Technical Arrangements of the 3.5GHz Band

Two Degrees Mobile Limited comments on the Ministry of Business, Innovation & Employment, Radio Spectrum Policy & Planning Discussion Document

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1 Executive Summary

Roll out of 5G is critical to delivering significant economic benefits to New Zealand in the future. Allocation of the 3.5GHz band is the first step in this process. 2degrees is pleased with the progress MBIE has made on a number of technical issues. We support MBIE's proposal that all users of the 3.5GHz band should be synchronised. However, further work is required to ensure the full benefits of 5G are delivered to New Zealanders.

The Change Management Process

The proposed change management process requires unanimous agreement among all users of the band or to rely on the Arbitration Act for a decision. While unanimous agreement between national mobile network operators is a reasonable expectation[1], given technologies and efficiency incentives, 2degrees is concerned that all users of the 3.5GHz band may not be able to regularly change the frame structure and sub-carrier spacing as technology evolves. We would be concerned if this requirement enabled operators serving a very small proportion of New Zealand consumers, including using LTE with 5G frame structures, to deny further 5G evolutions to the majority.

The 3.5GHz management right is a 20-year right and limiting it to its initial configuration is likely to significantly diminish what 5G and its future evolution can deliver to New Zealand, and associated consumer benefits. We expect multiple technology evolutions (both minor such as frame structure and sub-carrier spacing changes as well as potential major changes such as 6G). For example, the 1800MHz band was 2G band at the time of its allocation in 2000. However, it is currently a prime 4G band among all three mobile network operators. If technology changes were not possible, mobile operators would not have been able to offer 4G services and deliver the associated economic benefits to New Zealand consumers.

MBIE should adopt the proposal that change should be determined by *5G* operators in the management rights bands (either by unanimous agreement or through arbitration). Recognising the importance of potential 5G users in Crown spectrum, this should also apply to the Crown as owner of licenced spectrum, with criteria to determine Crown agreement to change. The criterion should be clearly set out from the start of the allocation, for example, that the change is in the long-term interests of New Zealanders and/or efficiency criteria. Including for certainty, it is important that the Crown's decision framework is set out by pre-established criterion, which support the interests of all New Zealanders/consumers. The criterion will also support any necessary arbitration process. In the event users of Crown spectrum cannot or do not wish to move to the new frame structure a guard band is required to avoid interference. The solution discussed in the next section (utilising the 3.3-3.4 GHz band for WISPs) offers a better outcome for both WISPs and 5G users in the event the WISPs do not synchronise with 5G or evolving frame structures.

WISPs should operate in 3.3-3.4GHz band

Moving WISPs to the 3.3–3.4 GHz band provides significant short and long-term benefits for industry and consumers. It has been confirmed that WISP equipment is available in this band. Analysis based on new information made available by vendors indicates that if LTE operates in the 3.3-3.4GHz band and 5G operates in the 3.5GHz band (3.4–3.8GHz) and the two systems are not synchronised (i.e. different 5G frame structures) there is significant

[1] The change management proposal previously submitted by mobile operators did not include users of Crown spectrum.

improvement in interference performance.[2] While this may not fully fix the interference, it is likely to provide a better solution than the two systems operating in the 3.5GHz band.

WISPs may or may not want to synchronise immediately and over time. The 3.3 - 3.4GHz band gives greater flexibility and protection if the WISPs do not synchronise with new 5G frame structures as the 5G frame structure is changed, benefiting both WISPs and 5G operators. In addition, shifting WISPs to this band provides them with 100MHz of spectrum if they can maintain 5G synchronisation as well as freeing up more of the 3.4–3.8GHz for other 5G services to consumers. If WISPs cannot synchronise they can operate in the lower portion of that band, for example 3.3–3.34 (40MHz), with room for a guard band.[3]

Given these substantial benefits, MBIE should consult the industry on WISPs operating in the 3.3-3.4GHz band. Expected delays in the auction allow further time for this. This will deliver a better outcome for New Zealand in comparison to WISPs operating in the 3.5GHz band. The interference studies presented in March showed that there is not enough spectrum in the 3.4-3.8GHz band to provide 100MHz to all three mobile operators, spectrum to WISPs and a sufficient guard band to protect from interference.

