Preparing for 5G in New Zealand

Submission | Ministry of Business, Innovation and Employment

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Public Version

Contents

Executive Summary

5G is an important and exciting technology evolution that promises to facilitate a large number of new mobile network applications, services and business models. Autonomous vehicles, smart cities, smart homes, virtual reality-enabled remote operations - many of these new services may be transformative in the long term.

5G will be 100 times faster, 20 times more responsive, and able to support 100 times as many connections than current mobile technologies. 5G will take us from a world of connecting people to each other and the internet to a world of connecting almost everything, and its deployment is undoubtedly critical for our national digital infrastructure.

Spark, Vodafone and 2 degrees are ready to start that deployment: 5G is the natural evolution of the mobile networks we operate in New Zealand today. At Spark, our internal projections already suggest we will need 5G in the near-term in order to meet demand for current services and to continue to achieve a lower network cost per bit in doing so. We are now moving to deploy 4.5G equipment that is upgradeable to 5G and to densify our network to provide the smaller inter-site spacing of our cell sites that 5G implies. But we need access to 5G spectrum – in both the C-band and mmWave bands – before we can deploy a 5G network. The most important thing Government can do to ensure early 5G deployment is to make spectrum policy decisions that support the early availability of 5G spectrum.

We expect that the initial drivers for 5G in New Zealand will be continued demand for existing mobile services and an expanding market for wireless home broadband services. Mobile services that support 4K and later 8K streaming and wider availability of unlimited mobile usage plans. Wireless home broadband plans that support unlimited usage plans and that can be used at multiple different locations. These are services we know there is unmet demand for today, but which current technology cannot consistently support.

In this context, we support improvements to our regulatory framework that will:

- Accelerate the allocation of the spectrum we will need to deploy 5G networks; and
- Reduce the time and costs associated with obtaining RMA and Local Government approvals for 5G cell sites.

New Zealand is behind key comparator countries in allocating 5G spectrum; we need to make key spectrum policy decisions quickly if we are to keep pace

Many countries have resolved policy objectives and/or are already in the process of making the spectrum necessary for 5G available to providers. Commercial 5G networks will have been launched in at least the following countries by 2020: Canada, China, France, Germany, Japan, Russia, Singapore, South Korea, UK, the US and 22 other countries. New Zealand spectrum allocation decisions and dates need to be set now as a matter of urgency if we are to keep pace.

Globally, the most referenced spectrum bands for initial 5G deployment are the 3400-3800 MHz (the **C-band**) and 24.25-29.5GHz (the **mmWave band**) bands. There is enough certainty around these bands now that we know they will be key parts of the 5G ecosystem in the near-term, so Government's policy priority should be to make these bands available for purchase and use as quickly as possible. We see commercial use cases for each of these bands in the near-term. Our preferred spectrum policy model in respect of each is:

For the C band:

- The Crown should confirm as soon as possible that all of the spectrum between 3400-3800MHz will be available for mobile applications by early 2020 in a TDD configuration. Current plans to allocate only 280MHz would place New Zealand well behind the C-band allocation targets in comparable developed countries. An auction for this band should be held in 2019.

- The Crown should agree terms now with existing C-band rightsholders to permit the early relinquishment of this spectrum at least in areas where 5G is likely to be deployed before the expiry of those rights. Compensation for this early relinquishment should be pegged to auction prices, pro-rated for the remaining length of time these management rights have remaining.

- WISPS currently operating in the C-band should be relocated to the 2300Mhz range currently held by the Crown, or to regional licences in the 3700- 3800MHz range that permit WISPS and mobile network operators holding urban spectrum rights in that range to co-exist. This relocation can occur progressively as operators roll nationwide 5G networks out.

- Notice should be provided now to the small number of satellite TV receive-only operators that they will need to cease use of those satellite dishes from 2020. Some consideration should be given to whether funding assistance should be provided to these consumers to assist with any transition costs.

- Mobile network operators should be permitted to purchase at least 100 MHz at any auction for the C-band.

For the mmWave bands:

- The Crown should auction all or most of the 3GPP band N 257 and N 258 (24.25- 27.5GHz and 27.5- 29.5GHz), available for 5G Mobile soon after World Radiocommunications Conference 2019 (**WRC19**) and inform existing rightsholders in those ranges now that their Management Rights will not be renewed upon expiration.

- Mobile network operators should be permitted to purchase at least 800MHz at any auction for the mmWave bands.

Today's infrastructure-based competition model will deliver 5G earlier, and with more innovation, to more New Zealanders

The Ministry's consultation paper asks whether spectrum policy should encourage infrastructure-based competition or retail-based competition.

We favour infrastructure-based competition. That competition model will deliver 5G to New Zealanders much earlier than any other model can, and will:

- Encourage service providers to transition customers to 5G quicker than any other industry model can.

- Encourage innovation and competition between mobile service providers and between fixed and mobile network providers better than any other industry model can.

- Ensure 5G network operators find the correct balance between competing with each other using separate physical infrastructure and sharing physical infrastructure where it is more efficient to do so.

Introduction

1. Thank you for the opportunity to comment on the Ministry's *Preparing for 5G in New Zealand* discussion document (**discussion paper**).

2. We support the Ministry developing a strategy/roadmap to support deployment of 5G new radio technologies, and proposals to allocate pioneer 5G bands as soon as possible. The deployment of 5G networks in New Zealand will bring about the next wave of economic and social benefits, but realisation of these benefits requires that these pioneer bands are re-planned and allocated to the highest value users as early as possible.

3. The increasing importance of mobile broadband technology in achieving efficiencies and advancements in transport, education, health, energy, agribusinesses and environmental systems is well understood, as is its increasing value to new consumer services. Governments around the world are promoting the transition towards 5G networks as this is seen as essential to meeting future economic, social and environmental objectives.

4. And off the back of Government policies, operators in major economies we trade with, and compare ourselves to, plan to deploy commercial 5G networks by 2020. If there is a single policy imperative that must come out of this process it is that New Zealand must keep pace with international 5G deployments.

5. Key policy decisions to enable that need to be made this calendar year if we are to deploy 5G networks in a similar timeframe, and auctions for 5G spectrum need to start in the next calendar year.

5G deployment underpins a digital economy

5G for a connected economy

6. Mobile networks continue to evolve rapidly with new generations of technologies deployed regularly. Mobile operators have already deployed 1G, 2G, 3G, 3G and 4G networks and Spark is now deploying 4.5G technology and preparing our network for a transition to 5G. Each generation adds significant capability and benefits to society. For example, 3G delivered basic mobile data capability and 4G delivered mobile broadband capability. Each of these generations of mobile technology was transformational at the time, as 5G will be when it is introduced.

7. 5G is used to describe the next generation of mobile communications technologies specifically designed to support a connected economy. To do this, 5G delivers a step change in technology performance, which will enable mobile network operators to deliver:

    a. **Faster speeds**. 5G networks will be 100 times faster than current technologies; and

    b. **Lower latency** (i.e. quicker reaction times): 5G networks will be five times more responsive than current technologies;

    c. **To more devices**. 5G networks will be able to support up to 100 times more devices simultaneously than current technologies.

8. Each of these three defining characteristics of 5G networks supports a large number of anticipated use cases, each of which will have different optimal network architectures and

characteristics. It is perhaps this feature - the ability to design and direct multiple “slices” of a 5G network to deliver different performance characteristics and outcomes for different use cases – that best describes its fundamental difference to today’s 4G networks. These use cases are commonly categorised into three:

a. Enhanced mobile broadband (**eMBB**): Use cases to more efficiently meet ever larger consumer demand for higher definition video, information and social media services. For example:

- Wireless broadband services that can deliver fibre-like broadband performance to homes and businesses.
- Mobile services that can deliver unlimited data plans and fibre-like speeds to mobile devices.
- New consumer services that deliver virtual and augmented reality.

