Indian Broadcasting & Digital Foundation

<u>Indian Broadcasting & Digital Foundation's ("IBDF") response to Telecom Regulatory Authority of India's ("TRAI") consultation paper on Assignment of Spectrum for Space-based Communication Services.</u>

1. We would like to thank TRAI for giving stakeholders the opportunity to provide inputs and comment on its "***Consultation Paper on*** **Assignment of Spectrum for Space-based Communication Services**"**,** as released on 06.04.2023. **("CP")**, against the background of the Department of Telecommunications' ("**DoT**") letter dated 16.12.2022 requesting TRAI to provide recommendations for granting spectrum to space-based communication services through auction.

2. The IBDF was established in 1999 under the name Indian Broadcasting Foundation and comprises of broadcasters of both news and non-news channels (such as General Entertainment, Sports, Music, Movies, Infotainment, etc.). Over the past twenty years, IBDF has worked arduously and is considered the apex organization representing television broadcasters. IBDF members manage 400+ channels and about 91% of television viewership across country. IBDF member channels' strength has grown over the years and represents around 95% of the industry revenues generating employment for millions of Indians. In 2021, IBDF expanded its purview to cover digital platforms, to bring all digital curated content providers under one roof, and was renamed as Indian Broadcasting and Digital Foundation, 'IBDF' as is known today.

3. We thank the TRAI for enabling a transparent consultation process and providing an opportunity to provide our responses to this CP, which contains multiple contentious issues that have been raised. On a perusal of the CP, it appears that it also involves assumptions/conclusions which go far beyond the questions in respect of selection of bands for auction and auction modalities for communication services, formulated for consultation. In view of the above, before providing responses to a few relevant questions as they relate to our members' interests as legacy users of satellite services, we would like to offer our preliminary observations and issues with some paragraphs and inferences in the CP, with a broad set of principle-based recommendations to contextualise our responses to the issues highlighted, and some of the queries posed, in the CP.

4. **PRELIMINARY OBSERVATIONS AND RECOMMENDATIONS –**

    a. The Indian Satellite Broadcasting Industry, also known as the Broadcasting and Cable Services (B&CS) industry, is an significant industry with Rs 709 billion in revenues in 2022, providing direct/indirect employment to 4.5 million people, while Television (TV) remains one of the largest media platforms with a reach of approximately 210 million households (900 million individuals watching TV), as per the Broadcast Audience Research Council ("**BARC**"). This huge audience is serviced, directly or indirectly, by approximately 350 broadcasters, 1764 multisystem operators (MSOs) registered with the Ministry of Information and Broadcasting ("**MIB**"), 4 Direct-to-Home (DTH) operators.[1]

[1] TRAI's Annual Report 2021-2022. Available at https://www.trai.gov.in/sites/default/files/Annaul_Report_23022023_0.pdf

b. **At the outset we reiterate the differences between *satellite spectrum* and *terrestrial spectrum* and why satellite spectrum needs to be governed differently from terrestrial spectrum.** We take the opportunity to highlight our concerns with the Department of Telecommunications (**"DoT"**) reference letters that seek to disregard the differences and equate *satellite spectrum* and *terrestrial spectrum* by calling them both "*access spectrum*", to erroneously impose the same rules for their assignment. We underline the implications of treating *satellite* and *terrestrial spectrum* as similar and issues in considering an auction route for both to be availed on an exclusive basis.

c. **Whether satellite spectrum can be auctioned at all is a matter of debate especially, since vertical frequencies of C Band, being satellite spectrum are part of a shared spectrum which is coordinated by the International Telecommunication Union ("ITU") and of which spectrum there is no scarcity**. It is important to note that television broadcasters do not have exclusive avail of any scarce spectrum (unlike telecom operators who require exclusive access to limited terrestrial spectrum for their operations). Television broadcasters utilize satellite spectrum, which is neither limited nor scarce, and is administered by the Government. There is a specific spectrum/frequency granted for exclusive use to telecom and radio operators, whereas in case of satellite TV channels, specific frequency allocation for exclusive use is not done by WPC. Further, satellite bandwidth is in abundance in comparison to the radio spectrum and will continue to increase as the number of satellites are increased from time to time, which must be done with the ITU's consent.

d. **The present consultation process and the CP do not provide the appropriate data, analysis or discuss any of the consequences that would follow to the existing ecosystem, including the cable and satellite broadcast sector**. Satellite spectrum is crucial to the functioning of the industry as broadcasters rely on the C-Band (3.7GHz to 4.2 GHz) to seamlessly distribute 885 registered TV channels to the DPOs. Furthermore, DTH operators use the Ku-Band (10GHz to 15 GHz) to distribute TV channels to their subscribers. Any proposal/consultation to auction the satellite spectrum which is traditionally used to provide broadcast services and utilized by the public broadcaster, Prasar Bharti, for dissemination of important news, current affairs, public welfare messages, entertainment, education, and infotainment must be preceded by carrying out a comprehensive exercise of the pros and cons of the same. We refer your attention to the IBDF written submissions made officially to the Ministry of Information and Broadcasting ("MIB") and the Honourable Minister, which proposals and requests may be referred to, from annexures 1,2,3,4, and 5 attached to this submission. (April 5th 2023, May 2nd 2022, April 13th 2021, March 31st 2021, March 10th 2021).

e. **Any consideration or proposal for auction of satellite spectrum is an aspect for concern, and the DoT's apparently pre-conceived intention to auction this spectrum and the CP's inclusion of the C-Band for consideration creates uncertainty for the entire satellite industry.** The downlinks for all broadcasters intended for reception by DPOs currently takes place through the C-band. As the Consultation Paper notes, C-band *"ranges from 4 GHz to 8 GHz and is commonly used for fixed satellite services (FSS) such as television and radio broadcasting, telephony, and data transmission"*.[2] This is aligned with the Radio Regulations (RR), which is an international treaty binding on the ITU member states, including India. Given the critical importance of the broadcasting sector, and significant consumer interest, it is essential that the status quo with respect to 3700 to 4200 MHz is not disturbed and broadcasting services can continue to operate and thrive. Even recently, the operations in C-Band were disturbed as result of the decision to reduce the guard band for C-band to a meagre 30 MHz, which led to a high potential interference in the said band and a deterioration of quality.[3] Consequently, Fixed Satellite Services ("**FSS**") (downlink) users operating in the C-band were obligated to take necessary steps, such as retrofitting expensive Band Pass Filter ("**BPF**"), to protect signal reception in the frequency range of 3.7 to 4.2 GHz band ("**FSS System**") against 5G transmissions, increasing operational costs.

f. **We would like to highlight that satellite-based service providers (or ~350 linear TV broadcasters) use less than 5% of the spectrum that is available to the 3 telcos on an exclusive basis.** According to an analysis by the President of Broadband India Forum ("**BIF**"), "*the current annual revenues of the mobile operators is of the order of Rs 250,000 crores whereas that of the Indian VSAT satellite operators is only about Rs 500 crores i.e., they have only 1/500th or 0.2% of the revenues of the telcos!*". With such differences in resources, the cash-rich can outbid the existing users, and lead to an unfortunate and oppressive outcome, with market failures for the existing use cases for satellite spectrum. Thus, the proposed 'equalised' treatment of satellite (broadcast) spectrum and terrestrial "Mobile" spectrum, would be discriminatory and unreasonable failing to meet the rigour of Article 14 of the Constitution of India, in trying to provide equal treatment to unequals.

g. **A thorough and comprehensive study on Spectrum**, terrestrial and satellite, considering its variable characteristics, nature, differentiated deployment, and variable assignment must factor in the international learnings/precedents, availability of spectrum, the international ecosystem, and the ability of any new services to co-exist with the existing users/ licensee/ for e.g. broadcasting permission holders. Further, a technical study must be carried out to gauge possible interference in signal/frequencies if allocation in C-band is made for 5G telecom services. Only once the above transparent exercise presents a comprehensible background, should TRAI circulate a consultation paper basis a background comprising above-mentioned findings for stakeholders, and to pose queries relevant to the assignment of spectrum, and the possible usage for space-based telecommunications, as distinct from the usage of satellite

[2] ¶ 2.16, Consultation Paper on Assignment of Spectrum for Space based Communication Services, TRAI, 6th April, 2023
[3] *"TRAI rejects broadcasters demand for 100 MHz guard band in 5G auction"*, by Best Media Info https://bestmediainfo.com/2022/04/trai-rejects-broadcaster-s-demand-of-100-mhz-guard-band-in-5g-auction-suggests-ways-to-avoid-interference

spectrum for broadcasting and other allocated services, including national usage etc. Norms and practices followed by ITU as also the NFAP should also be studied before undertaking this consultation process or proposing recommendations for the assignment of spectrum.

h. While the CP relates to the "Assignment of Spectrum for Space-based Communication Services" it has direct linkage with the section on "Spectrum Management" in Section 5 of Chapter 3 of the Draft Indian Telecommunications Bill 2022 ("**Telecom Bill**"). According to media reports[4], the Telecom Bill is currently being revised to be tabled in the upcoming Monsoon session of Parliament. Once enacted, it will set the legislative framework for spectrum management in India. Given the parallel exercise via the current CP, we strongly recommend:

    i. ***That the Telecom Bill is not tabled in the Parliament*** until TRAI finalizes its recommendations on issue of "Assignment of Spectrum for Space-based Communication Services", particularly the spectrum that is currently being used for uplinking and downlinking of TV channels.

    ii. ***That the Telecom Bill explicitly acknowledge the distinction between satellite spectrum and terrestrial spectrum*** and based on this distinction, outlines the legislative principles for the management of these two different spectrums in Section 5 of Chapter 3 of the Bill.

5. **SATELLITE SPECTRUM AS DIFFERENT FROM TERRESTRIAL SPECTRUM NEEDS TO BE GOVERNED DISTINCTLY.** There is a fundamental flaw in the understanding of the differences between satellite and terrestrial (mobile) spectrum which appears to be premised on a predetermined notion.

