Received by email

Dear Sir,

Please accept these submissions as input to your considerations relating to preparation for 5G. The following commentary is provided in direct response to the questions contained in your Discussion Document dated March 2018.

Q1. What are the likely uses for 5G in New Zealand initially and in the longer term?

We cannot currently predict all of the possible applications for 5G in either the short term or the longer term. Usage of this technology will evolve over time and prediction for its use with any degree of certainty is problematic.

However, we do expect that usage of 5G in New Zealand will initially simply be an extension of the usage of 4G in New Zealand. As devices are produced which support 5G functionality and associate spectrum allocations, these devices will be used in ways that are similar to that for 4G devices today. Over time, applications will be developed that leverage the specific functionality offered by 5G and these will be adopted by users based on their preferences.

The key to the introduction of new 5G services will be the availability and adoption of network slicing. Network slicing is essential to ensure that the full capabilities of 5G can be realised and differentiated from that capability supported by 4G technology. Network slicing will be required to enable the full range of characteristics promised by 5G to be realised. For example, slices will be required to specifically support extremely low latency services or very high bandwidth services or critical communication services. All types of service are unlikely to be supported optimally by a single network slice. Different network slices will need to be optimised for each extreme class of service. How these network slices will evolve will depend of the availability of the required network functionality, the availability of user devices to utilise the delivered functionality and the commercial viability of the given application classes. There is still much work to be done in terms of research and development, followed by standardisation and production in order to bring this type of functionality to reality.

Hence the future evolution of 5G usage is highly uncertain.

Q2. Do you consider competition should be encouraged at the infrastructure level or purely at the retail level for 5G? Why?

There are arguments for the promotion of both infrastructure and retail only competition.

In urban areas where user density is high, infrastructure competition can be a viable approach to service differentiation and so should be encouraged. However, as the density of cells increases, the proliferation of cell sites is becoming and increasing environmental issue. This problem will be accentuated with the small cells required for the implementation of some types of 5G deployments. Hence it will become increasingly desirable for multiple retail operators to share cell sites in order to minimise environmental and visual pollution. This may be restricted to the sharing of sites and towers in the first instance, but may well evolve into more complex forms of infrastructure sharing. Hence, although there can be advantages in having infrastructure competition, the reality of environmental pollution is highly likely to lead towards increasing use of wholesale sharing of infrastructure, with increasing competition at the retail level only.

In rural areas, the economics dictate that infrastructure sharing is essential today as illustrated by the formation of the Rural Connectivity Group. It is expected that this trend will be accentuated with 5G.

Q3. What regulatory issues need to be considered from a 5G perspective in New Zealand?

I think that a number of regulatory issues will arise as a result of 5G deployment in New Zealand. These issues will include:

- Co-siting and infrastructure sharing requirements, to reduce environmental pollution,
- The potential for roaming across all cellular infrastructure by all Retail operators,
- The introduction of Virtual Mobile Network Operators based on Network Slicing,
- The need for prioritisation to support critical applications and users (eg. Emergency services),
- The need for mobile operators to comply with Service Level Agreements, and appropriate penalties for non-compliance,

Q4. What aspects of these regulatory issues are most significant for 5G?

All of the issues identified under Q3 will be prominent for 5G.

Q5. Do you agree that the 3.5 GHz band is the top priority for allocation for 5G?

Yes. Without access to the 3.5GHz band it is hard to see how many of the 5G application classes can be implemented, especially in high mobility environments. This is also the favoured band in several overseas jurisdictions.

Q6. Do you have any comments on reallocating 3587 to 3690 MHz for 5G?

The greatest amount of spectrum possible within the 3.5GHz band would be highly desirable. Hence the reallocation of the 3587 to 3690 GHz spectrum will be highly desirable,

assuming this occurs throughout large chunks of the developed world. The availability of user devices using this spectrum will be the absolute key to its need.

Q7. Do you agree that the 26 GHz band is a high priority for allocation to 5G in New Zealand?

After the 3.5GHz band, the 26-28GHz spectrum will be the next highest priority band for allocation to 5G in New Zealand. However, we need to realise that technology for use in this band still requires a lot of development and even then will only be largely suitable for slow mobility environments, such as for fixed cellular and in building applications. It is unlikely to be suitable for high mobility environments in the near term, if at all.

Q8. Would this band be of interest to your organization for trials for 5G services in New Zealand?

Not applicable.

