Hong Kong
16 April 2021

Shri Amit Khare
Secretary
Ministry of Information and Broadcasting
Republic of India
New Delhi
By Email: secy.inb@nic.in

Comment on use of Satellite Transmission for Broadcast/Video Services in India

1. Introduction

The Government of India is now considering requests by terrestrial mobile networks for allocation of C-band frequencies currently used by the satellite and broadcasting industries. AVIA, which is the non-profit trade association for the video industry in the Asia Pacific region, and whose members supply video content to roughly 170 million Indian households, would like to contribute our comments in relation to these requests.

AVIA's 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 these satellite-related issues.

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. Satellites offer the ability to directly and instantaneously interconnect widely separated locations. Similarly, satellites offer an efficient way to reach a large number of receivers, e.g. for broadcasting purposes, and serving sparsely populated or remote areas and providing temporary connections for disaster relief, satellite news gathering (SNG) be it news gathering or large scale "live" sporting or entertainment events, program transfer between TV studios etc. With the gradual rollout of 5G networks, satellite systems are also 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).

---

[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/

2. Use of Satellite C-band by the Indian Broadcasting and Media Industry

The "C-band" (3.4-4.2GHz) is one of a limited number of frequency bands used by satellite operators to provide critical communications services around the world. At present, more than 180 telecommunications geostationary satellites provide services with a total of more than 2000 transponders using the C-band frequencies. The C-band is particularly important because of its wide coverage, and because the laws of physics make it uniquely robust for providing services in sub-equatorial regions, including much of India, which often suffer from very heavy rainfall. For these reasons of physics, C-band is irreplaceable and not substitutable.

Since its foundation, the Indian broadcasting industry has depended on C-band satellite connections to reach Indian homes receiving cable TV or satellite DTH services. At present, roughly 100 million Indian households receive their news and entertainment via cable TV services, and another 70 million via direct-to-home satellite. (Although the direct consumer link for DTH services is provided in different frequency bands, the programming reaches the DTH operator's headend via C-band distribution.) In the cable industry, 1724 registered MSOs and approximately 30,000 last-mile cable operators depend on C-band transmission to receive the TV signals that they retransmit to consumers.

In addition an unknown number of individual households have installed C-band satellite dishes for their household viewing. (One study a few years ago estimated the number of such households at about 450,000 . See Attachment 3, "C-Band Usage in India.")

Thus, the stakes for Indian society and the Indian economy in the smooth operation of C-band satellite distribution of broadcast signals are enormous.

Other users of C-band satellite networks include maritime services in India's waters, aeronautical services in Indian airspace, education services in India's schools, oil and gas production and emergency/disaster relief services. All of these rely on C-band's nationwide distribution and tropical weather resilience to ensure the functioning of Indian society.

3. Erosion of C-band Availability

Recognizing the essential nature of C-band services in tropical Asia, successive ITU World Radiocommunications Conferences have declined to identify the C-band in Asia for mobile "harmonization." In this respect, Asia's unique geography and climate have been recognized. However, national governments were authorized to identify frequencies in the 3.4-3.6 GHz band, as long as they took steps along their borders so as not to interfere with satellite services in neighboring countries.

Thus, prior to 2008, the entire band of 3.4-4.2 GHz was available for distribution of TV channels over India (and the other services mentioned above). It was actively used by India's national satellite operator as well as foreign-based operators of satellite networks to provide these services. But after 2008, the band in India was gradually reduced to 3.6-4.2 GHz, with the 3.4-3.6 GHz spectrum opened for use by the terrestrial mobile industry.

Unfortunately, mobile terrestrial services and satellite services cannot co-exist in the same geographical area. This fact has been confirmed by numerous ITU and IEEE studies and field trials. Satellite signals – coming from a small transmitter located 36,000 km away in geostationary orbit – are inevitably drowned out by the much more powerful and much closer terrestrial transmitters. When co-frequency use has been attempted, satellite signals are wiped out. This even applies when the satellite and terrestrial transmitters are operating not in overlapping, but in adjacent frequency bands. Thus, even the use of adjacent bands by terrestrial mobile services on the one hand and satellite services on the other must be carefully managed to ensure that hundreds of millions of Indians do not lose their broadcast TV service.

