Hong Kong
5 April 2021

Department of Information and Communications Technology
Republic of the Philippines
Manila
By Email: internet.satellite@dict.gov.ph

Comment in re: DICT Rulemaking for Inclusive Access to Satellite Services by the Asia Video Industry Association (AVIA)

1. Introduction

AVIA is grateful for the opportunity to offer our comments in relation to DICT's consultation and request for submissions on policies relevant to expanding the provision of internet services through inclusive access to satellite services. AVIA is the non-profit trade association for the video industry and ecosystem in Asia Pacific. Member organizations include some 80 Asia-focused companies building, operating, and providing content for TV consumers, and include operators of cable, satellite, mobile, IPTV and OTT services, as well as content providers to the Asian region and the world. Members are active in 17 jurisdictions in the Asia-Pacific region, and have broad experience in building a dynamic industry to meet the rapidly-growing demands of the region's over 700 million households consuming paid video programming. Because satellite transmission is the foundation of international video connectivity, many of our member companies are actively interested in the satellite-related issues raised in the DICT's paper.

Information and Communication Technologies (ICT) play an increasingly important part in the everyday lives of people throughout Asia, and Internet provides an ever more significant part of this. The COVID-19 outbreak has even more demonstrated this importance through the increased need for communicating important messages to the population, and to support home schooling, home working arrangements, virtual meetings and network based commerce. The COVID-19 pandemic has also seen several new entrepreneurial businesses starting up, and working through ICT and the internet. These are trends that are expected to persist also after the pandemic and are also factors that help to offer equal opportunities to the population throughout the entire country. Ensuring good access to ICT nationwide thus is essential for the socio-economic development a country and avoiding a divide between those that have access to ICT and internet and those who don't.

With wide coverage, independence from terrestrial infrastructure and ability to provide instantaneous, high reliability connections, satellites are playing an important part in the emerging ICT society. Due to their nature, satellites normally are international in nature with each satellite serving multiple countries. This is also one of the inherent qualities of satellites -- the ability to directly interconnect widely separated locations. Similarly, satellites offer an efficient way to reach a large number of receivers, e.g. for broadcasting purposes, mobile users, including maritime and aeronautical users, serving sparsely populated or remote areas and providing temporary connections for disaster relief, satellite news gathering (SNG), program transfer between TV studios etc. With the gradual rollout of 5G networks, satellite systems are playing an important role to interconnect cells of mobile networks and are also becoming an integral part of 5G/IMT, to permit efficiently meeting requirements for applications such as area coverage, high reliability communications and massive machine type communications (see also AVIA report[1] and several articles by ESOA[2] and GSC[3] on this topic).

AVIA therefore is most supportive of the "open skies" policy as reflected in the amendments of Executive Order (EO) 467 since this will facilitate access to the best and most economic satellite resources for Philippine Value-Added service (VAS) providers, Service Providers (ISPs) and other ICT operators to develop and provide their services.

2. Ensuring reliable satellite connections

We note the DICT objectives to provide universal access with quality, affordable, reliable, and secure ICT infrastructure throughout the Philippines, using satellite links as an integral part of the ICT infrastructure. To achieve those objectives, it will be important to ensure proper protection for satellite links to ensure forward-looking development across the country. Currently, there are proposals in some countries to use for terrestrial applications some of the frequency bands that have been used by satellite services, such as the terrestrial 5G/IMT deployment in C-band and Ka-band. Without proper mitigation techniques in place to facilitate co-existence, these applications could severely disrupt satellite connectivity and therefore hinder DICT in meeting its national objectives.

Fortunately, the implementation of proper mitigation techniques could ensure the coexistence between 5G/IMT systems and satellite networks in the same bands or in the adjacent bands. It is highly desirable that the mitigation techniques mentioned below could be considered as licensing requirements prior to deployment of terrestrial 5G/IMT networks since modifying the characteristics of 5G/IMT networks after deployment would be technically difficult and expensive or even impossible.

In this connection, it is vital to bear in mind that satellite distribution of TV channels plays a crucial role in meeting the needs of millions of Filipinos for news, entertainment and sports, via cable TV. Prior to the pandemic, the respected audience research firm Kantar estimated that 2.7 million Filipino households were connected to cable TV systems. (We believe the number has risen as households have been locked down during the pandemic.) While the "last mile" of transmission of programming for these households is provided through wired cables, the programming reaches hundreds of widely dispersed cable head-ends in the Philippines via C-band satellite transmission, which provides highly reliable all-weather distribution of both international and Philippine domestic TV channels. Without the vital satellite links, these households, throughout the country, would be deprived of their connections. Therefore, ensuring continuation of reliable C-band services to cable head-ends must be a priority goal.

