 'low power' and 'medium power' base station and user equipment**)
- Areas may comprise of multiple land parcels as long as they are contiguous (not disconnected)
    - Areas are to be no larger than the area limits set out in Table 12**: Proposed licence categorisation of private mobile network licences and technical conditions** and aggregating areas is not permitted
- Areas are to be no larger than the area limits set out in Table 12**: Proposed licence categorisation of private mobile network licences and technical conditions**
- No user equipment will be permitted to operate / be served outside of this polygon.

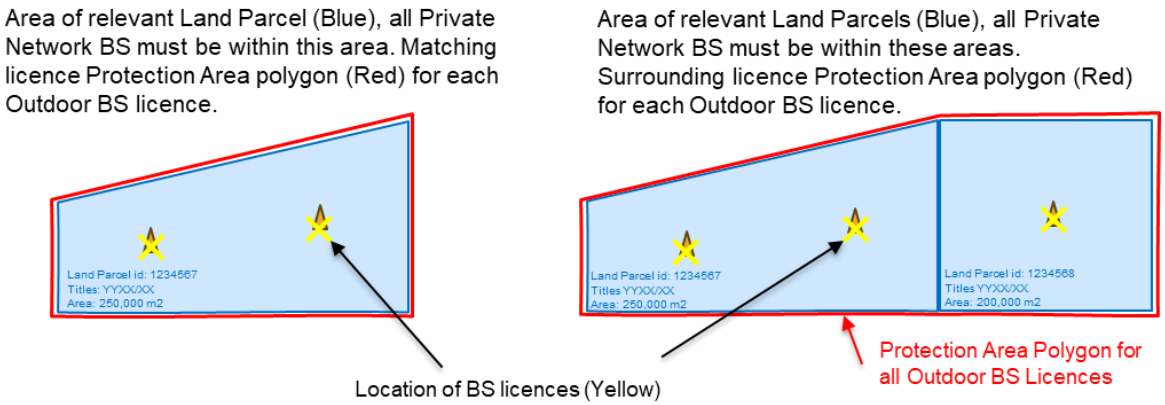


Figure 7: Examples of Outdoor per base station area licensing

[21] https://data.linz.govt.nz/layer/50823-nz-primary-land-parcels/

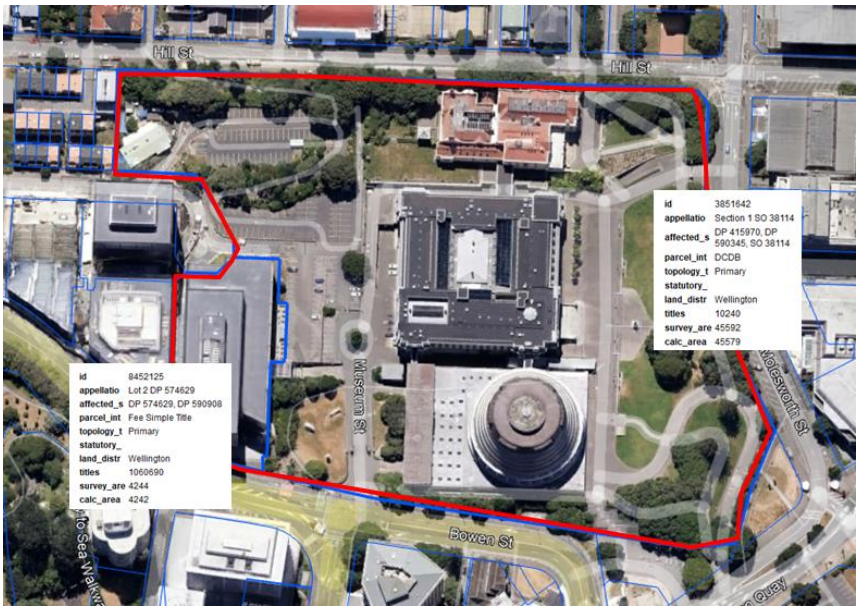


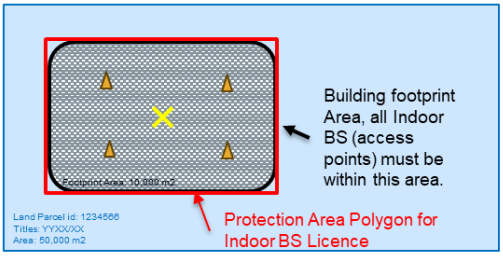
Figure 8: Sample outdoor licence polygon area (Red) comprising two relevant land parcels (Blue

Indoor Building licensing proposal: Based on LINZ land parcel and the building footprint polygon

For indoor licences (category B and D) licences are proposed to be based on LINZ land parcel and the building footprint polygon. The following attributes are proposed:

- The location recorded in the RRF is the centre point of the building identified in a relevant land parcel[Error! Bookmark not defined.]. The building footprint polygon is recorded as a protection area r ecorded on licence and in the RRF.
- An unlimited number of low power base stations can be placed within the building. No base station will be permitted to operate outside the building
- Building footprint area is to be no larger than the area limits set out in Table 12**: Proposed licence categorisation of private mobile network licences and technical conditions**.
- All base stations must be indoor and Low Power equipment category.
- Multiple buildings may be covered with a location for the centre point of the building. Up to a maximum of 4 locations are permitted for a licensee for a campus.
- No user equipment will be permitted to operate / be served outside of this polygon.

Area of relevant Land Parcel (Blue), all buildings must be within this area. Centre point of building recorded on BS licence (Yellow). Building footprint area matches Licence Protection Area polygon (Red) for Indoor BS licence. Unlimited Indoor BS/AP within this area.



Centre point of the buildings recorded as the BS licences. Relevant building footprint forms Licence Protection Area polygon (Red) for each Indoor BS Licence. Unlimited Indoor BS/AP within these areas.

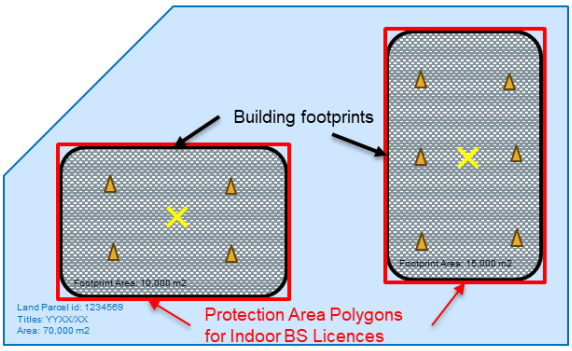


Figure 9: Example indoor building licence for one and two buildings on same land parcel

Figure 10: Sample indoor licence area for building in relevant land parcel (Blue), with BS Licence location at building centre (Yellow) with licence area polygon matching building footprint (Red)

Question 19: Do you agree with the proposed attributes for outdoor and indoor licensing of private mobile networks? Do you have any feedback on these proposals?

Licence holder proposal: Landowner, lease holder or designated site manager

The licensee should be the landowner, lease holder or designated site manager. This entity will take on the 'site manager concept.' For example, a spectrum licence for a commercial airport should be in the name of the airport operations company, or a site manager designated by that company. Licences will be non-transferable to ensure spectrum speculation does not occur.

If there is a dispute, we propose that the landowner will have the final say on who can hold the licence and, based on a request, RSM may cancel the licence. The landowner must provide proof they are the landowner including the title, and evidence that the licence is located on the land. In the event that RSM receive such an application, it will inform the licensee of the intention to cancel.

The source for land ownership and area definitions will be from Land and Information New Zealand (LINZ) Property Ownership & Boundaries dataset.**Error! Bookmark not defined.**

Licence Tenure proposal: Only as long as required, up to a 30 June 2033

It is expected that Private mobile networks could be deployed either long term (years) e.g. as part of site infrastructure, for a period (months) e.g. during a construction project, or temporarily (weeks) e.g. for events, harvesting of crops or forest etc.

The licence duration should only be set as long as it is required, and the maximum period is until 30 June 2033 (when the management rights are due to expire). Licences cannot be set beyond this period. However, as per the normal working practice (e.g. see section 4.4 of PIB 59) ahead of the expiration of the management right RSM will review these determine if what happens upon expiry.

Event licences must be only for the duration is needed for a maximum period of 2 months with a non-repeat period of 6 months from the expiry of the licence.

Temporary licences proposal: Maximum duration 2 months, no repeat for 6 months

Temporary licences can be for any deployment in Urban/Rural and Outdoor/Indoor Categories A, B, C or D above (see Table 12**: Proposed licence categorisation of private mobile network licences and technical conditions**), but are only for specific short-term industrial activities or events such as agricultural or forestry harvesting, construction sites, concerts and sports events. These licences have the same license rules as on-going licenses, but there are strict rules on their use and no renewals. These have the following attributes:

- Licence can have a maximum duration of 2 months.
- Repetition is not allowed for a 6-month period. Repetition is:
    - The same licensee in the same TLA. This allows to undertake different events around the country.
    - The same location. If there is a desire to have multiple events at the same location then a standard ongoing license is more appropriate.

Use or lose proposal: Statutory declaration required within 12 months

For on-going licences within 12 months of being granted a licence the licensee must implement their system. A statutory declaration is required within 12 months of the licence commencement date to declare that the system is operational. Note that false declarations are a criminal offence under Section 111 of the Crimes Act 1961. Where the licensee has not implemented and no statutory declaration has been received the licence will automatically be cancelled by RSM and that licensee cannot submit an application for that location or overlapping and nearby locations for a 12-month period.

For temporary licence the licensee is expected to implement their system for the period stated in their application (up to the maximum of 2 months). If they fail to do so, subsequent licence applications may be refused. Statutory declarations are not required for temporary licences.

Question 20: Do you agree with the proposals on temporary licences, licence tenure, licence holder and use or lose? Do you have any feedback on these proposals?

8.1.2. Proposals on technical limits on coverage and compatibility between private networks

Proposal on coverage licence boundary threshold limits

RSM propose to set a boundary coverage level limit of: -84 dBm / 10MHz

This boundary power level limit which would apply at the boundary of the licences area (see Figures 11 and 12 below as well as section **Error! Reference source not found.**1). This boundary level limit will be u sed for setting the licensing and planning rules. Should there be issues at a future stage (e.g. when another party looks to implement a nearby private network) the licensee may need to ensure that the boundary level limit is met (e.g. fall back to this level).

Outdoor networks with medium power base stations, are expected to be able to utilise antenna directivity (direction / azimuth and down tilt / elevation) and power (base station power and / or maximum antenna gain) to achieve required coverage, without exceeding boundary coverage level limit.

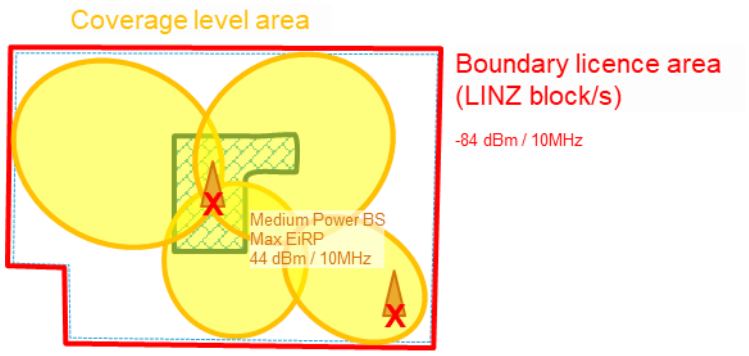


Figure 11: Example Outdoor Private mobile network deployment with medium power base stations with coverage constrained by antenna selection and design.

For indoor networks with low power base stations, multiple "assess point" type deployments are expected with mainly omni-direction antennas. The building external wall attenuation loss is expected to allow required indoor coverage levels, without exceeding boundary coverage level limit.

