

**SmarTone’s Responses to the CA’s Consultation Paper  
Arrangement for Assignment of Additional Spectrum in the 4.9 GHz Band  
For the Provision of Public Mobile Services  
And the Related Spectrum Utilisation Fee**

**1. Introduction**

- 1.1 SmarTone Mobile Communications Limited (“SmarTone”) is pleased to provide its comment to the captioned Consultation Paper jointly issued by the Communications Authority (“CA”) and the Secretary for Commerce and Economic Development (“SCED”) on 22 July 2020.
- 1.2 5G plays a pivotal role in the evolution of Smart City, as high-speed connectivity, low-latency, and the ability to handle a massive number of connections offered by 5G network is a fundamental building block for many Smart City applications.
- 1.3 In the Hong Kong Smart City Blueprint announced in 2017, 5G is identified as a key Smart City infrastructure.

*“Fifth generation (5G) mobile networks are the catalyst for smart city development, offering ultra-high speed and high capacity, supporting device-to-device ultra reliable/low latency communications, and enabling massive machine-to-machine communications for better implementation of Internet of Things (IoT). Hong Kong is all geared up for the commercial launch of 5G services and applications in 2020”*
- 1.4 The success of 5G in Hong Kong depends not only on the mobile industry, but also heavily reliant on the government policy on spectrum management and assignment.
- 1.5 The Radio Spectrum Policy Framework promulgated by the Government in 2007 sets out a number of spectrum policy objectives, the first one being *“to facilitate the most economically and socially efficient use of spectrum with a view to attaining maximum benefit for the community”*. Any spectrum assignment exercise must therefore aim at, amongst other things, promoting the long-term consumer and community benefits in Hong Kong.
- 1.6 A competitive 5G market is at the heart of achieving the aforementioned policy objective and to support the development of 5G and smart city in Hong Kong. This, in turn, depends on the government policy in preventing excessive concentration of spectrum which has a detrimental effect on competition in the market.
- 1.7 SmarTone welcomes the CA’s effort in releasing more spectrum in the 4.9 GHz for 5G services by relocating the existing Government uses to other frequency bands. In our submission to the first 4.9 GHz consultation paper in 2018, SmarTone has urged that more spectrum in the 4.9 GHz band should be made available for mobile services.

- 1.8 At the same time, to ensure that the additional spectrum in the 4.9 GHz band would bring the maximum benefits to the community, it is important that the spectrum assignment arrangement would promote a competitive market by setting a spectrum cap that would guard against over-concentration of spectrum.
- 1.9 In the following sections, we will elaborate our views with regard to the proposed spectrum cap and why we consider that a more stringent spectrum cap should be set for the spectrum in the 4.9 GHz band.

## 2. Spectrum Cap

- 2.1 In the consultation exercise for the assignment of 4.9 GHz band in 2018, to prevent over-concentration of spectrum holding by any individual operator, the CA had decided to limit any bidder in the auction to acquire only one frequency block with a bandwidth of 40 MHz of spectrum. The spectrum cap of 40 MHz was equivalent to 50% of the available spectrum (80 MHz) at that time because the minimum channel bandwidth of the 4.9 GHz band is 40 MHz according to the 3GPP technical specification.
- 2.2 In the current exercise, the CA has taken the view that the spectrum cap could also be set at 40 MHz for the additional spectrum of 4.9 GHz band. In other words, if the mobile network operator (“MNO”) which is an existing assignee of 40 MHz spectrum in the 4.9 GHz band acquires another 40 MHz of the additional spectrum, it will have 80 MHz of the 4.9 GHz band, which equals to 50% of the total available spectrum in the 4.9 GHz band (i.e., 80 MHz out of 160 MHz).
- 2.3 As mentioned in paragraph 21 of the Consultation Paper, the CA considers that the proposed spectrum cap would not give rise to over-concentration of spectrum holding by any individual market player and will unlikely have any impact on effective competition in the mobile market. We have tried to summarize the key considerations of the CA’s assessment stated in that paragraph as follows:
  - MNOs have been assigned with hundreds of MHz of spectrum across various frequency bands
  - Existing spectrums used for 2G, 3G or 4G mobile services could be re-farmed for the provision of 5G services
  - The CA will continue to identify and release more spectrum for mobile use
- 2.4 SmarTone would like to point out that the total spectrum holdings of individual MNOs have not been a key consideration in the spectrum cap previously set by the CA. It is also always true that existing spectrum can be re-farmed and more spectrum would be available in the future, but they should not be regarded as the key considerations in the competition assessment. In the previous settings of spectrum cap, the CA has focused on the over-concentration of spectrum holding in specific spectrum band in