2.1 Satellite uplinks

[1] https://avia.org/wp-content/uploads/2020/09/2185-ESOA-5G-Ecosystems-AVIA.pdf
[2] https://www.esoa.net/5g/
[3] https://gscoalition.org/

In satellite uplink bands, e.g. 5 925 – 6 725 MHz, 24.65-25.25 GHz, 27-27.5 GHz or 27.5-28.35 GHz, interference could happen from transmitting 5G/IMT stations into the receiving spacecraft receivers and from the transmitting satellite earth stations into 5G/IMT receivers.

2.1.1 Interference into receiving spacecraft

For interference into the receiving spacecraft, the interference would be an aggregate of interference from all 5G/IMT transmitters within the footprint of the satellite. This would likely include interference originating from 5G/IMT transmitters in several countries. Therefore, compliance with the ITU-R Radio Regulations would be required (such as Sections I and II of Article 21 of the Radio Regulations and ITU-R Report S.2367[4].)

2.1.2 Interference into receiving 5G/IMT stations

With respect to the interference into receiving 5G/IMT stations, transmitting satellite earth stations in the vicinity can cause interference. Section III of Article 21 of the Radio Regulations contains limits for transmitting earth stations to protect terrestrial receivers. However, there are several additional mitigation measures that can be implemented on the 5G/IMT side to facilitate co-existence and reduce the required separation between transmitting earth stations and receiving 5G/IMT base stations such as:

1) requirements for down-tilt of the antenna of 5G/IMT base stations;
2) use of (massive) MIMO (Multiple Input Multiple Output) technology to null the radiation pattern in the direction of earth stations;
3) maximum 5G/IMT antenna height and location requirements (e.g. indoor deployment, deployment at street-level).

Another mitigation technique which is of particular interest to explore would be applying cognitive radio techniques in the 5G/IMT networks. Interference into a 5G/IMT station would be from only a very limited number of transmitting earth stations, most likely just one. Each earth station will only transmit in a small portion of the satellite uplink band and if the 5G/IMT station avoid using that particular portion of the band in that particular location, interference would be avoided. If the 5G/IMT network applies cognitive radio techniques, the 5G/IMT base station would monitor its instantaneous interference scenario and the network could dynamically adapt to select frequencies without interference for each base station. In the licensing conditions, this could be achieved by either specifically requiring 5G/IMT to implement cognitive radio techniques or by requiring 5G/IMT to mitigate interference received from current and future transmitting earth stations. (Note that in some cases, the satellite uplink bands are only a portion of the 5G/IMT band, e.g. the IMT band 24.25-27.5 GHz with only 24.65-25.25/27-27.5 GHz being satellite bands, and so additional flexibility for applying cognitive radio techniques would be achieved if the administration in awarding 5G/IMT bands for the various operators would include a portion of non-satellite band for each of the operators.)

In identifying, amongst others, the 24.25-27.5 GHz band for IMT, WRC-19 recognized the need to mitigate interference from transmitting earth stations into receiving IMT stations and consequently

[4] https://www.itu.int/pub/R-REP-S.2367

invited ITU-R to develop ITU-R Recommendation(s) to assist administrations in this regard. This work is currently being undertaken by ITU-R Working Party 5D. The latest version of this work can be found in document 5D/TEMP 285[5].

2.2 Satellite downlinks

For satellite downlink bands, e.g. 3 400 – 3 600 MHz, interference could be from the transmitting spacecraft into the 5G/IMT receivers or from 5G/IMT transmitters into the receiving earth stations.

2.2.1 Interference into 5G/IMT receivers

With regard to interference from satellites to IMT systems, RR No. 5.432A and RR No. 5.433A applies, and stations of the mobile service in the frequency band 3400 – 3500 MHz and in the frequency band 3500 – 3600 MHz respectively shall not claim more protection from space stations than that provided in Table 21-4 of the Radio Regulations.

Section III of Article 21 of the Radio Regulations provides limits for transmitting spacecraft to protect terrestrial services, including 5G/IMT. These limits of the Radio Regulations are hard limits that can only be exceeded over the territory of an administration which has given its prior agreement. As a consequence, all satellite networks submitted to ITU by all administrations need to comply with these limits over the Philippines (unless explicit agreement to exceed the limits have been given by the Philippines) and thus, 5G/IMT is protected against interference from the transmitting spacecraft.