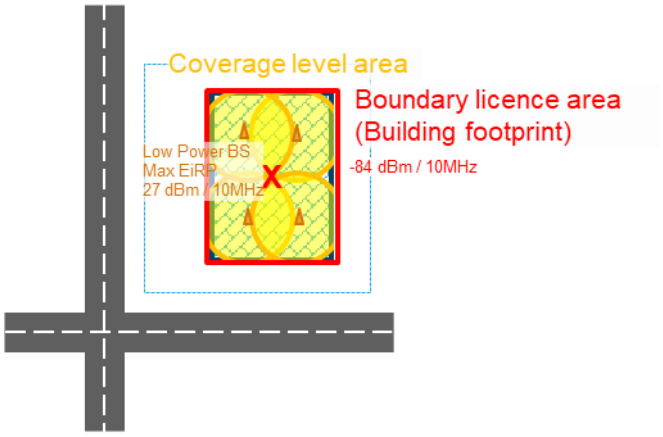


Figure 12: Example Indoor Private mobile network deployment with multiple low power basestations with coverage constrained by building loss.

Private mobile network base stations and user equipment will not be permitted to operate outside the licenced area (see section 8.1.1). While radio waves do not stop at boundaries and there will be signals present beyond these boundaries, when planning coverage, it is important to aim to constrain it within the bounds of the area on the licence as much as possible. This should minimise signals beyond the boundary and interference to nearby current or potential networks.

Based on the outdoor area maximum coverage areas proposed, and if we assume that area is a square, the diagonal could be the maximum coverage range for a single base station (i.e. one sectorised BS in one corner) in Table 15.

Table 15 Calculated comparison of Private mobile network outdoor coverage range and level

Licence type	Max area (m^2)	Diagonal range (m)	EIRP (Medium Power BS	Clutter Loss (P.2108, Suburban, Rural)	Range FSL	Licence boundary Edge level	UE Receiver noise floor	SNR
Urban Outdoor	500,000	1,000	44 dBm / 10 MHz	25 dB	103 dB	-84 dBm / 10 MHz	-95 dBm / 10 MHz	7 dB
Rural Outdoor	1,000,000	1,414	44 dBm/ 10 MHz	21 dB	106 dB	-83 dBm / 10 MHz		8 dB

The assumptions are contained in A2-4.0 and include: Private mobile network UE with typical parameters of ECC Report 358, Table 1[22] and Report ITU-R M.2292, Table 4[23] and -4 dBi antenna gain and 9 dB receiver noise figure.

The 7 dB level of SNR should provide a design margin to support an adequate throughput (SINR) accounting for system loading and coverage irregularity around the boundary for outdoor networks within a building for indoor. Actual coverage will depend on clutter (buildings, machinery, vehicles and foliage) and any terrain features on the site.

RSM also considered other licensing constructs and studies for shared (co-channel synchronised) use in similar frequency bands in other counties and regions when determining this level which can be found in Table 16 below:

Table 16 Sample of shared co-channel synchronised system coverage limits

System	Licence Boundary coverage level (normalised assuming 50 ohm systems with a receive antenna gain of 0 dBi)	Licence Boundary field strength	Location where the limit applies	Reference / source
ECC, WBB LMP (Wireless Broadband Low/Medium Power networks) in the band 3800-4200 MHz	-84 dBm / 10MHz	61 dBµV/m/5 MHz at 3 m	Exclusive licensed local area edge	Draft ECC Recommendation (26)03.[24]
ECC, Cross-border mobile / fixed communications networks (MFCN) in the band 3400-3800 MHz	-78 dBm / 10MHz	67 dBµV/m/5 MHz at 3 m	National border	ECC (15)01 recommendation.[25]
NZ, Regional Broadband in 3300 - 3340 MHz	-75 dBm / 10MHz	76 dBµV/m/ 20 MHz	Regional Broadband licence polygon	PIB 39, 4.7. Regional Broadband Use in 3.3 GHz, 4.7.2

[22] https://docdb.cept.org/document/28615
[23] https://www.itu.int/pub/R-REP-M.2292
[24] https://cept.org/files/2099/Draft ECC Recommendation (26)03.docx
[25] https://docdb.cept.org/document/515

				Engineering, Coverage.[26]
US, CBRS	-80 dBm / 10MHz		Census tract boundary at 1.5 m	§ 96.41 General radio requirements.[27]

Question 21: Do you agree with approach of have licence boundary coverage level limit of -84 dBm / 10MHz? Are there other private mobile network boundary coverage considerations RSM should consider, please provide details?

Proposals on inter-Private Mobile Network Protection and Isolation

RSM propose for inter-private mobile network co-existence, to set:

- A protection limit of -95 dBm / 10MHz based on a protection criteria of 0 dB I/N for private mobile networks
- For assessing new private mobile network licences to existing private network licence separation or 'cull' distances (i.e. neighbouring area for consideration, networks beyond these distances are not considered) are the following:
  - 5 km for outdoor to outdoor,
  - 3 km for indoor to outdoor
  - 0.5 km for indoor to indoor licences.
- Where the separation distance is less than these figures, an analysis is required (see A2-2.0, Annex 2)

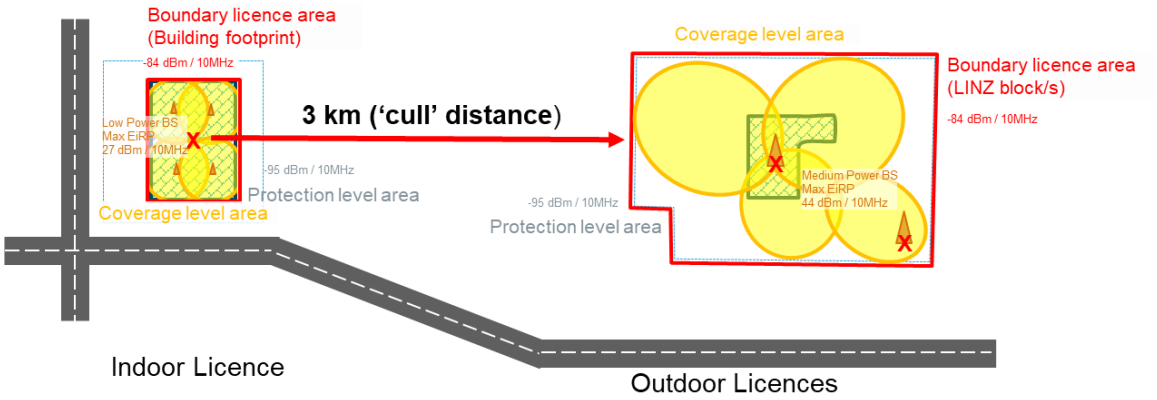


Figure 13: Example Indoor and Outdoor Private mobile network licence protection level areas

Multiple Private mobile networks are expected in nearby areas. Where inter-network interference potential can be shown to be below required protection levels, those networks can operate co-channel or on overlapping frequencies. If they do not meet the required protection level they will need to operate on adjacent channels and divide the total available bandwidth.

[26] https://www.rsm.govt.nz/about/publications/pibs/pib-39
[27] https://www.ecfr.gov/current/title-47/chapter-I/subchapter-D/part-96/subpart-E/section-96.41

When assessing interference it is to assumed that networks are synchronised and on the default frame structure (see section 8.1). The relevant interference scenario is Base Station to other network private network User Equipment, being considered more stringent than the converse user equipment to base station case.

The protection criteria is 0 dB interference to noise (I/N) criteria based on adoption in other regulatory frameworks[28] to improve spectrum reuse. Taking a typically assumed noise figure for the UE of 9 dB (ECC Report 358, Table 1[29] and Report ITU-R M.2292, Table 4[30]) the derived receiver noise floor would be -105 dBm / MHz. Therefore, for a protection criteria of 0 dB I/N the protected level would be -105 dBm / MHz, or -95 dBm /10MHz channel.

Based on the parameters in assumptions are contained in A2-4.0, Annex 2, four example deployment scenarios are derived:

Table 17: Sample PMN system parameters for BS-UE case

Scenario	BS height (m)	P_t (dBm/ 10MHz)	G_t (dBi)	Ant off-axis (dBi)	UE height (m)	Clutter Loss (dB)	Building Loss (dB)	Body loss (dB)	G_{UE} (dBi)
Outdoor open	30	34	10	-3	1.5	21	0	0	-4
Outdoor industrial	20	34	10	-3	1.5	25	0	0	-4
Indoor	3	21	6	0	1.5	28	24.4	0	-4
Indoor highrise	>15	21	6	0	>15	0	24.4	0	-4

Calculating the link pathloss to the interference protection level for User Equipment (-95 dBm/10MHz), the following minimum inter-network separation distances (with a “smooth-earth” propagation model (ITU-R P.452-18) would be required for co-channel (synchronised) operation:

Table 18: Sample PMN range of co-channel Interference scenarios for synchronised BS-UE case. (Note: Based on propagation model P.452 with smooth earth at 3400 MHz)

Base station of new private network	User Equipment of the existing private mobile network			
	Outdoor Open	Outdoor Industrial	Indoor	Indoor Highrise
	Calculated separation distance (km)			
Outdoor (Med Power)	2.58	1.67	0.06	1.68
Indoor (Low Power)	0.031	0.020	0.001	0.020

Taking a conservative view of this analysis, the inter-network distances to be considered for co-channel mutual interference assessment could be for:

- New outdoor licence: any existing outdoor licences within ~5 km, and indoor licences within ~3 km.

[28] See Draft ECC Recommendation (26)03 https://cept.org/files/2099/Draft%20ECC%20Recommendation%20(26)03.docx and Ofcom UK, OfW 590 - Technical Frequency assignment Criteria for Shared Access Radio Services, https://www.ofcom.org.uk/spectrum/frequencies/shared-access.

[29] https://docdb.cept.org/document/28615

[30] https://www.itu.int/pub/R-REP-M.2292

- New indoor licence: any existing outdoor licences within ~3 km, and indoor licences within ~0.5 km.

These separation distances can be used as a 'cull' distance meaning that networks beyond these distances do not need to be considered. This simplifies the assessment process, reducing administrative burden while maximising spectrum reuse. Further detail on the application can be found in A2-2.0.

Question 22: Do you agree with approach for inter-network interference protection based on 95 dBm / 10MHz based on a protection criteria of 0 dB I/N? Do you agree with the separation or 'cull' distances? If not, please provide details?

8.2. Regional Broadband: Proposed technical conditions, assignment and licensing mechanisms

RSM will look to largely use its existing framework and licensing rules for Regional Broadband, expanding this to new spectrum that may be made available. This section outlines matters for discussion on that framework and potential changes.

RSM is proposing two options for making spectrum available for regional broadband.

Option A (RSM preferred): Expression of interest, followed by auction and first in time licensing

RSM propose making spectrum available for regional broadband in two stages:

Stage One: An Expression of Interest (EOI) process will be used to assess the level of demand within a given area. To submit an EOI, respondents are required to provide their business name and contact details to RSM. This information is necessary to verify the legitimacy of submissions, enable follow-up engagement where required, and ensure the process reflects genuine market interest rather than speculative or non-serious expressions.

- Areas with more than one interested party would go to auction. The auction would provide exclusive rights to licence transmitters within a given area for a period of six-months.
- Areas with one or less interested parties would be available on a 'first-in' basis.

Stage Two: First in first served licensing will be available for unassigned areas following the six-month exclusive rights period (provided they are compatible with existing licenced transmissions).

