

**Submission to
the Ministry of Business, Innovation
and Employment (MBIE):**

**Comments on
Preparing for 5G in New Zealand**

APRIL 30TH, 2018

SAMSUNG



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1. Executive Summary

Samsung Electronics Co., Ltd (hereinafter Samsung) is pleased to take an opportunity to submit this document to the MBIE in response to the consultation on “Preparing for 5G in New Zealand¹”, and are grateful for the opportunity to work with the MBIE on 5G spectrum bands.

In section 2, Samsung provides views on questions asked on 5G. Samsung fully supports MBIE taking into account both the 3.5 GHz band and mmWave bands focusing on 26 GHz band 28 GHz for 5G. In order to drive an early 5G market using these bands with high prioritization before 2020 in New Zealand, Samsung would encourage MBIE to allocate these bands as early as possible, taking into account the readiness of the technology and global progress.

Finally Samsung thanks the MBIE for the opportunity to comment on this consultation, and looks forward to working closely with the MBIE continuously to enable 5G to be deployed in New Zealand.

2. Comments

We believe that both 3.5 GHz band and mmWave bands should have high priority for early 5G implementation. Recently, 3GPP has adopted these bands as 5G NR band.

- n77 (3.3 – 3.8 GHz, so called 3.5 GHz)
- n257 (26.5 – 29.5 GHz, so called 28 GHz band and 5G Frontier band²)
- n258 (24.25 – 27.5 GHz, so called 26 GHz band and 5G Pioneer band)

3GPP is going to finalise its work to develop technical specifications to support these frequency bands within the timeframe of Release 15 by June 2018. It is expected that commercial equipment supporting n77 and n257 based on 3GPP Rel-15 will be available no later than the end of 2018 or early of 2019.

Some European countries, e.g. the UK and Italy, conducted consultation process to make available upper portion of 26 GHz, i.e. 26.5 – 27.5 GHz, available before 2020. Significantly, in January 2018 Europe has committed to make at least 1 GHz of mmWave spectrum by 2020 and this is widely expected to be 26.5 – 27.5 GHz³. This band overlaps both the 26 GHz band and 28 GHz bands. Samsung would encourage MBIE to make 26.4 (or 26.5) – 28.35 GHz available first due to the early global availability of equipment to support this range. Once global movements and developments in the remainder of the 26 GHz band (24.25 – 26.5 GHz) are clearer, then MBIE could consider providing this remainder in a second phase once it's clear that global availability of equipment will materialise. Of course, we also encourage that the upper band from 27.5 GHz up to 28.5 GHz/29.5 GHz should also be considered in a second phase taking into account other countries preparations, 3GPP standardization status and eco-systems readiness.

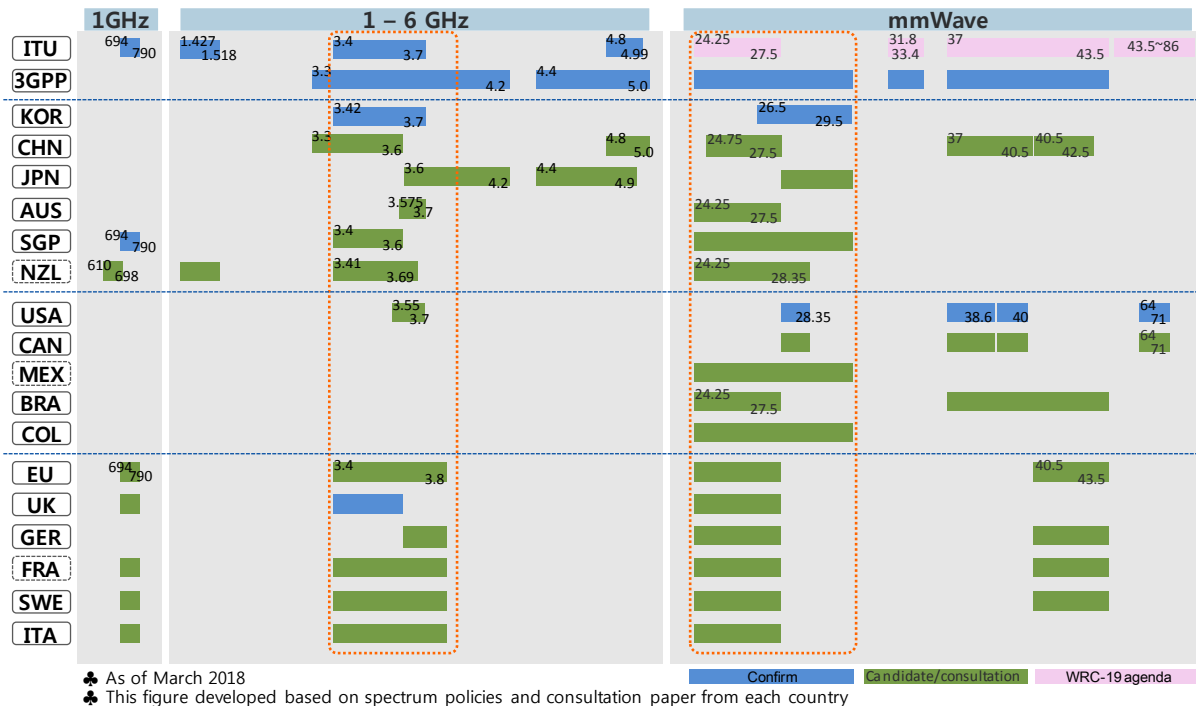
¹ Available at <https://www.rsm.govt.nz/projects-auctions/current-projects/preparing-for-5g-in-new-zealand-technical-consultation>