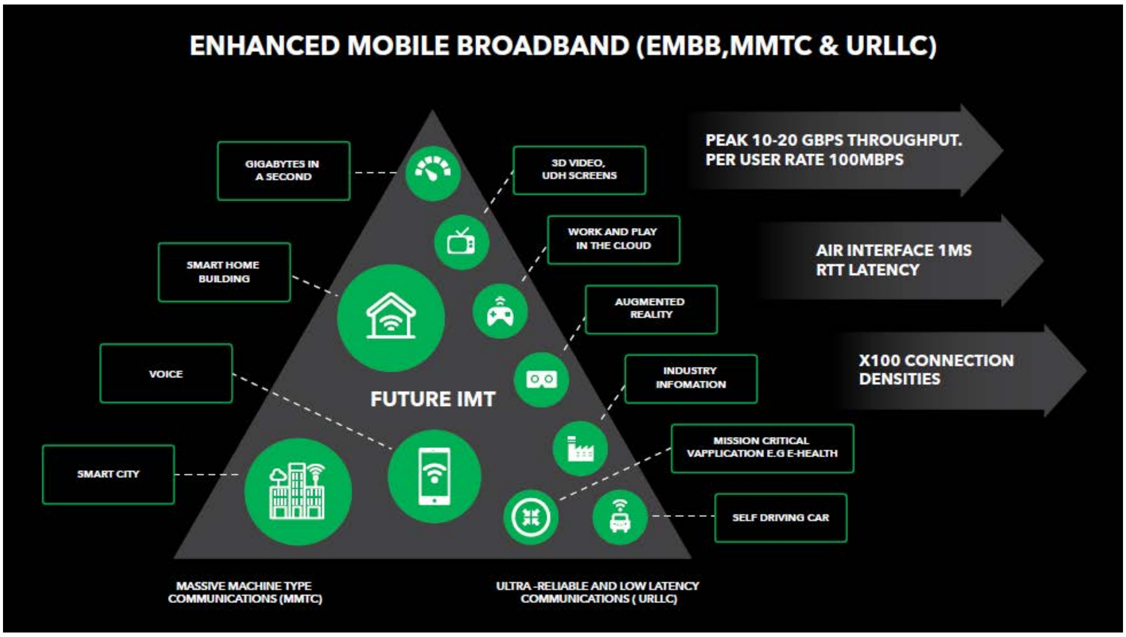
b. Massive machine to machine communications (**eMTC**): Use cases to support connections to, and communication between, tens of millions of connected devices to enable digital services that can help kiwi industries and homes become more efficient and grow faster. For example:

- Smart city services (including smart lighting, and smart energy, water and wastewater network management services).
- Smart home services (connected appliances).
- Real-time freight tracking and logistics management services.
- Industrial automation and remote management services.
- Stock, pasture, water, effluent and environmental management services.
- Health and safety monitoring and management services.

c. Ultra-reliable and low latency communications (**URLLC**): Use cases to support near-instantaneous communication between connected devices to support complex and integrated multi-user networks and services. For example:

- Virtual and Augmented Reality industrial services.
- Remote operation of health, educational and industrial equipment.
- Autonomous vehicles and intelligent transport systems.

5G networks are designed for a number of use cases[1]



source: Spark, IMT 2020 vision

9. The variety of use cases under eMBB, eMTC and URLCC is huge and will vary over time: today we can only see glimpses of what this connected future might mean and the innovations the technology might release. The Electricity Authority reports that over 70% of households have smart meters installed, giving consumers the power to better manage their energy use and bill.[2] These will migrate to 5G. Last year, Spark partnered with NIWA, Farmlands, and Ballance Agri-Nutrients to pilot IOT services to around 60 farms that lets those farms see real-time information about crop and pasture health.[3] Those services will be commercialised in the coming years. New Zealand firms are using our IOT services to monitor boats, giving boat owners peace of mind, and fuel tanks, applications we can already see wider use for in a 5G world.

10. Looking forward, we demonstrated in our Auckland 5G trial the potential of 5G for streaming 4k TV, virtual reality and security robotics. Japanese medical authorities and telecommunications providers have further successfully trialled remote medical examinations using 5G technologies.[4]

How operators will deploy 5G networks for these use cases

11. 5G is the natural evolution path for existing mobile networks. Just like 4G, and before that 3G, 5G technology gives mobile network operators a viable investment path to deliver greater capacity and faster speeds at a lower price per Gigabit.

12. With user demand increasing exponentially on our 4G network, we are continually adding 4G capacity to ensure we continue to deliver a user experience that meets our customers' expectations. That means adding 4G spectrum carriers (ie more 4G spectrum) and 4G sites or sectors. But that tactic will only take us so far: already now we can see the time coming where it

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[1] Diagram adapted from IMT 2020 vision
[2] See https://www.ea.govt.nz/consumers/what-are-electricity-meters/
[3] See https://www.computerworld.co.nz/article/620434/spark-niwa-others-launch-major-farm-iot-trial/
[4] See 18 April 2018 media report https://www.totaltele.com/499867/NEC-and-NTT-test-medical-applications-of-5G-in-Japan

will make more sense for us to divert that capacity-driven capital expenditure towards investment in new 5G network technology and spectrum that will deliver us an order of magnitude increase in spectral efficiency, throughput and $/Gbps rather than an incremental increase.

13. This requirement – to simply meet continued user demands for today's mobile and home broadband services - will be the first driver of 5G. In this form, 5G will be deployed as an overlay on our existing 4G network. From there, investment in additional 5G deployment to enable future new use cases – investment in much denser network topologies and in greater decentralisation of core switching and control functions - will follow as those use cases emerge and as spectrum to support them is made available.

14. For example, eMBB based deployments (to support improved performance of existing mobile services and fibre-like home broadband services) are the predominant driver of global 5G network investments announced to date. eMBB use cases rely on spectrum in both the mid-range (such as the C-band) and high-range (mmWave) bands to support a mix of targeted small cells deployed in conjunction with macro cells for capacity or for specialist campus/industrial/sports applications.

15. And *competition between* 5G networks will ensure that New Zealand realizes the benefits of 5G efficiently and early. The huge range of possible 5G use cases, and the diverse network characteristics each of these will rely on, will encourage dynamic infrastructure-based competition between 5G network operators, with small changes in network architectures and strategies creating different opportunities for network operators and for New Zealand consumers and businesses. One network operator may focus on delivering the best network performance (or network slice design) for home broadband and mobile broadband users. Another may focus on low-latency intelligent transport systems and virtual and augmented reality service performance. The competition between those two strategies will deliver innovation and long-term benefits for end-users.

<u>5G use cases and deployment characteristics</u>

Use case	Driver	What this deployment looks like
eMBB	For increased capacity and speed (for mobile and home broadband service experience).	Widespread deployment at C band for capacity and control plane, targeted mmWave deployment for better capacity management and for campus/industrial/stadium sites. Incrementally add capacity based on geographic growth.
URLLC	Services that require low latency such as virtual/augmented reality and gaming.	Same as eMTC. However, 5G cloud RAN deployment is required for low latency services.
eMTC	Increased capacity to serve large IOT device volumes.	Use current and 5G technologies in existing microwave bands. Transition current demand and spectrum to 5G for capacity or for synergies with technologies deployed for other use cases.