RSM consider that a market-based approach to licensing spectrum for regional broadband provides a fair and transparent process. RSM's previous experience is that demand has exceeded supply, with all areas of New Zealand receiving more than one expression of interest in the 3300 - 3340 MHz assignment process. The use of an EOI process enables RSM to assess genuine demand and differentiate between contested and uncontested areas. This aims to provide a proportionate approach, using auctions where demand exceeds supply to allocate spectrum to those who value it most, while enabling timely, lower-burden access in areas with limited demand.

This two-step assignment process broadly aligns with the 2023 assignment process for the 3300–3340 MHz band. The same specific rules and licence agreement requirements would apply to licences issued in this band. More information is available on RSM's website.

Option B: First in time licensing only

Under this option, spectrum would be assigned on a first-in, first-served basis to applicants that meet pre-defined technical and eligibility criteria. This approach enables rapid access to spectrum, as licences can be issued following a simple notification process without the need for a preliminary demand assessment or auction.

This model provides a low-cost, administratively efficient pathway to access spectrum and may be well suited to areas with limited or uncertain demand, where more complex allocation mechanisms may be disproportionate. It allows operators to acquire spectrum incrementally as required, supporting flexible and responsive deployment, particularly for smaller or regional providers.

However, RSM's previous experience indicates that demand for spectrum in comparable bands has exceeded supply, with all areas progressing to auction under the 2023 Expression of Interest process for the 3300–3340 MHz band. In this context, a first-in approach may not effectively manage competing demand and could risk assigning spectrum to early applicants rather than those who place the highest value on its use. This may reduce overall assignment efficiency.

Question 23: Do you have an interest in applying for regional broadband licences should further spectrum be band available and in what area? Which is your preferred option for assigning spectrum to regional broadband? Why?

Rules on service provision

The assignment process in 2023 was specifically targeted at delivery of broadband to end customers, particularly for rural connectivity (e.g., Fixed Wireless Access provide by Wireless Internet Service Providers). RSM propose that the requirement of delivery of broadband to end customers remain in place. The end-user requirement would be for the length of the licence duration and will not be modified.

RSM is of the view that the objectives of spectrum for regional broadband remain the same as in 2023 where it is for end user connectivity in rural areas. RSM note that urban areas are already well provided for, with many connectivity solutions available.

In line with the 2023 regional broadband assignment process, RSM propose that other use cases are not permitted (e.g. business to business, telemetry and telecommand solutions). If different use cases were to be permitted (e.g., non-end user broadband) this would change the nature of a potential assignment process. This would likely receive significantly more interest from a wider range of parties looking to provide different connectivity solutions. In turn, this would likely drive up the demand and therefore the value of the spectrum both in an auction process and potentially in charging (see Section 10). On the other hand, RSM would expect to see the spectrum more heavily utilised by a broader range of licensees.

Question 24: Do you agree that the spectrum should continue to be limited to the delivery of broadband to end customers? If not, why and what do you propose the spectrum should be used for?

Targeting Rural connectivity

RSM consider that the main purpose of this spectrum should remain for rural connectivity and not urban connectivity. While urban areas were not excluded from the 2023 process, in two of the options proposed in Section 0 (including the preferred option) a sharing model based on a geographic approach is proposed where private mobile networks would be permitted in urban areas and regional

broadband in rural areas (see A2-2.1, Annex 2 for definitions). This means that regional broadband would not be permitted in urban areas in those frequencies and would need to meet specific requirements outlined in A2-3.2.3, Annex 2 where emissions from regional broadband system must not exceed a field strength of 56 dBuV/m/20MHz anywhere in the urban areas as defined in A2-3.2, Annex 2.

Question 25: Do you agree that the regional broadband spectrum should be targeted for rural connectivity and not urban connectivity? If not, why and what do you propose?

Minimum spectral efficiency requirements

The 3340–3460 MHz spectrum range is a constrained resource with competing demand from multiple use cases. It is therefore important that it is allocated and utilised efficiently to maximise overall value. RSM has identified opportunities for existing regional broadband operators to improve the efficiency where new spectrum is sought. Accordingly, RSM are considering the introduction of minimum spectral efficiency requirements for new spectrum made available to regional broadband users under the options outlined in Section 7 in portions of the 3340 – 3460 MHz. These requirements would include:

- Equipment must be capable of supporting throughput / data rates that are comparable to 5G NR as outlined in Section 4
- Equipment must be capable of supporting the full bandwidth of the licence / assignment (e.g. 20 MHz, 40 MHz, 60 MHz or 80 MHz depending on the option in Section 7)
- Networks must be planned where the available spectrum is used in every single cell (n=1), maximising capacity and spectral efficiency. This would also apply to existing licensees in 3300 -3340 MHz seeking additional spectrum in 3340-3380 MHz (e.g. those licensees seeking to expand spectrum use).

These new spectrum efficiency requirements would not apply to the current 3300-3340 MHz portion of the band, and the settings would remain the same for current and future licences. This means that users can continue to use equipment of their choosing in the 3300-3340 MHz provided that it meets the current requirement under the technical framework and PIB 39 and they are not seeking spectrum in 3340 -3380 MHz.

Question 26: Do you support the introduction of minimum spectral efficiency requirements for regional broadband using new spectrum in the 3340 - 3380 MHz band? Please provide reasons for your view, including any anticipated benefits, risks, or implementation challenges.

RSM will look to implement additional spectrum for Regional broadband this through updating licensing rule sets (e.g. PIB 39), where necessary and work within the existing licence certification framework and to work within the RRF. Although not widely implemented, some frameworks of some countries have database or dynamic database approaches for 3500 MHz (e.g., CBRS in the US), these are complex to implement and have been are to solve specific national spectrum management issues for those countries (e.g. sharing between government and commercial users) that do not apply to New Zealand. RSM's approach is based on simple static licencing / administrative approaches and would not consider a database approach for 3500 MHz at this stage. Implementing database approaches for 3340 -3460 MHz in New Zealand would likely be bespoke and take considerable resource and time from industry and RSM.

8.3. Mobile: Proposed technical conditions and assignment licensing mechanisms

Current spectrum in the 3460 -3800 MHz is assigned in management rights to four private entities as outlined in Section 5.2. These management rights are exclusive and technology flexible / neutral (see section 4).

Mobile network operators have access to various amounts of spectrum in 3500 MHz and would likely want additional spectrum, particularly to support 6G in the future (see section 8). RSM note that the current 3GPP standardised technology only supports a maximum of 100 MHz carriers and if an party held more than (or had access to) this amount it may not be used efficiently at this point in time. RSM also note that 6G, which may support carriers greater than 100 MHz is not likely to be rolled out until the 2030s.

RSM therefore proposes that no party may access or use more than 100 MHz of spectrum for mobile networks in the 3300–3800 MHz band through any mechanism, including management rights or licence arrangements (e.g. leasing spectrum from other parties). Private mobile network service providers would be excluded from this requirement, for example MNOs can act as a service provider for licensees.

Question 27: Do you agree that mobile network operators should not be allowed to access more than 100 MHz at this time? Please provide reasons for your view.

Assignment process and methodology

Spectrum for mobile would be assigned via management right(s), likely based on 10 MHz lot sizes. The management right(s) would be awarded on an exclusive national basis using a market-based approach, such as an auction (see previous auctions). Any party would be able to participate in this process provided they meet the criteria of the assignment mechanism. Minimum deployment requirements will be implemented to ensure the spectrum is used.

Contiguous spectrum is desired by mobile networks and fragmented spectrum is less desirable. Given the frequency range of this spectrum, it would likely disproportionately benefit the adjacent management right holder. If Government proceeds with option 3 (Section 7), consideration would need to be given to how a fair assignment process is run. For example, a requirement for all rights holders in the range to reshuffle so the winning bidder can access contiguous spectrum.

Question 28: Do you support the proposed assignment approach for mobile spectrum? Please provide reasons for your view.

Spectrum charging and pricing methodologies

Spectrum charging and other market-based mechanisms are generally used for specific frequency bands where users are seeking exclusive access (i.e., require protection within an area under the licensing regime) and demand exceeds supply. These frequency bands are typically allocated via Management Rights and spectrum licenses.

RSM is of the view that demand that exceeds supply in the 3340 - 3460 MHz range, and so we are proposing to establish spectrum charges for the use-cases under consideration:

- For regional broadband: spectrum licence costs will be made up of several elements:
    1. an initial market-based allocation price for the exclusive right to place licences within particular areas (section 8.2)
    2. an annual spectrum charge based on the model already in-use in 3300—3340 MHz.
- For private mobile networks: spectrum licences which will cost an annual spectrum charge determined by site-specific characteristics including size and population density of the location.
- For spectrum made available as Management Rights for mobile use, a market-based allocation price.

All charges proposed here would be in addition to the annual licence fee which is applicable to all licenses, and which is prescribed in the *Radiocommunications Regulations 2001*. This is currently $150 including GST and will be updated to $190 (GST inclusive) as of 1 July 2026.

9. Spectrum charging for regional broadband

Our starting point for spectrum charging for regional broadband is the established method currently used for licences in the 3300–3340 MHz range. In that range, spectrum charging is undertaken annually and currently uses a per-capita rate of $0.085.

Based on recent analysis and industry feedback, the operational environment for regional broadband has evolved since the 2023 assignment. As a result of alternative service providers (e.g., satellite) WISPs have a reduction in demand for their services, reducing how they can monetise their licenced spectrum.

This is supported by the Commerce Commission's 2024 review of the telecommunications industry which identified WISPs are losing ground to satellite competitors and are having to invest in fibre to remain competitive despite serving 16 per cent of rural homes[31]. In the same report rural customers have to pay on average 29 per cent more for broadband in comparison to their urban counterparts[32].

RSM recently conducted a targeted engagement with WISPs who have advised they are facing a number of operating challenges, including the cost of licensing, increasing competition, limited spectrum availability, and the high cost and constrained supply of equipment. This is further evidenced by the rate of cancelled and unimplemented licences in the existing 3300–3340 MHz range. As at May 2026, 284 out of 597 licences issued since 2023 have still not met implementation requirements.

In order to recalibrate the value of spectrum for regional broadband, RSM propose to reduce the spectrum charge. We consider a reduction in the spectrum charge to be reasonable as it recognises

[31] ibid

[32] https://www.comcom.govt.nz/assets/p

the reduction in demand WISPs are facing and the corresponding reduction in their ability to monetise the spectrum.

We propose two options:

- Option One: retain all current settings (status quo)
- Option Two: reduce the per-capita rate to $0.06 (preferred).

Option One: Status Quo

The calculation is as follows:

$$Annual\ charge\ per\ 20\ MHz = Sub\ TLA\ pop\ count * \frac{0.085}{5}$$

Where:

- Sub TLA pop count is the 2023 population estimate for the relevant Sub TLA in question[33].
- Nominal population cost is the per person value of 20 MHz of national radio spectrum in the 3.5 GHz band, for 1 year. This is based off the 3.5 GHz valuation, with a national value per person of $0.085 for 20 MHz per year.
- GST is not included in the price above
- This charge will only be payable on the first five licenses taken out by a provider within a sub-TLA region (i.e. within a Community and Local Board Area).

Option Two: Amend the SRC (preferred)

Option Two proposes to modify the nominal population cost constant in the equation. By reducing the nominal population cost by 29 per cent, from $0.085 to $0.06. This is a 29 per cent reduction, which reflects the Commerce Commission's finding that on average rural customers pay 29 per cent more for broadband in comparison to their urban counterparts.

The calculation would be as follows:

$$Charge\ per\ 20\ MHz = Sub\ TLA\ pop\ count * \frac{0.06}{5}$$

Should this option be chosen to move forward with, the changes will apply to all WISP licences in 3.3GHz, including the 2023 allocation, from the financial year beginning July 2027. Before this time only new licences in 3340 - 3460 MHz will be eligible for the new spectrum charge.