Q9. Do you agree that the 31.8 to 33.4 GHz, 40.5 to 42.5 GHz and 42.5 to 43.5 GHz bands are a low priority for allocation to 5G in New Zealand?

Yes. These bands will on become important if devices become readily available for use in these bands at low cost. This will require a substantial adoption of these bands around the globe.

Q10. When do you think equipment is likely to become available in the bands identified in Q9?

Not known.

Q11. Do you have any comment on the possible allocation of 27.5 to 29.5 GHz to IMT?

This band is more likely to be adopted early in the evolution of 5G in some parts of the world. If this does happen then these bands may well become attractive in New Zealand and so this situation needs to be carefully monitored.

Q12. Is there demand for alternative uses other than IMT of the 1400 MHz band? If so, what uses?

Any spectrum below 6GHz and particularly below 3GHz will be valuable for cellular use in the future. This will become increasingly evident as 5G technology evolves so that it can support many applications that today require dedicated wireless technology and hence spectrum. One can envisage a time in the future where 5G technology can and does absorb all types of applications for radio based communication. Any application will simply become

an application over a specifically tailored 5G network slice. However, how long the technology takes to evolve into this environment is open to debate.

Q13. When is the demand likely to require consideration of reallocation of the 1400 MHz band for IMT, if at all?

This re-allocation should be considered as a longer term evolution path for sure. It will be essential at some point in time, but needs to be driven by the availability of end user devices and hence adoption overseas.

Q14. Is there a need for more sub 1 GHz spectrum for IMT/5G?

As indicated under my response to Q12 above, spectrum below 1GHz will become increasingly required over time. This spectrum offers the best potential for coverage extension with high mobility. As more applications migrate to the use of 5G based technology, increased certainty of coverage will be required and this will best be achieved using spectrum below 1GHz.

Q15. If so, how should we deal with radio microphones in the 600 MHz band?

Radio microphones will eventually migrate to use the cellular technology especially under the 5G evolution. The only issue will be the time required to achieve this transition which will be dependent on the time it takes to develop 5G technology and applications which supports this application at low cost. This will not happen in the immediate future, but it will happen.

Q16. When is the demand likely to require reallocation of the 600 MHz band to IMT, if at all?

The reallocation of the 600MHz spectrum for IMT could be useful in the short term. However, the actual need will depend almost exclusively on the opening of this band in large international markets which will drive the development of devices which use this spectrum. Without low cost, widely available end user devices the spectrum is useless.

Q17. Which allocation methodology should be used for allocating spectrum bands identified for use with 5G? Why?

Management licences would seem to be a useful allocation tool for spectrum for 5G. However, the universal use attributes offered by 5G needs to be supported by low cost infrastructure, which in turn needs to be supported by reasonable cost for spectrum. Many potential applications for 5G will only be realised if they can be delivered at low cost. High spectrum costs are likely to limit the range of applications that can be supported by 5G. Hence any form of spectrum auction for 5G spectrum needs to be structured to ensure that there is not an artificial shortage of spectrum which will drive costs up.

Q18. Should different allocation mechanisms be used for rights for regional providers and national providers? Why?

It is hard to imagine how regional operations of 5G technology will be economically viable. This could be enabled by a regulatory regime which enforces roaming across infrastructure, but otherwise would be challenging economically. Hence any regional allocations would need to be supported by a complementary regulatory regime.

Q19. Should deployment of 5G technology be specified for some or all bands? If not, why not?

Any restriction on the use of spectrum for 5G or any other standardised cellular technology would amount to “picking winners”. It would be far more rational to make all spectrum allocated for mobile services to be accessible by 5G technologies. Mobile operators can then make their own rationally economic choices as to what technology they deploy in what spectrum in what timeframe.

Q20. What implementation requirements should be specified and how should these be expressed? – time, extent, etc –

I assume that this question is aimed at the “use it or lose it” concept. There are many issues associated with predicting the future use of spectrum, many of which are not controlled by the bidders for spectrum. In order to avoid problems with spectrum hording, there needs to be some certainty that the spectrum allocations being offered to the market are aligned with international best practice. New Zealand can never dictate the development of end user devices and the spectrum that is included in these devices. This includes how this spectrum is structured in terms of FDD channel allocations or bandwidth allocations, etc. Implementation within specific bands will be almost exclusively determined by international developments in the use of these bands and so timing for implementation will follow these developments.