² Available at <https://qsacom.com/paper/initiative-develop-global-5g-market-28-ghz-spectrum-band/>

³ RSPG18-005 (January 20, 2018), Available at <http://rspg-spectrum.eu/2018/02/the-rspg-has-adopted-recommendations-to-policy-makers-on-5g/>

To date, it is expected that for 5G the USA would commercialise 28 GHz band (27.5 – 28.35 GHz) in 2018, Korea would commercialise 28 GHz (26.5 – 28.9 GHz) together with 3.5 GHz band (3.4 – 3.7 GHz) in March 2019⁴ and Japan would commercialise 28 GHz (27.5 – 29.5 GHz) together with portions of 3.6 – 4.2 GHz and 4.4 – 4.9 GHz in 2020.

Figure 1. Global 5G Spectrum Outlook



Taking into account above and figure 1, therefore, Samsung recognises that 5G using bands 3.5 GHz (3410 – 3690 MHz) and mmWave band (26.5 – 28.35 GHz) will be necessary to support 5G services starting before 2020. In particular, Samsung believes that both these bands will be the focus for early equipment eco-system development in several countries before 2020. Both bands as essential components for 5G services should be provided with same priority and timing for 5G in New Zealand.

In this section, Samsung provides views for some of questions asked.

<3. Possible frequency bands for 5G >

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

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

Regarding Q5 above, Samsung agrees that the 3.5 GHz band from 3410 MHz to 3690 MHz would be a priority for allocation for 5G in New Zealand. This band has been identified to IMT by previous

⁴ Refer from <https://www.zdnet.com/article/south-koreas-5g-spectrum-auction-to-start-at-3-billion/> and <http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=3047170&cloc=joongangdaily%7Cchome%7Cnewlist1>

WRCs. And many countries have a plan to use the 3.5 GHz band from 3.4 GHz to 3.7 GHz or portions thereof for their 5G service around 2020. For example, recently UK has finished the auction process within the band 3410 MHz to 3580 MHz. Korea is going to auction for the band from 3420 MHz to 3700 MHz in this June. In addition, many countries in the world are considering this band as primary band for 5G.

From standardization point of view, moreover, 3GPP defined 3.5 GHz band as one of the key 5G NR bands, and the band has been defined as n78.

