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Office of the Communications Authority
29/F Wu Chung House
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Wanchai, Hong Kong
(Attention: Head, Regulatory 3)

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Dear Madam/Sir,

The CA is seeking comments on its consultation paper **"Proposed Allocation of the 26 GHz and 28 GHz Bands to Mobile Service and the Associated Arrangements for Spectrum Assignment and spectrum Utilisation Fee".**

With reference to the captioned consultation paper, please find attached AsiaSat's views and comments on this issue.

Should you have any questions, please let us know.

Yours Sincerely

For Chan Yat Hung
Management, Spectrum

Encl.

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Comments on the CA Consultation Paper
"Proposed Allocation of the 26 GHz and 28 GHz Bands to Mobile Service and the Associated Arrangements for Spectrum Assignment and spectrum Utilisation Fee"

AsiaSat, 21 August 2018

The CA is seeking views and comments on their proposal to allocate spectrum in the "26 GHz band" (24.25 – 27.5 GHz) and in the "28 GHz band" (27.5-28.35 GHz) for the mobile service, more specifically for 5G in its Consultation Paper: Proposed Allocation of the 26 GHz and 28 GHz Bands to Mobile Service and the Associated Arrangements for Spectrum Assignment and Spectrum Utilisation Fee. This response is in particular focusing on the impact on the satellite services in overlapping frequency bands.

The Importance of 26 GHz and 28 GHz FSS bands to Hong Kong as a telecommunications hub

In ITU-R Region 3 as well as in the Hong Kong table of frequency allocations, the 27-31 GHz band is allocated to the fixed satellite services (FSS) (Earth-to-space) on a primary basis. Several satellites, including those of Hong Kong satellite operators, already use the band or parts of this band and major teleports in Hong Kong have, and have had for several years, operational, licensed antennas, transmitting in this band. Therefore when the CA states that the 27-27.5 GHz and 27.5-28.35 GHz bands have not been occupied for FSS purposes, this is not correct.

Furthermore, globally, there is a trend to develop and deploy "High Throughput Satellites" (HTS) offering wideband connections to end users, including mobile terminals ("ESIMs" (Earth Station In Motion)) through large numbers of small spotbeams with extensive frequency re-use. These satellites will also be used to provide 5G applications to end users and are thus instrumental also in respect of the deployment of 5G. Such satellites are currently also being developed by both Hong Kong and mainland satellite operators for launch in the coming years. While the user terminals accessing Ka-band HTS satellites normally will transmit at frequencies above the 26 and 28 GHz bands, the gateways normally will transmit within these bands, in particular starting from 27.5 GHz, but in this Region, also in the 27-27.5 GHz band. As more and more HTS satellites are deployed, one therefore will see increasing activity in these bands.

The 24.65-25.25 GHz band is allocated to FSS on a primary basis. In the Hong Kong table of frequency allocations, the 24.75-25.25 GHz portion of this band, i.e. the upper 500 MHz, is allocated to FSS on a primary basis. The 24.65-25.25 GHz band is a part of the 26 GHz band. This band is predominantly foreseen used for feederlinks for the broadcasting satellite service (BSS) and in particular for BSS in the 21.4-22 GHz band. Since this band was given definitive procedures for use only by WRC-12, noting the 15-20 year lifespan of a satellite, there has been little time to develop and deploy satellites using these bands. It is however known that there are plans in the

mainland to make use of these bands in future satellites. Over time, one therefore should expect to see use of the 24.65-25.25 GHz band for FSS increasing also in Hong Kong.

In considering terrestrial 5G in the 26 GHz and/or the 28 GHz band, it is important to recognize the need to safeguard the evolution and growth of also the satellite industry, including the satellite component of 5G, within Hong Kong as a part of the overall telecommunications infrastructure to serve its population and to enable Hong Kong to remain a regional telecommunications hub in the Asia-Pacific, attracting investment by local, regional and international players, with the jobs created in Hong Kong and the contributions to the Hong Kong economy.