(i) Satellite spectrum, also known as orbital spectrum, is a segment of electromagnetic spectrum used for sending signals from earth to space/satellite and from space/satellite to earth. Since these signals are transmitted from earth to space and vice versa, a **satellite network** has **no national territorial limits** and is not limited by geographical boundaries. Unlike terrestrial spectrum, satellite spectrum can be used by multiple service providers (including foreign service providers) on a **non-exclusionary basis**. Hence it is a **shared global resource** used for providing satellite-based communications, broadcasting, broadband connectivity, weather forecasting, Global Positioning Systems (GPS), etc. Since it is a shared global resource, it is **allocated administratively** to multiple service providers on a **non-exclusive basis. When multiple users can share the resource, making it exclusive is not an efficient use of the resource**.

(ii) On the other hand, **terrestrial spectrum** is a portion of electromagnetic spectrum that is used **exclusively** by a service provider to provide voice and data services

[4] https://www.thehindubusinessline.com/info-tech/data-protection-bill-and-telecom-bill-will-be-tabled-in-monsoon-session-of-parliament-vaishnaw/article66671875.ece

via earth-based transmitters. Since these services rely on earth-based transmitters located in a particular geographical area, a **terrestrial network has geographical boundaries**. Also, each frequency band in terrestrial spectrum can only be used by a single operator and cannot be shared. Different networks even in adjacent channels may cause significant inter-network interference, even with a guard band.[5] At any given point of time multiple operators seek to exclusively use spectrum, and this leads to scarcity. Under such circumstances, the public interest and efficient utilization of the terrestrial spectrum are best served by auctioning them.

(iii) It is because of these differences that satellite spectrum is regulated differently from terrestrial spectrum. For instance, as per international space laws, satellites are considered "space objects" and come under the jurisdiction of the International Telecommunication Union ("**ITU**"), a specialized UN agency responsible for allocation of global radio spectrum, satellite orbits and development of common technical standards. India along with 192 countries are members of the ITU, and satellite systems must be internationally coordinated as per relevant ITU Regulations to avoid harmful interference to radio services of other countries. On the other hand, terrestrial spectrum and networks have national boundaries and can be regulated independently.

<u>**ISSUES WITH THE DOT'S REFERENCE LETTERS TO TRAI dated 13.09.2021 and 16.08.2022.**</u>

(iv) **Satellite spectrum and terrestrial spectrum both may be described as 'access spectrum, however using this argument to conclude both should be actioned on an exclusive basis will lead to market failure.** Relevant paras from the DoT reference letter No. L-14006/01/2021-NTG, dt. 13.09.2021, in which DoT equates satellite spectrum with terrestrial spectrum by stating that they are both access spectrum, are reproduced here: *"6. The Department of Space had invited comments on Draft Spacecom Policy liberalizing space segment for private sector participation to provide commercial communication services in India. This includes the Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) satellite constellations operational over India. <u>In case of satellite communication, the subscriber is accessed from the satellite through "Access Spectrum" similar to "Access Spectrum" in terrestrial network</u> and the demand for such spectrum will potentially increase in the future.*

(v) While it is clear satellite spectrum and terrestrial spectrum may both be identified as an 'access spectrum', it is similar to identifying trains and airplanes as a means of transport. **However, using this similarity (*similar spectrum*) to conclude that both spectrums must be auctioned on an exclusive basis (*similar methods of allocation/assignment*) is akin to saying that "trains and airplanes provide transportation services and hence they must be regulated in the same manner."**

[5] *Jeong Seon Yeom et al., "Performance Analysis of Satellite and Terrestrial Spectrum-Shared Networks with Directional Antenna," ETRI Journal 42, no. 5 (2020): pp. 712-720, https://doi.org/10.4218/etrij.2020-0185.*

This is fundamentally flawed and disregards the principles for having different regulatory frameworks for different kinds of transportation services (*e.g. motorcycles, light motor vehicles, trains, airplanes etc*) even though they all provide the "same service."

(vi) **DoT's reference letter No. J-19022/01/2022-SAT dated 16.08.2022 disregards the fundamental distinction between satellite spectrum and terrestrial spectrum, and totally ignores the existing multiple uses of satellite spectrum.** The DOT letter provides information related to space-based communication services, in response to TRAI's inquiries in letters dated 27.09.2021 and 23.11.2021. in it, he DoT states its plans to auction satellite spectrum on exclusive basis, relevant part reproduced here: *"(b) <u>It is envisaged to auction the Space Spectrum on exclusive basis</u>. TRAI may explore feasibility and procedure of sharing auctioned spectrum among multiple service licensees. TRAI may provide recommendations on sharing of auctioned frequency bands between satellite networks and terrestrial networks also, the criteria for sharing and appropriate interference mitigation techniques for sharing and coexistence."*

(vii) **Our fundamental concern with DoT's Letter is that it has already made up its mind on how it plans to allocate satellite spectrum even before public consultation – *i.e., auction it on exclusive basis*.** This limits the scope of TRAI's consultation. It is also worrisome because the custodian of all natural resources has *suo moto* decided to auction satellite spectrum (without a public consultation or assessment of whether it is in the public interest) on an exclusive basis, based on a fundamentally flawed premise as explained in paras (i) – (vi) above.

(viii) **Our other concern with DoT's Letter is that it disregards existing uses of satellite spectrum (such as the C-Band and the Ku-Band that are currently administratively allocated) for satellite broadcasting.** The government is the custodian of natural resources, including spectrum, which are public property. Therefore, it must allocate these resources in the most efficient way based on each one's characteristics. The Supreme Court of India in 1995[6] held that 'airwaves' are a public resource, and a public authority should regulate their use in public interest. The Court also opined that the regulation of 'airwaves' in the public interest should guarantee access to diversity and plurality of opinions, because it is essential to the freedom of speech and expression under Article 19(1)(a) of the Indian Constitution. Hence auctioning of this spectrum will impact Indian satellite broadcasting (as illustrated in 3(a) below) and therefore diversity and plurality of opinions in the Indian Media and Entertainment industry.

[6] *Secretary, Ministry of Information and Broadcasting v. Cricket Association of Bengal 1995 (2) SCC (161).*

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6. PUSHBACK ON PROPOSAL TO ALLOCATE C-BAND SPECTRUM

(ix) It is an established and acknowledged fact that the spectrum frequencies between 3.7 to 4.2 GHz are earmarked for providing broadcast services in line with international practices, and this spectrum band is used by the satellites engaged in provisioning of broadcast and satellite services, also used for emergency and disaster recovery purposes. This band has large coverage and is a cost-effective solution for use by broadcast services which avail of and use the spectrum on a non-exclusive basis. Accordingly, around 250 million TV households and around 900+ registered TV channels are uplinked/downlinked using satellites through the C-Band spectrum and 2000+ registered Distribution Platform Operators ("**DPO**") re-transmit the signals upon reception from satellites. The cable and satellite broadcast sector provides employment to over 2 million people.

(x) Any proposal for allocation or auction of satellite spectrum must factor in the legal, international aspects, along with the socio-economic importance/relevance and impact of reallocation or reassignment. Any policy or fundamental change of law must also ensure continuity of operations and uninterrupted availability of important services.

(xi) We invite your attention to IBDF's letter dated April 5th 2023 (Annexure 5) where we have elaborated in detail our concerns regarding the Government's intention to allocate a major part of the C-Band spectrum, which at present is being used for broadcast services, for rolling out 5G telecom services. The proposal, if implemented would pose an existential threat to the broadcast industry, as it would not only significantly reduce the C Band spectrum available for broadcast services, but also result in interference with broadcast signals that can severely hamper and impact the quality of service/transmission.

(xii) As an industry practice, broadcasters have opposed the dual use of frequencies. Any proposal or assumption to share spectrum use between broadcast and telecommunication services must be reexamined, as satellite signals which are transmitted thousands of kilometers away are weaker and susceptible to be overpowered and inundated by terrestrial transmitters. Therefore, the concept of satellite internet should not be misrepresented or inaptly glorified as "*India being the first one to auction satellite spectrum*" at the cost of almost a billion Indian users losing broadcast services that are the world's most inexpensive and pervasive service. International experiences in U.S., E.U. and U.A.E. have already demonstrated and established that interference with the C band, e.g from telecommunication use, causes disruptions, as also evidenced during the trial runs for 5G services. Further, even TRAI in its 11.04.2022 recommendations on "Auction of Spectrum in Frequency Bands identified for IMT/5G" acknowledged the risk of interference in the event there was auction of 3300-3670 MHz bands by observing that *"IMT emissions in the 3300-3670 MHz may saturate Low Noise Block (LNB) of the FSS earth station".* Keeping in mind such risks, it had through its recommendation inter alia, emphasized the need for the usage of high-quality band-pass filters.

(xiii) It is suggested that all possibilities of interference/overlap must first be eliminated and the use conditions, soci-economic impact and climatic conditions for effective use of spectrum in India must be studied and examined, before proceeding with this exercise. It is disconcerting that despite the TRAI's expressed apprehensions and broadcasters' strong representations, the Department of Telecommunication ("**DoT**") has notified the National Frequency Allocation Plan 2022 ("**NFAP 2022**"), reducing the Guard Band from 30 MHz to 10 MHz. In the unfortunate event that the consultation does not consider the overwhelming challenges, or the administration adopts the general reference to auction designated broadcast spectrum, the broadcast industry would be exposed to catastrophic consequences. The reduction in the guard band under NFAP 2022 is already causing rising costs to enable quality of service for broadcasting sector. In fact, it is understood that the usage of spectrum is also impacted by climate conditions and the use and interference may fluctuate depending upon varying climate.

(xiv) Substantial investments of finance, time and resources have been made to ensure satellites for provision of broadcast and cable services, which would be compromised and will result in lost satellite capacity as 5G interference in C Band will impact thousands of head ends. Even in the introduction of 5G in the United States of America, detailed deliberation preceded the allocation of C-Band for 5G services, where the regulators had persuaded the satellite and broadcast operators to vacate the C Band spectrum against huge compensation running into billions of USD, aside from planned transition considering the interference and other impacts. Notwithstanding, the transition is still subject to litigation and closure of issues.