light of the different characteristics of different spectrum bands, such as the technical characteristics, the rollout limitations and the scope of use. We submit that the CA's consideration in the past is the right approach, and we have grave concern about the change in the CA's approach in the current exercise, which would lead to over-concentration of spectrum in the 4.9 GHz band. In this regard, SmarTone would like to provide its comments with respect to each of the above considerations and urge the CA to reconsider the issue of spectrum cap which is crucial to the development of 5G market in Hong Kong.

#### Considerations in the setting of Spectrum Cap

2.5 The total spectrum holdings of each MNOs are shown in Annex II of the Consultation Paper to illustrate that even the existing assignees of the 4.9 GHz band acquire another 40 MHz of the additional spectrum, the shares of spectrum holding of the MNOs would only change slightly and therefore the impact on competition would be minimal. We wish to point out that such analysis, which uses the overall spectrum holding of MNOs as a key consideration in the competition analysis, is deviated from previous CA's consideration in the setting of spectrum cap.

2.6 In the Joint Statement of the CA and the SCED entitled "*Arrangements for Assignment of the Spectrum in the 3.3 GHz and 4.9 GHz Bands for the Provision of Public Mobile Services and the Related Spectrum Utilisation Fee*" dated 13 December 2018, the CA's position on the issue of spectrum cap is as follows (Paragraph 25 of the Annex)

*"Having regard to the submissions received, the CA maintains the view that any over-concentration of spectrum may potentially pose competition risks and hence a spectrum cap is required. As regards the request to have a single cap for all the spectrum concerned rather than individual caps, given that the technical characteristics, the scope of use, and hence demand for the different frequency bands are different, it is not appropriate to treat them in a homogeneous manner and apply a single overall spectrum cap. The CA therefore considers it appropriate to maintain its proposals to impose an individual spectrum cap for the 3.3 GHz and 4.9 GHz bands." (emphasis added)*

2.7 As mentioned in paragraph 14 of the Consultation Paper, the CA has rightly pointed out that the 4.9 GHz band has the advantage of being able to support deployment of 5G services at all indoor and outdoor locations in Hong Kong, as compared to the spectrum in the 3.3 GHz and 3.5 GHz bands.

2.8 The deployment of 5G network requires sufficient spectrum in the mid-band (sub 6 GHz) to provide wide area coverage to meet the public demand for high speed, high capacity 5G services. Given the limitation of the 3.5 GHz band in the restriction zones of Tai Po and Stanley and that the 3.3 GHz band is for indoor use only, the spectrum in 4.9 GHz band is essential in

providing territory-wide 5G coverage to mobile service users in Hong Kong, which is unmatched by the 3.3 GHz and 3.5 GHz bands.

- 2.9 Given the distinctive technical characteristics of the 4.9 GHz band, the CA should take into account the existing spectrum holdings in the 4.9 GHz band and set an in-band spectrum cap limiting the amount of total spectrum in 4.9 GHz band that can be acquired by any operator at the upcoming exercise. Please refer to paragraph 2.24 to 2.27 below for our proposal on the level of spectrum cap.

