Huawei's Responses to RSM "Preparing for 5G in New Zealand" Public Consultation

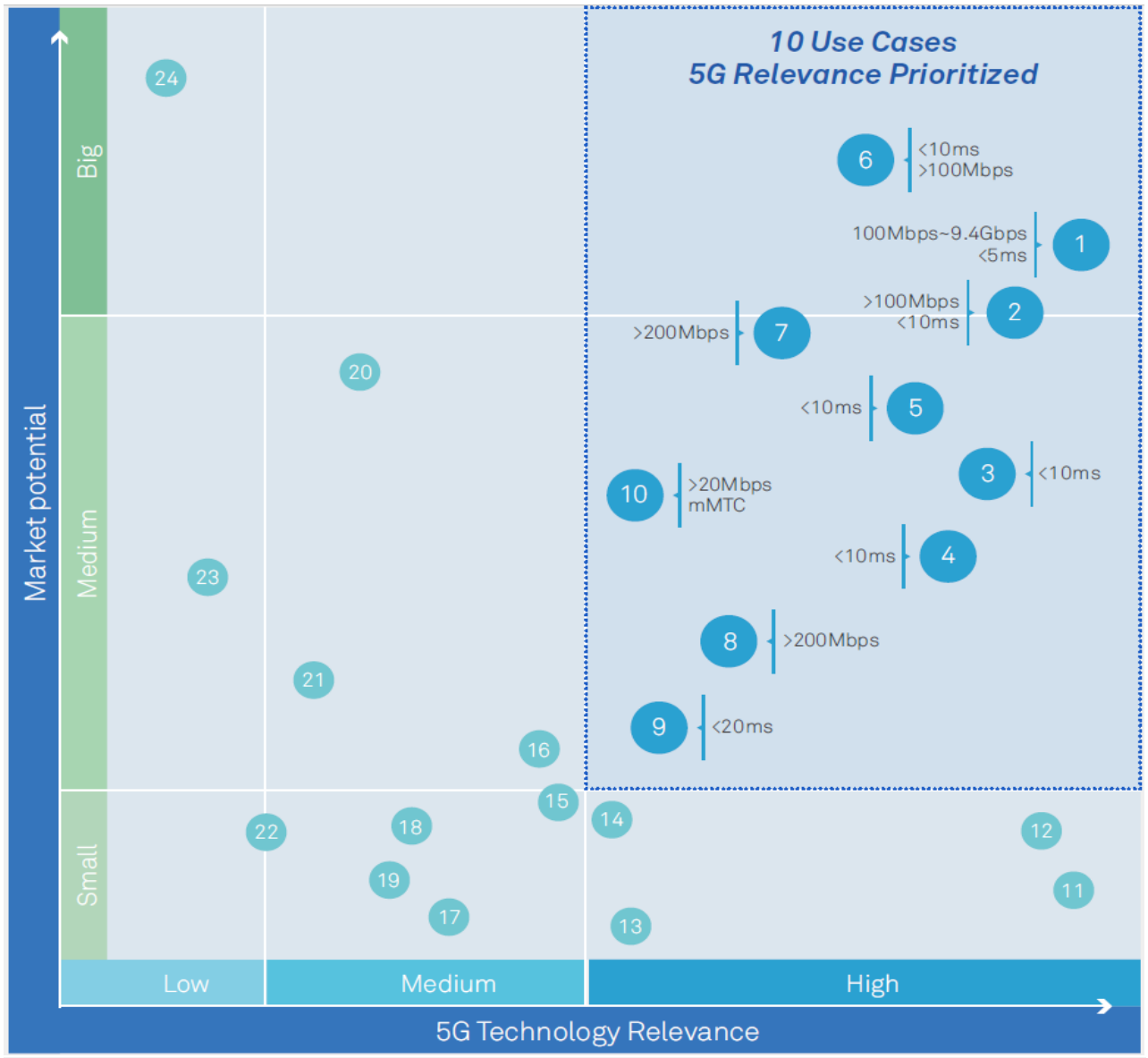
1. What are the likely uses for 5G in New Zealand initially and in the longer term?