Question 29: Do you agree there is a reduction in demand for WISP-provided regional broadband as a result of increased competition?

Question 30: Do you agree with reducing the nominal population cost for WISPs?

[33] List of Community and Local Board Areas with associated per-licence resource charge for 3.30 – 3.34 GHz assignment | Radio Spectrum Management New Zealand

10.Spectrum charging for private mobile networks

By charging a spectrum fee for private mobile networks, RSM ensures spectrum is used efficiently, fairly, and in ways that deliver the greatest overall benefit.

Without pricing, there is a risk that spectrum could be underutilised or held for speculative purposes, especially in areas where there are multiple potential users of that spectrum. Introducing a spectrum charge reinforces that access to spectrum carries an opportunity cost and should be justified by real, productive use.

Spectrum charging fees

The proposed framework calculates spectrum charges using bandwidth, geographic area, and StatsNZ population density category. Spectrum charges are a product of the characteristics of a license application and will vary between licenses.

The calculation would be as follows:

> *Base Rate × Bandwidth (MHz) × Area (km²) × Population Density Factor multiplier x No. years remaining*

Where:

- The base rate is $0.342 per MHz per populated square kilometre. This rate is based on an estimated national value of approximately $400,000 per MHz for a 20-year right in the 3.5 GHz band (2019 valuation), apportioned across New Zealand's approximately 58,401.78 populated square kilometres[34].
- Bandwidth is the MHz applied for. This will be up to 120 MHz, depending on the band assignment structure.
- Area is the defined area covered by the license application. Applications are expected to be associated with defined LINZ land parcels, and so these LINZ land parcels will be the area covered by each license application.
- Population density factor multiplier is the multiplier, identified below, which is associated with the relevant Statistics New Zealand Urban and Accessibility Category of the location being licensed.
- No. of years remaining is the number of years remaining until 30 June 2033.

Population density factor multiplier

The population density is proposed as a proxy for spectrum demand and congestion. Higher-density areas generally face greater coordination complexity and opportunity cost, which is reflected through the density factor. Statistics New Zealand data[35] provides an objective and regularly updated basis for this adjustment through its categorization of all locations into an urban and accessibility category.[36]

[34] Andrew Douglas-Clifford, 2025, Uninhabited Areas of New Zealand

[35] Refers, population index 2025 https://www.stats.govt.nz/assets/Uploads/Subnational-population-estimates/Subnational-population-estimates-At-30-June-2025/Download-data/subnational-population-estimates-at-30-june-2025-provisional.xlsx and see also https://www.rsm.govt.nz/assets/Uploads/documents/pibs/supplementary-document-to-pib-38v1.pdf

[36] https://www.stats.govt.nz/methods/functional-urban-areas-methodology-and-classification/

The proposed multiplier is as follows:

Table 19: Proposed Multiplier based on population density

Urban and accessibility category (includes all)	Stats NZ Criteria	Proposed multiplier
Urban areas		
Major	100,000 or more residents	10
Large	30,000 – 99,999 residents	8
Medium	10,000 – 29,999 residents	6
Small	1,000 – 9,999 residents	4
Low density / rural	5,000 – 10,000 residents	2
Very low density / rural	< 5,000	1

The lower bound (1) represents very low-density or remote areas where spectrum demand and congestion are minimal. It is set below the rural baseline (2) to provide a meaningful discount, while maintaining a non-zero price signal to reflect that spectrum still has value.

The upper bound (10) represents high-density urban environments, where spectrum demand, congestion, and opportunity cost are highest. It is calibrated to ensure urban areas face higher charges per unit area to reflect likely greater demand within these areas.

Question 31: Do you agree with the proposed spectrum charging approach for private mobile networks, including the proposed density bands and multiplier values, and the extent to which population density should influence charges?

10.1. Reserve pricing for national mobile use in management right

If further spectrum was to be made available for mobile network in management right a market mechanism would be used, likely to be an auction. In the case of an auction, RSM would need to set a reserve price and potentially revalue the spectrum to do so. RSM would look to address these issues at a later stage, likely in a specific auction consultation/catalogue.

Annex 1: Overview of Private mobile networks and international trends and supplementary information

A1-1.0 Overview of private mobile networks and international trends

Stakeholders with private mobile network interests claim that the evolution of industry is in its 4th industrial revolution and have called this "Industry 4.0". Defined as the phase of digitisation of the industrial sector, supported by the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics, this is shown in Figure A14[37].

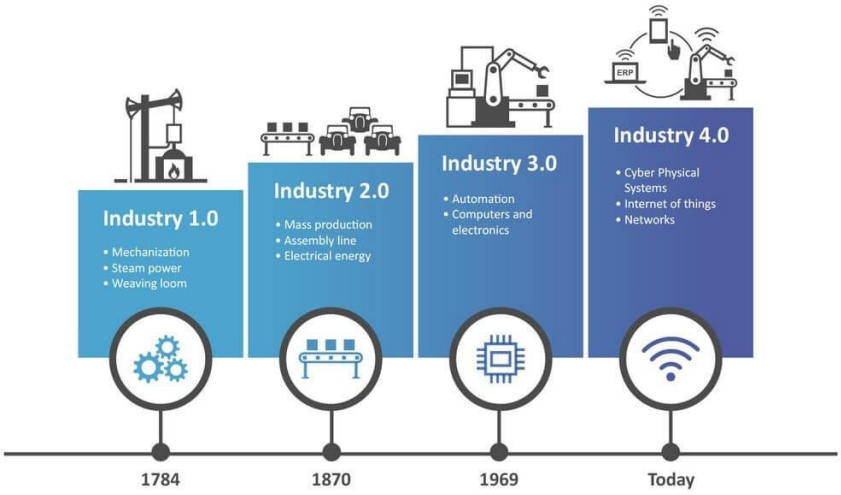


Figure A14-1: The stages of industrial development

Industry digitisation, using "smart" technologies like data analytics, machine learning, artificial intelligence (AI) and extended reality (XR), needs increased "connectivity" of machines, "things" and people. The attributes of various industries and venues make wireless communications important, where end-devices are in motion (mobility) and/or physical wiring is not feasible, economic or safe to install.

The requirements of industrial wireless are customisable to the use case (process application) and include:

1. High reliability - Mission critical
2. Deterministic - Low and predictable latency
3. Bandwidth - Down and uplink minimum throughputs, differentiation QoS
4. Coverage – continuity throughout operational area/campus indoor and outdoor, factoring unique local obstructions like industrial structures and plant

[37] https://sii.pl/blog/en/industry-4-0-the-industrial-revolution/

5. Secure – From interference and intrusion, data integrity and privacy

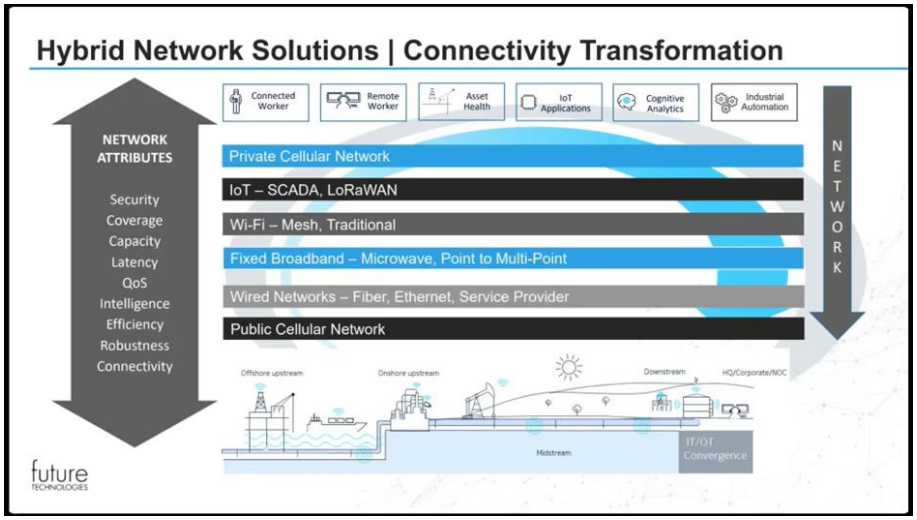


Figure A1-2: Range of Network Solutions for Industry Connectivity including Private (Cellular) Networks (Source: https://rcrtech.com/on-demand/industrial-wireless-forum-2025 Future Technologies, 2025)

Internationally, IMT / mobile technologies (3GPP standardised 4G LTE and 5G NR) are being deployed on dedicated spectrum in a local area as part of solutions for industrial wireless applications. The investment cases for these Private mobile networks (PN) are typically to support:

1. Higher production
    a. more process up-time
    b. more process output
2. Lower variable costs
    a. optimised resources (labour, energy, materials)
    b. less wastage (better quality, less scrap)
3. Lower fixed costs
    a. lower infrastructure total cost of ownership (TCO)
4. Lower risk
    a. improved safety
    b. compliance and environmental impact

Since PNs are generally part of operational technology (OT) investments the asset lifetime expectations are more than a few years and can be up to around 10 to 20 years, which is longer than for information technology (IT) at 3-5 years. RSM consider that demand for private mobile networks and many of the international trends are applicable to New Zealand.

A1-2.0 International regulatory frameworks supporting private mobile networks spectrum access

A number of countries have made spectrum available for Private mobile networks based on IMT technologies in band range 3 – 5 GHz, including the examples of countries with spectrum assignment / licencing policies for Private mobile networks in portions of the 3-5 GHz frequency range outlined in Table A1. It should be noted that most countries spectrum has not been made available exclusively to private mobile networks. Spectrum is usually available on a shared basis with other systems and services with actual available spectrum location specific.

Table A1-1: Examples of countries with spectrum assignment / licencing policies for Private Mobile Networks in portions of the 3-5 GHz frequency range

Country	Year made available	Frequency band (MHz)	Max Usable Bandwidth (MHz)	Assignment / Licensing construct where private mobile networks can access spectrum
Australia	2025	3400-3475 - Urban	75	Point-to-multipoint system (PMPS) licensing
		3950-4000 - Metro & regional	50	
	2024	3850-3950 – Metro & regional	100	Area-wide apparatus licences (AWLs)
		3750-3950 - Rural	200	
		3400-4000 - Remote	600	
Bahrain	2022	3800-4200	400	Private 5G networks
Belgium	2023	3800-4200	200	Private Local Broadband Radio Networks
Brazil	2022	3700-3800	100	Limited private service (SLP) licenses
Canada	2025	3900–3980	80	Non-Competitive Local Licensing (NCLL)
Germany	2019	3700–3800	100	Geographic/time-limited local licences
Japan	2020	4600–4900	300	Local 5G licences
Moldova	2025	3800-4200	400	Private 5G networks
Netherlands	2023	3400-3450, 3750-3800	50 + 50	Private local licenses.
Norway	2023	3800–4200	360 (40 MHz lower GB)	5G in non-public networks (NPN) in localized area
Poland	2023	3800–4200	100 + 300	100MHz for govt, 300 MHz for private.
Republic of Korea	2021	4720-4820	100	Dedicated private-5G allocations
Sweden	2022	3720-3800	80	Local permit
Switzerland	2024	3400–3500	100	Private Land Mobile Network licenses.
Taiwan	2023	4800-4900	100	Standalone non-public network
United Kingdom	2019	3800–4200	390 (2 x 5 MHz GB)	Shared Access Licence (SAL)
USA	2020	3550–3700	150	CBRS Three-tier shared access among different users

Some of the key elements of these private (or local area) network license constructs include:

- Fair and simplified assignment process: Area definitions linked to land use, use of lose, simplified license assignment process
- Maximising utility: Alignment with eco-ecosystems (e.g. IMT) with technology neutrality, bandwidth flexibility and sharing, allowance for TDD frame flexibility with co-ordination, duration terms allowing investment confidence, etc.
- Maximising spectrum utilisation: technical conditions (such as power, BS heights, etc.) to meet coverage requirements but minimise surrounding area "sterilisation"
- Impacts to adjacent band users: including national public mobile networks and wireless broadband services.