As also recognized by the CA, ITU, under WRC-19 Agenda Item 1.13, is seeking to identify internationally harmonized frequency bands which can offer very large bandwidths for 5G. Due to its importance to FSS worldwide, the 28 GHz is NOT on the list of candidate bands. There are however several other frequency bands on the list of candidate bands which could potentially be identified for IMT (5G) by WRC-19. It might be better for Hong Kong to aim for internationally harmonized bands for deployment of 5G rather than opting for bands which are not.
In respect of the specific questions raised in the consultation paper, AsiaSat would like to offer its responses as follows:

Question 1: What are your views on the proposed allocation of the 26/28 GHz bands to mobile service and of the sub-band 24.25-24.45 GHz to fixed service on primary basis? What are your views on the protection of radio stations of co-primary users on a first-come-first-served basis?

AsiaSat notes with interest the proposal to widen the fixed service allocation to overlap with the entire proposed 26 GHz and 28 GHz frequency bands to accommodate fixed wireless applications. Such applications would seem to be different in nature from those of the mobile 5G services which, according to this document, the CA is seeking spectrum for.

When OFCA, in referring to ITU studies states that "*preliminary study results show that subject to certain deployment constraints, IMT services are compatible with existing services in the 26 GHz band*", it is worth noting that in respect of compatibility with satellite services, the ITU studies are limited to studies on the interference into receiving space stations due to aggregation of emissions from multiple 5G base stations. So far, no studies have been conducted in ITU on the impact of IMT on deployment of new FSS earth stations. Also, with the large number of stations foreseen, 5G base stations or user terminals transmitting directly into the main reflector of an FSS earth station and thus being reflected towards the satellite has not yet been studied (it may be worth noting that this could happen into any reflector antenna pointed towards the satellite, not only those transmitting in the overlapping frequency band, a minimum 5G base station downtilt might be required to reduce the probability of this happening).

It is also worth noting that those limited studies that are being conducted are not yet finished or agreed within ITU.

SHOULD the next ITU World Radiocommunication Conference in 2019, WRC-19, decide to identify the 26 GHz band, or portions of it, for IMT, it is highly likely that this will be with certain conditions to facilitate compatibility with other primary services, including FSS. What these conditions might be are not yet known. AsiaSat is of the view that any identification for 5G by OFCA in the 26 GHz band as a minimum would need to adhere to the limitations prescribed by WRC-19.

When the CA later in the same paragraph is taking this one step further and even conclude that "*the ITU study results confirm the feasibility of introducing mobile service on top of the existing services in the two frequency bands*", AsiaSat thinks this would have been a very nice conclusion since this would mean that there would be no need for any limitation on deployment of future transmitting FSS earth stations within Hong Kong due to 5G using the same band. However, we think this conclusion is not supported by any ITU studies.

In respect of the suggested implementation of the first-come-first-served principle, if it is not as simple as just "*introducing mobile service on top of the existing services in the two frequency bands*" and there could indeed be compatibility issues between 5G and other services, AsiaSat is of the view that due to the foreseen widespread deployment of 5G, this would lock satellite uplinks to only the current uplink locations and frequency bands and would prohibit any evolution of the FSS, e.g. in conjunction with the introduction of HTS satellites where there might be a need for customers to set up virtual networks using their own gateway stations at their own premises. The suggested first-come-first-served approach therefore would not be compatible with the need for continuation and development of FSS.

There are three bands of relevance in respect of satellite operation: 24.65-25.25 GHz, 27-27.5 GHz and 27.5-28.35 GHz.

The 28 GHz band is a part of the 27.5-31 GHz globally allocated FSS band. As mentioned, several satellites, including those of Hong Kong satellite operators, already use the 27.5-28.35 GHz band and major teleports in Hong Kong have, and have had for several years, operational, licensed antennas, transmitting in this band. In Europe, the European Communications Commission (ECC) has assigned the 28 GHz band for satellite uplinks and NOT 5G. Furthermore, it may be noted that due to the importance of the band for FSS worldwide, WRC-15 decided NOT to consider the 28 GHz band as a candidate band for IMT (5G) under WRC-19 Agenda Item 1.13. Quite on the contrary, WRC-15 created WRC-19 Agenda Item 1.5 to study use of Earth Stations In Motion (ESIMs) operating in the 27.5-29.5 GHz uplink band (and the 17.7-19.7 GHz downlink band) to further expand the FSS applications for this band. Consequently, there will be no global trend to identify the 28 GHz band for 5G.