Key 5G policy decisions

16. New Zealand 5G networks will be deployed by mobile network operators. However, government has an important role:

a. Ensuring spectrum is available that allows us to make the most of 5G technologies;

b. Providing a coherent policy framework that delivers planning and investment certainty; and

c. Removing unnecessary impediments to infrastructure deployment.

17. Our request is that Government confirms its preferred policy settings for 5G deployment sooner rather than later. There needs to be clear policy decisions made so that operators can plan their investment and transition to new networks - we are already making decisions today that are contingent on securing additional 5G spectrum, and we are having to make those decisions in the absence of any clear policy on when that spectrum will be available, or in what bands.

18. The Ministry set out the Crown policy objectives for the regulation of radio spectrum in its most recent spectrum outlook report:

    a. Achieving the Government's social, cultural and economic outcomes;

    b. Maximising the radio spectrum value as input to social and economic development;

    c. Meeting the growing demand for wireless services;

    d. Promote healthy competition; and

    e. Ensuring an environment free of harmful interference for the sustainable development of wireless services and applications.[5]

19. We support these principles. However, the principles alone do not provide sufficient guidance on how 5G spectrum allocation decisions should be made. 5G standards and equipment leave economies discretion over the amount and timing of 5G spectrum availability to operators. This means the Government faces choices relating to new spectrum availability.

20. We would like to see the Ministry commit to a set of 5G-soecific principles that can guide Ministry and Government decisions on 5G spectrum and network deployment issues, and provide clearer guidance to market participants of the Government's position. There are technical, economic and social considerations in determining the overall policy. For example:

    a. **The value to society.** In determining the efficient use of spectrum, we expect the 5G benefits to mobile providers and customers to be swamped by the corresponding benefits to society as a whole. This means that inefficient spectrum decisions – i.e. to delay or withholding of spectrum capacity – will have costs far beyond the direct costs incurred by the industry.

       Government should therefore adopt as a policy that it will seek to prioritise access to internationally-standardised 5G bands above other, less valuable uses and, where necessary, work with existing rightsholders to clear these bands of alternative uses as quickly as possible.

    b. **Access to spectrum.** The benefits of 5G will be correlated with the amount, and placement, of spectrum made available to 5G network operators.

[5] From the RSM 2017-2021 spectrum outlook https://www.rsm.govt.nz/online-services-resources/pdf-and-documents-library/publications-and-guides/rsm-annual-reports-and-business-plans/rsm-outlook-2017-2021.pdf

Government policy should be to target:

i. *Specific bands for 5G. Operators require simultaneous access to low, mid and high bands. Current operators have access to low bands (<3GHz) through existing management rights, but new access will be required to new bands suitable for 5G, i.e. both C band (mid band) and mmWave (high band); and*

ii. *Large contiguous amounts of spectrum within those bands. Specifically, Government should target having at least 100MHz per network operator in the C band and at least 800MHz per operator in the mmWave bands to maximise the benefits to New Zealand of 5G technologies.*

c. **Allocation methodologies.** Affordable access to spectrum is fundamental to deployment. The greatest benefit to society from spectrum (increased GDP) is in its sustained use, not from revenue-based auctions. And earlier access to spectrum will allow New Zealand to realise the benefits associated with it, sooner.

The Government should adopt a policy of allocating 5G spectrum using a methodology that will maximise use of that spectrum rather than financial return to the Crown as maximising financial returns will inevitably reduce and delay 5G benefits. There is also a case for the Crown to consider mechanisms such as returning auction proceeds to spectrum purchasers in return for accelerated 5G deployments

21. We believe the Ministry has sufficient certainty over technology and spectrum trends now to commit to policy choices such as these that will promote 5G certainty for all parties. This would enable the Crown to, for example, resolve whether to re-plan and allocate the full 3400-3800MHz range to mobile applications as proposed below and whether to bring forward spectrum availability.

22. We are not the first country to address these policy issues: the table below summarises economies that have identified specific objectives such as these for 5G spectrum and deployment. These authorities aim, universally, to free up sufficient spectrum to both ensure competition and maximise the benefits of 5G deployment to the economy:

Authorities signalled approach to pioneer bands[6]

Economy	Mid band objective[7]	mmWave objective	Commercial deployment	Industry structure
Canada	Decision expected 2018	Decision expected 2018	2020	Competition
China[8,9]	100MHz+ per provider	2GHz+ per provider	2020	Competition
France	390MHz	(not listed)	2020	Competition
Germany[10]	400MHz	3.25GHz	2020	Competition
Japan	500MHz	2GHz	2020	Competition
Russia[11]	Decision expected 2018	Decision expected 2018	2020 (pre-commercial 2018)	Competition
Singapore[12]	Consulting	Consulting	2022	Competition
South Korea[13]	300MHz	1GHz+3GHz	2019	Competition
UK[14]	400MHz	3.25GHz	2019	Competition
USA[15]	150MHz shared plus 400MHz	3.85GHz	2018	Competition
EU	400MHz	3.25GHz	EU target 2020	A competition based framework

Source: Information from Analysys Mason report

New Zealand: signalled approach to pioneer bands

Economy	Mid band objective	mmWave objective	Commercial deployment	Industry structure
New Zealand	280MHZ	3.25GHz	Dependent	Competition

Source: Information from RSM 5G workshop

[6] Information taken from April 2018 Analysys Mason report for CTIA *Global Race to 5G – Spectrum and Infrastructure Plans and Priorities*.
[7] Planned available of spectrum, i.e. after allocations complete.
[8] See GSMA notes at page 24 https://www.gsmaintelligence.com/research/?file=67a750f6114580b86045a6a0f9587ea0&download
[9] CTIA paper referring to Analysys Mason 5G readiness index. https://www.ctia.org/news/race-to-5g-report
[10] Aims to allocate 26GHz and 28GHz bands for 5G, i.e. 5.25GHz.
[11] 400MHz in C band and 4.25GHz in 26/28GHz band have been made available for testing and 5G deployment at the 2018 World Cup.
[12] IMDA is consulting on a 5G spectrum which anticipates commercial 5G by 2022 and total mobile spectrum demand of ~3.4GHz at that date.
[13] MSIT aim to make 1300MHz of 5G spectrum available by 2018, 300MHz in C band and 1GHz in the 28GHz
[14] Ofcom also considering 3800-4200MHz for shared use.
[15] FCC has also signalled that 400MHz of 3700-4200 would be appropriate in the short term https://www.fiercewireless.com/wireless/fcc-s-o-rielly-suggests-freeing-up-200-300-megahertz-c-band-spectrum

23. It is apparent from the table above that, while New Zealand's target allocation for mmWave bands is on par with other countries' allocations, our target C-band allocation is well below every other country surveyed by Analysys Mason and should be revised upwards.

Regulatory considerations for 5G in New Zealand

5G and competition

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

Initial demand likely to be driven by eMBB services and demand growth for existing services

24. The key initial 5G drivers are likely to be for capacity to meet existing growth, and for enhanced broadband services. Almost all of the major announced deployments globally have been for eMBB purposes. US operators are deploying mmWave networks later this year – for predominantly eMBB purposes - and we expect that commercially proven products that will drive further eMBB related demand will be available by 2020. We expect a similar transition in the New Zealand market.

25. There has been significant growth in data demand and this growth will require additional spectrum and 5G technologies to meet that demand from around **[ ]Confidential**

    [ ] **Confidential**

26. **[ ]Confidential**

27. eMBB services, and capacity growth for existing mobile services, will initially be supported largely by C-band deployments. But in order to guarantee per-user throughputs that support 4k TV and HDTV mmWave spectrum will required.