Table 1. 5G NR operating bands in FR1 (450 – 6000 MHz)⁵

NR operating band	Uplink (UL) operating band BS receive / UE transmit $F_{UL, low} - F_{UL, high}$	Downlink (DL) operating band BS transmit / UE receive $F_{DL, low} - F_{DL, high}$	Duplex Mode
n1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
n2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n5	824 MHz – 849 MHz	869 MHz – 894 MHz	FDD
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
n8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
n20	832 MHz – 862 MHz	791 MHz – 821 MHz	FDD
n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
n38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD
n50	1432 MHz – 1517 MHz	1432 MHz – 1517 MHz	TDD
n51	1427 MHz – 1432 MHz	1427 MHz – 1432 MHz	TDD
n66	1710 MHz – 1780 MHz	2110 MHz – 2200 MHz	FDD
n70	1695 MHz – 1710 MHz	1995 MHz – 2020 MHz	FDD
n71	663 MHz – 698 MHz	617 MHz – 652 MHz	FDD
n74	1427 MHz – 1470 MHz	1475 MHz – 1518 MHz	FDD
n75	N/A	1432 MHz – 1517 MHz	SDL
n76	N/A	1427 MHz – 1432 MHz	SDL
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD
n79	4400 MHz – 5000 MHz	4400 MHz – 5000 MHz	TDD
n80	1710 MHz – 1785 MHz	N/A	SUL
n81	880 MHz – 915 MHz	N/A	SUL
n82	832 MHz – 862 MHz	N/A	SUL
n83	703 MHz – 748 MHz	N/A	SUL
n84	1920 MHz – 1980 MHz	N/A	SUL

Regarding Q6 above, as emphasised, entire band from 3.4 GHz to 3.7 GHz are being considered and will be used for 5G in many countries. Therefore, Samsung recommends the MBIE to consider the entire band from 3410 MHz to 3690 MHz for 5G service if the band could be possible.

We recognise that there has been little or no deployment of services in the lower part of the 3.5 GHz band (3410 to 3487 MHz and 3510 to 3587 MHz) and the upper part of the 3.5 GHz band (3589 to 3700 MHz) is largely unused in New Zealand. Meanwhile, rights in these bands would be effective by October 2022. Therefore, it would be one of the possible approaches that the 3.5 GHz band could be deployed at specific regions/area requiring more spectrum such as dense urban and hotspot first, and then usage of the band could be extended to other regions/areas taking into account expiration of the incumbent rights.

⁵ 3GPP TS 38.101-1 V15.1.0 (2018-03), User Equipment radio transmission and reception; Part 1: Range 1 Standalone (Release 15)

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?

Samsung strongly supports that both 3.5 GHz band and mmWave bands such as 26 GHz and 28 GHz should be taken into account as the same priority in order to fulfil 5G Vision⁶ and technical performance requirements⁷ to support 20 Gbit/s peak data rate using both bands below 6 GHz and mmWave bands.

Table 2. 5G NR operating bands in FR2 (24.25 – 52.6 GHz)⁸

NR Operating Band	Uplink (UL) operating band BS receive / UE transmit $F_{UL\ low} - F_{UL\ high}$	Downlink (DL) operating band BS transmit / UE receive $F_{DL\ low} - F_{DL\ high}$	Duplex Mode
n257	26500 MHz – 29500 MHz	26500 MHz – 29500 MHz	TDD
n258	24250 MHz – 27500 MHz	24250 MHz – 27500 MHz	TDD
n260	37000 MHz – 40000 MHz	37000 MHz – 40000 MHz	TDD

As described in Figure 1, from the various studies and investigation around the world, it is foreseen that various spectrum bands will be required. Specifically, many administrations and industries have recognised the potential for early availability of the 3.5 GHz band and mmWave bands (26 GHz and 28 GHz) for 5G services.

While the 3.5 GHz band offers advantages from coverage and good radio propagation perspectives, mmWave bands are required to provide wider contiguous bandwidth to support the high data throughput that is an essential characteristic of the full 5G vision.

Both lower bands below 6 GHz (focusing on 3.5 GHz band) and mmWave bands will be necessary to realise new services in 5G era, taking into account the varied ITU references and global investigations.