(xv) Any consultation about satellite spectrum must examine the most important aspect of an existential threat to broadcasters, being wholly dependent on the C Band spectrum for Uplinking and Downlinking of signals. Regrettably, the tone and tenor of the questions posed in the CP suggest the entire process to be a fait accompli and appear to predetermine 5G services as the preferred assignees without even examining the impact that it would cause upon both, the broadcast/satellite services and the 5G services. The context set in the CP, and the questions posed appear to unilaterally treat 5G services as the preferred utilization and assignment, for satellite/broadcast spectrum without due appreciation of importance and power of broadcast, cable and satellite, as an existing serving utility for public good, catering to the various elements of human interest namely news, education, entertainment, sports, and evolving media usage. Even as recent as 2 years ago, Cable and satellite Broadcast was declared to be an "*emergency and essential service"* during the pandemic since it was the most viable means of dissemination of information to the public about various protocols, guidelines, etc.

7. IMPLICATION AND IMPACT OF SPECTRUM ASSIGNMENT BY AUCTION

(xvi) **Regulatory uncertainty for the Indian Satellite broadcasting Industry**. The IBDF suggests that any allocation of satellite spectrum ought to be considered vis-a-vis the terms of usage between the GoI and ITU, to examine whether the satellite spectrum can simply be auctioned at all. The proposal for auction of satellite spectrum is an aspect for concern, and it is highly debatable whether satellite spectrum can even be auctioned at all especially, since vertical frequencies of C Band, being satellite spectrum are part of a shared spectrum which is coordinated by the ITU and of which spectrum there is no scarcity. The very fact that satellite spectrum has no boundary limits and has an international character raises a fundamental question as to whether exertion of authority over such spectrum can be construed to be within exercise of sovereign power, like those as conferred under Section 4 of the Indian Telegraph Act. It is our submission that assignment of satellite spectrum for broadcast should continue to be administratively allocated without compromising the existing stakeholders or creating any existential concerns for them.

(xvii) **Satellite spectrum is a shared global resource and auction of it will affect international coordination mechanisms.** As stated above, satellite spectrum is a shared resource and is governed by ITU frequency coordination and different management rules. The allocation of satellite spectrum requires both global coordination and national management, whereas terrestrial spectrum allocation is managed by the national government alone. As mentioned above, satellites are "space objects" that come under the jurisdiction of the ITU, which is a specialized UN agency responsible for allocation of global radio spectrum and satellite orbits, along with the development of common technical standards. As part of its management process, ITU has an international binding treaty for its 193 member countries, including India, called the "Radio Regulations" ("**RR**"). The RR determines how the radio frequency spectrum is shared across different services, including space services, and presents detailed guidelines on using specific equipment to ensure successful coexistence of services across the radio spectrum. According to ITU, international coordination is necessary on spectrum matters.[7] The use of satellite spectrum involves regional coordination with neighbouring regions to avoid interference with spectrum use by other countries**.** It is essential for countries to follow a common global standard. Any deviation would disrupt existing and time-tested coordination mechanisms, as illustrated in the case of uplinking of a live event in Country A and downlinking it in Country B.

[7] *Joaquin Restrepo, Radio Regulations, pg 6, available at:* https://www.itu.int/dms_pub/itu-r/md/15/wrs18/sp/R15-WRS18-SP-0003!!PDF-E.pdf

Under the ITU's regulatory framework for space services[8], the right to use orbital and spectrum resources for a satellite network are negotiated with administrative authorities on a need basis, which would not be possible if spectrum is exclusively assigned to a service provider. The ITU's dispute resolution mechanism only provides for member states to be represented[9]. In other words, there are no provisions under the ITU regulations[10] for an exclusive spectrum holder to resolve disputes with other member states.

(xviii) The revenue potential, and the social economic impact of the two sectors is also very different. This consultation exercise proposes to auction spectrum without having considered wider implications or impact an auction will have upon the existing ecosystems, for e.g. **Reduced competition and gatekeeping and hence impacting plurality and diversity of opinions.** As satellite spectrum is non-rivalrous in nature, i.e., multiple satellite operators can use the same spectrum without diminishing the availability of that spectrum for others, then using an auction to provide exclusivity is inefficient, exclusionary, and hence anti-competitive. For example, in the B&CS sector, administrative allocation allows the C-Band to be shared between 350 broadcasters and more than 1700 DPOs for uplinking and downlinking of channels. If this were to be auctioned, many of these broadcasters and DPOs would not have the resources to acquire the necessary spectrum. Hence the auction creates entry barriers to the market for spectrum and many small broadcasters who are currently in the market would be deprived of the opportunity to broadcast their channels. Limitation of participation due to auctions would also reinforce concentration amongst dominant players, creating gatekeepers who could corner spectrum, rent-seek from broadcast and broadband providers, and create entry barriers.

(xix) **Auction of satellite spectrum will result in reduced competition and impact plurality and diversity of views.** This would limit / restrict content distribution, and potentially violate the broadcasters' freedom of speech and expression, since the right to propagate ideas (in the form of TV channels) has been recognized by the Supreme Court[11] within ambit of free speech and expression. Additionally, the Supreme Court held[12] that there could not be any restriction on the freedom of speech and expression on the grounds of public interest, or any grounds other than within Article 19 (2) of the Indian Constitution. Furthermore, the Supreme Court in the 1995 'Airwaves Judgement'[13] held that *"Airwaves being public property, it is the duty of the State to see that airwaves are so utilised as to advance the free speech right of the citizens which is served by **ensuring plurality and diversity of views, opinions and ideas.**"* (emphasis added). Thus, is submitted

[8] *itu.int*
[9] *Constitution of the ITU, Article 56, available at https://www.itu.int/en/council/Documents/basic-texts/Constitution-E.pdf*
[10] *ITU, Regulatory Publications, "The Radio Regulations (RR) form an integral part of the Administrative Regulations", available at: https://www.itu.int/en/publications/ITU-R/Pages/default.aspx*
[11] *Sakal Newspapers v. Union of India (1962 AIR 305)*
[12] *Indian Express Newspaper v. Union of India (1985 SCR (2) 287)*
[13] *Secretary, Ministry of Information and Broadcasting v. Cricket Association of Bengal 1995 (2) SCC (161)*

that the broadcast sector must be guaranteed full protection against any such disruption which is being proposed through this consultation exercise.

(xx) **A disproportionate reduction in the usage and efficiency of satellite spectrum and complete destruction of value,** is a very important and relevant reason why the auction methodology should not be followed for the assignment of satellite spectrum.

(xxi) **The wider objective and use of satellite spectrum (C-Band / Ku-Band) for broadcast is more important**. Cable and satellite Broadcast has been and remains relevant to reach remote areas and for providing emergency services. The assignment of spectrum must acknowledge and appreciate the cost of the alternatives, for e.g. the provision of broadband services to enable internet access in underserved areas/population. It ought to be considered that to make internet/broadband affordable for all persons, the cost of provision of service(s) must be factored. It is apparent that interested telecom operators desiring to venture into this space have already made huge investments for deployment of satellites. In the event an auction takes place, the telecom operators would have no option but to pass on the burden of expenses to the end consumers, since they would purchase the same for a huge price at auction. This would make provision of internet services to end consumers unaffordable when rates would escalate, as higher the operational costs, higher the price and lower penetration.

(xxii) **Auction of the C-Band and Ku-Band will lead to disruption in broadcasting services.**

a. **Interference between satellite-based services and terrestrial services and artificial scarcity of spectrum for satellite-based services**: The B&CS sector has already faced interference with terrestrial services provided by Telcos in the recently auctioned 5G spectrum, as some portion of the C-Band (i.e., 3.3GHz to 3.67GHz) was auctioned in the 2022 auction, thereby reducing the guard band to just 10MHz from 100MHz. there is bound to be larger interference, If more frequencies in the C-Band are auctioned as proposed in the CP Additionally, if auctioned, C-Band frequencies (3.7-4.2 GHz) may be used for non-broadcast services and will create artificial scarcity for broadcasting services, which will have implications for the supply and hence the price (or license fee) for broadcasters.

b. **Risk of satellite redundancies if non-broadcasting entities use satellite frequencies for terrestrial transmission:** If satellite frequencies are auctioned, they could be used either for satellite or terrestrial transmission. If a spectrum holder decides to use these frequencies only for terrestrial transmission, would lead to redundancies of satellite.

c. **If India's public broadcaster Prasar Bharati fails to secure frequencies** either in the C-Band or Ku-Band, it may be unable to perform its important role in dissemination of news, entertainment, emergency communications or its statutory functions under the Prasar Bharati (Broadcasting Corporation of India) Act.

d. **Impact on coverage of international events, including live sports events**. Long-established international coordination under the ITU-RR framework, currently, facilitates the availability of broadcast signals of any live event from overseas into India, since the overseas uplinking service provider only shares frequency details for downlinking in India, close to the date of the event. However, the auction of frequencies would hold all spectrum usage subject to discretion of the spectrum holder, and gatekeep for a host of events and obligations for broadcast, impacting costs as well.

(xxiii) It is apparent that the broadcasters have a very small fraction (<5%) of the total spectrum that 5G spectrum possess. If an auction methodology is followed for satellite spectrum it would result in gross inefficiency and would create an opportunity for otherwise influential and rich entities to act as gatekeepers against the economically weaker stakeholders/start-ups and eliminate any competitive choice to be deployed for benefit of consumers. Therefore, a perfect balance needs to be attained to ensure that both the objectives (of introducing satellite-based internet and safeguarding the existing service providers like broadcasters, DTH & cable operators) are parallelly fulfilled without compromising or creating an existential crisis for any ongoing service/venture.

(xxiv) Additionally, it remains unclear how the framework of an auction and exclusive licensing, (for instance, mandatory intra-band sharing of frequency spectrum with other satellite communication service providers (as not required under the current law) can possibly function. This will create fetters on fair price discovery, while also possibly depriving satellite owners of getting their fair share. The option to sell satellites services will be limited to exclusive licensees of the spectrum block. Only licensees to a spectrum block will be able to buy services for that spectrum block, leading to reduced prices. Moreover, a scenario where a satellite is unable to sell services for a specific spectrum block upon exclusive licensee's unavailability/ refusal to avail its services cannot be ignored.