Q21. What should be the consequence of non-implementation – lose spectrum, additional payment, other

The consequences for non-implementation within any spectrum allocation, would need to depend on the reasons for non-implementation. If internationally standardised technology is available for use in the specific spectrum allocation, and implementation does not proceed, then this might trigger some form of sanction. On the other hand, if the standardised technology is not available, then I don’t think that sanctions are either logical or necessary. Hence there needs to be substantial care in the implementation of any form of sanction.

Q22. Should the implementation requirements be different for regional and national providers? What should these be and why?

I don't understand why there would be any differentiation, providing the non-implementation consequence model is carefully structured as indicated under my response to Q21.

Q23. Should acquisition limits be imposed on 5G bands? If so, what should these be and why?

Any form of acquisition limits will need to be carefully managed. In the end, this becomes a Commerce Commission issue in terms of commercial dominance. My preference would be for there to be no limits imposed on spectrum acquisition for 5G, but that it be clearly communicated that the outcome from any allocation process will be subject to close scrutiny by the Commerce Commission in terms of resulting market dominance.

Q24. Should acquisition limits be imposed for regional providers? If so, what should these be and why?

As indicated above, I do not see any opportunity for regional service providers unless the Regulatory framework is structured appropriately to support such models. Hence until the Regulatory framework is defined, then this this question is not helpful.

Q25. What term should be used for management rights suitable for 5G? Why?

The investment for nationwide implementation of 5G infrastructure will be considerable. Hence the term used for management rights will need to be shaped to enable a reasonable return on the investment of spectrum. So if the cost to acquire spectrum is high, then the term for the management rights will need to be long – 15 to 20 years. Alternatively, if the cost to acquire spectrum for 5G is low, then the term for the management rights could be lower – say 10 to 15 years. This suggests that the term for the management rights for 5G need to be developed as part of an overall framework for the definition of the spectrum rights, taking a variety of factors into account.

Q26. Should the 5G bands be replanned as TDD bands or some bands or parts of bands be retained as FDD? Why?

Whether the 5G bands are planned for FDD or TDD will depend entirely on the availability of internationally standardised equipment for use in these bands, including the availability of low cost end user devices. It is essential that New Zealand does not attempt to determine what approach will be used independent from international standardisation efforts combined with international market take-up of usage within these bands. This may or may not require an appropriate mix of both FDD and TDD in different bands.

Q27. What bandwidth should be used as the basis for allocation? Why?

The bandwidth used in the different bands as the basis for allocation will depend on a variety of factors including:

- The Regulatory support for wholesale and retail service provider separation,
- The regulatory support for enforced roaming across service provider infrastructure,
- The use of TDD vs FDD access approaches,
- The length of the wavelength for a given band – longer wavelength bands will need narrower bandwidth allocations and shorter wavelength bands will need wider bandwidth allocations.

The principle should be that bandwidth allocations should be as large as possible within the context of the above factors. This should mean that 100MHz and greater bandwidths will be preferred above 3 GHz, whereas 20MHz bandwidths should be preferred below 3GHz.

Q28. What out of band emission limits should apply to management rights when first created for allocation? Why?

Out of band emission limits for all forms of radio transmission should be kept as tight as possible, while being economically realistic. In the case of 5G transmissions, the economic reality will be determined by the international standardisation of the technology. New Zealand will have little ability to influence this process and so will need to adapt the out of band emission limits to best reflect these standards. Additional filtering could be enforced in New Zealand, but this would impact on infrastructure costs and hence consumer prices. So care needs to be taken to find a good balance between out of band emissions and system cost.

Q29. Should out of band emission limits be different if the band is technology neutral? If so, what out of band emission limits should be applied?

I am not sure what is meant by the term “technology neutral” in this context.

Q30. How should interference between adjacent frequency 5G TDD networks be managed? Should this be the same for all frequency bands?

If a band is allocated for use by 5G TDD carriers, then interference between the various users of the band should manage the interference between themselves. The 5G technology will be designed to operate in an interference limited mode and so interference between networks in adjacent allocations should be largely similar to that for self-interference. The major difference will be if one or both of the networks are using “coordinated” interference management models, where the adjacent network spectrum cannot by definition be coordinated.

I don’t see how different regimes can be applied to different frequency bands, so I would expect that a single well considered regime should be applied to all bands where TDD is in use.

Q31. How should interference between different technologies within the same band be managed, if bands are technology neutral?