MBIE needs to continue its involvement in the Crown spectrum

This is the first time a TDD system will be rolled out on a mass scale in New Zealand. Co-existence of TDD systems introduces additional complications that were not present in the co-existence of FDD systems. Multiple parties with different technologies will be operating in adjacent spectrum. Not all parties have the resources to deal with technical and procedural complications that may arise in the event of interference and there could be serious interference consequences. Therefore, MBIE cannot leave it to the operators who use the Crown spectrum to manage the interference.

There is a need for MBIE to oversee the Crown spectrum to ensure any interference issue from within Crown spectrum is properly managed. MBIE should specify guard band requirements (based on the recent interference analysis submitted to MBIE) in the spectrum in the event they fail to synchronise.

2degrees has the following specific comments on MBIE's proposal:

- 2degrees supports the requirement for all users of 3.5GHz band to synchronise their transmission to the agreed frame structure.
- An 18-month notice period for an unsynchronised WISP operator to vacate the band is a significant encroachment into private management right holders' rights to use the spectrum. A more appropriate notice period would be 6-9 months. In any case, it must be possible for operators to ensure WISPs have vacated spectrum by November 2022, when spectrum management rights begin (i.e, for an 18 month notice period, this notice must be able to be provided in May 2021 prior to use of the spectrum). Spectrum is being purchased to allow 5G rollout from this date. Importantly, not all WISPs are rural (there are many high sites in urban areas e.g. Sky Tower, Colonial Knob). Given initial rollouts are expected to be in more urban areas we support synchronisation from this date for these 'zones'. Not doing this could result in significant service issues. This will also be more important for operators in the lower portion of the 3.5GHz band, that are expected to be closer to WISPs (also located in the lower portion of the band).

[2] The technical analysis presented in March workshop considered 5G/WISP interference when unsynchronised, with both systems within the pass band of each other. New out of band filter rejection figures that apply when the two systems operate outside each other's pass band have been provided by vendors.
[3] We consider any potential interference between current 3.3-3.4GHz band SRDs/amateur users and WISPs would be limited and could be addressed. With the wide bandwidth available at 3.3–3.4GHz, there is flexibility for the SRDs/amateur users to find 'clean' spectrum.

- It should be clear what constitutes harmful interference, so that interpretation debates are not allowed to result in harm to industry and consumers (for example, extensive service delays and disruptions rather than addressing harmful interference within 10 working days).
- MBIE should mandate a common timing source with minimum performance requirements.
- 2degrees supports the proposed frame structure, sub-carrier spacing and special slot arrangement. However, given new information on other frame structures and special slot arrangements have come to light recently, MBIE should allow the technical working group the opportunity to consider the new information before it finalises its decision.
- Synchronising of 5G networks on a large scale has not been tested in New Zealand. While WISPs have received assurance from vendors that their networks are capable of synchronisation with the 5G frame structure, we consider this should be tested. The industry technical working group should address how the synchronisation of networks is initialised and maintained.
- 2degrees do not support the proposed calculation methodology for unwanted emissions. A fixed antenna gain is used based on current knowledge. This does not allow for an increase in antenna gain from changes in technology and could restrict the operation of 5G in the future. MBIE should define the emission limits without factoring in antenna gain, as 3GPP has done.
- TRP is more suited to active antenna systems. 2degrees recommends that TRP is used for enforcing compliance.
- The amateur services operating in the 3.3 - 3.41GHz band have the potential to cause interference to 5G systems. MBIE must specify a guard band to limit this interference.
- Current Short Range Device (SRD) users are not likely to cause interference to 5G. However, future increases in SRD numbers and resulting cumulative interference could cause harmful interference. MBIE should put in place measures to cap the number of users at current levels.

2 Response to specific MBIE Questions

The following provides 2degrees' comments on specific questions raised in MBIE's consultation document, "*Technical Arrangement of the 3.5GHz band".*

Q1 Do you agree with the proposed rules of co-existence and the process of change?