As emphasised, the 3.5 GHz band would be essential band for 5G. However if the 3.5 GHz band from 3410 MHz to 3690 MHz would only be available and allocated for 5G in New Zealand, this would mean that only 280 MHz bandwidth would be provided for 5G. From the ITU-R 5G vision (Recommendation ITU-R M.2083) and 5G technical performance requirements (Report ITU-R M.2410), hundreds of MHz would be required to realise 5G. For example, ITU-R recommends that the minimum requirement of peak data rate is 20 Gbit/s for downlink, assuming the peak spectral efficiency as 30 bit/s/Hz, means that the required bandwidth would be approximately 670 MHz. For the minimum requirement of user experienced data rate is 100 Mbit/s for downlink at Dense Urban-eMBB, assuming the 5th percentile user spectral efficiency as 0.225 bit/s/Hz, means that the required bandwidth would be about 450 MHz. As such the 280 MHz of bandwidth in 3.5 GHz band would not

⁶ Recommendation ITU-R M.2083, IMT Vision – “Framework and overall objectives of the future development of IMT for 2020 and beyond”, September 2015

⁷ Report ITU-R M.2410, Minimum requirements related to technical performance for IMT-2020 radio interface(s) & Report ITU-R M.2411, Requirements, evaluation criteria and submission templates for the development of IMT-2020, November 2017

⁸ 3GPP TS 38.101-2 V15.1.0 (2018-03), User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone (Release 15)

be supportive of 5G fully vision and performance requirements and therefore mmWave band supporting hundreds of MHz bandwidth should also be essential element for 5G.

We fully recognise that management rights in the lower part of the 26 GHz band (24.549 to 26.4 GHz) will be expired in 2022, meanwhile, management rights in the upper part of the 26 GHz (26.4 to 28.35 GHz) already expired in January 2018. This means that the upper part of the 26 GHz band could be available to use 5G service immediately in New Zealand.

Therefore, Samsung would encourage MBIE to make 26.4 (or 26.5) – 28.35 GHz available first due to the early global availability of equipment to support this range. Once global movements and developments in the remainder of the 26 GHz band (24.25 – 26.5 GHz) are clearer, then MBIE could consider providing this remainder in a second phase once its clear that global availability of equipment will materialise. Of course, we also encourage that the upper band from 27.5 GHz up to 28.5 GHz/29.5 GHz should also be considered in a second phase taking into account other countries preparations, 3GPP standardization status and eco-systems readiness. Meanwhile, it should be noted that some issues are being studied in ITU-R TG 5/1 for sharing and compatibility issue between 23.6 GHz and 24 GHz to protect Earth-Exploration Satellite Service (EESS-passive). These study results might give some impacts to the 26 GHz band at WRC-19, such as more stringent unwanted emission levels, certain guard band, etc.

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 Q9?

Regarding Q9, yes, Samsung could agree. In case of 31.8 to 33.4 GHz band (hereinafter 32 GHz), study progress toward WRC-19 in ITU-R is not much compared to other bands below 43.5 GHz. And this band was not allocated to Mobile Service in the Radio Regulations and the band has only small bandwidth. Industries and administrations have only small interest in this band for 5G usage.

In case of bands from 40.5 to 43.5 GHz, these bands have been agreed as one of 5G NR bands in 3GPP recently. Even though some administrations and regional preparatory groups for WRC-19 have some interests to use these bands, there are small activities to utilise the bands at this moment.

Therefore, those bands could be taken into consideration as a low priority for allocation to 5G in New Zealand.

Regarding Q10, as mentioned above, we foresee that most of studies and development are focused on bands below 40/40.5 GHz to be commercialised around 2020 - 2022. Therefore, equipment to support bands 40.5 to 43.5 GHz seems to be available after 2022 – 2025 based on market needs.

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

As described in this Consultation paper⁹, some countries such as USA, Korea, Japan, Canada, Singapore, etc. will use or are earnestly considering the band from 26.5 to 29.5 GHz (hereinafter 28

⁹ Available at <https://www.rsm.govt.nz/projects-auctions/current-projects/preparing-for-5g-in-new-zealand-technical-consultation>

GHz) or portions thereof, as 5G Frontier band, for their 5G in very near future.

And GSA¹⁰ as global suppliers association for mobile communications has published the report¹¹ in April 2018. From the report, most of 5G trials in the world are being focused on 28 GHz band as described in following figures.