4. Interference Issues

There are three different interference mechanisms which will impact reception of satellite signals TV distribution companies, and their ability to retransmit these signals to consumers:

a. Co-frequency interference

Due to the long distance to the satellite and the power limitations of the satellite, the incoming satellite signal's power flux density at the earth station location is very low. Terrestrial mobile equipment which is much closer to the earth station can produce significantly higher power levels at the input to the satellite receiver than the desired satellite signal.

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 satellite 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". The Report concludes that the sharing between IMT-Advanced and satellite services is feasible only when there are a limited number of satellite earth stations at known, specific locations, (which is not the case in India, where satellite earth stations are operated by thousands of cable operators as well as several hundred thousand individual households) and deployment of IMT-Advanced is limited to the areas outside of the minimum required separation distances for each azimuth to protect these specific satellite earth stations.

The above study, in line with all other studies on this topic, 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.

b. Adjacent band interference

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

- *Unwanted out-of-band emissions of IMT transmitters*

Due to the very low power level of the incoming FSS signals, unwanted emissions generated by IMT base stations or user terminals operating in adjacent frequency bands can create interference to satellite receivers. When 5G/IMT and satellite networks operate in adjacent bands, interference to satellite receivers will occur unless adjacent band interference issues carefully managed by implementing appropriate mitigation techniques.

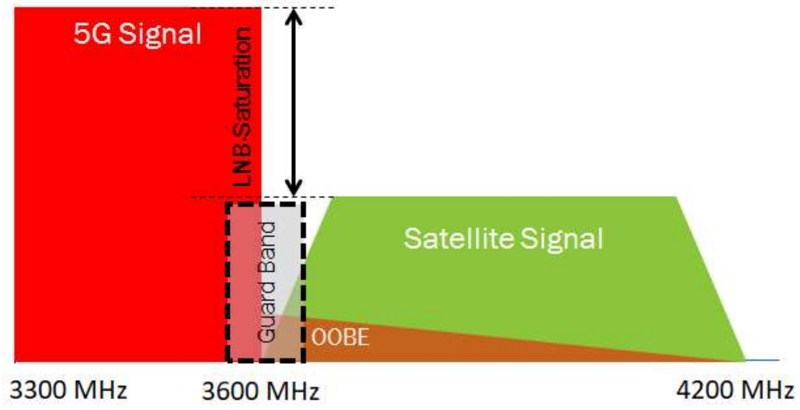

Figure 1: Adjacent Band Interference from IMT to Satellite Receivers
(note: OOBE = Out of Band Emissions)

Out-of-band emissions (OOBE) of 5G/IMT transmitters will be received as in-band by satellite receiving earth stations operating in adjacent frequency bands. Studies, including those in the above ITU-R Re[ort S. 2368, 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. If there is no guard band, or if the guard band is too small, there will be major interference into satellite reception or the separation distance must be large. To mitigate OOBE, other measures such as requirements on 5G/IMT base station antenna downtilt, maximum antenna height (e.g. no antennas on his rise rooftops or hills) and types of deployment (e.g. only indoor deployment), would help to reduce the required separation distance.

Another mitigation technique to reduce the required separation distances would be to impose tighter limits on IMT out of band emissions, i.e. additional filtering on the IMT installations, as a part of the licensing requirements for IMT.

- *FSS receiver 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. Satellite 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, distorting and wiping out the satellite signal. Studies, amongst others in the above mentioned ITU-R Report S.2368, have shown required separation distances ranging from in the order of around 10 km for suburban macro-cell 5G/IMT base station deployment to around one kilometer for small-cell indoor deployment.

As for OOBE, to mitigate LNA/LNB overdrive, measures such as requirements on 5G/IMT base station antenna downtilt, maximum antenna height (e.g. no antennas on high rise rooftops or hills) and types of deployment (e.g. only indoor deployment), would help to reduce the required separation distance.

Another 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 to allow the filter to provide the required discrimination. 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.