2degrees supports the following aspects of MBIE's proposal:

- All users of 3.5GHz band should synchronise their transmission to the agreed frame structure.
- Unwanted emissions in the Crown spectrum should not cause harmful interference. In the event of harmful interference, the licensee should remedy the harmful interference within 10 working days. After this Crown has the right to cancel the offending licenses.
- If harmful interference occurs between synchronised and unsynchronised transmission in the private management rights, the unsynchronised operator has the primary responsibility to address the harmful interference. 2degrees considers that synchronisation will be required in urban areas, but for other areas (for example more rural locations where unsynchronised operations could potentially continue beyond the start of the management right), proposes any harmful interference that arises should be fixed within 10 working days of notice.
- Synchronisation parameters, technical compatibility and harmful interference rules will be imposed through an agreement and all parties must be party to the agreement.

However, we have concerns over:

- **Change management process:** As noted earlier the proposed change management process could severely hamper the evolution of 5G. While we strongly support MBIE's proposal to now adopt 5G synchronisation across the band, we are concerned as to how 5G frame structures can change over the 20-year period of the management rights. We do not consider this should be held up by a very small minority of users. We support unanimous support by 5G (not LTE) operators in private management rights and/or the Crown as owner of spectrum for multiple licence holders, with arbitration as a backstop. The Crown would be required to make a decision on changing frame structures based on established criteria only, for example the long-term benefit of New Zealand consumers and/or efficiency considerations.
- **Timing to vacate the band:** Operators in private management rights are not allowed to licence for 18 months in areas where there are existing unsynchronised licences in the Crown spectrum. This is a significant encroachment into private management right holders' rights to use the spectrum. A more appropriate notice period would be 6-9 months. In any case, it should be possible to have full access to spectrum by 1 November 2022, when the management rights are transferred, i.e. notice should be able to be given in May 2021 (or later) to ensure spectrum management rights are available for 5G rollout by purchasers of spectrum from 1 November 2022.
- **Not mandating a timing source:** MBIE's proposal does not specify a timing source. A timing source with a minimum performance requirement should be mandated for all parties using the 3.5GHz spectrum to ensure that there is no interference.
- **Definition of Harmful Interference:** It would be harmful to both consumers and industry if delays and consumer service disruption resulted from debates on the interpretation of harmful interference. This should be clear upfront, for example relating to ITU standards and regulations.

Q2. Do you have any additional comments about the process?

There appears to be an underlying assumption that if MBIE is able to set up rules appropriately then there is limited need for MBIE to get involved in the future.

That may be so if all systems deployed in the 3.5GHz band remain unchanged. However, over time this is unlikely to be the case. We expect MBIE will need to have continued involvement to ensure Crown spectrum users are managing interference appropriately and not likely to cause harmful interference to 5G band users.

Q3. Do you agree with the proposed frame structure?

2degrees is generally supportive of the proposed frame structure and sub-carrier spacing. The frame structure and sub-carrier spacing proposed by MBIE is supported by the technical working group.

However, there are other frame structures that have been recently proposed which were not considered by the industry working group. MBIE should allow the technical working group the opportunity to consider the new information before it publishes the auction catalogue.

Q4. Do you agree with the proposed arrangement for the special slot?

2degrees is generally supportive of the proposed arrangement for the special slot (S slot) (10:2:2). However, as noted in our response to Q3, new information has recently been made available on other S slot arrangements. This has not been considered in detail. We recommend the technical working group considers the new information before MBIE publishes the auction catalogue.

Q5. Do you agree with the process for defining the start of the TDD frame for the first time?

Synchronising with an existing network is not difficult in theory. However, there is limited experience in synchronising multiple large-scale networks. Therefore, there is a requirement for network operators to test the synchronisation process to ensure that all networks can synchronise and maintain synchronisation within agreed specifications.

The WISPs have received assurance from their vendors that their networks are capable of synchronisation with the 5G frame structure. However, this has not been tested. Just as 5G operators need to be a party to the initial and ongoing synchronisation test regime, so do WISPs.

The industry technical working group that was tasked with synchronisation should be tasked to address how the synchronisation of networks are initialised and maintained.

Q6. Do you agree with the proposed solution for a synchronization source and timing alignment?

The technical working group proposed a common timing source is adopted. MBIE should adopt this proposal.

A common timing source and minimum performance requirements should be mandated so there is certainty all users of the 3.5GHz band need to meet minimum performance requirements. GPS is such a source, however, this is dependent on a US system. If it is not considered secure enough then MBIE should consider using the New Zealand atomic clock.