RSM has reviewed these international regulatory frameworks including their implementation and practical adoption. This has informed RSM's analysis and the proposals in this consultation. Some examples of international frameworks of particular interest include:

- Australia (ACMA) area-wide licences (AWL)[38] and point-to-multipoint system licences[39] in the 3400–4000 MHz band. AWLs are service and technology-flexible, and scalable to different network sizes and topographies.[40]
- Germany (BNETZA) 3700-3800 MHz band for local assignments, on a flexible and needs-oriented basis for business models that require spectrum for separate, autonomous telecommunications networks.[41]
- United Kingdom (OFCOM) shared access licence framework, aiming to make it easier for people and businesses to access spectrum for a wide range of local wireless connectivity applications.[42]

RSM note that some elements from international regulatory frameworks may not be applicable or implementable in New Zealand. For example, frameworks using database or dynamic database approaches (e.g., CBRS) are complex to implement and are to solve national spectrum management issues for those countries (e.g. sharing between government and commercial users) that do not apply to New Zealand. At this point in time for 3300 MHz, this would require significant work with resources from RSM and industry that is not available for unclear benefits. This resource would exceed simpler static / administrative approaches. In the longer term, innovative database and dynamic database approaches offer promise for future frameworks in different bands.

A1-2.1 International licence constructs and a range of power limits implemented.

RSM has conducted a review of some international licence constructs where there are a range of power limits implemented as outlined in Table A1-2.

[38] https://www.acma.gov.au/publications/2023-06/instruction/rali-ms47-licensing-and-coordination-procedures-area-wide-licences-awl-3400-4000-mhz-band

[39] https://www.acma.gov.au/publications/2025-09/instruction/rali-ms50-frequency-coordination-and-licensing-procedures-point-multipoint-system-licences

[40] https://www.linkedin.com/posts/applications-for-area-wide-licences-awls-share-7178908978767097856-QjA6/

[41] https://www.bnetza.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/FrequencyAssignment/LocalBroadband3,7GHz.pdf

[42] https://www.ofcom.org.uk/spectrum/frequencies/shared-access

Table A1-2: Private mobile network License constructs and power limits summary

Country / region	Power Category		
	Low power base station	**Medium power base station**	**User terminals/ equipment**
Europe ECC [Decision (24)01]	24 dBm/channel for BW ≤ 20 MHz 18 dBm/5 MHz for BW > 20 MHz (21 dBm/10 MHz)	44 dBm/channel for BW ≤ 20 MHz 38 dBm/5MHz for BW > 20 MHz (41 dBm/10 MHz)	Mobile/nomadic: 28 dBm TRP Fixed: 28 dBm EIRP
United Kingdom	27 dBm/channel for BW ≤ 20 MHz 21 dBm/5 MHz for BW > 20 MHz (24 dBm/10 MHz)	42 dBm/carrier for BW ≤ 20 MHz 36 dBm/5 MHz for BW > 20 MHz (39 dBm/10 MHz)	Mobile or nomadic terminal stations: 28 dBm Fixed or installed terminal stations: 35 dBm/5MHz EIRP
Australia	17 dBm/MHz EIRP (27 dBm/10 MHz)		28 dBm TRP
Canada	20 dBm/MHz EIRP (30 dBm/10 MHz)	37 dBm/MHz EIRP (47 dBm/10 MHz)	Mobile 30 dBm/channel BW EIRP Fixed 20 dBm/MHz EIRP
United States	Category A: 30 dBm/10 MHz EIRP	Category B: 47 dBm/10 MHz EIRP	23 dBm TRP (26 dBm proposed)
Japan	Indoor 14 dBm/MHz (24 dBm/10 MHz)	Outdoor 28 dBm/MHz (38 dBm/10 MHz)	
New Zealand proposal	≤ 27 dBm/channel for BW ≤ 20 MHz ≤ 24 dBm/10 MHz for BW > 20 MHz	≤ 44 dBm/channel for BW ≤ 20 MHz ≤ 41 dBm/10 MHz for BW > 20 MHz	Mobile / Nomadic 28 dBm EIRP Fixed 28 dBm EIRP

A1-3.0 International adoption of Private mobile networks

In countries with spectrum for Private mobile networks in the 3GPP Frequency Range 1 (defined as 410 -7125 MHz, typically spectrum for private mobile networks is within the 2000 -5000 MHz range), such- as Germany, Japan and Republic of Korea, industry adoption has steadily grown in the last few years.

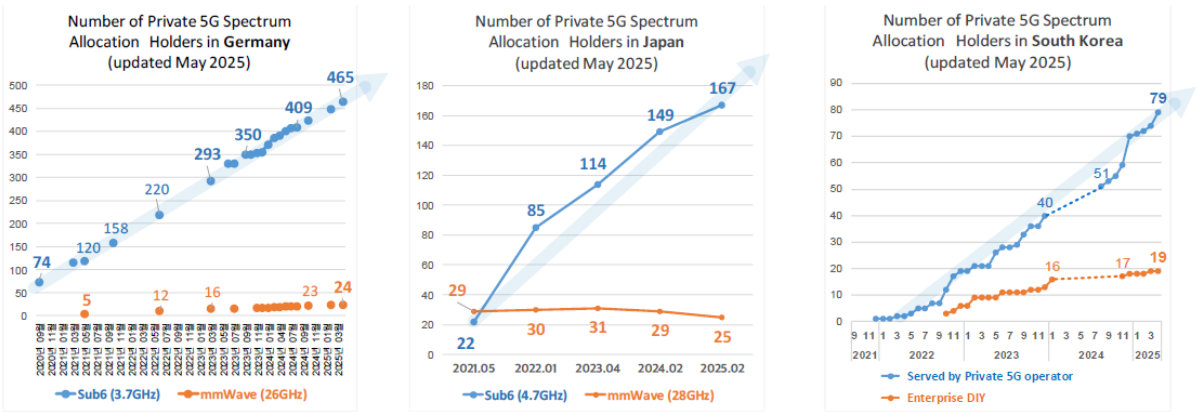


Figure A1-15: Industry provided number of Private 5G Spectrum allocations in Germany, Japan and Korea (Source: netmanias.com, May-2025[43])

[43] https://www.netmanias.com/en/?m=view&id=oneshot&no=16333

Some industry analysts consider that the number of existing Private mobile networks globally >5,000 with expectations of >40,000 by 2030, and of these >80% are expected to be 5G.

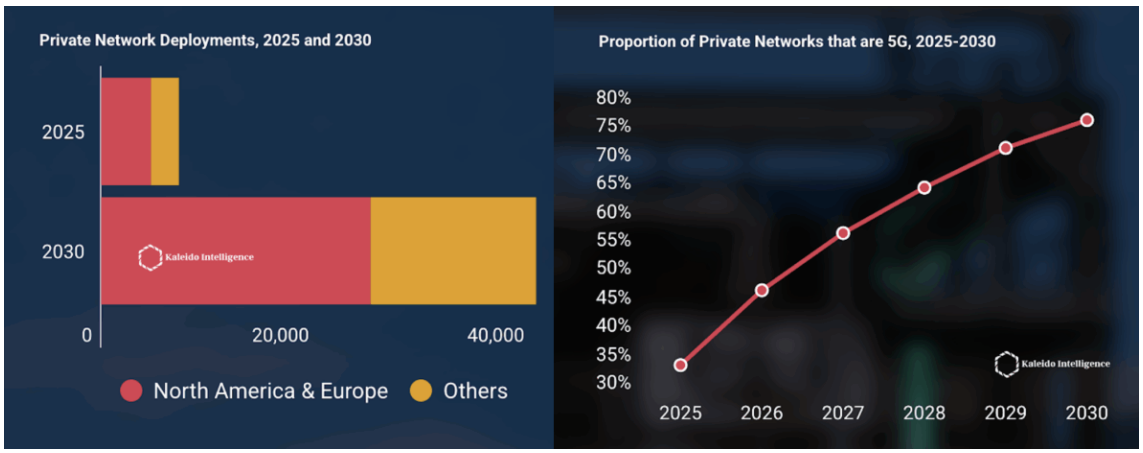


Figure A1-16: Industry provided private LTE & 5G Networks Outlook 2025, Kaleido Intelligence[44].

A1-4.0 Study of channel bandwidth requirements

Comparing the maximum channel data rates from section 6.3 to the typical use case single user throughput requirements the possible spectrum (channel) bandwidth requirements depending on the TDD slot resource configuration can be observed in Table A1-3. Highlighted in red are where the throughput requirement would not be met even with 100 MHz of bandwidth (the maximum channel), and highlighted in green where a more efficient spectrum use could result when using the non-default, alternate TDD frame structure configuration.

Table A1-3 Study of channel bandwidth requirement based on use case single user throughput

	Throughput (Mbps) Required			Bandwidth (MHz) Requirement			
				DL/UL 74/26		DL/UL 54/46	
Use Case	Downlink	Uplink		Downlink	Uplink	Downlink	Uplink
Discrete Automation	5	5		10	20	10	10
Remote Control	5	50		10	>100	10	80
Process Monitoring	1	1		10	10	10	10
Electricity Grid	10	10		10	40	10	20
Medical Monitoring	1	1		10	10	10	10
Robot - Sensor/Audio	1	1		10	10	10	10
Robot - Video	1	50		10	>100	10	80

[44] https://www.rcrwireless.com/20250731/private-5g/private-5g-500pc-growth

Critical Coms - Voice, MCPTT	1	1		10	10	10	10
Critical Coms - MC Video	12	12		10	40	10	20
Critical Coms - MC Data	1	1		10	10	10	10
Live Broadcast Video Feed	10	75		10	>100	10	100
Live video for AI 4k	1	25		10	60	10	40
AGV/drones 4x video	1	20		10	60	10	40
Video collab in HD	5	5		10	20	10	10
Video 8K; VR 2K@90fps	100	10		60	40	60	20
Video 4K 3D; VR 1K@60fps	50	10		40	40	40	20
Video 4K 2D	25	5		20	20	20	10
Video VR 720p@30fps	20	2		10	10	20	10

Annex 2: Supplementary information for assigning spectrum in the 3340 -3460 MHz band to new uses

This annex provides supplementary information to support the proposals in this consultation document in assigning spectrum in the 3340 -3460 MHz band to new uses. It contains definitions of urban and rural areas, management of coexistence between private networks and other systems along with characteristics and assumptions. Following the consultation, feedback and decision making, these elements may be used to further developed frameworks for RSM's standard rulesets (e.g .PIBs).

A2-1.0 Definition of urban and outside urban geographic areas

The urban and outside urban geographic area definitions are used in the proposals of this consultation This includes sharing between Regional broadband and private mobile networks in the 3340-3480 MHz band.

The definitions of the geographic areas are derived from Statistics NZ definitions with two main criteria relevant to the licensing and certification rules are below:

- **Urban areas**: Inside Major, Large, Medium and Small Urban Areas as defined by Statistics New Zealand (see Urban Rural 2025 | Stats NZ Geographic Data Service);
- **Rural areas:** Outside the Major, Large, Medium and Small Urban Areas as defined by Statistics New Zealand (see Urban Rural 2025 | Stats NZ Geographic Data Service), and; Outside the High and Medium Urban Accessibility areas using the method and classification as defined by Statistics New Zealand (see https://www.stats.govt.nz/assets/Uploads/Methods/Urban-accessibility-methodology-and-classification/Download-document/Urban-accessibility-methodology-and-classification.pdf.)