28. In locations where existing demand growth is most likely to exhaust existing spectrum capacity – stadiums, concert venues or campus' – we expect deployment of mmWave band spectrum soon after, or contemporaneously with, C-band spectrum.

Future uses are potentially very broad

29. We have described the additional use cases currently predicted to drive 5G deployments in detail above. eMTC and URLLC use cases will emerge as technology matures and industries (both public and private) adopt more technology-driven business models.

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

Infrastructure-based competition has served New Zealand well in mobile markets and is the fastest path to widespread 5G deployment in New Zealand.

30. Wireless technologies are continuously evolving with generational change occurring rapidly and repeatedly. In Spark's network:

    a. UMTS (3G) was introduced in 2009;

    b. LTE (4G) was introduced in 2013;

c. LTE-Advanced (4.5G) was introduced in 2016; and

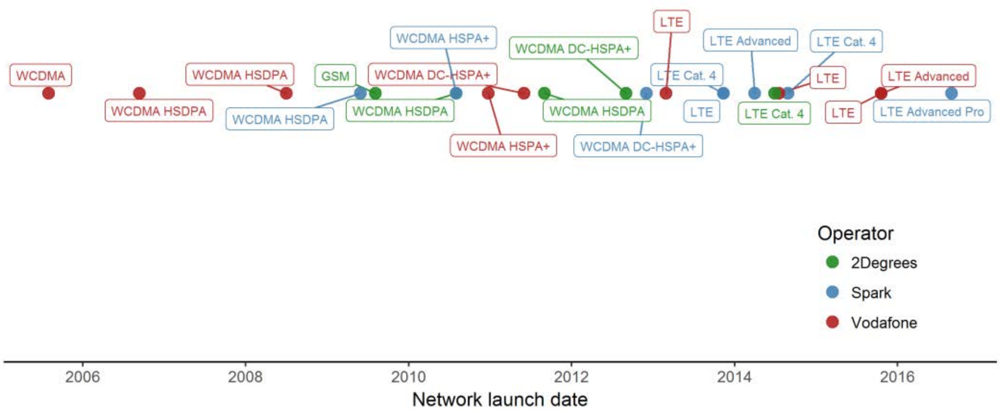
d. We expect to introduce 5G New Radio (5G) in or around **[ ]Confidential**; and

e. Already standardisation work (at the research stage) is underway on 6G.

31. All of New Zealand's MNOs have already indicated they plan to deploy 5G networks - 5G is necessary for capacity and will be deployed to complement 4G networks – and Spark and Vodafone have already started trials of it.

32. This is not surprising – 5G is the natural evolution of existing mobile businesses and in a competitive market failing to deploy innovations such as new generations of mobile network technology is tantamount to accepting you do not have a sustainable position in the market. Mobile competition in New Zealand has featured a constant trend of infrastructure upgrades and innovations as the three mobile network operators have vied for market leadership positions:

Network launch dates: operators have competed to have the latest technology



Source: NERA analysis of GSMA intelligence data

33. The announcements to date are a strong signal that the market considers it is economic to deploy 5G networks in competition to each other, and that infrastructure-based competition will continue into the 5G era.

34. The current industry structure has delivered significant benefits to consumers. Commerce Commission monitoring consistently reports an innovative market with a variety of services and deployment of modern technologies into the New Zealand market, widespread availability of mobile services, and prices that compare well to overseas countries. Government should favour a continuation of this competitive model.

35. We believe the industry structure we have today will also deliver efficient 5G infrastructure, and future technology upgrades from then, earlier than any other model could.

36. As set out above, 5G is expected to be deployed initially as an evolution of existing 4G networks, relying on the existing network for coverage and initially as a control layer. As further demand growth intensifies and new use cases for 5G emerge – particularly URLLC and eMTC use cases - operators will be able to invest to add standalone capability and further densify the access network to add capacity. Or, where economics dictates, operators will make rational decisions to share infrastructure. Regulatory and policy settings that encourage infrastructure-based competition as well as sensible infrastructure-sharing should be advanced, but regulation that encourages and/or subsidises a monopoly 5G infrastructure should not.

Chorus' proposed 5G model

37. Chorus has proposed a UFB-like model to deploy the 5G network – asking that the Government dispense with competition in a significant part of the economy and replace it with a network owned and operated by a monopoly provider (the same operator as the monopoly fixed line network that 5G will compete with).

38. We do not support a monopoly 5G network. In a monopoly situation there is:

    a. little or no room for operators to demonstrate innovation;

    b. strong incentives on the monopoly provider to act to foreclose competition; and

    c. strong incentives to extract windfall profits.

39. These outcomes reduce overall consumer welfare. And in Chorus' case these concerns would be magnified even further by its existing monopoly ownership of New Zealand's fibre network: it is that very network that 5G promises to compete with. It is difficult to see Chorus operating a monopoly 5G network to its fullest extent when doing so would directly cannibalise its existing fixed line business.

40. Of equal concern, is the incentives such a policy would create for existing mobile network operators. 5G services will not exist in a vacuum: they will need to compete with 4G and 4.5G services. In a world where there is only one 5G network, existing mobile network operators (and retailers) will have strong incentives to retain customers on existing technologies rather than to transition customers to 5G services they will have to pay Chorus for.

41. The most likely consequence of this policy would therefore be an industry structure where the key parties – both retailers and single wholesale provider - have incentives to minimise the network capabilities offered to customers. Compare this to infrastructure competition where the integrated players have incentives to maximise the network capabilities offered to customers to win those customers away from their competitors.

Regulatory issues

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

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

42. 5G does not require a different regulatory framework than what already exists for mobile operators today:

    a. Obligations relating to radio frequency exposure limits are set in NZ Standard NZS2772 and these will apply to new infrastructure;

b. The NESTF has been successful in streamlining the deployment of low impact mobile sites; and

c. Interference co-ordination is provided through the Radiocommunications Act framework, i.e. AFELs/PLs settings.

43. The framework already exists and has worked well, and nothing fundamentally changes with 5G. However, some enhancements may be needed to:

a. Update the spectrum management frameworks for the technical characteristics of new technologies, i.e. when TDD networks are deployed, adjacent band interference amongst non-synchronised networks will need attention (MBIE's technical group is already looking in this); and

b. Update NESTF to reflect the shift away from coverage sites to smaller capacity sites designed for mmWave spectrum bands.

Electromagnetic exposure

44. The discussion paper also asks whether there might be EMF exposure implications. While 5G technologies provide for significantly higher data rates than for current generation technologies, that does not necessarily translate to higher exposure levels.

45. 5G technologies are subject to compliance to the same strict exposure standards as current wireless devices and networks. The New Zealand standards are set out in New Zealand Standard NZS2772 recommended by the Ministry of Health. The standard is not technology specific and the information on which it is based is reviewed regulatory via the Interagency Committee.

46. That interagency committee, a technical advisory committee, takes into account the latest international research and ensures New Zealand remains aligned with the international approach. Respected organisations such as World Health Organisation (**WHO**), WHO recognise International Commission for Non-Ionising Radiation Protection (**ICNIRP**) and IEEE set radiofrequency guidelines and standards. The limits are developed following reviews of all the peer reviewed scientific literature and guidelines are based on evaluations of biological effects that have been established to have health consequences. These standards also apply to devices and networks operating at higher data rates, including 5G devices and base-stations.