Figure 2. Count of 5G demonstrations and trials according to spectrum bands used

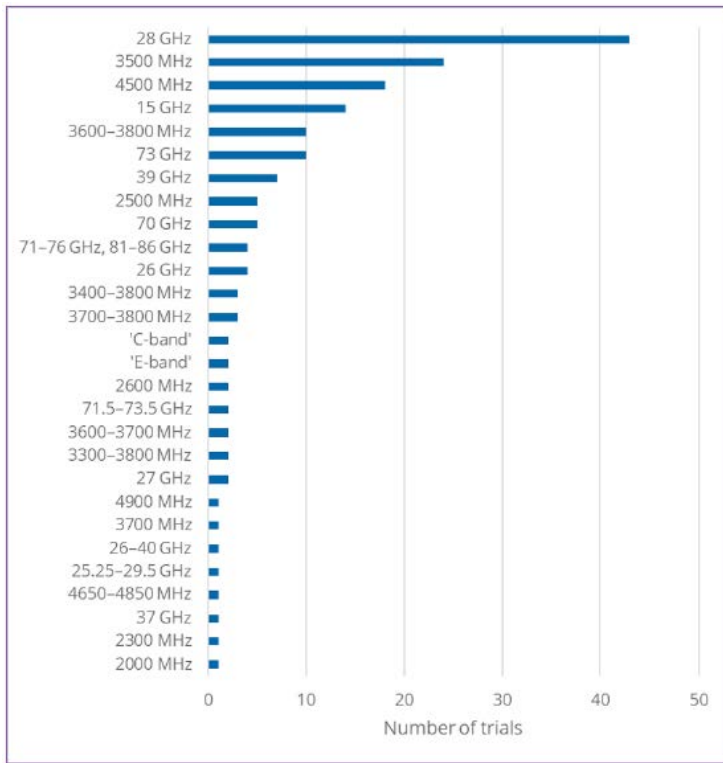
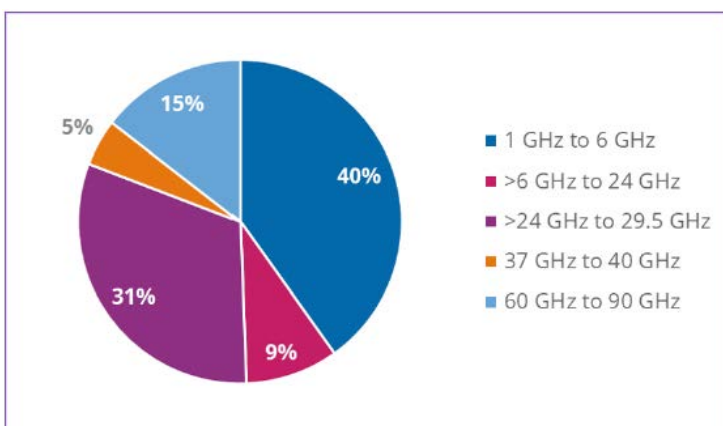


Figure 3. Distribution of number of 5G demonstrations and trials by broad spectrum ranges



On the other hand, 3GPP as global partnership to develop 5G technical specifications has defined the

¹⁰ <https://gsacom.com/>

¹¹ 5G Update – Global Market Trials, April 2018, GSA. Available at <https://gsacom.com/paper/5g-update-global-market-trials-2/>

band from 26.5 to 29.5 GHz as n257 for 5G NR band. The technical specifications to support 5G commercialization in several countries before 2020 will be defined by June 2018¹² finally. Especially, Korea will start 5G commercial services from March 2019 using 28 GHz band from 26.5 to 28.9 GHz. This means that equipment to support this band will be ready before 2019. Therefore, the 28 GHz band to be commercialised soon is one of the promised and key bands for 5G. Therefore, we suggest that the MBIE should consider the 28 GHz band up to 29.5 GHz, if possible.

<5. Management rights for 5G >

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

From table 1 and 2 above, we recognise that several band plan options such as FDD, TDD, SUL and SDL are the defined for 5G NR. From these tables, however, the most important point is that essential bands such as 3.5 GHz and bands above 24.25 GHz should adopt TDD band plan only for 5G. Therefore, we recommend that 5G bands both 3.5 GHz band and 26 GHz band be replanned as TDD mode, taking into account global harmonization and economy of scale.