Huawei explores the top 10 applications that will harness the versatile capabilities of 5G based on our understandings and insights of global markets. These 10 use cases are Cloud Virtual and Augmented Reality (VR/AR), Connected Automotive, Smart Manufacturing, Connected Energy, Wireless eHealth, Wireless Home Entertainment, Connected Drones, Social Networks, Personal AI Assistance, and Smart City. Huawei believes many of these use cases have great potential to thrive in New Zealand.

5G networks will offer an unprecedented leap in bandwidth speeds in comparison to previous mobile networks. For example, downlink peak data throughput could reach 20 Gbps, while uplink peak data rates could be as high as 10 Gbps. 5G will also reduce latency and improve overall network efficiency. Streamlining network architectures will deliver end-to-end latency requirements of less than 5 ms. This will allow 5G to offer ultra-reliable low-latency communication for machine-to-machine and public safety applications.

The early 5G is foreseen to improve the quality and customer experience of online video. 5G Wireless Broadband can provide "Mobil Beyond Giga" service, delivering 8K video streaming to one's living room TV, and this is expected to drive a 6-fold increase in demand for bandwidth. VR gaming, modeling, and other services can be rendered over the cloud, and then transmitted to terminals in real time, via reliable high-speed 5G networks.

Mobile networks are designed to create a super connected world, in which the generated data is contextualized, constructed and processed over the cloud, continuously creating value. Connected cars, smart manufacturing, global logistics tracking, smart agriculture, smart metering, and other applications are some of the first, most promising areas for IoT to focus on.



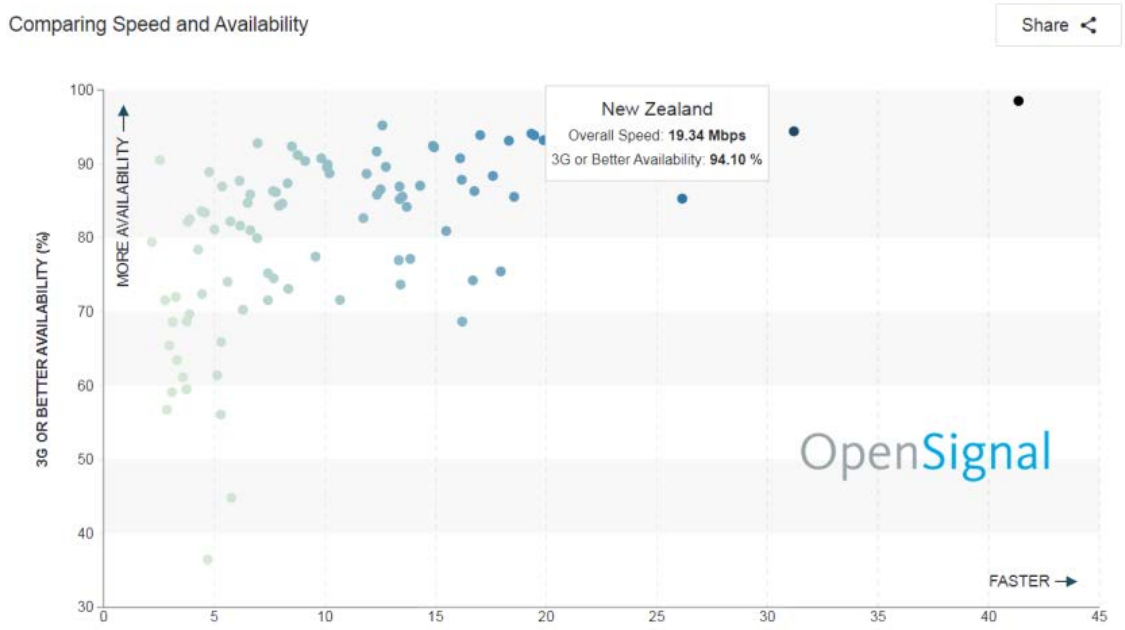
Index Definitions

1. **Cloud Virtual & Augmented Reality** – Real-time Computer Rendering Gaming/Modeling
2. **Connected Automotive** – ToD, Platooning, Autonomous Driving
3. **Smart Manufacturing** – Cloud Based Wireless Robot Control
4. **Connected Energy** – Feeder Automation
5. **Wireless eHealth** – Remote Diagnosis With Force-Feedback
6. **Wireless Home Entrainment** – UHD 8K Video & Cloud Gaming
7. **Connected Drones** – Professional Inspection & Security
8. **Social Networks** – UHD/Panoramic Live Broadcasting
9. **Personal AI Assistant** – AI Assisted Smart Helmet
10. **Smart City** – AI-enabled Video Surveillance