These two main criteria are used for determining which geographic are a given location falls within. The criteria are given Table A2-1**: Mobile / FWA geographic area: Urban areas and Fixed Satellite Service Geographic area: Outside Urban area (based on Statistics NZ definitions 2025)** below provides the different geographic areas for the purposes of sharing which are in Tabe A1-2 below.

Table A2-1: Mobile / FWA geographic area: Urban areas and Fixed Satellite Service Geographic area: Outside Urban area (based on Statistics NZ definitions 2025)

Urban and accessibility category (includes all)	Criteria
Urban areas – all conditions below apply	
Major	100,000 or more residents
Large	30,000 – 99,999 residents
Medium	10,000 – 29,999 residents
Small	1,000 – 9,999 residents
High urban accessibility	0 – 15 minutes drive time (In average traffic conditions at 50 km/h) from major urban areas
Rural - Outside Urban areas	

Urban and accessibility category (includes all)	Criteria
These locations that are outside the urban areas as defined above. These include rural settlements and medium, low remote and very remote urban accessibility categories.	

A2-2.0 Managing coexistence between private mobile networks

This provides a generalised assessment outline for co-frequency compatibility between private networks and private networks and regional broadband (FWA) at urban/rural boundaries in band portion 3340 – 3380 MHz. It assumes that all networks are based on 5G NR band n78 and are using the default synchronised and frame structure (see section 4, 6.2 and 8.1), and therefore frequency adjacent systems will co-exist without significant mutual interference.

The approach outlined below is the proposed generic process with further details to be developed into a licence framework. The characteristics and parameters for compatibility studies are outlined in A2-2.0.

Assessment area – cull distances

Inter-network distances to be considered for co-channel mutual interference assessment are for:

- New outdoor licence: any existing outdoor licences within 5 km, and indoor licences within 3 km.
- New indoor licence: any existing outdoor licences within 3 km, and indoor licences within 0.5 km.

That is other Private Networks further away can be culled from the interference analysis in the licence application (see section 8.1.2). Licences within these distances will require further analysis

The following scenarios outline the typical generic process for assessing co-channel licence compatibility.

A2-2.1 Scenario 1 – Indoor PMN use to Indoor PMN

- Determine the path from the new licence location (building centre) to existing licence location. If the separation distance is <0.5 km, undertake analysis to determine if the protection criteria is met, considering the following:
    - Maximum Indoor EIRP at new licence centre point as omni antenna (assume it radiates in all directions)
    - Maximum Base Station height i.e. if high-rise building the top floor
    - Apply building entry loss (BEL) at both ends of link using Recommendation ITU-R P.2109.
    - Apply propagation loss model over terrain using a Digital Elevation Model and Recommendation ITU-R P.452
    - Apply clutter loss using Recommendation ITU-R P.2108 for generalised / non specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths.

- User Equipment height to be equal with the recorded Base Station antenna height in the existing licence.
- Apply body loss (default 0 dB) and receive user equipment antenna gain as omni (default -4 dBi, Report ITU-R M.2292, Table 4)
- Determine signal power level is less than the protection criteria of -95 dBm / 10MHz at existing licence location.
- Repeat analysis for reverse link from neighbouring licence location.

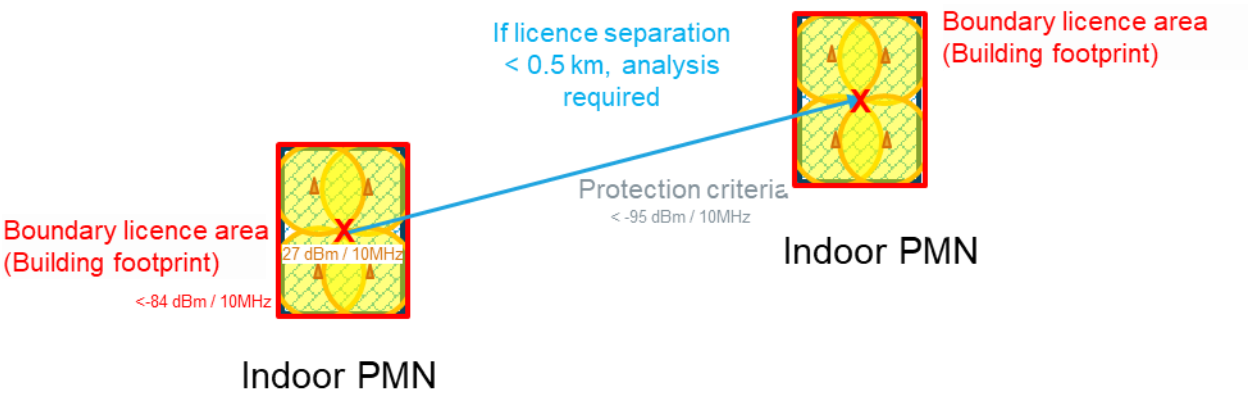


Figure A2-1: Scenario 1 - Indoor PMN use to Indoor PMN

A2-2.2 Scenario 2 –Indoor PMN use to Outdoor PMN

- Determine the path from the new licence location (building centre) to existing licence location protection area (polygon of the licence). If the separation distance is <3 km undertake analysis to determine if the protection criteria is met, considering the following:
  - Maximum Indoor EIRP at new licence centre point as omni antenna (assume it radiates in all directions)
  - Maximum Base Station height i.e. if high-rise building the top floor
  - Apply building entry loss (BEL) at the at indoor end of link using Recommendation ITU-R P.2109.
  - Apply propagation loss model over terrain using a Digital Elevation model and Recommendation ITU-R P.452
  - Apply clutter loss using Recommendation ITU-R P.2108 for generalised / non specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths.
  - User Equipment height assumed to be the default 1.5 m height
  - Apply body loss (default 0 dB) and receive UE antenna gain as Omni (default -4 dBi, Report ITU-R M.2292, Table 4)

- Determine signal power level is less than the protection criteria of -95 dBm / 10MHz at existing licence location.
- Repeat analysis for reverse link from neighbouring outdoor BS licence locations.

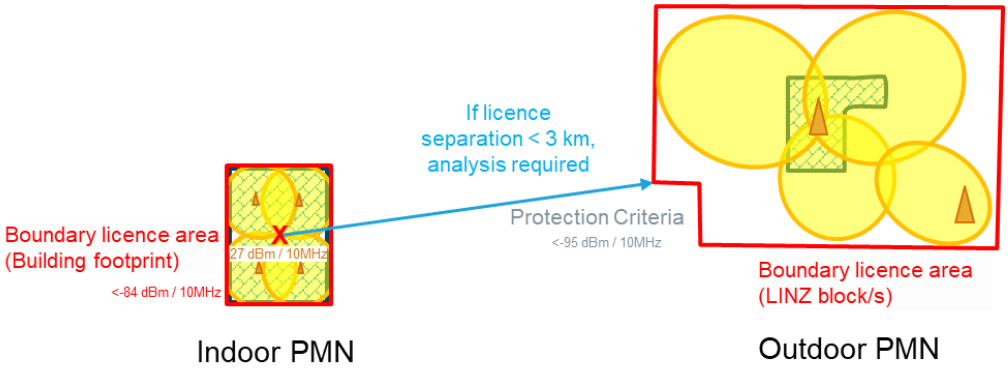


Figure A2-2: Scenario 2 –Indoor PMN use to Outdoor PMN

A2-2.3 Scenario 3 – Outdoor PMN to Indoor PMN

- Determine the path from the new Base station location(s) to the exiting licence location. If the separation distance is <0.5 km, undertake analysis to determine if the protection criteria is met, considering the following:
  - Maximum power EIRP at each base station licence point with sectorised antenna pattern
  - Apply propagation loss model over terrain using a Digital Elevation model and Recommendation ITU-R P.452
  - Apply building entry loss (BEL) at indoor end of link using Recommendation ITU-R P.2109
  - Apply clutter loss using Recommendation ITU-R P.2108 for generalised / not specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths.
  - User Equipment height to be equal with the recorded Base Station antenna height in the existing licence
  - Apply body loss (default 0 dB) and receive UE antenna gain as Omni (default -4 dBi, Report ITU-R M.2292, Table 4)
  - Determine signal power level is less than the protection criteria of -95 dBm / 10MHz at existing licence location.
  - Repeat analysis for reverse link from neighbouring indoor licence location.

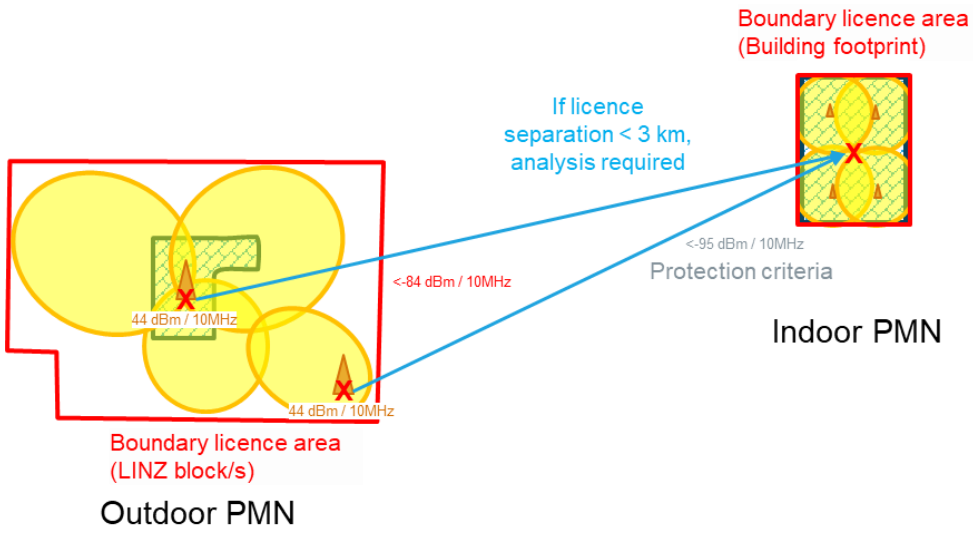


Figure A2-3: Scenario 3 – Outdoor PMN to Indoor

A2-2.4 Scenario 4 – Outdoor PMN to Outdoor PMN

- Determine the path from the new Base station location(s) to the exiting licence area. If separation distance is <5 km, undertake analysis to determine if the protection criteria is met, considering the following:
    - Maximum power EIRP at each base station licence point with sectorised antenna pattern
    - Apply propagation loss model over terrain using a Digital Elevation model and Recommendation ITU-R P.452
    - Apply building entry loss (BEL) at indoor end of link using Recommendation ITU-R P.2109
    - Apply clutter loss using Recommendation ITU-R P.2108 for generalised / not specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths.
    - User Equipment height assumed to be the default 1.5 m height
    - Apply body loss (default 0 dB) and receive UE antenna gain as Omni (default -4 dBi, Report ITU-R M.2292, Table 4)
    - Determine signal power level is less than the protection criteria of -95 dBm / 10MHz at existing licence location.
    - Then carry out reverse from existing outdoor BS licences to new boundary polygon, calculation to ensure receive protection.