To enable FSS to develop and evolve, e.g. to accommodate the new HTS satellites that are currently being developed, AsiaSat would advise strongly against deployment of 5G in the 28 GHz band. Any such deployment should only be on strict non-protected basis and appropriate limits should be applied to avoid interference to receiving space stations. Should 5G base stations encounter interference in the 28 GHz band, mechanisms should be in implemented to automatically switch to 24.25-24.65 GHz, 25.25-27 GHz or other bands where interference from FSS is not an issue.

For the 27-27.5 GHz band, this band is allocated to FSS in ITU-R Regions 2 and 3. Again, earth stations in Hong Kong are already in operation which are licensed also for this band. While this band is being considered for IMT (5G) by ITU, this band provides a most valuable opening for GSO gateways for HTS networks in this region. With the current large interest for NGSO networks with several networks already deployed or in the process of being deployed and noting that one single NGSO system could block access for all GSO networks in the "NGSO bands" (28.6-29.5 / 18.8-19.7 GHz), use of the 27-27.5 GHz could prove essential in enabling sufficient uplink bandwidth for GSO HTS networks, in particular for gateway links. For this reason, AsiaSat would advise against identifying this band for 5G. SHOULD the CA nevertheless consider this band for 5G, this would need to be in a manner that would not limit the ability to develop and deploy future transmitting gateway stations in the band, e.g. through 5G operating on a strictly non-protected basis, base stations which, if encountering interference, should switch to alternative frequencies where interference from FSS in not an issue (e.g. 24.25-24.65 GHz or 25.25-27 GHz). To provide the required protection of receiving space stations, 5G transmitters in the 27-27.5 GHz band also should adhere to ITU and other relevant standards and limits as may be established. To limit the interference area around transmitting earth stations, a reasonable minimum elevation angle, e.g. 20°, could be considered for earth stations in this band, reducing the emissions levels of earth stations towards the local horizon.

The 24.65-25.25 GHz band is foreseen used primarily for BSS feederlinks. For this reason, the expected use would be for a limited number of larger earth stations, e.g. > 3.5 m antennas located at the Hong Kong teleports or at the premises of the BSS and pay TV providers located in Hong Kong. While not totally rejecting the use of this band for 5G, AsiaSat is of the view that the ability to provide uplinks from the Hong Kong teleports needs to be safeguarded. Moreover, should there later be a need to establish transmitting earth stations at other locations, e.g. at the premises of broadcasters or pay-TV providers, there would be a need for a consultation process wherein which compatibility between 5G and the FSS uplink would be assessed and if necessary, adjustments of the frequencies of the affected 5G base stations would be considered. To facilitate co-existence and reduce the interference area around earth stations, minimum earth station antenna sizes, e.g. 3.5 m, and minimum earth station elevation angle, e.g. 20° could be considered. Also, like for 27-27.5 GHz, to offer protection of receiving space stations, 5G transmitters in this band would need to comply with ITU and other relevant standards and limits as these may be established.

Question 2: Do you have any views on adopting an administrative assignments approach for the release of spectrum in the 26/28 GHz bands?

AsiaSat does not have any particular views on the approach for making spectrum for 5G available. However, in any approach, the current use of 28 GHz and portions of 26 GHz and its further development by the FSS needs to be safeguarded. AsiaSat also notes that the CA states that they aim at making spectrum for 5G available from April 2019. In this conjunction, AsiaSat would like to point out that under WRC-19 Agenda Item 1.13, ITU will study international harmonization for exactly 5G offering very wide bandwidths. WRC-19 will take place October/November 2019. The CA may be in a better position to decide the appropriate frequency bands for use by 5G in Hong Kong once ITU has decided on what bands to internationally harmonize and on what conditions.

Question 3: Do you have any views on the proposed band plan with frequency slots of 100 MHz each?

AsiaSat does not have any particular views on the bandwidth to be used by 5G, but assumes that it might be beneficial to align this with international standards. After WRC-19 has decided on harmonized frequency bands for very wideband 5G and the industry subsequently have developed standards, the CA might be in a better position to determine the appropriate channel bandwidth.

In consideration of channels and use of channels by various 5G operators, due consideration would need to be given to use of those channels which are not overlapping with satellite frequency bands and those that overlap.