2.2.2 Interference into receiving satellite earth stations

Interference from transmitting 5G/IMT stations into receiving earth stations could occur both in-band and in the adjacent bands. Since geostationary satellites are some 36-40 000 km away from the receiving earth stations, the path loss leads to very low incoming signals. 5G/IMT transmitters will on the other hand be located much closer and with a much lower path loss. This can lead to 5G/IMT signals with much higher levels than the incoming satellite signal (e.g. a 5G/IMT transmitter at a distance of 500 m will have a path loss about 100 dB less than that of the satellite signal).

Three interference mechanisms from 5G/IMT transmitters will affect receiving satellite earth stations:

- Co-frequency interference;
- Adjacent band interference in two forms:
  Interference from 5G/IMT in one band will interfere with satellite reception in adjacent bands through;
  - Out-of-band and Spurious emissions of 5G/IMT transmitters falling in the satellite receive band

[5] https://www.itu.int/md/R19-WP5D-210301-TD-0285/en

- The powers of the incoming 5G/IMT signal affecting the operating point of the satellite receiver front-end LNA/LNB, driving this into non-linear operation and gain suppression (i.e. LNA/LNB overdrive).

The impact of broadband wireless access or 5G/IMT on satellite receiving earth stations in the 3 400 – 4 200 MHz band, including all three above-mentioned interference mechanisms, has been studied on several occasions and is well documented in several reports such as in ITU-R Reports M.2109[6], S.2199[7] and S.2368[8] and APT Report APT/AWG/REP-05[9].

2.2.2.1 Co-frequency interference

It is widely recognized that satellite receiving earth stations and 5G/IMT transmitters cannot co-exist in the same frequency band within the same geographic area. Studies related to co-frequency sharing between FSS earth stations and IMT systems have been carried out in the ITU-R prior to WRC-15. The study results are contained in ITU-R Report S.2368; "Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15". This Report gives examples of the separation distances required between IMT base stations and FSS earth stations. Separation distances are at least 10s of km and typically exceed 100km. The Report concludes that the sharing between IMT-Advanced and FSS is feasible only when there are a limited number of FSS earth stations at known, specific locations, and deployment of IMT-Advanced is limited to the areas outside of the minimum required separation distances for each azimuth to protect these specific FSS earth stations.m

All of the above studies conclude that significant separation distances are required for co-frequency co-existence, ranging from several hundred kms for suburban macro-cell 5G/IMT base station deployment to some few kilometers or less than one km for small-cell indoor deployment. By requiring use of mitigation techniques such as downtilt or maximum antenna height of 5G/IMT base station antennas or by limiting types of deployment, it is possible to reduce the required separation distances, but it is clear that in particular for outdoor 5G/IMT deployment, the distances will remain significant.

2.2.2.2 Out-of-band emissions of 5G/IMT

FSS and IMT systems co-frequency sharing in the same geographical area is neither feasible nor practical. Numerous studies have shown this fact, and both satellite and terrestrial mobile stakeholders agree that this is true. Even when 5G/IMT and FSS operate in adjacent bands, interference to FSS receivers will occur unless adjacent band interference issues carefully managed by implementing mitigation techniques as shown in Figure 1 below.

---

[6] https://www.itu.int/pub/R-REP-M.2109
[7] https://www.itu.int/pub/R-REP-S.2199
[8] https://www.itu.int/pub/R-REP-S.2368
[9] https://www.apt.int/AWG-REPTS

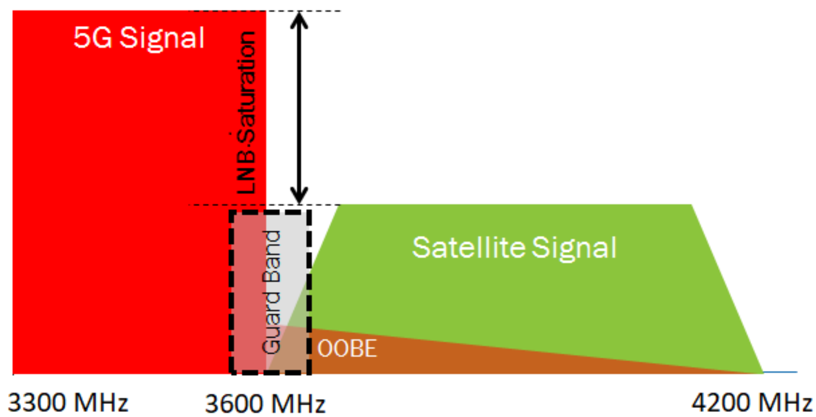

Figure 1: Adjacent Band Interference from IMT to FSS

FSS earth stations are very sensitive to interference from IMT advance systems. While the separation distances related to adjacent band compatibility issues are significantly smaller than those for co-frequency operations, it may not be feasible to ensure separation, in particular if FSS earth stations are deployed in large numbers or without the knowledge of their locations. Hence, careful consideration should be given to adjacent band compatibility issues which are out of band emissions and LNA/LNB overdrive.