(xxv) It is relevant to take note that even in the constitutional reference made to the Hon'ble Supreme Court in the 2G case, the Hon'ble Supreme Court had observed that "*auction as a method of disposal of natural resource cannot be declared to be a constitutional mandate under Art. 14*" and that while "***auction may be best way of maximizing revenue, but revenue maximization may not always be the best way to serve public interest***".[14]

(xxvi) The extant administrative allocation and status quo in respect of allocating spectrum for broadcast services should be maintained as auctioning the same will have detrimental impact on the broadcast industry. The CP appears to advocate the auction route for spectrum allocation despite the provision proposed under Schedule 1 of the draft Indian Telecommunication Bill, 2022. In this regard, it may be noted that Clause 5 of the draft Indian Telecommunication Bill, 2022 states

[14] Re: Special Reference No. 1 of 2012

that the Central Government may assign spectrum for telecommunication *"through administrative process for governmental functions or purposes in view of public interest or necessity as provided in Schedule 1*". The Schedule 1 provides a list of services, Serial number 15 of the said list is reproduced below: "*15. Certain satellite-based services such as: Teleports, Direct To Home (DTH), Digital Satellite News Gathering (DSNG), Very Small Aperture Terminal (VSAT), National Long Distance (NLD), International Long Distance (ILD), Mobile Satellite Service (MSS) in L and S bands."* Therefore, it is submitted that in view of the intent as expressed above, spectrum for broadcast services should continue to be assigned administratively as the very basic nature of broadcasting does not allow for the auction model to be followed particularly, in respect of teleport services and its corresponding distribution. Please note that even globally, spectrum for satellite communication services in bands such as C-band, Ku-band and Ka-band, is assigned administratively.

(xxvii) It is important to highlight that television broadcasters do not have exclusive avail of any scarce spectrum (unlike telecom operators who require exclusive access to limited terrestrial spectrum for their operations). Television broadcasters utilize satellite spectrum, which is neither limited nor scarce, and is administered by the Government. There is a specific spectrum/frequency granted for exclusive use to telecom and radio operators, whereas in case of satellite TV channels, specific frequency allocation for exclusive use is not done by WPC. Further, satellite bandwidth is in abundance in comparison to the radio spectrum and will continue to increase as the number of satellites are increased over time, which has to be done with the ITU's consent.

8. PROTECTION OF LEGACY USERS AND BENEFICARIES OF SPECTRUM ALLOCATION

(xxviii) We point out that DTH systems in India form a major delivery system for broadcast of linear channels with an estimated 80 million consumers and over 800 channels. The DTH system serves millions of viewers in rural and urban households in India and constitutes one of the major sources for their information, entertainment, and education.

(xxix) The CP does not clearly set out the problems that necessitate a rethinking of the existing assignment of spectrum. It is not as if the current open market framework is a *laissez faire* situation, with no regulation. It is noteworthy that the current system of administrative allocation of Satellite Spectrum duly provides for a Regulatory framework mandating the service providers to procure the requisite licenses from the appropriate authority as well as furnishing material to satisfy the regulatory authorities that they possess the required technical, financial, and legal credentials to procure the Satellite Communication system. While broadcasters and satellites, both Indian and foreign, enjoy a broad freedom to contract under a regulatory regime between broadcasters and satellites, broadcasters are required to inform DoT about the specific frequency band allocated and pay royalty to use the bandwidth. Additionally, broadcasters require permission from the MIB before uplinking or downlinking their channels. Thus, the government can exert some control over *who* is given the license. In view of this situation, there is no explanation for why a new method of exclusive auctions for spectrum bandwidth is being contemplated.

(xxx) The need to protect legacy users is reflected in the International Telecommunication Union (ITU) policy (refer to ITU Allocations under Appendix 30, 30A and 30B) and as set out in the CP. Therefore, all ITU assignments of spectrum arrived at post international coordination need to be protected while any of the new systems, including Low Earth Orbit ("**LEO**") Satellites need to operate on a no-interference basis vis-à-vis the existing systems and legacy users. Therefore, the policy for spectrum assignment needs to reinforce the ITU policy (Allocations under Appendix 30, 30A and 30B of the ITU Policy), which is elaborated in detail in the CP, as otherwise the legacy incumbent users would be left to fend for themselves in the face of heavy interference generated by LEO systems. It is observed that while the LEO systems have uplinks in the 28 GHz band, however the downlinks are in the Ku-band (10.7 to 12.7 GHz), which is currently used by DTH satellite systems in India, as found in the CP, at para 1.5 on page 6, which sets out the frequency bands to be considered by TRAI for providing recommendations in respect of Space-based communication services, as extracted below:

1.5 Through the afore-mentioned letter dated 16.08.2022, DoT provided a list of frequency bands to be considered by TRAI for providing recommendations with respect to space-based communication services, as given below:

S. No.	Frequency Band	Link	Remarks
1	10.7 – 12.75 GHz	Space to Earth	**Ku Band DTH Downlinks**
2	12.75 – 13.25 GHz	Earth to Space	**Ku Band DTH Uplinks**
3	13.75 – 14.5 GHz	Earth to Space	**Ku Band DTH Uplinks**
4	17.1 – 18.6 GHz	Space to Earth	17.7–18.4 GHz is used for Earth to Space also.
5	18.8 – 19.3 GHz	Space to Earth	
6	19.3 – 19.7 GHz	Space to Earth	
7	19.7 – 21.2 GHz	Space to Earth	
8	27.5 – 29.5 GHz	Earth to Space	27.5–28.5 GHz has been identified for implementation of IMT in India.
9	29.5 – 31 GHz	Earth to Space	

Table 1.1: List of frequency bands referred by DoT

(xxxi) It must be noted that the mere allocation of Bands does not alleviate the interference faced by the legacy systems like DTH or other licensed systems in the same band. The Government should balance interests and avail of an opportunity to frame a satellite policy spanning Geostationary Satellite Orbit (GSO) and Non-

GSO, which ought to protect the legacy systems serving tens of millions of consumers, instead of opening up the spectrum to new satellite operators, which may cause direct interference with the legacy assigned or licensed users and established systems, resulting in undue benefit for new operators at the cost of existing consumers benefitting from the satellite broadcasting ecosystem.

(xxxii) It is relevant to consider that that precisely to deal with such situations, the Office of Communication (OFCOM) in the UK proposed changes in the rules pertaining to the licensing of LEO satellites, so that they can coexist without degrading other consumer services. These rules include a check to guard against any restriction of competition that could arise if the granting of the license prevents subsequent parties from entering the market.[15]. The India Space Policy needs to delineate and develop a similar scope and strategy before it begins licensing spectrum to various contenders for purely revenue realizations.

(xxxiii) We invite your attention is to Para 1.6 of the CP which quotes from the DoT letter that while Plan Bands are not Permitted in India for foreign GSO systems, TRAI may relook at this provision. Para 1.6 : *"While providing the above list of frequency bands, DoT also mentioned that "TRAI can however provide recommendations for other frequency bands also." Besides, DoT stated that "these frequency bands include "Planned bands" that when used by GSO systems in accordance with Appendices 30, 30A & 30B of Radio Regulations are reserved by ITU for use by National systems. Use of 'Planned Bands' by foreign GSO satellites is not permitted in India. TRAI may, inter-alia, take into account this aspect with respect to GSO systems, in the consultation process". The information on the Planned bands, as provided by DoT, is given in the CP, on page 7 as table below:*

S. No.	Plan	Frequency bands		Applicable Appendix of ITU's Radio Regulations
		Uplink	Downlink	
1	FSS Plan	12.75 - 13.25 GHz, 6.725 - 7.025 GHz	10.7 - 10.95 GHz, 11.2 - 11.45 GHz, 4.5 – 4.8 GHz	Appendix 30B
2	BSS Plan		11.7-12.2 GHz	Appendix 30
3	BSS feeder links Plan	14.5 - 14.8 GHz, 17.3 - 18.1 GHz		Appendix 30A

Table 1.2: Details of Planned Bands

It ought to be considered carefully that providing such a concession to GSO Satellite systems, which is not permitted today, without strategic consideration against the existing use and benefits, would have long term implications for the

[15]OFCOM's Space Spectrum Strategy (Nov 2022)
<https://www.ofcom.org.uk/__data/assets/pdf_file/0023/247181/statement-space-spectrum-strategy.pdf

Indian Space Sector and future Indian GSO HTS systems, including those planned by ISRO. It would have been appropriate to provide a reason for such consideration, after obtaining the opinion of the Department of Space (DoS) for such a move, since DoS is planning to use the above bands in its upcoming satellites e.g. GSAT-22 which uses the FSS plan

(xxxiv) It is not clear why no responses have been sought on the benefits to stakeholders and consumers, if any, due to adopting such a strategy, the potential pricing and a possible open licensing architecture which does not define or otherwise except any potential players. The questions set out in the CP put the stakeholders in a "*straight jacket*" and appear to serve pre-determined ideas and assumptions, in demanding responses to specific queries about the modalities of auction. to develop a considered and robust strategy on spectrum and its assignment, it would be more revealing and effective to consider an approach like the one followed by the OFCOM in its strategy paper for the UK. As revealed from the CP queries, there appears to be an abnormal hurry to proceed with auctions of spectrum and/ or administrative allocation, which could bind the country into space concessions, the impact of which cannot be ascertained at present as many of these systems are developing and also facing legal challenges in several countries where these are permitted to operate by national authorities without due consideration of legacy usage, against properly planned consideration of potential future usage.

9. NECESSARY STUDY, REFERENCE TO INTERNATIONAL PRINCIPLES PRIOR TO SUBSTANTIVE POLICY CHANGE

(xxxv) This CP and consultation exercise is a matter of serious concern, as it proposes to auction spectrum without having carried out any study of the outcome and impact such auction will have upon the existing ecosystems. The TRAI has not conducted any comprehensive study based on current data and analysis, or presented any data for background in the current CP that reflects the impact that allocation of C Band Spectrum for 5G services can cause to the broadcast industry nor has it done any research or study to assess the disruption which will be caused as a result of such allocation.

(xxxvi) It is proposed that a transparent and evidence-based study should be conducted about the possibility of using alternate bands, the current usage and deployment of available bands by extant and prospective 5g services, before encroaching on a band which is already in use and is catering to a specific set of services.