Question 4: Do you have any views on the proposal of assigning (a) 3 300 MHz to 3 700 MHz of spectrum in the 26/28 GHz bands for the provision of large scale public 5G services and (b) the remaining 400 MHz to 800 MHz of spectrum in the two frequency bands to other entities for the provision of 5G services in specified locations on a shared basis?

AsiaSat notes that while the 28 GHz band would seem unsuitable for 5G deployment due to the limitations that it could impose on the development and deployment of FSS, there is 2 650 MHz of spectrum in the 26 GHz band (24.25-24.65 GHz and 25.25-27 GHz) which could be suitable for large scale public 5G services without raising any issues in respect of FSS. This is more than half of the bandwidth considered in this consultation.

Moreover, there is 600 MHz of bandwidth (24.65-25.25 GHz) where 5G could be introduced on certain conditions (see the discussion under Question 1). This band could be considered to meet the requirements described under (b).

With this, a total of 3 250 MHz of the 4 100 MHz bandwidth, about 80% of the band considered in this consultation, would be made available to 5G.

Question 5: Do you have any views on the proposed caps of (a) 800 MHz of spectrum in the 26/28 GHz bands for spectrum designated for the provision of large scale public 5E services; and (b) 400 MHz of the Shared Spectrum designated for the provision of specified location services?

AsiaSat has no view on a possible cap on the spectrum assigned to each assignee, but emphasizes that in selection of frequency bands for different types of assignees, these should be selected from the bands identified in the response to Question 4.

Question 6: What are your views on the proposed method of assigning spectrum in the 26/28 GHz band to qualified applicants for the provision of large scale public 5G services?

Question 7: Do you have any preference on the assignment of spectrum in either the 26 GHz or 28 GHz band?

As explained in the response to Question 4, frequencies for large scale public 5G services should be selected within the 24.25-24.65 GHz or 25.25-27 GHz bands.

Provided that the frequencies are selected from within these bands, AsiaSat has no particular view on how capacity within these bands is distributed between assignees.

Question 8: What are your views on the proposed assignment method for the Shared Spectrum?

AsiaSat understands that when the CA in this consultation is referring to “shared spectrum”, this is referring to several 5G operators sharing the spectrum, not 5G sharing the band with other services. Nevertheless, should the band 24.65-25.25 GHz band, or portions of it, as suggested in the response to Question 4 be considered for such 5G use, sharing with BSS feederlinks is necessary. Due to the foreseen limited geographical 5G deployment to certain locations and also noting that the BSS feederlink earth stations will be limited to the major teleports and the premises of some broadcasters and pay TV providers, with the appropriate measures as discussed in the response to Question 1, AsiaSat believes that co-existence between such 5G deployment and BSS feederlinks may be feasible in many cases.

Question 9: What are your views on the network and service rollout obligations proposed to be imposed on the use of spectrum assigned for the provision so large scale public 5G services?

As long as the 5G deployment is within the frequency bands and following the principles as laid out in the responses to Questions 1 and 4, AsiaSat does not have any particular view on the timeline of the rollout.

Question 10: What are your views on the proposed performance bond for guaranteeing compliance with the proposed network and service rollout obligations for using spectrum assigned for the provision of large scale public 5G services?

AsiaSat is of the view that the performance bond should be such that only serious operators are assigned frequencies for 5G. In addition to meeting the milestones of the rollout plan, there should also be requirements for the assignees meeting other requirements, e.g. technical requirements to ensure compatibility with other services, for the bond to be released.

In respect of "shared spectrum" assignees, AsiaSat is of the view that there should be some incentive also for these to meet technical requirements to ensure compatibility with other services.

Question 11: Do you have any views on the proposal for SUF as set out in paragraphs 45 to 50 above?

AsiaSat is of the view that if SUF is to applied to a frequency band, it should be applied to all users of the band and according to their specific characteristics and spectrum usage in a fair and reasonable manner.

As explained in the responses to Questions 1 and 4, AsiaSat recommends that for large scale public 5G services, frequencies are selected that do not overlap with FSS. Following this advice, SUF in respect of FSS would be an issue only in respect of the bands for "shared spectrum" 5G. AsiaSat assumes that due to the geographically localized nature of the "shared spectrum" 5G, this will also be reflected in any SUF imposed on other users of the band such as FSS.