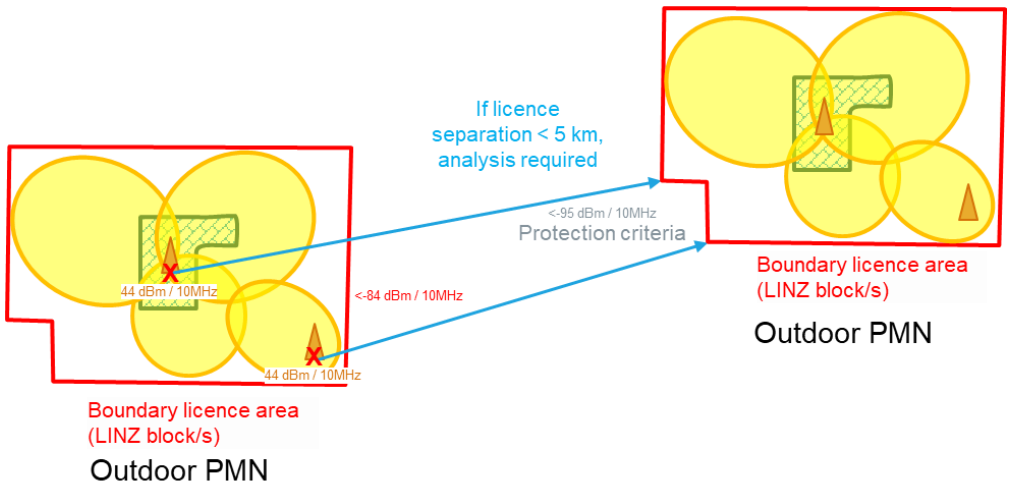


Figure A2-4: Scenario 3 – Outdoor PMN to Indoor

A2-3.0 Managing coexistence between the different users in band and adjacent bands

This section provides a generalised overview of the co-existence considerations and aspects of different systems for the scenarios:

1. Co-channel operations of private networks and regional broadband FWA in band portion 3340 – 3360 MHz for options 1 and 3 or 3340 – 3380 MHz for option 2 at the boundary of Urban and Rural areas.
2. Adjacent channel operations of private networks above 3360 MHz for option 1, or 3340 MHz for options 2 and 3, with regional broadband FWA below.
3. Adjacent channel operations of private networks below 3460 MHz with national mobile networks above.

These considerations and scenarios are intended to be developed into a licence framework

A2-3.1 Coexistence of different systems in co-channels

The inter-system co-channel scenario for private network and regional broadband applies for a portion of the band only at boundaries of Urban (where private networks are allowed) and Rural (where regional broadband is allowed).

A2-3.2 Private Network in Urban to Regional Broadband in Rural Area

Regional Broadband networks have existing licence conditions based on certain interference protection levels. Therefore, for expanded Regional Broadband use in shared spectrum with Private Networks across Urban/Rural boundaries the same protection is expected.

The base station of a Private Network must put a field strength no greater than 34 dBuV / m per 20 MHz (reference PIB 39, 4.7. Regional Broadband Use in 3.3 GHz, MPIS Level Determination) into any point in the protection area (polygon) of a Regional Broadband.

The characteristics and parameters for compatibility studies are outlined in A2-4.0. The following scenarios outline the typical generic process for assessing co-channel licence compatibility.

A2-3.2.1 Scenario 5 - Indoor Private Network to Regional Broadband

- The cull distance calculated for inter-network analysis is <1 km between a new private mobile network location (building centre) to an existing regional broadband protection areas. Determine the path from and if the separation distance is <1 km, undertake analysis to determine if the protection criteria is met, considering the following:
    - Maximum Indoor EIRP at new private mobile network licence centre point as Omni antenna (assume it radiates in all directions)
    - Maximum Base Station height i.e. if high-rise building the top floor
    - Apply building entry loss (BEL) at the indoor ends of link using Recommendation ITU-R P.2109.
    - Apply propagation loss model over terrain using a Digital Elevation model and Recommendation ITU-R P.452
    - Apply clutter loss using Recommendation ITU-R P.2108 for generalised / not specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths
    - Determine field signal level is less than 34 dBuV/m/ 20MHz anywhere in existing regional broadband protection area.

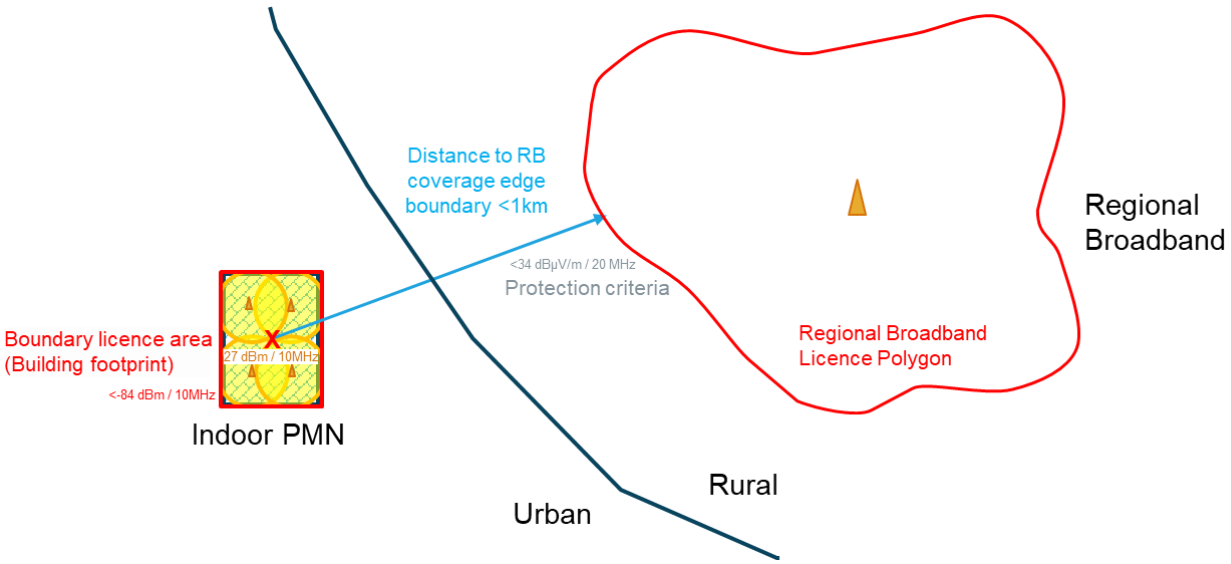


Figure A2-5: Indoor Private Network to Regional Broadband

A2-3.2.2 Scenario 6 - Outdoor Private Network to Regional Broadband

- The cull distance calculated for inter-network analysis is <42 km between base station(s) for a new private mobile network location (to an existing regional broadband protection

areas. Determine the path and if the separation distance is <42 km, undertake analysis to determine if the protection criteria is met, considering the following:

- Maximum Outdoor EiRP at licence location with sectorised antenna
- Recorded base station antenna height
- Apply propagation loss model over terrain using a Digital Elevation model and Recommendation ITU-R P.452
- Apply clutter loss using Recommendation ITU-R P.2108 for generalised / not specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths.
- Determine field signal level is less than 34 dBuV/m/ 20MHz (reference PIB 39) anywhere in existing regional broadband protection area.

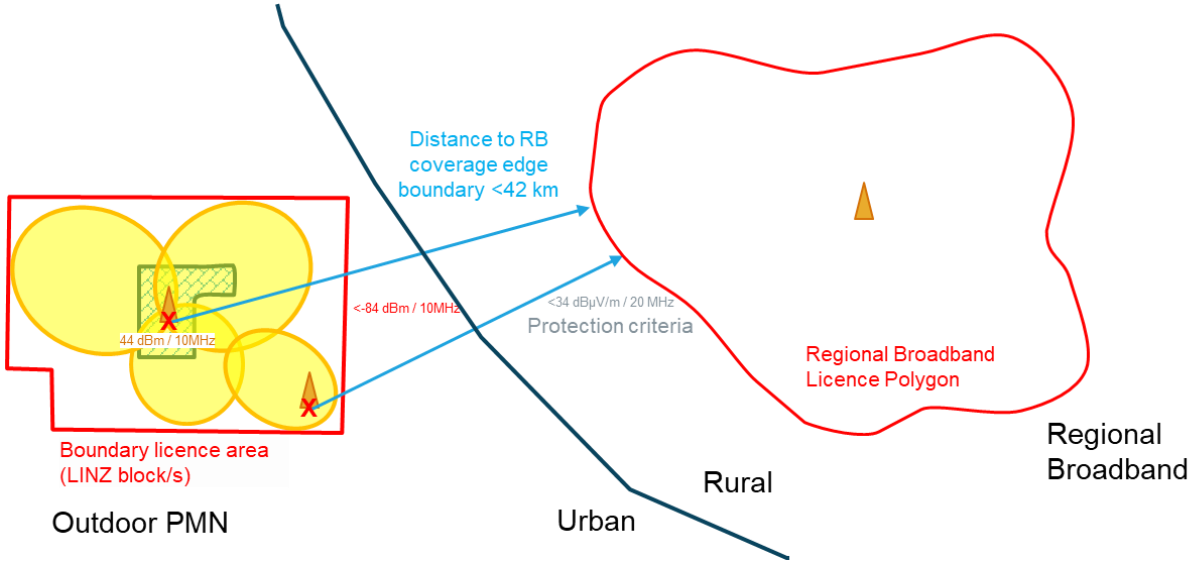


Figure A2-6: Outdoor Private Network to Regional Broadband

A2-3.2.3 Scenario 7 - Regional Broadband to Urban/Rural boundary

As the deployment of private networks in urban areas is expected to be a higher number and more dense than regional broadband networks, the co-existence analysis is simplified to the protection level any where in an urban area.

- The cull distance calculated for inter-network analysis is <30 km between each base station licence location to any urban/rural border point. If <30 km, undertake analysis to determine if the protection criteria is met, considering the following:
  - Maximum regional broadband EIRP at licence location with sectorised antenna
  - Recorded Base Station antenna height
  - Apply propagation loss model over terrain using a Digital Elevation model and Recommendation ITU-R P.452

- Apply clutter loss using Recommendation ITU-R P.2108 for generalised / not specific paths or Recommendation ITU-R P.452 with a digital surface model for specific paths.
- User Equipment height assumed to be the default 1.5 m height
- Determine field signal level is less than 56 dBuV/m/ 20MHz anywhere in an urban area. Where this level is determined to be equivalent to -95 dBm / 10MHz assuming a standard 50 Ohm isotropic receive antenna at a frequency of 3,400 MHz. This is based on the interference protection criteria for a private network user equipment of 0 dB I/N.

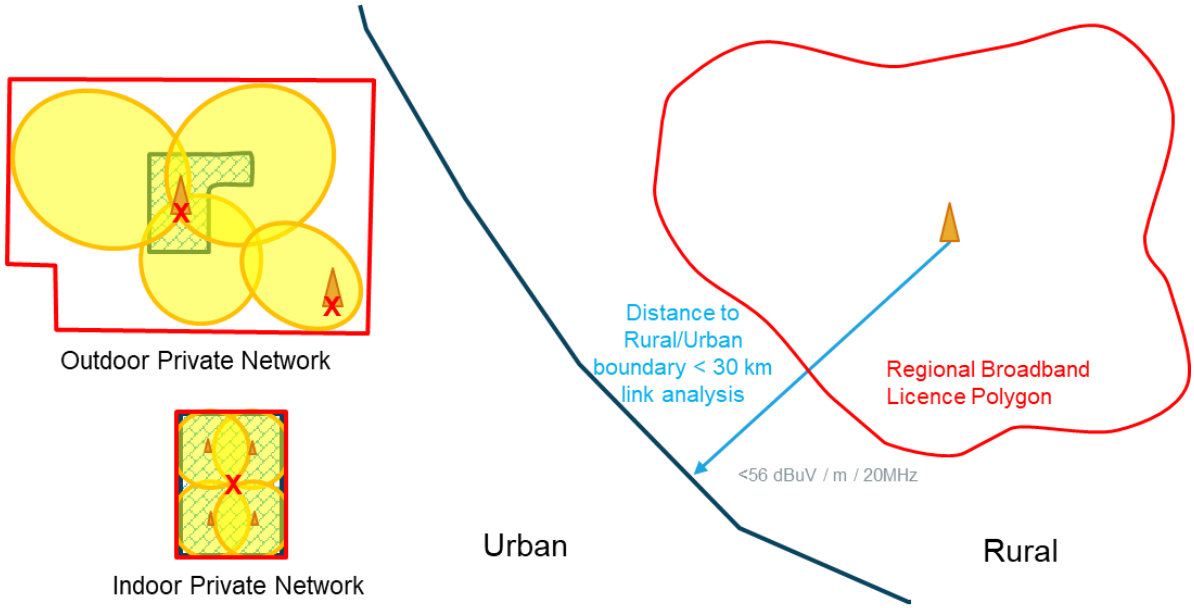


Figure A2-6: Scenario 7 Regional Broadband to Urban/Rural boundary

A2-3.3 Coexistence of different systems in adjacent channels

The proposed technical conditions for new private network or regional broadband fixed wireless access systems, align with existing 3300 – 3800 MHz band for default TDD frame structure synchronisation and specifications aligned with 5G NR band n78. Therefore, it is expected that frequency adjacent systems will co-exist without significant mutual interference.