(xxxvii) We submit that it is most relevant that before responding to the questions that are essentially centered around quantum, frequency bands for gateway links and user links, the requirements of practical limit on number of NGSO satellite systems in LEO & MEO, exclusive assignment, provisions for new entrant, assignment on shared basis, etc., there must first be a clear and comprehensive and clear study undertaken and presented on the various aspects highlighted in the submissions above. Notwithstanding the assumptions and leading observations in the CP, international practices from the US, Mexico & Brazil are also evidence of the fact that the auctioning methodology has not succeeded, and the countries have shifted to administrative allocation.

(xxxviii) Therefore, it is submitted that TRAI should defer the present consultation process to first undertake such studies and any consultation on the subject must occur only if the same is determined to be feasible and if it guarantees continuity, stability, and sustainable environment for the existing stakeholders/permission holders. TRAI, being the expert body, is best placed to take this obligatory route and to invite and anticipate properly considered responses from the stakeholders.

10. CONCLUSION

(xxxix) **IBDF**'s demand for the preservation of existing users in the C-band, Ku and Ka bands are very explicit and follow the ITU guidelines of the use of coordinated satellite slots and the right of such users to be provided an environment of no-interference from any new system. It is reiterated that there exists significant consumer interest in the survival of the broadcasting sector. The rights of other service classes must not be prioritized over the rights of the broadcasting sector.

(xl) That the present consultation process needs to be deferred to first undertake a researched study including technical studies on the subject(s) detailed in the Consultation Paper to determine whether it is feasible, and if it guarantees continuity, stability, and sustainable environment for the existing stakeholders/permission holders. The present CP can be until a comprehensive study is presented after a thorough analysis by TRAI including the OFCOM Space Strategy and the FCC Docket against the viability and feasibility to enable continuity, stability and a sustainable environment for existing stakeholders and broadcasting permission holders.

(xli) The methodology for assignment of spectrum for user links for space-based communication services in higher spectrum bands (such as C-band) should be administrative, as is the globally accepted practice. The auction method of assignment of spectrum is unsuitable, as it is inconsistent with ITU's Regulation Framework and may lead to segmentation.

(xlii) **S**atellite spectrum for use by broadcasters should continue to be administratively allocated as vertical frequencies of C Band is a shared spectrum which is coordinated by ITU and of which there is no scarcity. Status quo should be maintained as auctioning the same will have a detrimental impact on the broadcast industry.

(xliii) Any recommendation that is finally made by TRAI must first consider the existential threat to the broadcasters and legacy users who are wholly dependent on the C Band spectrum for Uplinking and Downlinking of signals.

(xliv) Frequency spectrum in higher frequency bands (such as C-band) for satellite communication services ought not to be exclusively assigned to preserve media diversity and to avoid consolidation of frequency spectrums with larger entities. Rather, frequency spectrum should be assigned on a shared (non-exclusive) basis. The mandatory intra-band sharing of frequency spectrum with other satellite communication service providers does not appear to be a feasible policy. The sharing of frequency spectrum among satellite communication service providers should be left to mutual coordination since there is no compelling need for an overarching framework.

(xlv) Auctioning of satellite spectrum is not in public interest. Even the Supreme Court, in the Presidential Reference[16] to the 2G spectrum judgement (a judgement on terrestrial spectrum that us assigned on an exclusive basis), emphasised that *"Auction may be the best way of maximising revenue, but revenue maximisation may not always be the best way to serve public good."* Drawing from this judgement and the fact that satellite spectrum can be shared amongst multiple service providers without diminishing what is available to others, administrative allocation is the most efficient method of allocation.

(xlvi) Seeking to auction such a shareable resource is an attempt to artificially change the characteristics of satellite spectrum. This will disrupt existing use cases of satellite spectrum and lead to market failures for such markets. It is for this reason that there are no international best practices or precedents that India can draw upon. TRAI has also acknowledged this fact in para 3.122 of the CP, noting that countries like the US and Brazil, that tried auctioning have reverted to administrative allocation.

"3.122 *On examination of the international experience on auction of spectrum for space-based communication services, it has been observed that a few countries, such as USA, Brazil and Saudi Arabia, have conducted auctions for frequency spectrum in the past. USA and Brazil conducted auction of satellite spectrum along with orbital slots. <u>However, both the countries have reverted to administrative assignment</u>. Saudi Arabia recently conducted auction of spectrum in S-band. Since the technical characteristics of S-band are such that it is assigned on exclusive basis for MSS, auction can be conducted in a manner similar to the spectrum auction for terrestrial mobile services. Therefore, it can be inferred that internationally, <u>there is no design model available for auction of the frequency spectrum in higher frequency bands such as C-band, Ku band</u>, and Ka band, which are sharable among multiple service providers.*

3.123 *In view of the above, there may be a need to look for new methods to assign frequency spectrum for space-based communication services. The Authority is undertaking the exercise for assignment of spectrum for space-based*

[16] *Special Reference No. 1 of 2012, [2012] 9 SCR 311*

Indian Broadcasting & Digital Foundation

> *communication services through a market mechanism for the first time and <u>there is no international experience in auction of space spectrum</u> on the matter except few cases where orbital slots along with spectrum have been auctioned."*

For these reasons, and all the points mentioned in our submissions, we strongly recommend that satellite spectrum be administratively assigned and not auctioned.

Accordingly, in this submission, the IBDF has limited itself to matters of policy and fundamental principles, rather than any specifics in respect of auction, which is reiterated as not being a valid process to be considered for Broadcast Satellite Spectrum.

Q.1. For space-based communication services, what are the appropriate frequency bands for (a) gateway links and (b) user links, that should be considered under this consultation process for different types of licensed telecommunications and broadcasting services? Kindly justify your response with relevant details.

IBDF Comments:

(a) The above question should be reframed to create a distinction between the existing space-based services such as VSATs, Broadcasting (C&S), DTH, Maritime and other legacy services and any telecommunication services or future GSO HTS and LEO/MEO services.

(b) The reason for this distinction is that there is no occasion to disturb the present licensed/permission-based services including the methodology of allocation of spectrum, which is as per ITU guidelines.

(c) Access charges which are collected by the WPC for ITU allotted spectrum to these services cannot be extrapolated to create any presumption that vertical frequencies transmitted by Satellites, whether foreign and/or Indian, can be auctioned.

Q.3. Whether there is any practical limit on the number of Non-Geo Stationary Orbit (NGSO) satellite systems in Low Earth Orbit (LEO) and Medium Earth Orbit (MEO), which can work in a coordinated manner on an equitable basis using the same frequency range? Kindly justify your response.

IBDF Comments:

(a) Spectrum sharing is important not only amongst LEO/MEO systems but most important to first consider the existing legacy users and services, with legacy users and services having priority of use without interference.

(b) That it is the duty of each country to frame rules which permit shared use of spectrum not only between the earlier licensed systems, but also regarding those which follow later. In India, there should be a constitution of a Space Body which should look at these strategic issues which have a long-term bearing on the nation rather than just trying to garner revenues from auction.

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Q.4. For space-based communication services, whether frequency spectrum in higher bands such as C band, Ku band and Ka band, should be assigned to licensees on an exclusive basis? Kindly justify your response. Do you foresee any challenges due to exclusive assignment? If yes, in what manner can the challenges be overcome? Kindly elaborate the challenges and the ways to overcome them.

IBDF Comments:

(a) There is no requirement or rationale to support disturbing the present arrangements for allocation of spectrum. The bands of C, Ku and Ka are characterized by the use of satellite spectrum by applications such as Broadcasting, VSATs, DTH, Maritime etc., as elaborated in the CP. These are licensed/ permission-based services and the spectrum allocations are based on the permissions/ licenses so granted.

(b) The DoT in its letter dated 16.08.2022 (Annexure-2 to the Consultation Paper) mentions auctioning the spectrum for space-based communication services on an exclusive basis. However, it is submitted that the exclusive assignment of frequency spectrum in higher frequency bands (such as C-band) for satellite communication services is not a practical solution.

(c) The current model allows the same frequency spectrum to be availed by different satellites and, hence, different broadcasters. The same (or overlapping) spectrum blocks can be assigned to multiple service providers/users, with each one using a different satellite, which is far more advantageous to the broadcasting industry, and to consumers in general, as it lets satellites sell services in the open market, thus reducing cost and promoting innovation. By permitting exclusive licenses or auctions, the government is itself creating barriers to entry and reducing competition, while simultaneously increasing costs.

(d) The importance of diversity in media is paramount, in directly promoting more efficient exchange of ideas and opinions, as imperative for a healthy democracy. The Indian media space is extremely diverse, with big national channels offering services alongside smaller regional niche channels. It is a valid apprehension that assigning spectrum in frequency bands (such as C-band) on an exclusive basis will lead to consolidation of frequency spectrums with relatively bigger market entities, to the exclusion of smaller players. Any entity unable to obtain a spectrum license will have to bear upscale costs to secure access from successful licensees or inevitably get eliminated. The possibility that successful, and bigger, licensees may be unwilling to provide access to other entities altogether must be considered. The risk of raising the entry barrier for those entities willing to enter the market, thus establishing the perfect conditions for a dominance bias market that discriminates based on financial strength.

(e) We suggest that the administration make provisions to ensure that any new users which are licensed for GSO HTS or NGSO systems need to operate on "*no interference basis*" to the existing systems. Further, new systems must provide well documented evidence that no interference will be caused to existing systems due to their operations and steps they intend to take to ensure this.

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Q.5. In case it is decided to assign spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services to licensees on an exclusive basis,

(a) What should be the block size, minimum number of blocks for bidding and spectrum cap per bidder? Response may be provided separately for each spectrum band.

(b) Whether intra-band sharing of frequency spectrum with other satellite communication service providers holding spectrum upto the prescribed spectrum cap, needs to be mandated?

(c) Whether a framework for mandatory spectrum sharing needs to be prescribed? If yes, kindly suggest a broad framework and the elements to be included in the guidelines.

(d) Any other suggestions to ensure that that the satellite communication ecosystem is not adversely impacted due to exclusive spectrum assignment, may kindly be made with detailed justification.