47. We expect that international agencies will continue to monitor the effects of 5G deployments as networks are deployed and to explicitly consider whether any change to the standard is required. The New Zealand standards sets maximum public exposure levels more than 50 times lower than the recognised threshold for established effects and independent monitoring of cell sites shows that average EMF emissions are, in practice, very small fractions of the levels set in the New Zealand standard.

48. In itself, 5G deployment is not expected to raise any new issues regarding application of the New Zealand Standard. If anything, 5G technologies are more spectrally efficient and "targeted" in providing coverage. Overall RMF emissions will be lower than would be the case if we continued

with the current generation of mobile technologies.[16] A number of factors contribute to reduced EMF emissions:[17]

a. 5G radio technologies are more spectrally efficient, which means that less radiowave emmissions are necessary to meet demand. Mobile technologies only transmit to meet actual demand and, therefore, for any level of demand spectrally efficient technologies will transmit less; and

b. 5G antennae form narrow beams that target a specific area where there is demand, compared to current technologies that broadcast radiowaves to the whole coverage area. This means that emissions are better targeted to where there is actual demand.

49. Nonetheless, we understand that the deployment of additional base-stations may reignite public concerns, and that the industry and government need to provide comfort that the risks are being managed. Both Ministry for the Environment via National Environmental Guidelines document and Ministry of Health website can assist with this.

National Environmental Standard for Telecommunication Facilities (NESTF)

50. We support the NESTF, it has significant benefits to streamlining deployment of national infrastructure which are best considered and subject to rules at the national level. We believe the combination of NESTF, National Code of Practice for Utility Operators' Access to Transport Corridors (the Code), TCF Community Engagement Guidelines and operator approaches is working generally as intended, and this has facilitated the deployment of essential infrastructure.

51. However, a number of issues are emerging which may require updating of the NESTF standard early in 2019 to update the NESTF for 5G modern technologies and changes in planning rules, as opposed to 2021, when the next review scheduled to take place. This would not be due to a change in policy or RMF emissions, but simply to reflect the different form factor of modern technologies.

52. The NESTF currently defines a permitted activity on the basis that an antenna fits within a 700mm diameter cone and protrudes no higher than 3.5meters than the existing pole in the road such as a light pole. Within rural zoned areas a telecommunication facility can be up to 25m in height but no closer than 50m to residential or education building. The NESTF has successfully promoted the upgrading existing and the deployment of new rural telecommunications services and we support the standard. However, the parameters are based on 4G antennas deployed at the time. 5G antenna panel designs are trending toward a (different) rectangular shape, being shorter and wider than traditional 3G/4G panel antennas. While the overall size may occupy the same or less area, and there is no increase in EMF emissions through the use of 5G beamforming array panels, there is a risk that 5G panels may not fit within current NESTF parameters.

53. Further, there have been changes in planning practices, particularly where energy efficient LED streetlighting is being deployed and policies to increase housing density are changing the urban environment. The NESTF pole antenna height restriction is defined as an attachment relative to

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[16] See ITU Dec 17 workshop https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Pages/Programme.aspx and Lewicki paper https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Documents/Fryderyk_Lewicki.pdf

[17] Also see the GSMA paper discussing what 5G means for EMF https://www.gsma.com/publicpolicy/wp-content/uploads/2017/10/5g_iot_web_FINAL.pdf and ITU Dec 17 workshop https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Pages/Programme.aspx and Lewicki paper https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Documents/Fryderyk_Lewicki.pdf

the height of the surrounding infrastructure, i.e. 3.5 metres higher than the surrounding infrastructure.

54. Antennas are preferably around 3.5 meters higher than the surrounding urban landscape as this provides efficient coverage and minimises EMF exposure. However, as parameters are defined relative to the then existing pole network, this is creating tensions:

    a. Energy efficient LED lights (when with new poles) are shorter than traditional light poles they are replacing - at around 6 meters in residential zones and 8 or 10m on busy traffic routes relative to existing 8 to 12-meter poles; and

    b. Housing densification is expected to increase the height of dwellings in areas targeted for densification.

55. Antenna deployed in areas with new street light poles and LED lights and/or higher dwellings would not be able to be both (a) consistent with the NESTF; and (b) deployed at an efficient height relative to the local buildings. The NESTF will need to be reviewed to ensure that antenna are positioned taller than the buildings permitted by Unitary and District Plans.

56. Ideally, the NESTF would be updated to define permitted activities relative to the surrounding urban landscape rather than a particular pole network design, i.e. permitting antennae with the same relative height as today to existing and new dwellings (rather than the height of the pole network).

57. We will have more idea of available 5G equipment, and likely impact in the New Zealand setting, in early 2019. Therefore, we recommend monitoring developments and returning to the NESTF early in 2019.

58. We also support the Ministry for the Environment initiative to develop under the Resource Management Act a New Zealand Planning Standard for Infrastructure and Roading. The Planning Standard is anticipated to streamline network utility infrastructure deployment. The Ministry for the Environment working group is developing a planning standard setting out the policies and rules for network utilities - these potentially replace separate district plan requirements and would facilitate the deployment of local and national network utility infrastructure. The Planning Standard facilitates better enables the construction of infrastructure especially in high growth areas supporting new housing, transportation, and we support its implementation.

5G band plan

Technical requirements to deliver 5G capability

59. There are technical requirements that inform spectrum planning. The deployment of 5G requires:[18]

    a. More spectrum;

    b. Larger bandwidth carriers;

[18] For more details, Pls see : *5G: A Tutorial Overview of Standards, Trials, Challenges, Deployment, and Practice, M Shafi et al, IEEE JSAC, June 2017*

c. Network densification; and

d. Massive MIMO technology.

60. Spectrum, and spectrum planning decisions, will determine the capabilities of infrastructure deployed and services. The key constraints being that spectrum will be required in multiple bands and in large contiguous blocks.

5G requires spectrum to be available at low, mid and high frequency bands

61. 5G is intended to be provided over a number of bands. 3GPP 38.104 lists the bands for 5G starting with an alphabetical letter N. The bands will be used differently for different coverage and different applications. For a complete list of 5G bands please see 3GPP 38.104 table 5.2.1.

62. Authorities are considering bands in low frequencies <1GHz, mid frequencies 1GHz to 6GHz and high frequencies > 6GHz for 5G. Generally, these will be applied to different applications. A low power IOT network might be based on low frequencies, whereas eMTC will require mid frequencies to support the performance requirements.

63. An enhanced mobile broadband deployment (eMBB) may, for example, use:

a. 3400- 3800 MHz band only;

b. 26500 MHz to 29500 MHz only;

c. 24250 Mhz to 27500 Mhz only;

d. or any combination of the above;

e. Control channel for 5G carried over existing LTE bands and user traffic in the above bands;

f. Or any other combination of control and user plane traffic.

64. Initial 5G deployments for eMBB are likely to be in:

a. 3300- 3800 MHz- 3GPP band N 78; and in

b. 24.25 - 27.5- 3GPP band N 258 ;

c. 27.5- 29.5 GHz- 3GPP band N 257

d. 37.0- 40.0 GHz - 3GPP band N 259 is also defined

65. The 5G peak rates of 20 Gbps and 100 Mbps cell edge rates cannot be obtained using C-band alone as this would in turn require unobtainable SNRs (especially for the peak rates) and modulation schemes. Therefore, mmWave bands are also needed. Early deployments in mmWave bands are expected to be in 24.25- 29.5 GHz besides the C band.

Large holdings within band are required

66. Further, large contiguous bandwidths are required for efficient provision of services. There are significant efficiency losses from less bandwidths anticipated by some allocations.