Q7. Do you agree with the calculation methodology for the unwanted emission mask, particularly the choice of the nominal antenna gain?

2degrees does not support the calculation methodology for an unwanted emission mask that uses a fixed antenna gain. The antenna gain figure is based on current knowledge. The 3.5GHz management rights are 20-year rights and are likely to see significant technological changes during this period. Fixing the emission figure based on current knowledge will be limiting. 3GPP standards have specified emission limits excluding the antenna gain for this reason. MBIE should adopt the same approach in defining emission limits.

We understand a number of regulators are using TRP for setting emission limits, and some of these regulators have already allocated the 3.5GHz band. It is highly likely other regulators will have resolved the question of how to use TRP to enforce compliance by the time MBIE allocates the 3.5GHz band in New Zealand.

Q8. Do you agree with the choice of EIRP over the TRP?

MBIE prefers EIRP because it is consistent with the way RSM calculates and measures compliance with Adjacent Frequency Emission Limit (AFEL). However, as noted above, TRP is used by several regulators and used by 3GPP to define out of band emissions.

As MBIE correctly noted, TRP is more suited to active antenna systems. Roll out of 5G will see large scale introduction of active antenna systems and active antenna systems will become the main stay of cellular networks. Trying to manage this new paradigm based on the existing compliance regime will not produce the most efficient outcome for the 3.5GHz band, or future cellular bands. As such, 2degrees recommends that TRP is used.

Q9. Do you have any other comments regarding the out-of-band emission masks?

Out of band interference is mainly an issue for adjacent systems. The limits don't have a significant impact on synchronised adjacent management right holders.

While it is important to set the out of band emission levels correctly, they should not impose unnecessary restrictions on 5G systems where management right holders have to sacrifice spectrum at the band edges to meet the out of band emission requirements.

Q10. Do you agree with the technical compatibility analysis between the amateur operation in 3300-3410MHz and 5G (or compatible technology) in the 3.5GHz band?

2degrees does not agree with the assessment of interference from amateur operation in the 3.3 - 3.41GHz band to 5G services. The amateur radios are not synchronised with 5G and operating at 30dBW next to sensitive 5G radio systems is likely to cause interference (both amateur systems to 5G and vice versa).

MBIE should specify a guard band between the amateur operation and 5G systems. Currently no interference study has been done to estimate the guard band requirement. It is recommended that this is considered by MBIE in detail. Industry analysis and input could be provided.

Q11. Do you agree with the technical compatibility analysis between SRD operation in 2900-3400 MHz and 5G (or compatible technology) in the 3.5GHz band?

2degrees does not agree that SRD will not cause interference. Currently there are only a low number of Ultra Wide Band (UWB) users and this is not likely to cause interference. However, with the increasing popularity of IoT, this GURL could be used for IoT or other SRD applications and result in significant interference from this band. The Act does not deal with cumulative interference and there are no means to address interference from a large number of users.

The only way to ensure that there will be no interference is to cancel/amend the GURL so that there is no possibility of having large numbers of devices rolled out in this band. There are many other bands where IoT-type devices can be used, therefore this will not limit the proliferation of IoT for New Zealanders. Not addressing this would mean MBIE keeping the door open for significant potential interference, and associated disruptions to 5G and WISPs, in the future.

Q12. Do you agree with the arrangement for satellite services in the frequency range 3800-3840 MHz?

MBIE has already agreed the protection to existing satellite users in 3.8 - 3.84GHz range and agreed to consider any future licences on a case by case basis. 2degrees is comfortable with this arrangement.

Q13. Do you agree that operators should be permitted to choose to not follow these technical principles as long as no harmful interference is caused to their adjacent operators?

2degrees agrees with the above proposal in principle. 5G operators in private management right should have the freedom to choose what they want provided they do not cause interference.

However, 2degrees is concerned that operators within the Crown spectrum may not have the resources or capability to assess and manage interference. This could cause significant harm to adjacent users (including management rights holders and their consumers).

As such, we are uncomfortable with this principle being applied directly to the Crown spectrum, without MBIE robust oversight to ensure there is no harmful interference caused by users of Crown spectrum.

Q14. Do you agree with the same technical principles should be imposed throughout the 3.5GHz band?

2degrees support the same technical principles being imposed throughout the whole 3.5GHz band.