IBDF Comments:

Please note our comments provided and references made, hereabove in paras 4 to 9 of this submission. It is reiterated that as a policy, satellite spectrum for broadcasting services does not need to be auctioned, and that notwithstanding the priority given to legacy users of spectrum allocated, any new systems/space-based communication services must accede to operate on a non-interference basis to existing systems and legacy users.

Q.7. Whether any entity which acquired the satellite spectrum through auction/assignment should be permitted to trade and/or lease their partial or entire satellite spectrum holding to other eligible service licensees, including the licensees which do not hold any spectrum in the concerned spectrum band? If yes, what measures should be taken to ensure rationale of spectrum auction and to avoid adverse impact on the dynamics of the spectrum auction? Kindly justify your response.

IBDF Comments:

That the allocation of satellite spectrum should continue to be done by administrative allocation and we do not support the proposals for auction of spectrum which should be allocated administratively

Q.8. For the existing service licensees providing space-based communication services, whether there is a need to create enabling provisions for assignment of the currently held spectrum frequency range by them, such that if the service licensee is successful in acquiring required quantum of spectrum through auction/ assignment cycle in the

relevant band, its services are not disrupted? If yes, what mechanism should be prescribed? Kindly justify your response.

IBDF Comments:

(a) All new systems must necessarily operate as per ITU provisions of their licenses as purely on no-interference basis, and the Government of India has no locus standi to "auction" any satellite spectrum which the service operators enjoy on Indian or foreign satellites, by virtue of, and as governed by, ITU coordinated orbital slots with associated emissions.

(b) Notwithstanding the current unallocated satellite spectrum, it is necessary to maintain a continuity of licensing and spectrum assignment provisions, as applicable for all service providers such as C-Band broadcasting, DTH, VSATs, Maritime, Aeronautical and other related services, for the preservation and legitimate treatment of existing broadcasting service licensees.

Questions 9[17], 10, 11, 12,13,14, 15

IBDF is not responding to these questions given IBDF's stance to address only fundamentals from a Policy perspective.

(a) Notwithstanding, in view of submissions made, we reiterate that these questions pertain to auction modalities of shared IMT and Satellite use of 28 GHz band which in IBDF's opinion should not be subject to auction and nonetheless, not be used for IMT at all.

(b) At the outset, it is stated that the C-Bands and the Ku-Band should not be termed as higher frequency bands, and this terminology should be preserved for the use of Bands 28 GHz and above

(c) In accordance with the ITU coordination procedures, the band from each satellite (identified by its orbital location) to Earth and from Earth to such satellite is a protected band for that specific orbital location for which the Government India, as a signatory to the ITU-RR, has acceded to the ITU and the right holder countries. Hence this band cannot be used in a shared manner except that satellites at a different orbital location can use the same band, pursuant to the ITU coordination. Hence, if there are any other systems, which use these bands, and have an impact on the orbital location to earth terminals or earth terminals to the satellite at the orbital location, this must happen on a non-interference basis.

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[17] Q.9. "*In case you are of the opinion that the frequency spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services should be assigned on shared (non-exclusive) basis – (a) Whether a broad framework for sharing of frequency spectrum among satellite communication service providers needs to be prescribed or it should be left to mutual coordination? In case you are of the opinion that broad framework should be prescribed, kindly suggest the framework and elements to be included in such a framework. (b) Any other suggestions may kindly be made with detailed justification.*"

Q.16. What should be the methodology for assignment of spectrum for user links for space-based communication services in higher spectrum bands like C-band, Ku-band and Ka-band, such as (a) Auction-based, (b) Administrative, (c) Any other?

Please provide your response in respect of different types of services (as mentioned in Table 1.3 of this consultation paper). Please support your response with detailed justification

IBDF Comments:

(a) The CP has not adequately made out a case for prescribing any framework for sharing of frequency spectrum among satellite communication service providers, and in fact itself concedes that *"Globally, spectrum for satellite communication services in higher bands such as C-band, Ku-band and Ka-band, is being assigned administratively except for a few exceptions, in which orbital slots alongwith spectrum have been auctioned."*[18]

(b) Auctioning of the Spectrum will cause segmentation. The current model of Satellite Spectrum allocation allows the operators to optimally use the spectrum band with multiple satellite operators providing services to various stakeholders. Further, the inefficiency of the proposed auction model for satellite spectrum is evident from the fact that countries like the USA, Mexico and Brazil have failed to successfully adopt the auction model and have resorted to administrative allocation due to the myriad of technical and commercial difficulties associated with satellite spectrum allocation. In case, the proposed auction model for the allocation of Spectrum is adopted it will result in dominant players grabbing huge portions of spectrum thereby restricting smaller players or even eliminating them from the market, thus hampering the optimal and equitable use of the spectrum.

(c) The consideration for adoption of an auction model is even more surprising given the pronouncements by the Government of its intention to facilitate spectrum liberalization and empowerment of the broadcast sector by formulating policies that promote the "ease of doing business".[19] In such circumstances where emphasis is being placed on developing the broadcasting by way Satellite Communication, the adoption of the auction model will prove to be counter-productive as it will run contrary to the aim of inclusivity of all the market players in a level playing field.

(d) It is reiterated that the spectrum for Bands such as C-Band, Ku-Band and Ka-Band for GEO satellites, which are duly coordinated, is owned by such satellites under ITU coordination via a multi-country process in which the Government of India, via the WPC, is the representing administration. Consequently, for various licensed services such as C-band Broadcasting, DTH, VSATs, Maritime, Aero communications, the service providers take leased capacity from the respective satellite operators who have acquired the ITU coordination rights. The users pay the satellite operator the lease charges as applicable for the satellite in use, and as per the rates prevailing in

[18] ¶ Para 3.73, Consultation Paper on Assignment of Spectrum for Space based Communication Services, TRAI, 6th April, 2023

[19] "*Govt. unveils new policy reforms for satellite communication services*", by Business Standard https://www.business-standard.com/article/economy-policy/govt-unveils-new-policy-reforms-for-satellite-communication-services-122102600982_1.html

international markets, where some of these leases may be for a long duration, i.e. 5 years or more based on the satellite. These satellites have a wide footprint which may cover in addition to India, up to 140 or more countries as is the case for Asiasat or Intelsat satellites. Irrespective of the use in India, all the transponders on the satellite are active and beam over the territories covered in the footprint, including India. In India, the WPC charges administrative spectrum charges only for uplink on the satellite, whereas If the transmissions are from a foreign country (as is quite common, from Singapore, Hong Kong or Dubai), the respective Indian users downlink the signals directly and WPC is not involved.

(e) Auction of spectrum is inconsistent with ITU's Regulation Framework, which governs spectrum globally, and is based upon the fundamental principles of equitable access, flexibility, and harmonization.[20] It provides that the allocation of Satellite Spectrum should be undertaken with an approach that is least restrictive and provides level-playing field to all players in order to achieve optimal usage of the Satellite Network. The allocation and operation of the satellite spectrum requires multilateral coordination and cooperation. It is a standard practice across all countries to allocate the spectrum through an administrative procedure at charges which cover the administrative costs. The CP also notes that there have been a few instances where countries had conducted auctions of Satellite Spectrum, which later reverted to administrative allocation. Therefore, at present, there is no design model available for auction of the frequency spectrum in higher frequency bands including C bands, which are sharable among multiple service providers.[21]

(f) Therefore, Satellite Spectrum is a shared commodity which is incapable of being exclusively allocated to a specific operator and as such, it fails to meet the fundamental requirement of being an auctionable commodity. Moreover, Satellite Spectrum auction is a complicated model which cannot be implemented without global coordination as per the ITU Constitution and ITU(RR).

(g) Legacy services and licensed operators in C-Band, Ku and Ka bands need to operate in the existing environment and there is no occasion or possibility of auction of these bands for the licensed services cited in the CP. Further, in respect of the satellite spectrum, it is important to note that:-

(i) The spectrum belongs to the satellite operator which execute leases with Indian consumers, if any. It does not belong to the Government of India.

(ii) Based on the service, there may be millions of terminals which are in use. These 'receive only' terminals do not need to be licensed and can use any spectrum in the range of the Low Noise Blocks.

(iii) The spectrum used is only limited to uplink to the satellite and downlink to the terminal and is very directed having a beamwidth of only 1.5 degrees (typical).

[20] https://www.itu.int/en/council/Documents/basic-texts/Constitution-E.pdf
[21] ¶ 3.122, The Consultation Paper

Hence the same frequencies in say the C-band or Ku-band can be used by dozens of satellites over India and there is no exclusivity involved in for example, an operator using 13.8 GHz, which can be used by other operators on other satellites as well.

(iv) The satellite usage of frequencies cannot be compared with Terrestrial usage where a specific frequency is universally transmitted via dozens of towers and repeaters by virtue of which it is omnipresent in use and cannot be used by other operators.

(v) Any Non-GSO systems which are permitted to operate in these bands must necessarily operate on a non-interference basis only as is very clearly laid down by the ITU regulations for the operation of Non-GSO systems and also explained in the Consultation Paper itself.

Q17. Whether spectrum for user links should be assigned at the national level, or telecom circle/ metro-wise? Kindly justify your response.

Q18. In case it is decided to auction user link frequency spectrum for different types of services, should separate auctions be conducted for each type of services? Kindly justify your response with detailed methodology.

IBDF refrains from providing any comments on this matter for new uses, except to say that all such operations must be on a non-interference basis to existing systems. It is reiterated that the mention of auction is meant to be only for new services under IMT or Non-GSO systems.

Other Questions

IBDF submits that the remaining questions, which are specific to auction modalities and pertain primarily to space-based LEO and GEO-HTS systems, therefore it is refraining from providing any comments on the same.

Annexure 1

Gmail

IBDF . <ibdf@ibdf.com>

C Band spectrum threat for Broadcast & Cable Services due to 5G/6G

President IBDF <president@ibdf.com> Wed, Apr 5, 2023 at 4:13 PM
To: secy.inb@nic.in
Cc: secy-dot@nic.in, cp@trai.gov.in, IBDF <ibdf@ibdf.com>

Shri Apurva Chandra
Secretary,
Ministry of Information & Broadcasting,
Government of India,
A Wing, Shastri Bhawan,
New Delhi.