#### Re-farming of existing spectrum for 5G services

- 2.10 It is true that the MNOs could re-farm the existing spectrum used for 2G, 3G or 4G for the provision of 5G services. However, the re-farming arrangement is not without limitations.
- 2.11 First, re-farming of existing spectrum would be subject to the limitation of available spectrum resources. Careful management of spectrum resources has to put in place in order not to adversely affect the performance of existing services. There is always a risk that if the spectrum for existing services is reduced substantially, the service performance of the existing services would be adversely affected.
- 2.12 Secondly, while the re-farming of existing spectrum using the dynamic spectrum sharing (DSS) technology enables a speedy 5G network rollout and a seamless transition between 4G and 5G, it is not without limitations as the spectrum resources are still shared among the 4G and 5G services.
- 2.13 In view of the above, re-farming of existing spectrum should not be viewed as a substitute for 5G spectrum in the long term.

#### New 5G spectrum

- 2.14 As announced in the consultation papers on 19 August 2020, the CA will make available 140 MHz of spectrum in the 600/700 MHz band and 15 MHz of 850 MHz band in the coming years. However, it is noted that the 70 MHz spectrum in the 600 MHz band will be for indoor use only due to the interference issue with the Mainland. Also, the 15 MHz of spectrum in the 850 MHz band will not be assigned until November 2023. Hence the supply of new spectrum from these bands would not be a sufficient and timely measure to offset the adverse impact brought by the over-concentration of spectrum in the 4.9 GHz band.

#### Over-concentration of spectrum

- 2.15 In this section, we would like to illustrate the extent of over-concentration of 5G spectrum. As mentioned above, 4.9 GHz is the only mid-band spectrum that can be used to provide wide area 5G network coverage including the restriction zones in Tai Po and Stanley, and re-farming of existing spectrum for the provision of 5G services is not a substitute in the

long term. As such, it is our view that the issue of spectrum concentration should be reviewed with respect to the spectrum holding in the 4.9 GHz band only. To allow any individual operator to hold 50% of the total available spectrum in the 4.9 GHz band is likely to give rise to competition concern.

- 2.16 Even if we take a similar approach as per the CA’s analysis in paragraph 21 of the Consultation Paper, but only take into account the spectrum holding of 5G mid-band spectrum (i.e., 3.3, 3.5 and 4.9 GHz bands) of the MNOs, the concern on over-concentration of spectrum is still apparent.
- 2.17 The table below illustrates the scenario (with respect to 5G mid-band spectrum) if the existing two assignees of 40 MHz spectrum in the 4.9 GHz band acquire another 40 MHz of the additional spectrum in the band.

<b>Operator</b>	<b>3.3 GHz</b>	<b>3.5 GHz</b>	<b>4.9 GHz</b>	<b>Total</b>	<b>Share in Total</b>
<b>A</b>	20	60	80	160	<b>34.8%</b>
<b>B</b>	30	50	80	160	<b>34.8%</b>
<b>C</b>	30	40		70	<b>15.2%</b>
<b>D</b>	20	50		70	<b>15.2%</b>
<b>Total</b>	100	200	160	460	<b>100%</b>

- 2.18 As shown above, the 5G mid-band spectrum holding of the largest operator would be more than double of the smallest operator. Such a substantial imbalance in MNOs’ spectrum holdings would more than likely affect the competitive landscapes of the market. MNOs subject to spectrum capacity constraints would have less ability to compete in the downstream mobile service market. Competition in the market would be reduced and the long-term interests of Hong Kong public would suffer as a result.

- 2.19 Another assessment tool which could be used to show the spectrum concentration level and the potential impact on competition is the Herfindahl-Hirschman Index (“HHI”). HHI is widely used by overseas regulators and the Competition Commission (“CC”) in Hong Kong to assess market concentration. The following is extracted from the Merger Guidelines issued by the CC on the use of HHI:

*“The HHI measures market concentration. It is calculated by adding together the squares of the market shares of all the firms operating in the market. The increase in the HHI resulting from the merger is calculated by subtracting the pre-merger index from the expected value of the HHI following the merger, the difference being known as the “delta”. Both the absolute level of the HHI and the expected change*

*resulting from the merger can provide an indication of whether a merger is likely to raise competition concerns.”*

2.20 While the above use of HHI is for the measurement of market concentration in the case of merger and acquisition, HHI could also be used to measure spectrum concentration across operators. The same methodology as above could be adopted, with the market shares figures being replaced by the shares of spectrum holding of each operator.