67. National authorities and equipment vendors support carrier bandwidths of 100MHz in the C band band and 800MHz in the mmWave bands - the latter achieved by carrier aggregation (**CA**) of multiple lower bandwidth carriers. For example, ITU-R M 2410 provides guidance on minimum bandwidths. In order to meet the spectrum efficiency figures given in M 2410 800MHz bandwidth is needed.

68. These carriers need to be contiguous at 3.5GHz but CA is possible in mmWave (it is not possible to aggregate across bands).

69. Further, the GSA notes that large channel bandwidths will reduce terminal front end complexity and power consumption compared to multiple carrier aggregations.[19]

70. **[ ]Confidential**

71. Based on our recent 5G trial results, the peak rates and per user rates supported in different bands, with different bandwidths and in different environments are given below:

    [ ]

72. **[ ]Confidential**

Carrier aggregation

73. Carrier aggregation is available from equipment vendors, this will be needed to support the large per operator (1GHz or more) bandwidths that authorities are making available to mobile operators. **[ ]Confidential**

74. Referring to 3GPP 38.104:

    a. Band N 258 is 24.25 to 27.5 Ghz

    b. Band N 257 is 26.5- 29.5 Ghz

75. The bandwidths for each of these bands is specified as either of 50 MHz, 100 MHz, 200 MHz and 400 MHz respectively – see table 5.3.5-2.

76. The channel bandwidths supported in the C band are 5/10/15/20/25/30/40/50/60/70 /80/90/100 MHz respectively.

77. Inter band CA in the N 258 and N 257 bands will be developed over time and indeed in the trial we had **[ ]Confidential**

78. The implication for spectrum planning is that:

    a. It is more efficient to have a contiguous 100MHz carrier in the C band

    b. And a minimum of two contiguous 400MHz carriers in the mmWave bands which CA can be deployed across.

3.5 GHz band

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

[19] See https://gsacom.com/paper/future-imt-3300-4200-mhz-frequency-range/

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

3.5GHz and 26/28GHz are pioneer bands and should be a priority

79. The 3.5GHz and 26/28GHz are pioneer bands and are a priority - they are necessary for a complete suite of 5G services and major economies have made (or plan to make) these bands available.

80. Authorities have progressed these bands the furthest as the pioneer 5G bands and this is where equipment will be available. Commercial 5G network equipment and devices for the 3.5GHz band are expected to become available during 2018 and for the 26/28GHz band in 2019. Accordingly, there is little risk progressing allocation of both C and mmWave bands.

81. Nonetheless, while both pioneer bands are a priority and necessary for 5G deployment, we appreciate that planning and implementation are at different stages through different markets:

    a. The C band range is largely settled internationally and authorities are in the process of allocating to mobile applications. The Crown has notified MR rights holders that that the rights will not be renewed and significant work has already been undertaken on re-planning;

    b. While differing approaches have been taken to mmWave – i.e. the 26GHz band is subject to WRC 19 ratification and the 28GHz band is non-WRC but supported by many large markets (US/Japan/Korea) – there is substantial and growing international support for 26/28GHz as a pioneer band for 5G;

    We believe the Ministry should feel confident to accelerate planning and re-allocation of the 26GHz band soon after WRC 19. At WRC 15, MBIE was not supportive of 28Ghz band even though the US and Korea gave clear indications of its likely use. More countries have now joined this position. MBIE should review its position on the 28Ghz band and make it available for mobile. This can be done early as this band is not subject to WRC 19 deliberations.

82. Therefore, we believe the Crown can make key policy decisions relating to the re-planning of both 3.5GHz and 26/28GHz bands this year with a view to auctioning both bands in 2019. We need certainty of future spectrum availability so that we can complete planning to roll out the network, and we see near-term use cases for both of these bands.

The Ministry should aim to re-allocate the entire 3400-3800MHz range

83. The Ministry should be looking to maximise spectrum availability within the 3300-4200MHz band identified for mobile services. While different jurisdictions are making different parts of this band available, all are looking to maximise allocations to support competitive markets and large contiguous carrier sizes. Significant markets aim to extend the allocation from 3400 to 3800MHz, including european member states such as Germany, UK, and France amongst others.

84. We appreciate that the band has existing users that would either need to share the expanded band or vacate to alternative bands but we expect that the Ministry can re-plan and auction 3400-3800MHz in a single auction, and address existing user and transition issues with different implementation arrangements.

85. In particular:

a. We support the proposal not to renew the existing allocation of 3589-3639 Mhz for satellite downlink services but consider the protection contours (exclusion zones) offered to protect Inmarsat are overly conservative;

b. We strongly recommend the Ministry reconsider its decision not to include the 3700-3800MHz range in its C-band allocation. We note that C-band television receive only (TVRO) devices in the range 3700- 3800 are unlicensed devices, that have never been encouraged or formally recognised by the Ministry and are not afforded protection from interference. We recommend that public notifications to users to move from this range be undertaken now, and the range included in future planning for the band. Sensible transition arrangements can be made for these devices, and provision could made to cover sensible transition costs for affected users. Internet streaming is now a viable alternative for people seeking to obtain access to overseas content.

86. Authorities internationally aim to maximise C band spectrum available to mobile applications, and failing to maximise New Zealand spectrum availability has implications for 5G capabilities that can be deployed or competition.

87. There is little point in doing a separate re-allocation of 3587- 3690Mhz or 3700-3800MHz range. This is inefficient and may be costly to operators if MR holders are required to then re-stack their holdings to make them contiguous.

88. In any case, we believe there are limited numbers of end users for which a transition to internet-based services would be required. As we discuss further below, regional operators (WISPS) could be encouraged to relocate to 3700- 3800 Mhz. As they operate mainly in rural areas, this will not preclude the band from mobile use in urban areas.

26 GHz band

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

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

89. mmWave band allocation is also a priority as this is where the big service gains will come from - both 26GHz and 28 GHz bands are a priority. We have already undertaken a trial using 26.65 to 27.45GHz to provide 800MHz bandwidth, and we see near-term use cases for this spectrum in very-high traffic sites.

90. We appreciate that planning of 26/28GHz spectrum may be behind 3.5GHz, but decisions should be made with a view to re-allocation occurring soon after WRC 19. Furthermore, MBIE should review its opposition to the 28GHz band as expressed during WRC 15.

91. As mentioned earlier, while there is no single band that has a priority status for 5Ginitial deployments in New Zealand are likely to be in bands N 257 and N 258.

Other extremely high frequency bands

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?

Q10. When do you think equipment is likely to become available in the bands identified in 08?

92. We support the Ministry developing a plan for other bands such as those noted in the consultation paper – we request MBIE keep a watching brief on international developments in these bands.

93. But these bands are lower priority in our view - the 26/28 GHz band appears to have the necessary momentum to support near-term commercial deployment.

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

94. New Zealand is a small market and cannot dictate its choice of frequency bands. The US, Korea, Japan and Singapore all intend to use 27.5- 29.5 GHz, which is enough scale to ensure global vendors and device manufacturers will support it. Yet part of this range is not covered by the scope of the consultation paper and there is no reason given for this. In fact, during WRC 15 when the bands for future agenda items were being finalised New Zealand opposed the inclusion of 27.5- 29.5 GHz despite the known positions of US and Korea and Spark's reservation to the oppose position.

95. We are concerned that by limiting the scope of mmWave bands to only up to 28.35 GHz the MBIE is constraining industry's ability to source handsets that may have backward compatibility to band 5. In summary we are very keen for all the range 24.25- 29.5 GHz to be opened for mobile.