11. Hologram 12. Wireless eHealth – Remote Surgery
13. Wireless eHealth – Ambulance Communication
14. Smart manufacturing – Industrial Sensors
15. Wearable – UHD Body Camera
16. Drone – Media 17. Smart manufacturing – Cloud Based AGV
18. Home – Service Robotics (Cloud AI Assisted)
19. Drone – Logistics 20. Drone – Fly Taxi
21. Wireless eHealth – Hospital Nursing Robot
22. Home – Home Surveillance
23. Smart Manufacturing – Logistics & Inventory Monitoring
24. Smart City – Trash Bin, Parking, Lighting, Traffic Light, Meters

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

NZ Mobile Network Operators (MNOs) have been providing world top class mobile services to subscribers. Reader can find from the graph provided by OpenSignal (https://opensignal.com/reports/2016/08/global-state-of-the-mobile-network#speed-3g-lte) that NZ subscribers' overall 3G and 4G mobile speed is ranked top 12th amongst 95 countries in the 2016 study. In the study comparing the Speed and Availability of mobile service, NZ MNOs once again map themselves world 1st class as per the snapshot below.



In 3GPP Release 15 the NSA (non-standalone) network architecture allows the build of 5G supported by existing 4G infrastructure. NZ national MNOs have built up reliable LTE networks for which moderate up-grade and up-scaling would be sufficient to support the rollout of early 5G services.

Operators deserve to have the flexibility to design and build 5G network to meet the specific needs of the operators' own subscribers. The services needed by 5G subscribers are far beyond the scopes of what the existing 3G and 4G networks provide. Infrastructure needed to provide the relevant 5G services, therefore, may not be of uniform property. An infrastructure level competition gives an operator to customise its network design in provision to its customers' requirements.

On 16th April 2018 Huawei released its SingleRAN Pro solution which gives operators reassurance that their investment on existing hardware and infrastructure will not be wasted when 5G arrives. SingleRAN Pro allows multi-RAT (Radio Access Technologies) baseband and RF hardware resource sharing including 5G. The rollout of early 5G network, in accordance with 3GPP Rel 15, will be built on LTE network. LTE and 5G NR can co-exist and share the same low frequency bands without having to full free those bands from LTE use. With the uplink spectrum sharing between LTE

and 5G NR, transmission acrss 5G NR uplinks and downlinks can occur t high frequency bands, while the 5G NR uplink can also exploit spectrum resources in lower frequency bands that the operators have been using for LTE, e.g., 700, 900, 1800 and 2100MHz. In preparation for 5G, Huawei NZ has been working with our NZ customers in trailing and deploying relevant products.

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

Huawei recommends the ministry to reference/follow regulatory recommendations made by international standardization bodies (e.g. ITU, IEEE, IEC, CEPT, EN, ICNIRP, ETSI, CISPR, etc).

ITU - International Telecommunication Union
IEEE - Institute of Electrical and Electronics Engineers
IEC - International Electro-technical Commission
CEPT - European Conference of Postal and Telecommunications Administrations
EN – European Telecommunications Standards Institute.
ICNIRP - International Commission on Non-Ionizing Radiation Protection
ETSI - European Telecommunications Standards Institute
CISPR - International Special Committee on Radio Interference

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

Other regulatory efforts may be required in order to enable deployments of the new technologies, including but not limited to,