Dear Sir,

Background:
Spectrum frequencies 3.7 – 4.2 GHz are earmarked for providing broadcasting services. The large geographic coverage of C-band satellite beams represents a cost-effective communication solution, while its low susceptibility and robustness to weather impairments, especially in sub-equatorial regions like India, making C-band the most suitable band to guarantee high service availability. All the satellites (INSAT,GSAT, and International Satellites) used for Broadcast and Satellite Services use this band. Additionally, services in the C band are essential in emergencies and in disaster recovery. For these reasons, C-band is irreplaceable and not substitutable. Therefore, it is imperative that the existing satellite systems operating in the C-band be protected while allocating C-band frequencies to the upcoming 5G deployment. A 100 MHz guard band in C-Band (i.e., 3.6 – 3.7 GHz) should be maintained so as to mitigate any form of interference due to provisioning of IMT services to ensure current and future C-band broadcasting services can continue to operate and thrive.

Mobile terrestrial services and satellite services cannot co-exist in the same geographical area. Satellite signals – coming from a small transmitter located 36,000 km away in geostationary orbit – are weak and 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. This has already played out in the UAE, Singapore, EU and USA where satellite reception has been adversely affected due to 5G roll out in the adjoining frequencies. As a consequence, there will be huge disruption in the cable and satellite industry and thousands of cable operators and hence millions of consumers stand to be affected.

TRAI had, in 2018, recommended auctioning C band spectrum between 3300-3600 MHz band for 5G services, which was later increased to 3300-3670 MHz by DoT. During the consultation process initiated by the regulator, the broadcasters had objected to the addition of 70 MHz. Reducing 100 MHz guard band to 30 MHz has two implications:

- Filters of 3700-4200 MHz, even if used, cannot filter out these out of band emissions as these fall in the 3700-4200 MHz band.
- LNB Overdrive: The LNBs used in Cable Headends, which are typically designed for 3400-4200 MHz, would get overdriven (saturated) due to high terrestrial transmissions. This overdrive could have been prevented by the use of filters of 3700-4200 MHz but with Out Of Band Emissions (OOBE) falling in the pass band of filters, the interference will lead to complete loss of signals.

The broadcasting industry has been voicing its concern over the disruption of satellite services due to dual use. In this regard, we have had several meetings with MIB, DOT/WPC, TRAI and other Senior Government officials and submitted various representations highlighting our concerns. IBDF and other industry bodies viz. AVIA, AIDCF etc had also apprised MIB about the debilitating impact of reduction in guard band on the entire broadcasting sector and consumers vide our earlier letters dated 10 March 2021, 31 March 2021, 13 April 2021 and 2 May 2022 (copy enclosed).

These culminated in clear acceptance and recognition by the TRAI that the interference will indeed disrupt the C-band broadcast TV signals. The disruption caused by 5G signals was also evident during the trials conducted a few months back.

TRAI vide its recommendations dated 11 April 2022 on 5G Auctions, while acknowledging the broadcasters' concerns, on reduction of guard band from 100 MHz to 30 MHz, specifically outlined the actions on part of the MIB based on the realization that the proposed auction of the 3300-3670 MHz bands will cause serious interference in C&S services.

TRAI has accepted the following (vide Paras 2.48 to 2.64 of the recommendations):

- That there will be interference in the Bands of 3700-4200 MHz which is used by C&S industry.
- That there will be issues of Low Noise Block (LNB) overdrive.
- That there is a need to use filters with sharp cut-off in Headends to eliminate interference.
- That MIB needs to sensitize MSOs, DTH Operators and Other C&S users on this subject and implications.

In its recommendation, TRAI had also suggested that there is a need to make use of high-quality bandpass filters operating in the 3700-4200 MHz range.

Issue:
The Government of India has notified reforms in Satellite Communications and also notified the National Frequency Allocation Plan 2022 (NFAP 2022) on 26 Oct 2022. Alarmingly, the entire 3700 MHz – 4200 MHz band (used for C-band downlinking) has now been set for dual use of Satellite and Mobile services (5G). Without adhering to TRAI's recommendation and DOT's own Telecommunication Engineering Centre (TEC) Generic Requirements, NFAP 2022 has further reduced the guard band between broadcasting and 5G services to 10 MHz rather than 30 MHz which was prescribed earlier.

In addition to the above, recent media reports have stated that DoT intends to allocate spectrum up to 4000 MHz for 5G and 6G use. The C&S industry has been clamouring for the preservation of the Broadcast C-Band Spectrum (3700-4200 MHz) for many years. This spectrum is host to approximately 900 channels across 6 major satellites. TRAI has also accepted the position that allocating even in the band 3300-3670 MHz to 5G will cause severe interference in the C-Band up to 3800 MHz and the use of C-Band filters (3700-4200 MHz) will be essential. This new proposition of allocating the band up to 4000 MHz for 5G (making it a range of 3300-4000 MHz) will mean that the already scarce C-Band spectrum will get reduced by 60%, leaving only a small band (4000-4200 MHz) for use by the broadcast industry. This has the potential to fundamentally change the nature of the linear broadcast industry which is entirely reliant on satellite based channel delivery and would also adversely impact the cable ecosystem.

Compromising the C-Band spectrum being used by the broadcast industry is not feasible for the reasons enumerated below:

1. Spectrum Used by the Satellites is an orbitally designated spectrum and is not owned by the Govt of India for Auction

The transmission of the C-band satellites is a highly directional transmission wherein satellites located 2 degrees apart over the orbital locations over India can use the same frequencies. This can be called a vertical use of the frequencies and the term "Spectrum" is inappropriate to be used for such satellite usage. The reason for this is that the same set of frequencies can be used by a different set of users of each satellite in the orbit using exactly the same frequencies.

Thus, users of Asiasat, Intelsat, Measat, and GSAT satellites use the same set of frequencies over India. There is no concept of spectrum or spectrum scarcity for such usage of frequencies.

2. Frequencies for each orbital location are coordinated by the International Telecommunication Union (ITU) and allocable by respective satellites

ITU manages a cooperative system of international coordination on the radio frequencies used by satellites, aimed at preventing such systems from interfering with each other or with other radio systems. It oversees a satellite frequency registration process whereby an ITU Member State sends a description of the radio frequencies planned to be used in a project of its satellite operators.

The Govt of India via WPC is a signatory to the ITU and is required to follow all procedures for coordination of all orbital locations and all frequencies used at each respective orbital location. Thus, each orbital location of all Asiasat, Intelsat and Measat satellites (amongst others) has been duly coordinated by the Govt. of India, which has acceded the use of specific C-band frequencies by the respective satellite owners for all users in the footprint of the satellite, including from India. These frequencies fall in the Band of 3700-4200 MHz.

3. Govt of India cannot allocate the users which use these satellite bands

Under the Open Skies policies for the use of C-band, the satellite operators sign up the users for the use of the satellite. The contracts are signed directly between the broadcasters/ teleport operators and are paid for in foreign exchange. The Govt of India cannot either encroach on the frequency of these ITU coordinated satellite operators, nor assign any specific users who will use these frequencies.

Many of the contracts for these capacities are signed outside of India and the signals are downlinked as per the authorization under the ITU and the Govt of India has no role, once a downlink permission is issued.

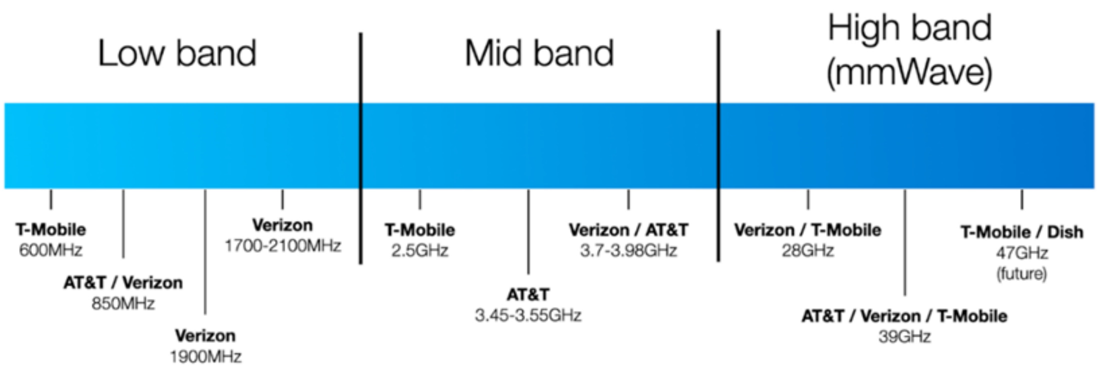
4. Terrestrial Auction of these bands will violate ITU commitments

Satellite operators have been granted the right to use an orbital spectrum on no-interference basis. Recognizing the essential nature of C-band services in tropical Asia, successive ITU World Radiocommunication Conferences have declined to identify the C-band in Asia for mobile "harmonization". This means that the Govt of India cannot auction such spectrum which will directly interfere with the ITU coordinated satellite frequencies.

Moreover, the usage of terrestrial spectrum is omni-present i.e. precludes the use of any other usage in the same frequency band due to the high powers of transmission used. However, the satellites use the same set of 3700-4200 MHz frequencies, from multiple orbital locations and the use from one location does not preclude the use from another location.

5. There are alternate bands where 5G/6G can be launched

For 5G/6G to achieve its required data rates, ultra-low latency, increased network capacity, reliability and secure services, more spectrum resources and much larger available bandwidth (more than 500 MHz wide frequency blocks) than ever before is necessary. This is not available at C-band. 5G at C-band would only be an interim solution somewhere between 4G and 5G and would need to be transferred to higher frequency bands later to provide the data rates required for 5G. Instead of spending resources on deploying what at best would be of use for a transitional period, it might be better to focus on enhancing the spectrum efficiency in using the existing lower frequency bands already allocated to 2G/3G/4G/5G and develop IMT 2020 in bands suitable to provide the data rates required. For this purpose, millimeter wave (mm wave), New Radio (NR) and Extremely High Frequency (EHF) (mainly above 30 GHz) bands are alternatively good options to provide wide spectrum and most countries have permitted the use of 5G via auctions in these bands. The user-phone ecosystems support such bands. It may be noted that 5G use in USA is already heavily into mm Wave bands.