Possible ultra-high frequency bands

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

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

96. The 1400 MHz band is identified in international standards as being for Mobile use. This is one of the few bands where all three regions agreed during WRC. 3GPP defines bands N 50, 51 75, 76 for three different band plans: FDD, TDD and SDL.

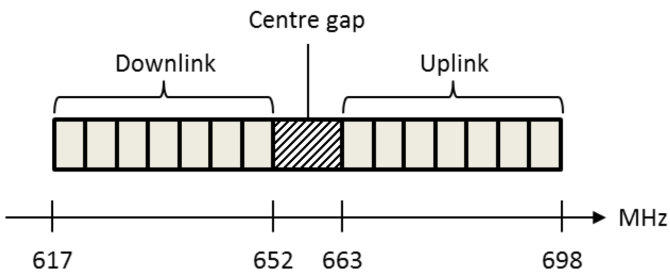
97. Spark anticipates using this band for mobile services. There are many services or applications that fall under the umbrella of eMTC and URLLC that will benefit from frequency bands that have better propagation conditions than, say, the mm wave bands. The applications here do not need the large bandwidths that are needed by eMBB, which make the 1400MHz (or **L-band**) suitable. In this regard we would view the use of this band for SDL as a waste of good spectrum when more down link capability can be made available via adjusting DL/UL time slot ratio in other bands.

98. We believe the Ministry should monitor developments with a view to making further decisions following WRC 19 when international trends become clearer.

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

99. Yes, and the 600Mhz band is a good candidate. 600MHz spectrum will augment existing sub-1GHz spectrum holdings currently used for mobile service in New Zealand which are critical to ensuring consistent service experience for customers due to their longer propagation characteristics relative to mid-range and high-frequency bands. The following proposed band arrangement was jointly submitted to ITU r WP 5D by NZ and other Administrations, which we support.

<u>600MHz band plan</u>



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

100. They could be placed in TV white spaces.

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

101. As with the 1400 MHz band, the Ministry should monitor developments with a view to making further decisions following WRC 19 when international trends become clearer.

Spectrum Allocation

Allocation methodology

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

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

102. The objective should be to allocate spectrum to the most efficient use – the greatest benefit to society is in its sustained use. This is consistent with objectives adopted by overseas authorities who seek to maximise, in allocation mechanisms, spectrum usage and benefits to society rather than revenue to the Crown, for example, Australia and UK.[20]

103. Spectrum auctions remain the best means of achieving these objectives. They ensure that spectrum, where there are competing users, is allocated to the highest value uses. Auction methodologies have been already used to allocate 3.5GHz range spectrum in a number of countries such as the USA, Australia, Ireland, and the UK, and we expect most of the world to follow this practice.

104. Perhaps a more challenging question, though, is what Government should do with the proceeds of these auctions. Currently revenue received from spectrum auctions is predominantly returned to Government and used to fund general Government spending. Given the social and economic value to New Zealand from faster and more efficient use of this spectrum, and the mobile broadband technologies it supports, we believe there is a clear case for these proceeds to be used in a smarter way. A recycling of that revenue to support accelerated network deployment – in the same way road user levies support transport funding – should be considered.

105. For example, if operators bidding for spectrum were required to spend their bids on accelerated network deployment, New Zealand would see earlier, and more widespread, deployment of 5G technologies than would otherwise be the case.

106. The Crown may choose to use different allocation mechanisms for regional providers. However, the same rates should apply to users of similar spectrum irrespective of the allocation mechanism to ensure efficient use of spectrum overall. Where there is no discernable market derived value, then an alternative valuation mechanism such as administrative pricing should apply. This may be very low or nominal where the spectrum has little alternative use but would approach an auction price where substituting for the MR approach.

107. In all cases, the structure of the auction should be decided as early as possible as preparation for the auction is very dependent on how the auction is to be conducted. Significant time and cost can be wasted in preparing for all possible auction types if the final type is not disclosed until close to the auction.

Implementation requirements

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

108. We do not support a technology specific approach to spectrum. Such an approach assumes that Government and/or market participants can accurately predict what specific technology particular spectrum bands will be used for throughout the term the spectrum is sold for. Neither party can. In a competitive market, operators will use their allocations for the most efficient use.

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

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

[20] See decisions here https://www.communications.gov.au/documents/spectrum-pricing-review and the background paper discussing principles here https://www.communications.gov.au/have-your-say/spectrum-pricing-and-commonwealth-holdings

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

109. Implementation requirements have become common features of spectrum allocations, supporting the objective that in use spectrum brings most economic benefits. However, any implementation requirements would need to reflect how released spectrum is expected to be used. For example,

a. 5G deployments are expected to be incremental to existing 4G deployments. 5G will be initially be deployed using a non-standalone configuration;

b. mmWave spectrum is expected to be used in high demand areas and where the specific performance aspects of mmWave are required; and

c. Any obligations should recognise that use of any spectrum relies on the availability of devices, which New Zealand operators have little control over. Provision should be made for the government and spectrum purchasers to agree to amend some implementation requirements where necessary.

110. Non-implementation should have an additional payment option to extend the right for two years further. This allows for the possibility that vendor equipment costs don't come down as fast as expected or handset band support is implemented more slowly than expected. These are both risks for intending spectrum owners, but loss of the spectrum may be unduly harsh when many of the factors in a business case are currently unknown. There does need to be the ultimate sanction of loss of spectrum applied so that spectrum can be reallocated to others who are prepared to use it.

111. There should be no difference (other than geography) between regional and national implementation obligations. The fact that spectrum may be less useful in some areas (for example areas with low population density) has already been taken account of in the price that the owner of the spectrum was prepared to pay for it. There is no need for a further concession that end users in some areas should have to wait longer to receive the benefits of the spectrum than users in other areas.

Acquisition limits

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

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

112. We don't support acquisition limits. Acquisition limits might have a place where there is a concern that parties might game the allocation process or "squat" on spectrum that would be valuable to alternative parties. However, this situation is unlikely to occur in New Zealand and the present *use it or lose it* provisions are a ready deterrent for this behaviour.

113. There is no need for acquisition limits to be applied, for example, to this spectrum in the way they were applied for 700 MHz spectrum. There was a potential risk with 700MHz spectrum that one or two parties might take up all of the available spectrum with the effect of excluding anyone else from offering 4G services in rural areas. This doesn't apply to the spectrum ranges being considered for 5G – in all cases they represent only one of the blocks of spectrum that could be used over the next five years to provide broadly similar services, such as those using 4G-designated spectrum.

114. Further, acquisition limits potentially create significant distortions as these drive carrier spectrum holdings rather than maximising the efficient use of spectrum.

115. If the Ministry does wish to consider acquisition limits further, we recommend that any such limits be designed to ensure operators are not preventing from purchasing the standards-implied target amounts (100MHz of C-band spectrum and 1000MHz of mmWave band spectrum).

Duration of allocated rights

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

116. In New Zealand the current approach to setting the term for management rights has provided for a 20-year period. We continue to support 20 years, but recognise that the pace at which technology is evolving means there may be a case for reducing the tenure of rights to 15 years. Anything less would be too short a period over which to recover investments.

117. In a practical sense we also don't want all of New Zealand's mobile spectrum renewing at once. There are already a number of spectrum renewals around 2030, so we would prefer that any renewals for 5G spectrum not occur in close proximity to that date.

Management rights for 5G

Band planning

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

118. The C band and mmWave bands should be planned as TDD. The L band and 600 MHz bands should be planned as FDD.

119. TDD will be suitable for eMBB applications that are the primary use of the C band and mmWave bands.

120. FDD will be suitable for eMTC and URLLC applications and even some eMBB applications for the L band and 600 MHz bands.