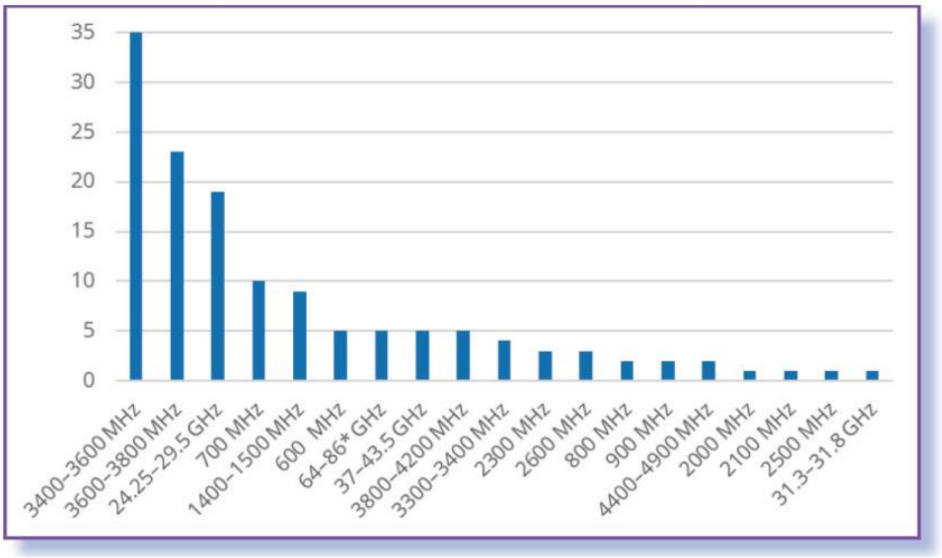
- IoT device deployment and management;
- Additional regulation for vehicle to vehicle communication systems;
- Clear process that simplifies and speeds up infrastructure acquisition for network densification.

In light of rolling out 5G outdoor macro and micro sites, we suggest to review regulations relevant to site acquisition, in particular in urban areas, for example street lamp poles which may be a suitable solution. We also suggest the ministry to consider 5G use case requirements from industry verticals for regulatory framework consideration.

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

Huawei agrees that 3.5 GHz band is the top priority for allocation for 5G.

Figure 1: Count of countries where there is regulator 5G activity, per band, based on regulator proposals, consultations or spectrum allocations (excludes temporary allocations for testing / trialling purposes)



In line with release plans referenced across numerous countries, the 3400~3800 MHz appears to be the primary 5G band with greatest potential for global harmonization. The chart above is presented in GSA's report "Spectrum for 5G: Plans, Licenses and Trials, Jan 2018", showing the counts of frequency bands included by countries that have been conducting 5G regulatory activities. It is found that 3400~3800MHz is the most popular spectrum. Worth noting is that in 3GPP 38.104 5G NR specification, it defines 3400~3800 MHz in TDD mode.

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

Huawei supports reallocation of 3587 – 3690 MHz for 5G. To note, CEPT, Japan and Korea has already made announcement of their official plans for 3.5GHz, which includes the mentioned band.

Furthermore, Huawei strongly encourage the ministry to also include 3690-3800MHz for 5G, consistent with CEPT planning. This frequency range has been identified by 3GPP Rel 15 as part of the premium 5G bands.

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

From the chart included in response to Q5, the 26GHz band is currently the third most popular 5G band. Huawei agrees that 24.25 ~ 29.25GHz (and 37-43.5GHz) will be the most promising millimeter wave frequency band for early deployment and adoption of 5G system. n258 (24.25-27.5GHz) will be discussed in WRC-19 agenda item 1.13.

Further to note, although n257 (27.5-29.5 GHz) is not included in the WRC-19 Agenda item 1.13, it is being considered for 5G use in the USA, South Korea and Japan. The n257 has also been included as one of the FR2 bands for 5G in the 3GPP specification. n257 can still be adopt by regulators as potential 5G band as long as there is no border interference issue and there is confidence on ecosystem readiness.

Huawei recommends the ministry to consider the allocation of either 26GHz and/or 28 GHz band for 5G as per existing mobile allocation in ITU-R radio regulation. Furthermore, Huawei has announced firm roadmap of 5G products in both 26 and 28GHz. Huawei NZ strongly recommends the ministry to priorities the allocation of 3.5GHz, followed immediately by mmWave bands.

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

Huawei NZ has strong interests to continue trialing 5G using the mmWave band, not only with MNOs, but also with industry verticals that could benefit from the high throughput and robust capability delivered by 5G.

Throughout March and April of 2018, Huawei NZ has conducted and completed multiple trials with Spark using both the mmWave and 3.5GHz 5G bands in Wellington and Auckland. We are also keen to move from trials to commercial deployments as early as 2019.