Satellites can exhibit a very high degree of spectrum re-use. Even with a minimum elevation angle of 20°, about 120° of the geostationary arc is visible in Hong Kong. Assuming that frequencies can be re-used every 2-3°, this means a 40-60 times frequency re-use in Hong Kong just be geostationary satellites. In addition, non-geostationary satellites can re-use the frequencies simultaneously even further through a large number of satellites by use of geometries that avoid that of geostationary networks and each other. In addition to this, all frequencies in all satellites can be re-used twice at the same location by use of two orthogonal polarizations. In assessing the spectrum occupancy, this unique ability of FSS of extensive frequency re-use needs to be taken into account in determining the SUF per individual FSS licensee.

When the CA in footnote 13 as an example claims that using spectrum for satellite uplinks would deny the use of the same spectrum for the fixed service (FS), AsiaSat would like to point out that

this is not an accurate statement. FSS and FS has for decades shared the same spectrum successfully from locations geographically closely separately. This is possible due to the highly directive antennas used by FSS earth stations. Noting that for the case of the 26 GHz and 28 GHz bands, these are satellite uplink bands, in respect of transmitting FS stations, no separation at all would be required.

Also in respect of the mobile service (MS), it is not accurate to say that use by spectrum for satellite uplinks would deny the use of the spectrum for MS. Such an assumption also would seem to be in contradiction to the CA' conclusion that "*the ITU study results confirm the feasibility of introducing mobile service **on top** of the existing services in the two frequency bands*" (the claim that there are actual ITU studies that draws this conclusion is questioned by AsiaSat). It is correct that exactly at the location of the earth station, there probably would be interference into MS receivers. However, by help of the highly directive antennas of FSS earth stations directing the power towards the satellite and very little towards the ground (typically, the signal towards the ground will be more than 60 dB attenuated, i.e. less than one millionth of the signal strength transmitted towards the satellite, due to attenuation offered by local factors such as terrain, buildings etc. at these high frequencies and by use of appropriate 5G deployment, e.g. use of MIMO, sector disabling, indoor deployment or selective base station locations and cell shape/size, spectrum used by FSS can be re-used by 5G throughout Hong Kong, even within relative close vicinity of FSS transmitting earth stations.

It can thus be seen that FSS transmitting earth stations would NOT deny the use of the same spectrum in Hong Kong by other services like FS or MS.

In respect of spectrum for large scale public 5G services, AsiaSat understands that 5G assignees will be allocated non-overlapping spectrum to be used pan-Hong Kong to develop their services and re-use these frequencies as they see fit. With the outlined SUF scheme for 5G, it would seem that a total SUF of $21,600 would be charged for the entire 5G usage within Hong Kong per MHz. AsiaSat assumes that should the CA follow the advice of AsiaSat and allocate spectrum for large scale public 5G in frequency bands not overlapping with FSS, incompatibility with FSS would not be an issue. In this case, there would be no requirement to charge a SUF to the FSS. However, should the CA decide to not follow the advice of AsiaSat, AsiaSat assumes that the same logic would be applied in respect of the satellite industry as in respect of the 5G industry, i.e. a total SUF of $21,600 would be charged for the entire satellite usage within Hong Kong per MHz. Since the FSS spectrum as explained above, can and will be re-used by a large number of users from various locations within Hong Kong, AsiaSat expects that this will be used to break down the $21,600 for the entire FSS industry to individual assignees and individual locations.

In respect of the "shared spectrum" 5G, AsiaSat assumes that like for 5G a SUF of $ 1,080 per MHz would be applied to the satellite industry per 50 square kilometres. Again, the satellite industry can and will re-use the frequencies, but since the re-use now is from within an area smaller than the

entire Hong Kong, AsiaSat understands that this will need to be factored in in breaking down the $ 1,080 per MHz to individual assignees and individual locations.

AsiaSat supports CA's proposal in paragraph 49 to apply the SUF charging scheme gradually as outlined in paragraph 43 also to new entrants. In respect of determining the level of congestion for when to apply the SUF, AsiaSat observes that it is the assignment of spectrum to one assignee which provides the denial of other users, not what might be the instantaneous occupancy. Determination of when to apply the SUF therefore should be based upon assignment of spectrum, not occupancy.