2.21 We have calculated the HHI for the following scenarios of 5G mid-band spectrum holdings (details shown in **Annex 1**):

Scenario 1 – The existing distribution of 5G mid-band spectrum among the 4 MNOs;

Scenario 2 – The existing assignees of 4.9 GHz band acquire the additional spectrum in the 4.9 GHz band;

Scenario 3 – The two other MNOs which do not have spectrum holding in the 4.9 GHz band acquire the additional spectrum in the 4.9 GHz band

2.22 The HHI of the three scenarios are summarized below:

Scenario	HHI	Delta
1	2674	n/a
2	2844	Increased by 170
3	2504	Reduced by 170

2.23 Since scenario 2 (i.e., the existing assignees acquire the additional spectrum in the 4.9 GHz band) will produce an increase of HHI by more than 100, it is generally considered that the resulting spectrum concentration would raise competition concern. On the other hand, scenario 3 (i.e., the other two MNOs acquire the additional spectrum in the 4.9 GHz band) will produce a significant decrease of HHI, which would likely be regarded as an indicator of a more competitive market.

### Level of the Spectrum Cap

2.24 A summary of spectrum caps previously set is provided in **Annex 2**. The range of spectrum caps previously set is from 33% to 40%, with two exceptions as in the auctions of 900/1800 MHz in 2018 and 4.9 GHz in 2019. It should be noted that the deviations of spectrum caps set in the two exceptions are with specific reasons. The former one (900/1800 MHz in 2018) was a re-assignment exercise of existing spectrum, and the latter one (4.9 GHz in 2019) was set according to the minimum spectrum bandwidth as defined in the 3GPP standard.

2.25 It is worth noting that in the assignment of the Spectrum in the 3.5 GHz Band last year, “...the CA decides to impose a spectrum cap of 70 MHz in

*the assignment of spectrum in the 3.5 GHz band with a view to achieving the objectives of ensuring effective competition, promoting spectral efficiency, and enabling the provision of reasonably good and efficient 5G services by the successful bidders.”*

2.26 The CA has rightly imposed a spectrum cap to prevent over-concentration of spectrum holding by any individual operator in the 3.5 GHz band. The same consideration has been adopted by the CA in the setting of spectrum caps in the auctions of 3.3 GHz and 4.9 GHz bands. A consistent approach should therefore be adopted in the setting of spectrum cap in the 4.9 GHz band to prevent over-concentration of spectrum to the detriment of market competition. We propose that the same spectrum cap (i.e. 35%) used in the previous 3.5 GHz auction should be applied with regard to individual operator’s spectrum holding in the 4.9 GHz band in view of the following:

- The mid-band spectrum is important new spectrum for wide area 5G network deployment;
- 4.9 GHz band is similar to 3.5 GHz band in that it could be used for wide area 5G network deployment for both indoor and outdoor location;
- What’s more, 4.9 GHz is the only mid band that can be used to provide coverage in the restriction zones;
- The two separate assignment exercises in 4.9 GHz band is closely related. The first assignment of 80 MHz of 4.9 GHz band was completed in December 2019. The coming assignment of additional 80 MHz of 4.9 GHz band will likely be completed by the end of 2021. Given the close proximity of the two exercises (in just 2 years’ time), an in-band spectrum cap should be applied, which take into account the existing spectrum holding in the 4.9 GHz band. This is important to prevent over-concentration of spectrum holdings in the 4.9 GHz band by any individual operator.

2.27 We wish to reiterate that the level of spectrum cap in the auction of 4.9 GHz band in 2019 was due to the fact that 40 MHz is the minimum channel bandwidth of the 4.9 GHz band according to the 3GPP standard. Given that more spectrum in the 4.9 GHz band is now available, to prevent over-concentration of spectrum in the 4.9 GHz band by any individual operator, the spectrum cap for the assignment of the additional 80 MHz spectrum should take into account the existing spectrum holdings in the 4.9 GHz band.