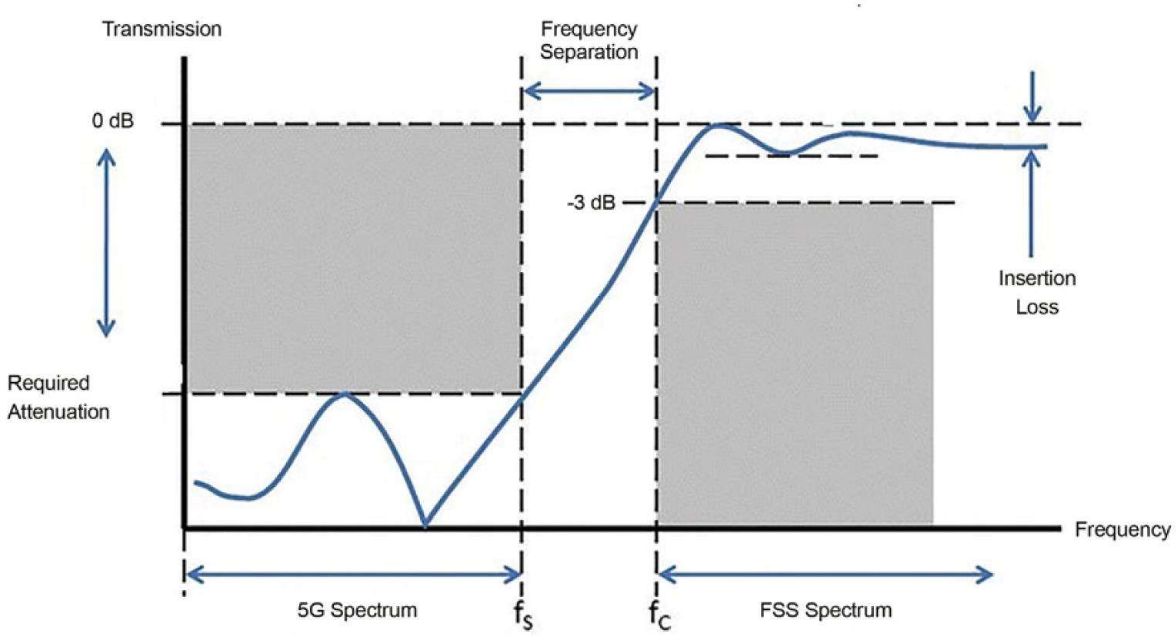

Figure 2. Filter and Guard Band

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, it is important to note that 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.

For consumer-grade satellite receive terminals, 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.

5. Summary

The C-band frequencies remain vital to Indian broadcasting. If mobile industry requests for bands up to 3.8 GHz are granted, the result will be chaos in the broadcasting industry.

- Over 20 Indian and foreign satellites over India would lose more than 50% of their available capacity, by comparison to the entire 3.4 - 4.2 GHz band. (These include GSAT satellites recently launched such as GSAT-30 and GSAT-10.) A mad scramble for remaining frequencies would ensue among TV channel operators, prices would likely rise and the economic damage to the industry would be huge.

- On the ground, tens of thousands of cable and DTH operators would be deeply affected. In order to ensure operability of the remaining frequencies they would have to deploy filters at considerable cost to them. Despite the new filters, interference would be likely. There would be mass confusion, and cable operator agitations could ensue.

It is worth noting that in making such a move, India would be sacrificing the very real, current-day interests of tens of thousands of cable operators and hundreds of millions of consumers, in favor of theoretical benefits for IoT machines.

We urge the Ministry of Information and Broadcasting to intervene with the spectrum regulators to avoid these outcomes. Alternative frequencies are available for terrestrial mobile operations and they should be utilized.

If desired, AVIA would also be pleased to share further information with MIB with regard to these issues. We would be pleased to organize a dialogue between the Government and our members, if that would be useful. For any further information, please feel free to contact AVIA's representative in New Delhi, Mr. Anjan Mitra, (anjan@avia.org) .

Sincerely yours,

John Medeiros
Chief Policy Officer

Attachments:
1) "The Importance of Retaining C-band for Satellite Service in the Asia Pacific, study by AsiaSat, June 2018
2) "Choosing the Right Spectrum for 5G", study by AsiaSat, May 2020
3) "C-band Usage in India," Euroconsult, 2014

CC: TRAI
Department of Telecommunications

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