9. 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?

Huawei is in the view that 40.5- 42.5, 42.5- 43.5 GHz, even 37- 40.5 GHz bands should have similar priority as the 26 GHz band within the millimeter wave range. We highly recommend the ministry to conduct more studies referencing WRC-19 results to consider IMT identification for these frequency bands.

In order to support longer term 5G development, we also encourage the ministry to consider IMT identification in 66-76 and 81-86 GHz.

For 31.8~33.4 GHz, we believe this band should be of lower priority. Our survey shows that industry interest for this frequency band appears to be declining, due to limited availability of bandwidth in this frequency range. The IMT usage in this frequency band could also require guard band with stringent requirements to protect passive service allocations that are in the immediately adjacent bands. In addition, global eco-system for this band is weak as per comparison to other millimeter wave frequency bands for IMT applications.

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

Huawei is highly positive that the 40.5-42.5, 42.5- 43.5, 66-76 and 81-86 GHz bands have great potential to be globally or regionally harmonized in WRC-19. We are unable to provide an indicative timeline on equipment availability, but as a global ICT vendor, we are closely monitoring market interests through continuous customer and standardizing body engagements.

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

The frequency band of 27.5-29.5 GHz, though not included in the WRC-19 Agenda item 1.13, is considered for 5G in the USA, South Korea and Japan. Huawei recommends the ministry to consider the allocation of 28 GHz band for 5G as per existing mobile allocation in ITU-R radio regulation.

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

L-band is a good complimentary band to combine with frequency bands below 1 GHz (e.g. 700, 800, 900 MHz). Allocation of 91 MHz of spectrum in the L-Band to IMT as SDL mode would increase the capability (capacity) and robustness (deep coverage) of 5G services in New Zealand. From an ecosystem perspective, New Zealand can benefits from the economies of scale from development of the L-band in Europe.

In the case of 5G standalone system, the TDD access scheme has highest potential, to accommodate asymmetry traffic requirements. The same 5G NR equipment can serve both TDD and SDL market.

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

Huawei encourages the ministry to commence on regulation planning for the L-band (1400MHz) for IMT early. We also encourage the ministry to, from year 2020 onwards, coordinate incumbent frequency owners to relocate off this band.

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

5G application and system needs to access different frequency band to address diversified requirements from the varied 5G usage scenario envisioned. The sub 1GHz spectrum could provide deep and large coverage for eMBB, IoT, including to fulfill low latency applications and services.

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

We suggest more studies to be conducted on coexistence of 5G system and radio microphone. If reallocation for radio microphones to an alternation band is required, a compensation plan may be applied base on fair and reasonable negotiation between 5G service provider and incumbent users of this band.

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

The 600 MHz band is being considered for mobile service by some countries in Asia Pacific Tele community (APT) and in Region 2. Several countries joined the footnotes during WRC-15, with APT Wireless Group (AWG) now developing a frequency arrangement plan for this band. In the U.S. 600 MHz will be commercialized for MBB around year 2020. We recommend the Ministry to consider 600 MHz band in the long term plan for IMT service.

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

The question posed is more appropriate for MNOs.

However, Huawei highly recommends the Ministry to inject measures to crackdown on frequency “land-banking” and speculations in 5G spectrum allocation activities to optimize usage and adoption.

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

N/A

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

3GPP Rel 15 38.104 has specified NR spectrum bands and access mode recommendations. Huawei strongly believes that more bands, such as Band 40, will be included in future 3GPP Releases. The ministry is encouraged to observe and follow 3GPP recommended specifications.

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

N/A.

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

N/A.

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

N/A.

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

To ensure effective delivery of 5G services that meets ITU-R's IMT-2020 target values (DL100Mbps and UL 50Mbps) in a commercial scale, contiguous spectrum of 100MHz bandwidth in 3.5GHz band to be allocated per MNO will be a critical consideration factor.

For bands above 6GHz, at least 800MHz~1000MHz per of contiguous spectrum bandwidth per MNO is recommended for early stages of 5G. Our recent 5G trial conducted with Spark in a real indoor environment using 800MHz of bandwidth in the 28GHz band achieved a peak throughput of 18.23Gbps. The minor throughput gap from the theoretical 20Gbps peak throughput outlined by IMT-2020 in a real world environment can be closed through increasing the bandwidth used.