2.28 In view of the above, we propose that no individual operator should have more than 35% (same spectrum cap as in the 3.5 GHz band auction) of the total available spectrum in the 4.9 GHz band (i.e., 35% of the total 160 MHz spectrum in the 4.9 GHz band). Given that the minimum allowable channel bandwidths for the 4.9 GHz band is 40 MHz, the spectrum cap should be set at 40 MHz for the total 160 MHz spectrum in the 4.9 GHz band. In other words, the existing spectrum holdings in the 4.9 GHz band should be taken

into account in setting the limit of 40 MHz for the 4.9 GHz band for any operator (both existing and new assignees).

### **3. Spectrum Availability**

- 3.1 To unleash the full potential of 5G network, it is widely recognized that each mobile operator would need to have access to at least 80 to 100MHz of the 5G mid-band spectrum.
- 3.2 That is why many advanced markets, such as China, Japan and Korea etc., have assigned new 5G mid-band spectrum of 100 MHz to individual operator for the provision of 5G services. **Annex 3** provides an overview of the overseas 5G mid-band spectrum overseas arrangements for the CA's information.
- 3.3 In this regard, we would urge the CA to continue its effort in releasing more spectrum for 5G services, as operators would definitely need additional spectrum to provide sufficient capacity as demand takes up in near future.
- 3.4 According to the spectrum allocation information published by OFCA, 300 MHz in the 4.5-4.8 GHz band is currently allocated for the use of fixed and fixed satellite services and is vacant at the moment.
- 3.5 The 4.5 - 4.8 GHz band has been allocated for 5G use in Japan, with 100 MHz of spectrum in 4.5 to 4.6 GHz band already assigned to NTT DoCoMo. We also understand that the 4.5 to 4.8 GHz band is being considered for assignment in a number of countries, including Latin America, Russia and other Asian countries. It is likely that more and more countries will adopt the band for 5G use given the increasing demand for 5G traffic over time.
- 3.6 It is expected that the eco-system supporting the entire n79 band would become more mature in 3 to 4 years' time when more and more countries allocate the band for 5G services. Device availability should not be an issue in the long term because devices supporting the n79 band (from 4.4 to 5.0 GHz) are in principle capable to support the whole range of spectrum in the band.
- 3.7 The release of more spectrum in the 5G mid-band would enable operators to achieve better spectral efficiency and to support 5G territories-wide rollout, including in the restriction zones of Tai Po and Stanley areas. SmarTone would therefore request the CA to consider releasing more spectrum in the 4.5 to 4.8 GHz band for mobile services in the longer term.

### **4. Assignment Method of the Spectrum**

- 4.1 The Radio Spectrum Policy Framework promulgated by the Government in 2007 states that a market-based approach in spectrum management will be used for spectrum wherever the CA considers that there are likely to be



competing demands from providers of non-Government services, unless there are overriding public policy reasons to do otherwise.

- 4.2 If our proposal on the spectrum cap (i.e., any individual operator, be it existing or new assignee of the 4.9 GHz band, is not allowed to acquire more than 40 MHz of the total available spectrum in the 4.9 GHz band) is adopted by the CA, then there would be unlikely competing demands for the additional spectrum in the 4.9 GHz band (unless there is new entrant interested in acquiring the spectrum).
- 4.3 Besides, we believe there are also public interest reasons to administratively assign the additional spectrum to the two mobile operators which have not acquired the 4.9 GHz band spectrum last year. As shown in the spectrum concentration analysis in section 2 above, it would be the best scenario in promoting a competitive 5G market which will bring long-term and sustainable benefits to the Hong Kong community.
- 4.4 It is worth noting that China and Japan have administratively assigned the 5G mid-band spectrum to their mobile operators. Such move will incentivize the operators to invest more in their networks and services, thereby achieving long-term socio-economic goals of the community.
- 4.5 Given the above, we submit that it is in the public interest to administratively assign the additional spectrum in the 4.9 GHz band to the two remaining MNOs which had not acquired any spectrum in the 4.9 GHz band in 2019, by giving a Right of First Refusal (“RFR”) to each of them to acquire 40 MHz of the spectrum. The RFR should be subject to the same terms as the 4.9 GHz spectrum assigned in 2019 to ensure that all MNOs are placed at a level playing field.