A2-3.4 -Coexistence with non-default band configuration including synchronisation

Should a licensee choose to deploy a system with configuration non-default to the 3300 – 3800 MHz band, including equipment specifications or un-synchronised (or semi-synchronised) TDD frame structure, regardless of who deployed first, they must accept any harmful interference received from any other systems with default configuration anywhere in the 3300 – 3800 MHz band. They also must not cause interference any systems with default configuration anywhere in the 3300 – 3800 MHz band. If interference occurs, the non-default system operator must immediately implement mitigation measures. Such-as creating additional network de-coupling (isolation) for co-existence:

- Lowering transmitter powers
- Increasing antenna down tilt
- Change the antenna pointing
- lowering antenna heights
- Using more directional antennas or distributed antenna systems
- orient and locate base stations to take advantage of shielding from clutter such-as buildings
- Using semi-synchronised frame structures that reduce timeslots where there is interference. For example, some semi-synchronised frame structures mean that only the non-default system operator uplink time slots are not aligned with default system operator (e.g. interference would only occur to the use equipment and not the base station in that timeslot).
- Or as a last resort creating frequency separation (guard-bands) with-in individual licence bandwidth.

It is suggested a licensee that chooses to deploy a system that undertake analysis and possible coordination with adjacent users ahead of commencing transmission to ensure that there is sufficient isolation and interference is prevented**.**

A2-4.0 Characteristics and assumptions for Private Mobile Networks

The tables below outline the characteristics and assumptions for private mobile networks throughout this document.

Table A2-2: Outdoor Licence parameters

Parameter	Value	Reference
Base Station		
Medium Power maximum transmit EIRP	44 dBm/channel for BW ≤ 20 MHz ≤ 41 dBm/10 MHz for BW > 20 MHz	See section 8.1
Maximum antenna height above ground level	20 m Urban and 30 m Rural	See section 8.1
Assumed antenna gain	10 dBi	ECC Report 358, Table 8, Medium Range (MR) BS
Assumed noise figure	10 dB	Report ITU-R M.2292, Table 1, Micro ECC Report 358, Table 6
Receiver noise floor	-104 dBm / MHz	Derived
Protection criteria I/N	0 dB	For private networks only, otherwise -6 dB I/N
Protected level	-104 dBm / MHz	Derived
User Equipment		
Maximum UE transmit EIRP	28 dBm	See section 8.1
Maximum UE antenna height above ground level	20 m Urban and 30 m Rural	UE height/altitude not to exceed BS height
Assumed Antenna height	1.5 m	Co-existence assumption
Assumed antenna Gain	-4 dBi	ITU-R M.2292, Table 4

Assumed body loss	0 dB	For IoT devices, for handheld devices 4dB may be used. See Report ITU-R M.2292, Table 4.
Assumed noise figure	9 dB	ECC Report 358, Table 1 Report ITU-R M.2292, Table 4
Receiver noise floor	-105 dBm / MHz	Derived
Protection criteria I/N	0 dB	For private networks only, otherwise -6 dB I/N
Protected level	-105 dBm / MHz	Derived

Table A2-3: Indoor Licence parameters can characteristics

Parameter	Value	Reference
Base Station		
EIRP	≤ 27 dBm/channel for BW ≤ 20 MHz ≤ 24 dBm/10 MHz for BW > 20 MHz	See section 8.1
Base station location	Must be indoors within a building or within an enclosed space having attenuation characteristics at least equivalent to those of a building	See section 8.1
Maximum antenna height	N/A	See section 8.1
Assumed antenna gain	0 dBi (Omni)	ECC Report 358, Table 8, Indoor BS
Assumed noise figure	13 dB	ITU-R M.2292, Table 1, Pico / Femto ECC Report 358, Table 6
Receiver noise floor	-101 dBm / MHz	Derived
Protection criteria I/N	0 dB	For private networks only, otherwise -6 dB I/N
Protected level	-101 dBm / MHz	Derived
User Equipment		
UE location	Must be indoors within a building or within an enclosed space having attenuation characteristics at least equivalent to those of a building	
Assumed Antenna height	1.5 m	
Assumed antenna Gain	-4 dBi	ITU-R M.2292, Table 4
Assumed body loss	0 dB	For IoT devices, for handheld devices 4dB. ITU-R M.2292, Table 4.
Assumed noise figure	9 dB	M.2292
Receiver noise floor	-105 dBm / MHz	Derived

Protection criteria I/N	0 dB	For private networks only, otherwise -6 dB I/N
Protected level	-105 dBm / MHz	Derived

Table A2-4: Other considerations / propagation

Parameter	Value	Reference
Propagation losses	Recommendation ITU-R P.452	ECC Report 358
Clutter losses	Recommendation ITU-R P.452	ECC Report 358, Table 26. Requires a specific terrain profile (i.e. DEM and DSM).
	Recommendation ITU-R P.2108	ECC Report 358. Where bare Earth is used.
Assumed Building Entry Loss (BEL)	24.4 dB Applied for the indoor case only	ITU-R P.2109-2 for 3.4GHz, 30% probability, thermally efficient buildings.

Annex 3: Summary of questions asked

Question 1: Do you agree that spectrum should be made available to private networks and that there is demand for private mobile networks?

Question 2: Do you agree with the 8 factors RSM should consider when making spectrum available to private mobile networks in New Zealand? If not, what would you prefer and what would you suggest on the factors above?

Question 3: Do you agree with RSM's definition of a private mobile network? If not, please provide detail.

Question 4: Do you agree location categorisation, example sites, areas and network design characteristics? Are other private mobile network locations and categories that RSM should be considering?

Question 5: Do you agree with the use cases, latency and throughput figures? Is there something else that RSM should be considering?

Question 6: What equipment are you seeking to operate in the 3340 -3460 MHz band and do you do you agree with RSM's analysis that there is a range of readily available equipment that supports 3GPP 5G NR band n78 (3300 -3800 MHz)?

Question 7: What frame structures do you wish to operate for Private Mobile Networks and has RSM captured the main options in Figure 2? Would you choose to use a frame structure other than the default frame structure noting the onus will be on that party to prevent and rectify interference issues (see the technical framework in section 4 and section 8.1 for further details)? Please provide reasons for your views, including any evidence where relevant. We also welcome any additional comments or information that RSM should consider in relation to synchronisation, frame structure, or the operation of Private mobile networks in this band.

Question 8: Do you agree that private mobile networks can use available spectrum (carrier) at each base station and that full frequency reuse is achieved (frequency reuse n=1) within the facility or campus? If not, why?

Question 9: Do you agree with the assessment of spectrum needs for private mobile networks and that up to 60 MHz would meet nearly all use cases with some use cases requiring more? If not, please provide technical analysis on your spectrum needs.

Question 10: What throughput/Data rate(s) can be achieved by Regional Broadband networks? Can these networks use available spectrum (carrier) at each base station and that and can full frequency reuse is achieved (frequency reuse n=1)

Question 11: Do you agree with the throughput/Data rate(s) can be achieved by Mobile Networks? Do you agree that these networks use available spectrum (carrier) at each base station and that and can full frequency reuse is achieved (frequency reuse n=1)?

Question 12: What is your preferred option for making the 3340 – 3460 MHz band available? Please provide details on why.

Question 13: Do you agree with the proposed equipment (base station and user equipment) power categories in Table 10 providing a balance of coverage and frequency re-use? If not, please provide specific details, including the impact on spectrum reuse / sterilisation.

Question 14: Do you agree with the licence attribute and the proposed licence categories including associated technical conditions such as area, base station category and maximum height outlined Table 12? If not, are there other key private mobile network location coverage requirements you foresee for private mobile networks in New Zealand? Please provide details.

Question 15: Do you support minimum spectral efficiency requirements in the 3340 - 3460 MHz band? Please provide reasons for your view, including any anticipated benefits, risks, or implementation challenges.

Question 16: Do you agree with the proposed channel plan and adopting a subset of the available channels to reduce the risk of fragmentation / minimise inefficiency and to simplify channel assignment? Do you agree that equipment will be required to have a tuning range covering 3340 -3460 MHz? Do you agree on the proposed channel stacking order? If not, what do you suggest, please provide details.

Question 17: Do you agree private mobile networks with the need to have measures to reduce the risk of first movers getting an advantage over other potential nearby users (e.g. overlapping or nearby private mobile networks where spectrum reuse is not possible) to maximum utility as well as prevent spectrum hoarding and speculation? If so, which option do you prefer and why?

Question 18: Noting that the overarching framework and technical conditions for the 3300–3800 MHz band are already established (see section 4), including a default frame structure and synchronisation approach, do you agree that equipment deployed for Private Mobile networks must be capable of operating using the default frame structure?

Question 19: Do you agree with the proposed attributes for outdoor and indoor licensing of private mobile networks? Do you have any feedback on these proposals?

Question 20: Do you agree with the proposals on temporary licences, licence tenure, licence holder and use or lose? Do you have any feedback on these proposals?

Question 21: Do you agree with approach of have licence boundary coverage level limit of -84 dBm / 10MHz? Are there other private mobile network boundary coverage considerations RSM should consider, please provide details?

Question 22: Do you agree with approach for inter-network interference protection based on 95 dBm / 10MHz based on a protection criteria of 0 dB I/N? Do you agree with the separation or 'cull' distances? If not, please provide details?

Question 23: Do you have an interest in applying for regional broadband licences should further spectrum be band available and in what area? Which is your preferred option for assigning spectrum to regional broadband? Why?

Question 24: Do you agree that the spectrum should continue to be limited to the delivery of broadband to end customers? If not, why and what do you propose the spectrum should be used for?

Question 25: Do you agree that the regional broadband spectrum should be targeted for rural connectivity and not urban connectivity? If not, why and what do you propose?

Question 26: Do you support the introduction of minimum spectral efficiency requirements for regional broadband using new spectrum in the 3340 - 3380 MHz band? Please provide reasons for your view, including any anticipated benefits, risks, or implementation challenges.

Question 27: Do you agree that mobile network operators should not be allowed to access more than 100 MHz at this time? Please provide reasons for your view.

Question 28: Do you support the proposed assignment approach for mobile spectrum? Please provide reasons for your view.

Question 29: Do you agree there is a reduction in demand for WISP-provided regional broadband as a result of increased competition?

Question 30: Do you agree with reducing the nominal population cost for WISPs?

Question 31: Do you agree with the proposed spectrum charging approach for private networks, including the proposed density bands and multiplier values, and the extent to which population density should influence charges?

Question 32: Are there any other comments you wish to make?