Bandwidth

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

121. It is important that mobile operators should be able to acquire spectrum in large contiguous blocks (up to 100MHz at 3.5Ghz and 1000MHz at mmWave) to realise the maximum benefits of 5G.

122. The auction lots should enable operators to build holdings consistent with 3GPP channel standards. There is no guarantee that any other channel bandwidths will be supported by 5G equipment and devices.

123. The proposed 20MHz and 100MHz lots appear appropriate – avoiding increased auction complexity from having a smaller allocation size and permitting operators to acquire efficient carriers. However, the optimal lot size may be influenced by the amount of spectrum available, bandwidths supported by the technology, whether the Ministry proposes to introduce caps and number of auction participants. The Ministry may need to revisit lot sizes at the time of auction planning.

124. Further, there needs to be an opportunity to realign allocations to assemble contiguous blocks within each band. This will be particularly important if there are separate auctions for the 3.6 to 3.7 and the 3.4 to 3.6 parts of the C-band as has been suggested.

Out of band emissions

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

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?***

125. 3GPP 38 104 defines two types of base stations, their out of band emissions and the ACLR characteristics:

a. BS type 1 H- where the transceiver array is different from the composite antenna (radio distribution network and antenna array). Here two reference points are defined, on the transceiver array boundary and in the far field region- the later known as the radio interface boundary.

b. BS type 1-O and type 2-O- here the transceiver array and the composite antenna are all in one package. In this case only the radiated interface boundary is defined.

126. In order to define the emission limits, one would need to identify the base-station type and have some idea of the composite antenna characteristics. This is something the industry should agree on first.

Interference between TDD networks

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

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

127. This issue is being addressed in the Ministry's technical working group.

Access to spectrum for regional providers

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

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

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

The full 3.5GHz band should be re-planned and allocated to new mobile broadband use

128. The discussion paper may be interpreted to suggest that regional license holders have greater rights than MR holders in the band. Management Rights holders have been told their holdings will not be renewed, without any reservation of C-band spectrum for them. In contrast, the consultation paper suggests Government is considering reserving C-band spectrum for regional operators. We expect the Crown to treat all spectrum holders and users equally and fairly.

129. All spectrum users have the legitimate expectation for continued access to spectrum on rights expiry as a default position.

130. But all spectrum rights holder expectations are bounded by changes in technologies and band use. For example, the Crown has in the past recovered and re-planned spectrum for alternative uses.

131. We support recovering the full 3.5GHz band spectrum and making the band available for mobile broadband deployment. There has been a change in use with standards and jurisdictions re-allocating this band for mobile applications. This is in contrast to, for example, the 2100MHz and 1800MHz bands, which are intended to be carried forward in essentially the same form with existing services and end users. When a band is re-planned there are no existing end users – all the services have to change so there can be no expectation that there is some residual right beyond the period that was actually paid for when the MR commenced.

132. When a band is re-planned, there can be no reasonable expectation, beyond the expiry of the previous Management Right, that there will be any continued availability to spectrum within that band. The new auction process is used to decide who will be the future beneficiaries of future Management Rights – there is no incumbency benefit through a re-plan.

133. Accordingly, there is no need to set aside specific C-band spectrum for regional use. Regional operators should be entitled to bid in the allocation auction, and some lots might be defined regionally but they must be treated the same way as other current users of C-band spectrum.

Provision of spectrum for regional providers

134. Nonetheless, we recognise that the provision of broadband services to rural customers is important and that a transition to alternative bands should be provided for over time in this case.

135. We believe the Ministry should consider transition arrangements for existing regional users, and identify a spectrum range that services can be deployed to when services are re-located. For example, it is likely that scale 5G networks will initially be deployed in urban areas and that a phased approach can be taken to transitioning rural-centric WISPs to new holdings. The Ministry could consider a model whereby rural providers:

  a. Are permitted to remain at current locations subject to 6 months notice from the new MR holder to vacate the band. This should be set out prior to the assignment stage of any allocation so that any conditions on the new right are known to prospective purchasers; and

  b. For those providers asked to vacate other frequencies should be identified and set aside now for new regional deployments. Those frequencies should:

    i. Provide for similar propogation characteristics as the C-band, so as to minimise coverage implications of any transition; and

    ii. Be supported a healthy device and equipment ecosystem so that WISPs can easily purchase equipment in the course of any transition.

136. Our review of available future bands for WISPs suggests that the Crown's current 2300MHz holding is the most appropriate band to migrate these providers and their end-users to. Failing

that, the Crown could retain a rural management right in the 3700-3800MHz range. This band could co-exist with urban 5G rights holdings for mobile use.

Timing

3.5 GHz band

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?

137. The Ministry should aim to make spectrum available by early 2020 in the C band and soon after WRC 19 for the mmWave bands. Major economies are deploying scale 5G networks from 2020 and we believe New Zealand should closely follow.

138. For example, the GSA reports that 48 operators in 33 countries have publicly committed to timeframes to launch 5G networks. Fourteen operators in 11 countries have now made commitments to launch some form of 5G-based service (even if on a limited basis) within 2018. Commercial 5G networks will have been launched in at least the following countries by 2020: Canada, China, France, Germany, Japan, Russia, Singapore, South Korea, UK, the US and 22 other countries.[21] These are all countries that are major trading partners or that we compare ourselves to – important infrastructure being delayed risks New Zealand businesses and consumers falling behind their counterparts in these countries.

139. **[ ]Confidential**

140. In all implementation scenarios, the Ministry should aim to make policy decisions this year, and auction C band in 2019 and mmWave band shortly after WRC19. This would:

    a. Provide more spectrum certainty so that operators can more efficiently operate the existing 4G network and plan for 5G deployment; and

    b. Preserve the option for early re-allocation of C band spectrum. The Ministry should ensure that both pioneer bands can be re-allocated by 2022 at the latest (while maintaining the option to bring this forward).

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

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

141. Obtaining an early release from incumbents (Option 3) looks to be the most practical approach.

142. In all cases, in order to more effectively begin the process of transitioning spectrum to 5G, the Ministry should establish a band plan and confirm an auction for the spectrum in the band. This would confirm the options available to current rights holders - i.e. if transitional arrangements and separate 3700-3800MHz licenses were available for regional providers which might mitigate some concerns.

143. Government could then either: enter into commercial negotiations with existing rightsholders to buy-out existing licences; or seek the agreement of those rightsholders to a conditional buy out

[21] GSA *Evolution from LTE to 5G - April 2018 Update* https://gsacom.com/download.php?id=5933

with compensation to be set at a pre-determined percentage of the final auction price for the C-band, pro-rated to the remaining life of the existing rights. Actual transition out of the band can be provided for progressively, as 5G networks are deployed across urban, then rural, geographies.

26 GHz band

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?

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

144. The Ministry should make policy decisions that ensure the spectrum is available for mobile use soon after WRC 19 (in respect of the spectrum current available) and upon expiry of existing management rights (in respect of the spectrum still subject to management rights).

Other bands

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

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

145. The Ministry should continue to monitor overseas development and New Zealand IOT demand.

146. There are a number of IOT networks deployed. Low-band spectrum such as 600 MHz are likely to be for IoT use cases where large numbers of devices with very wide coverage footprint are required, i.e. for logistics, asset tracking, and smart grid applications. It is only when we get to needing tens of millions of devices that existing LTE and LoRa technologies will have limitations.

END