## 5. Other Issues

- 5.1 **Network Rollout** – To prevent spectrum hoarding and all acquired spectrum will be put into efficient use in a timely manner, we submit that all spectrum acquired by existing or new assignees, should be subject to the same network rollout and performance bond requirement. We do not support the proposal of having different treatments in terms of performance bond requirements in the case of new assignees or existing assignees.
- 5.2 **Reserve Price** – In the event that the CA is minded to conduct auction to allocate the spectrum, SmarTone submits that the reserve price should be set as low as possible to avoid unnecessary intervention of the setting of spectrum price. In any event, the reserve price should be no more than the level as set in the auction of 4.9 GHz band in October 2019.

## 6. Questions of the Consultation Paper

- 6.1 Below please find our responses to the specific questions raised in the Consultation Paper.

6.2 *Question 1: Do you have any views on the proposed amendment to the Hong Kong Table of Frequency Allocations as regards the allocation of the 4.80 – 4.83 GHz band to mobile service on a co-primary basis in addition to fixed service, and the 4.99 – 5.00 GHz band to fixed service on a co-primary basis in addition to radio astronomy service?*

**Answer:** We have no objection to the proposal, but please refer to our suggestion to release more 5G mid-band spectrum in section 3 above.

6.3 *Question 2: Do you have any views on assigning the additional spectrum in the 4.9 GHz band by way of auction and allowing all interested parties to apply for participation in the auction?*

**Answer:** Please refer to sections 2 and 4 above.

6.4 *Question 3: Do you have any views on the proposal to divide the additional spectrum in the 4.9 GHz band into two 40 MHz blocks?*

**Answer:** We support the proposal.

6.5 *Question 4: Do you have any views on the proposed spectrum cap of 40 MHz to be imposed on each bidder?*

**Answer:** Please refer to section 2 above.

6.6 *Question 5: Do you have any views on adoption of the SMRA auction format for the assignment of the additional spectrum in the 4.9 GHz band?*

**Answer:** Please refer to section 4 and 5.2 above.

6.7 *Question 6: Do you have any views on the network and service rollout obligations proposed to be imposed on the successful bidders of the additional spectrum in the 4.9 GHz band, and the associated performance bond (in the case of new assignees of spectrum in the 4.9 GHz band) or undertaking (in the case of existing assignees of spectrum in the 4.9 GHz band) proposed to be provided by successful bidders to secure compliance?*

**Answer:** Please refer to section 5.1 above.

6.8 *Question 7 - Do you have any views on the proposal in relation to the setting and collection of SUF as specified in paragraphs 30 and 31 above?*

**Answer:** We support the proposal.

**SmarTone Mobile Communications Limited**

**1 September 2020**

## Annex 1

### Scenario 1 – Existing 5G spectrum holding (Base Case)

Operator	3.3 GHz	3.5 GHz	4.9 GHz	Total	Share in Total	HHI
A	20	60	40	120	31.6%	999
B	30	50	40	120	31.6%	999
C	30	40		70	18.4%	338
D	20	50		70	18.4%	338
Total	100	200	80	380	100%	2674

**Scenario 2** - The existing assignees of 4.9 GHz band acquire the additional spectrum in the 4.9 GHz band

Operator	3.3 GHz	3.5 GHz	4.9 GHz	Total	Share in Total	HHI
A	20	60	80	160	34.8%	1211
B	30	50	80	160	34.8%	1211
C	30	40		70	15.2%	231
D	20	50		70	15.2%	231
Total	100	200	160	460	100%	2844