Out-of-band emissions of 5G/IMT transmitters will be received as in-band by satellite receiving earth stations operating in adjacent frequency bands. The above studies have shown that for immediate adjacent frequency bands, separation distances would be required ranging from in the order of some tens of kilometers for suburban macro-cell 5G/IMT base station deployment to less than one kilometer for small-cell indoor deployment. By introducing a guardband between the 5G/IMT band and the satellite band, the separation distance can be reduced.

To mitigate out-of-band emissions interference, measures such as 5G/IMT base station antenna downtilt, maximum antenna height, and types of deployment would be required. (Considerable attention has been given to waveguide filters installed at the satellite receiver front-end. It is important to note that such a filter <u>will have no effect</u> in mitigating interference due to out-of-band emissions of 5G/IMT transmitters since this interference will be received in-band. Such filters will only have an effect in respect of LNA/LNB overdrive as discussed below.) The other mitigation measure <u>that could</u> mitigate out of band emissions interference is to specify the out of band emission levels in the 5G/IMT licensing process so that the desired guardband/separation distance is obtained.

2.2.2.3 LNA/LNB overdrive

Satellite front-end receivers, Low-Noise Amplifiers (LNA) or Low-Noise Block downconverters (LNB), are designed to receive the very low incoming satellite signals, and their dynamic range is adjusted accordingly. FSS earth stations operate with a frequency response in the 3400-4200 MHz band which mean that most LNAs and LNBs are designed to receive the entire satellite band, e.g. 3 400 - 4 200 MHz.

The 5G/IMT signal at the input of the front-end receiver can easily be many tens of dBs higher than the incoming satellite signal. Such a high signal could drive the LNA/LNB out of its intended operating point causing non-linear operation, creating intermodulation and gain suppression, wiping out the satellite signal.

The best solution to mitigate LNA/LNB overdrive is to install a RF waveguide filter between the output of the antenna and the input of the LNA/LNB. Important to note is that for installation of such filters to have an effect to mitigate the LNA/LNB overdrive problem, a guardband would be required between the 5G/IMT band and the satellite band. Depending on the filter characteristics being used and the separation distance deemed acceptable, the guardband requirement will vary. Typically somewhere in the range of 50 - 100 MHz has been adopted or considered for the deployment of terrestrial 5G/IMT in several countries while protecting the FSS operations. As shown in Figure 2 below, the filter could be operated properly if there is frequency separation (i.e guardband) between the edge of the IMT/5G transmission and the FSS transmission to provide the waveguide filter the necessary bandwidth to reject the 5G interference at the FSS earth station.