Therefore Huawei strongly encourage the ministry to include 3400~3800MHz for 5G IMT, so that national MNOs and regional network providers can have adequate spectrum to provide early 5G services in meeting IMT-2020 requirements.

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

N/A.

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

Stable policy and regulation environment is important to create confidence for the industry to invest in 5G. Huawei has no comment on the terms. We, however, has observed a well maintained spectrum evolution by 3GPP. It is shown in 3GPP 38.104 that nearly all the management rights in NZ have been recognized as 5G re-farmable, and we strongly believe 3GPP will keep on maintaining the IMT 5G spectrum in the future technology evolution.

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

3400~3800MHz is being standardized to TDD mode by 3GPP Rel 15. In addition 3GPP Rel 15 has put forwards a range of other frequency bands with defined FDD or TDD access mode. Huawei recommends the ministry to refer to 3GPP specifications.

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

The envisioned 5G requirements demands large bandwidth for both 3.5GHz and 26GHz, and continuous bandwidth per 5G network will reduce the complexity of system design and facilitate lower investment required on infrastructure and devices, more importantly, it will maximize spectrum utilization.

Many countries are working to make available 300~400 MHz contiguous bandwidth in 3.5GHz band for 5G with a target of at least 100 MHz of contiguous spectrum allocated per MNO. For millimeter-wave development, Huawei is of the view that contiguous bandwidth of 800-1000 MHz per MNO is necessary to meet the 5G ultra-high capacity requirement for effective commercial adoption and use.

We strongly suggests the ministry to plan the bandwidth in the principle of facilitating large continuous bandwidth and avoid spectrum fragmentation.

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

Huawei suggests the ministry to refer to specifications defined by 3GPP.

29. 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?

The ministry may learn from other regulatory bodies, such as CEPT, could provide a good example for technology neutrality in 3.5 GHz band and 26 GHz band.

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

Synchronization (common clock and aligned uplink and downlink transmissions) between TDD networks operating in adjacent frequency blocks (not requiring inter-operator guard band nor additional filtering) is the most efficient way to avoid interference between MNOs 5G networks.

In recent Ofcom (UK) 5G C-band spectrum auction, synchronized transmission is a prerequisite requirement. The Chinese Ministry of Industry and Information Technology in its notice（工信部无〔**2017**〕**276**号）imposes on intra-band and inter-band interference free, however, without giving any specific mitigation measures.

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

Common clock and alignment of UL and DL transmissions is also possible in case of NR network and LTE network operating in adjacent frequency blocks. According to 3GPP's design principle of 5G, if MNO networks can be synchronized, the interference is manageable between different TDD technologies within the same band.

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

N/A

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

N/A

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

N/A

35. 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?

Huawei NZ is receiving accelerated interest by MNOs to speed up their 5G network planning and deployment. Interest is mainly across the 3.5 GHz band, as such, Huawei will put forward 5G NR commercial products before the end of 2018 for NZ MNOs ready for deployment when the 3.5GHz frequency band becomes available.

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

It is also important for regulator to develop national 5G policy to guide and promote New Zealand 5G network and service development. Both option 3 and 4 in the RSM consultation paper are reasonable and feasible methods to archive early access in the mentioned frequency band. Government intervention will be helpful to strengthen confidence and balance interest for both IMT and incumbent right holders.

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

Huawei NZ encourages the ministry to play key roles to coordinate between incumbent right holders and MNOs. Government intervention will be critical to enable this band for early 5G development and access.

38. 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?

Huawei NZ encourages the ministry to start planning the re-allocation of 26GHz mmWave bands (NR bands n257 and n258 have been specified in 3GPP 38.104).

Huawei NZ strongly recommends the ministry to priorities the allocation of 3.5GHz band as soon, and later considers the allocation of mmWave around year 2020.

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

Please refer to our response to Q36.

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

We suggest starting preliminary coordination activity with incumbents on this band, possible development is highly likely to materialize after 2020.

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

We suggest starting preliminary coordination activity with incumbents on this band, possible development is highly likely to materialize after 2020.