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

For information, 3GPP is going to finalise the detailed technical specifications for 5G NR by June 2018. The following tables summarise what kinds of channel bandwidths are defined for 5G NR. In 3GPP, the transmission bandwidth configuration N_{RB} for each base station (BS) channel bandwidth and subcarrier spacing (SCS) is specified as table 3 and 4 for FR1 and FR2 respectively.

Table 3. Transmission bandwidth for FR1

SCS [kHz]	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	70 MHz	80 MHz	90 MHz	100 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}
15	25	52	79	106	133	[160]	216	270	N.A	N.A	N.A	N.A	N.A
30	11	24	38	51	65	[78]	106	133	162	[189]	217	[245]	273
60	N.A	11	18	24	31	[38]	51	65	79	[93]	107	[121]	135

Table 4. Transmission bandwidth for FR2

SCS [kHz]	50 MHz	100 MHz	200 MHz	400 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}
60	66	132	264	N.A
120	32	66	132	264

At this moment, we have no specific suggestion for channel bandwidth as the basis for allocation. As noted in the consultation document, 20 MHz for frequencies between 3 GHz and 6 GHz could be possible. However, from UK and Korea examples, 5 MHz and 10 MHz could also be considered as minimum channel bandwidth. If New Zealand would adopt an auction as allocating method for 5G,

¹² In case of NSA (Non-Standalone) mode, 3GPP had developed the required technical specifications in December 2017. And 3GPP will finalise the technical specifications for SA (Standalone) mode by June 2018.

smaller bandwidth such as 5 MHz and/or 10 MHz might be somewhat convenient due to possibility of varied band combinations for auction.

In case of frequencies above 24 GHz, 100 MHz channel bandwidth would be a suitable option taking into account state of art in relevant technology, global trends, etc.

On the other hand, it should also be noted that contiguous bandwidth per mobile operator would be one of the important elements to realise 5G by reducing complexity of equipment design and implementation price.

<7. Timing >

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?

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?

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?

From Q35 to Q39, we recognise that New Zealand is one of the leading countries to roll out new generation mobile broadband systems in the world. As noted in the consultation paper, 3.5 GHz band and 26 GHz band would be ready soon when the rights in those bands would be expired. To roll out of 5G networks and service, spectrum band should be ready timely. Through Recommendation ITU-R M.2083, ITU-R recommends that 5G would be available around 2020. In addition, operators in New Zealand want to roll out their 5G networks from 2020. Therefore, we recommend that early access to the 3.5 GHz band be ready before 2020 prior to the expiry of existing rights in 2022 if there would be no more request from existing rights holder.

26 GHz band (26.4/26.5 GHz to 28.35 GHz) is also one of the key essential spectrum bands for 5G. In order to fulfil 5G requirements defined by ITU-R, the 26 GHz band should also be provided timely.

We recommend that both 3.5 GHz band and 26 GHz band be ready and provided at the same time with mobile industry.

With the same approach, therefore, Samsung would encourage MBIE to make 26.4 (or 26.5) – 28.35 GHz available first due to the early global availability of equipment to support this range.

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

As noted in consultation paper, band above 30 GHz could be likely used as additional capacity layers for 5G networks. However, bands above 30 GHz would be considered as the next phase after initial

deployment of 5G in 2020. Therefore, those bands could be considered after 2022 – 2025 timeframe when industry in New Zealand would require.

3. Acronyms and Abbreviation

3GPP	3 rd Generation Partnership Project
BS	Base Station
EESS	Earth-Exploration Satellite Service
eMBB	Enhanced Mobile Broadband
FDD	Frequency Division Duplex
FR1	Frequency Range 1 (450 MHz to 6 GHz)
FR2	Frequency Range 2 (24.25 GHz to 52.6 GHz)
GSA	Global mobile Suppliers Association
ITU	International Telecommunications Union
ITU-R	ITU-Radiocommunication sector
MBIE	Ministry of Business, Innovation and Employment
NR	New Radio
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
Rel	Release
SCS	Subcarrier Spacing
SDL	Supplementary DL (Downlink)
SUL	Supplementary UL (Uplink)
TDD	Time Division Duplex
TG	Task Group
UE	User Equipment

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