The operators should be required to manage this themselves, within defined out of band emission criterion for each technology. However, I am not sure where these situations might arise and so specific instances of potential conflict need to be identified and appropriately analysed. For example, in bands allocated through management rights this shouldn't be a major problem. The problems should only arise in bands where there are more general licencing regimes. In these situations, the users of the bands need to make suitable technology choices to avoid interference, assuming there will be some form of spectral power density limitation applied for all users for this type of spectrum.

Q32. Should regional uses be provided for in the 3.5 GHz band plan? Why?

Definitely not. This will be a prime band for national 5G service delivery and so should be optimised for this purpose.

Q33. If allowed in the 3.5 GHz band, how could this be managed or facilitated?

I don't think this is a practical approach. Any allocations in the 3.5GHz band for regional use would need to be part of a specific dedicated allocation which will lead to inefficient use of the spectrum.

Q34. Which alternative bands may be suitable for regional allocation? Why?

This depends on the purpose for which the regional allocation is being used. If the primary use is for regional Wireless Internet Service Provider applications, then spectrum needs to be allocated to meet these needs in bands for which equipment is being manufactured, as is the case today. This would certainly involve the 2.4GHz and 5GHz bands. Is there a defined need for additional spectrum for these applications?

Q35. Is early access to the 3.5 GHz band required for roll out of 5G networks prior to the expiry of existing rights in 2022? If so, why?

The allocation of spectrum in the 3.5GHz band, with allocations in the 100MHz bandwidth region is essential for the widespread deployment of 5G services with high bandwidth and high mobility. This band is most likely to be introduced early by developed nations around the world and hence will enable the early manufacture of both network equipment and end user devices for the 3.5GHz band. For example, South Korea is intending the use this band for commercial 5G implementation in the 2019 timeframe. Hence it is highly likely that early implementations of 5G technology will be made in this band in the 2020 timeframe, around the world. If New Zealand wishes to keep abreast of this new technology, it is likely that there will be a strong demand for access to the 3.5GHz band prior to 2022.

Q36. How could early access to the 3.5 GHz band be achieved?

Not easy. Some access might be achieved early through careful negotiation with the incumbent users. Such negotiation might free up a portion of the spectrum which could then be allocated for early 5G implementations. However, it is hard to see how this approach would lead to full commercial 5G implementation in the 3.5GHz band.

Q37. Should the government be involved in early access arrangements for the 3.5 GHz band?

The Government needs to provide clear messages to the industry as to what will happen post 2022 and then support the opportunity for parties to negotiate early entry to the band for 5G technology. This implies that any form of allocation process for post 2022 band allocation needs to be defined well in advance of 2020, so that the parties know what they are negotiating for in terms of likely allocations, bandwidths, FDD/TDD, etc.

Q38. Is early access to the 26 GHz band required for roll out of 5G networks prior to the expiry of existing rights in 2022? If so, why?

I am not convinced that this is as essential as it is for the 3.5GHz band. The technology for use in this band is much less mature than that for the 3.5GHz band and so it will be slower to get to market. This may mean that 2022 is not an unreasonable time for the introduction of 5G technology into this band.

Q39. How could early access to the 26 GHz band be achieved?

A similar process could be undertaken as that for access to the 3.5GHz band. However, the need for accelerated access to this band needs to be carefully tested with industry before too much effort is put into enabling this to happen.

Q40. When is demand for the bands above 30 GHz likely to eventuate?

This will depend on the development of suitable technology that is subsequently standardised and put into production. When this will happen is quite hard to determine at this time.

Q41. When is demand for the 600 and 1400 MHz band likely to eventuate, if at all?

Again, the timing is dependent on international adoption of these frequency bands and hence the development of the associated technology. The timing for this adoption is far from certain at this time.

Conclusion

There is a strong need to urgently prepare a strategy for the provision of spectrum for the introduction of 5G technology in a variety of bands. This strategy needs to address both spectrum allocation and regulatory components. Once such an over-arching strategy is put in place through industry consultation, there needs to be rapid focus on the provision of access to the 3.5GHz band for early 5G implementation. It is likely that both the strategy and 3.5GHz allocation issues will need to be dealt with in parallel in order to ensure that New Zealand does not fall behind the rest of the developed world in terms of 5G implementation.

In regard to all allocations of spectrum for 5G, it will be essential to ensure that international trends for allocation and hence technology implementation are tracked with the utmost care. It will be essential for a successful implementation of 5G technology, that New Zealand is aligned with the majority of large scale implementations around the world to ensure that end user devices are available in a timely manner at low cost. New Zealand must be a fast follower with the implementation of this technology.

Thanks

Dr Murray Milner

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