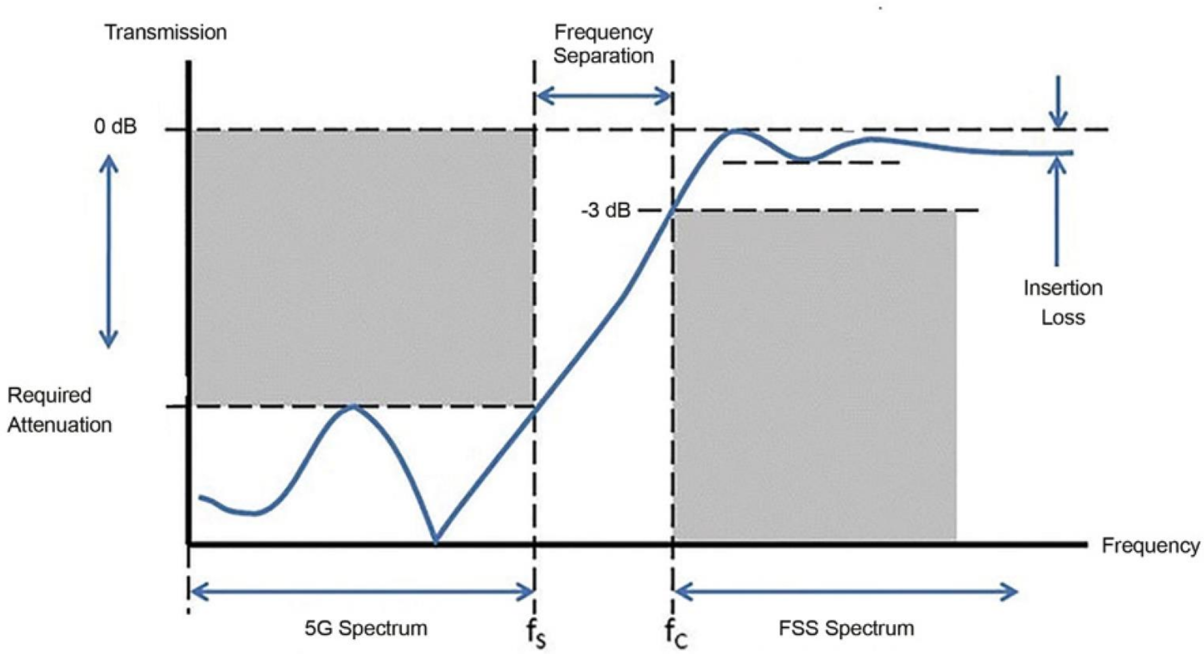

Figure 2. Filter and Guard Band

While such waveguide filters could mitigate the LNA/LNB overdrive problem, it is important to note that they will not totally eliminate the 5G/IMT incoming power and therefore, separation distance is still required. Moreover, as mentioned, such filters will have no effect to mitigate any out-of-band emissions interference from 5G/IMT transmitters.

Furthermore, there is a cost associated with introducing such filters. As of today, depending on the performance requirement, filters typically cost between USD 200 and 600, with some reportedly as cheap as USD 70, but then with unknown performance. A typical provincial cable company in the Philippines operates 5-6 satellite dishes to receive programming, and will require high-performing filters to ensure operational continuity. If we take US$300 as a likely cost for a single filter, this means expenditure of at least US$ $1,500-1,800 for each cable operator – the vast majority of which are small businesses operating on very limited margins.

At the same time, for consumer-grade satellite or very small aperture terminal (VSAT) installations, such a cost can become a large portion of the entire antenna installation. In the case of satellite antennas that are already deployed, there is also the cost of having personnel travel to antenna sites to retrofit the antennas with waveguide filters. It is also worth noting that many current consumer grade or VSAT antennas have the antenna feedhorn and the LNA/LNB molded together in one unit and it is not technically possible to separate the two in order to insert a filter in between.

Over the last few years, a significant amount of work has been undertaken to study and develop filters for such use and many articles have been published on this topic (see e.g. articles by AsiaSat[10], and AsiaSat[11] on this topic).

3. Summary

Prior to allowing terrestrial 5G/IMT systems in certain bands, it is necessary that technical rules are adopted to ensure FSS operations are protected. The specific mitigation techniques required will be based on various factors. Therefore, it is incumbent upon each regulator to carefully analyze the use of frequency bands in their own country and establish and implement mitigation techniques to ensure current and future satellite services can operate and thrive. It is equally important to involve stakeholders, users and incumbents in such an assessment to ensure all relevant inputs are taken into consideration.

In summary, AVIA strongly supports the DICT initiative to further enhance the "open skies" policy in the Philippines with the objectives to develop the ICT infrastructure and internet provision through use of satellite links in an economic and efficient manner. AVIA would like to emphasize the need to provide adequate protection of satellite links so that satellite services can play their full role in bringing advanced communications throughout the country.

AVIA would also be pleased to share further information with DICT with regard to ensuring economic, efficient, and reliable all-weather satellite connections and we would welcome any further questions or queries that DICT might have in this regard.

[10] https://www.asiasat.com/innovations/5g-initiatives
[11] https://www.asiasat.com/news/whitepaper

About the Asia Video Industry Association (AVIA)

AVIA is the non-profit trade association for the video industry and ecosystem in Asia-Pacific. It serves to make the video industry stronger and healthier through promoting the common interests of its members. AVIA is the interlocutor for the industry with governments across the region, leads the fight against video piracy and provides insight into the video industry to support a vibrant industry ecosystem. AVIA evolved from CASBAA in 2018.

AVIA's leading members include: AsiaSat, Astro, BBC Studios, Discovery Networks, The Walt Disney Company, WarnerMedia/HBO Asia, NBCUniversal, Netflix, now TV, SES, Star India, TrueVisions, Turner International,TV5MONDE, ViacomCBS Networks International, A&E Networks, Baker McKenzie, BARC, beIN Asia Pacific, Bloomberg Television, Blue Ant Media, Brightcove, Canal +, Cignal, CMS, Dolby, Eutelsat, France 24, Globecast, Globe Telecom, Irdeto, Intelsat, La Liga, Kantar Media, Mayer Brown, Measat, Media Kind, Media Partners Asia, Motion Picture Association, NAGRA, NBA, NHK World, Neilsen, Premier League, Singtel, Skyperfect JSAT, Sony Pictures Television, Starhub, Synamedia, Telstra Global, TMNet, TV18, TVBI, Verisite, Viaccess, Viacom18, and Zee TV