**Scenario 3** - The two other MNOs which do not have spectrum holding in the 4.9 GHz band acquire the additional spectrum in the 4.9 GHz band

Operator	3.3 GHz	3.5 GHz	4.9 GHz	Total	Share in Total	HHI
A	20	60	40	120	26%	676
B	30	50	40	120	26%	676
C	30	40	40	110	24%	576
D	20	50	40	110	24%	576
Total	100	200	160	460	100%	2504

**Annex 2**

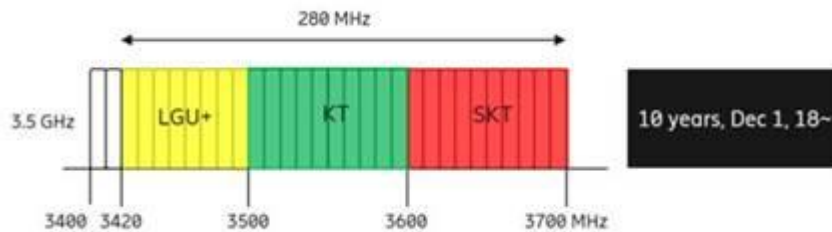
Band	Total bandwidth	Date of auction	Spectrum cap
2600 MHz	90 MHz (45 MHz x2)	Jan 2009	30 MHz (33% of 2600MHz)
2300 MHz	90 MHz	Feb 2012	30 MHz (33%)
2100 MHz	118.4 MHz	Dec 2014	40 MHz (33%)
900/1800 MHz	200 MHz	Dec 2018	90 MHz (45%) overall, and sub-cap of 20 MHz (45%) on 900MHz
3.5 GHz	200 MHz	Oct 2019	70 MHz (35%)
4.9 GHz	80 MHz	Oct 2019	40 MHz (50%)
3.3 GHz	100 MHz	Nov 2019	40 MHz (40%)

### Annex 3

Below are some of the advanced markets where mid bands (i.e. 2.6 GHz, 3.5 GHz and 4.9 GHz) were / are being assigned with each operator getting 100MHz (except the case of LGU+ in Korea which gets 80 MHz).

#### Korea

- 3.5 GHz: KT 100 MHz, SKT 100 MHz, LGU+ 80MHz



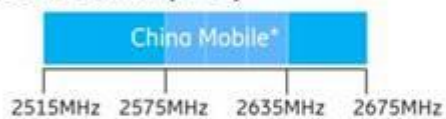
#### China

- 3.5 GHz: CT 100 MHz, CU 100 MHz
- 2.6 GHz: CMCC 160 MHz
- 4.9 GHz: CMCC 100 MHz

#### 3.5GHz Band (N78)



#### 2.6GHz Band (N41)



#### 4.9GHz Band (N79)



#### Japan

- 3.6-4.1 GHz: 4 MNOs, 100 MHz each for docomo, Rakutan and SoftBank. 100+100 MHz for KDDI.
- 4.5 GHz: Docomo 100 MHz



### Finland

- 3.41-3.8 GHz: 3 MNOs, 130 MHz each
- Mobile providers Telia, Elisa and DNA paid just over the reserve price to secure the same amount of spectrum. Telia, formerly TeliaSonera, offered €30.2 million for Band A (3.41-3.54 MHz). The second biggest carrier Elisa paid €26.3 million to acquire Band B (3540-3670 MHz), and DNA won Band C (3670-3800 MHz), only bidding the starting price of €21 million.

### Europe

Europe has pointed out the 3.4-3.8 GHz as a 5G pioneer band. Since there are three or four operators per countries, it is expected that MNOs will have 100 MHz each in the next few years. Over time, it is also expected that the 3.8 – 4.2 GHz will become available to MNOs. The following link documented some 5G spectrum assignment status in Europe.

<https://5gobservatory.eu/5g-spectrum/national-5g-spectrum-assignment/#1533313745961-d2a5cc14-241a>