The above deployment chart in USA shows that there is just Verizon/ AT&T in the 3.7 to 3.98 Band, while High Bands (mmWave) are well utilized.

6. Comparison to USA is not appropriate

While in USA, a part of Mid band spectrum up to 4000 MHz has been allotted for 5G use, the Federal Communications Commission (FCC) authorized upto ~US$ 9.7 billion in payments to cover the costs of launching new satellites and filters placed on earth stations to shift the spectrum users on top of the incentive payments. These funds were paid out of auction proceeds of 5G spectrum. Consequently, SES has launched two new satellites (SES-18 and SES-19) and three additional satellites are being brought into service (SES 20,21 and 22). Intelsat has likewise launched new satellites (Galaxy 35,36 and 37). The Indian C-Band Satellite ecosystem will become completely dysfunctional if the C-Band spectrum up to 4000 MHz is encroached upon and will lead to virtual decimation of the C&S ecosystem especially in rural areas.

7. Flawed assumption of scarcity of spectrum for broadcasting sector

Prescribing auctioning as the primary method of dispensation on the assumption of scarcity of spectrum across all the range of services is flawed. Specific to the broadcasting sector, while usage of scarce spectrum may be the case for telecom operators, who require exclusive access to the limited 'terrestrial spectrum', broadcasting does not avail any exclusive access to such scarce spectrum, within the same fold as telecom operators. However, if mobile industry requests for bands up to 3800 MHz is granted, over 20 Indian and Foreign satellites over India would lose more than 60% of their available capacity, by comparison to the entire 3400 MHz – 4200 MHz band. Scramble for the remaining frequencies amongst TV channel operators would drive up the prices and the resulting economic impact on the industry would be catastrophic.

8. Consumer Impact

With the reduced bandwidth for Broadcast, the interference generated by 5G in the C-band will directly and immediately impact thousands of headends across the country. The impact will be highest for headends located in interior markets and rural areas due to the quality of hardware currently deployed (Antennae, other equipment and wiring), operator scale and the non-feasibility of filters (challenges of cost and immediate availability) needed for such a sharp cut off of the band. The impact will be felt by millions of consumers in these markets, where the disruption will be immediate and significant. Most of the homes impacted will be in the middle or lower income groups, for whom TV is the only, and the most reasonable form of entertainment, information dissemination and education available.

In view of the foregoing, we implore the Government not to auction 3700 MHz to 4200 MHz band by virtue of the sanctity seemingly granted under NFAP-2018 to prevent complete decimation of the cable & satellite industry and the millions of TV consumers / viewers.

We solicit your urgent intervention in this matter for the reasons stated above.

A small delegation of IBDF members is also keen to meet you in person to apprise you about the aforesaid issues in greater detail. We would be grateful if you could kindly grant us an audience at your earliest convenience.

Look forward to your kind confirmation.

Yours sincerely,

K. Madhavan
President

Encl.: as above

Copy to:
1. Shri K. Rajaraman, Chairman, DCC & Secretary (T), Department of Telecommunications
2. Dr. P. D. Vaghela, Chairman, Telecom Regulatory Authority of India

Indian Broadcasting
& Digital Foundation

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---------- Forwarded message ----------
From: President IBF <president@ibfindia.com>
To: secy.inb@nic.in
Cc: IBF India <ibf@ibfindia.com>, asmib.inb@nic.in, jspna-moib@gov.in
Bcc:
Date: Wed, 10 Mar 2021 10:10:19 +0530
Subject: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services- Request for Intervention

Shri Amit Khare
Secretary,
Ministry of Information & Broadcasting,
Shastri Bhawan, A Wing,
New Delhi – 110 001

Sub: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services - Request for Intervention

Dear Shri Khare,

The Indian Broadcasting Foundation (IBF) would like to seek your urgent intervention in the proposed set of actions on the anvil to make part of the C-Band Spectrum, now used by the Cable and Satellite (C&S) Industry unavailable.

These set of actions to use the Satellite downlink Spectrum used by broadcasters and Cable operators either unavailable or beset with severe interference issues to make services unviable.

As per the current National Frequency Allocation Plan 2018 (NFAP-2018) only spectrum outside this band of 3700-4200 MHz (which is used by used by Broadcasters and MSOs) i.e. 3300-3600 MHz is earmarked to be used by the 4G/5G services. While this band has been free over the years, potential auctions for 5G are likely to allocate it for 5G use. Various International studies including those affiliated with the ITU, IEEE and field trials conducted have concluded that the IMT and satellite services cannot co-exist in the same geographical area, and that the IMT operating in 3.4-3.6 MHz will have detrimental effects on satellite reception in the entire 3.4 - 4.2 GHz band. It will be required by regulations that the 5G operators use special filters to restrict any out of band emissions which may affect satellite signals.

However, the matter of concern for the industry is that the existing NFAP-18 is now proposed to be revised post-haste to include new bands for 5G use by DOT's arm, WPC wherein bands from 3400 to 3800 MHz or even beyond till 4000 MHz may be earmarked for 5G services. DoT has already constituted a Committee for this under WPC (Copy enclosed in Annexure).

If as a result of this revision, any allocation of frequencies to 5G services beyond the current NFAP-18 upper limit of 3600 MHz is done, it will lead to serious disruption of Satellite services for media and broadcast in the 3700-4200 MHz band. Today over 600 licensed satellite channels over India operate in this band.

The disruption occurs due to the following reasons:

(i) The power received from satellite at receiver LNBs is much lower (~60 dB lower) than that of 5G Terrestrial signals which operate at a very heavy power level. This leads to the overloading of the LNBs of satellite Antennas and no signal can then be received.

(ii) Simultaneous use of the band by Satellite and Terrestrial 5 G services is not possible.

As an example, in 2019, the Arab Spectrum Management Group (ASMG) had announced that it plans to allocate 3.3 to 3.8 GHz spectrum range for use by mobile broadband. Since the allocation of the 3.4 to 3.8 GHz band in 2020 the C-band downlinks operating even in the normal C-Band have been affected severely in Dubai. The same is the case in the EU, US and Singapore.

The entire Linear TV broadcasting industry revolves around the use of C-Band Spectrum where the downlinks by all broadcasters intended for reception by DPOs (Cable operators, MSOs, DTH operators) are in the band of 3700-4200 MHz as prescribed by the ITU and also governed by the downlink policy by the Govt of India.

So far as 5G services are concerned, there are many bands which are available for use, while the same is not the case for C-band Cable and Satellite Services. In fact, most of the new deployments in 5G networks are in the "mmWave bands" also termed as the 5G-nr-Bands (n-258-26 GHz, n260- 39 GHz, n261-28 GHz) where very large bandwidths are available. However, as these bands require higher number of towers, there is a profit motive towards subsuming the C-Band used by C&S services.

The use of part (or full) C-Band spectrum has been done in other countries by compensating satellite operators as well as C&S industry by tens of billions of dollars using which, the ground networks are being fitted with 5G terrestrial filters, and new satellites which do not use the part of C-Band spectrum now being used for 5G are being developed and launched. In case of India in the absence of availability of space resources, any decision to subsume the C-Band will be catastrophic. Half of all channels on satellites will become unserviceable in the current bands, and most of satellites including INSAT/GSAT satellites will become partially defunct.

Of equal importance is the uplink band of 5900-6400 MHz which is the paired uplink band for 3700-4200 MHz downlink C-Band. In case this band is allocated to any wide area public services including Public wi-Fi, these will interfere with the satellite uplinks and downlinks.

While as IBF we understand the need to provide resources for 5G, we believe that a very studied and transparent approach needs to be followed to ensure continuity of Services and growth in these sectors. As a background, prior to 2008, the entire band of 3400-4200 MHz had been reserved for Fixed C-Band Satellite Services (Space to Earth). This is divided into two parts- the Normal C-Band (3700-4200 MHz) and the Lower extended C-Band (3400-3700 MHz). In 2007, the satellite services in the lower extended C-Band were asked to shift to the normal

C-Band vide No. L-14035/02/2007-LR Dated 16.01.2007 (Shifting of existing satellite based operation in the band 3.4GHz to 3.7GHz to normal 'C' band (3700-4200) or Ku band.

This leaves only the band of 3700 MHz to 4200 MHz now the sole band which is used for C-band downlinks on which the entire broadcasting and C&S services industry in India is based. This entire bandwidth from 3700MHz to 4200MHz is required to cater to the transmission needs of approx. 1000 channels. Using this frequency band in part or full will also lead to creation of bandwidth crisis for C-band Cable and Satellite which can be very much avoided by proper planning. We would like to flag these issues in advance for appropriate actions and directions to ensure the sustenance and growth of M&E industry in India.

Spectrum Auctions in the 700 MHz-900 MHz Bands

We have noted that the DoT has issued notification for Spectrum Auctions to be held in March 2021 for the 700-900 MHz bands. As per the notification a single auction process will be carried out for assigning spectrum blocks in various bands, viz. 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands.

However, it will herald serious problems for the C&S sector in India, the magnitude of which is fully yet to be appreciated.

Cable TV services have been using the spectrum up to about 900 MHz in both analog and digital implementation and Cable Internet is one of the preferred mediums for urban and rural broadband.

Impact on the C&S Industry and Digitalization Plans

The band identified is APT700 band plan (698-806 MHz) with FDD based 2x45 MHz frequency arrangement. In essence, there is a spectrum band of 108 MHz (698-806) MHz which TRAI has proposed be adopted for use of LTE and be auctioned. The problem is that the use of these very bands is critical for Cable TV and rural broadband, to be delivered by LCOs and MSOs as recommended by the TRAI.

The 700 MHz is called the upper UHF band, and, the band in various countries has only been given after following a due process of consultation and providing alternative transmission mechanisms and safeguards for the Digital, Analog and cable TV Transmissions in these respective countries.

The VHF, UHF and upper UHF bands which span from 300 MHz to 850 MHz are extensively used for Cable TV in India which remains coaxial or hybrid coaxial. In most areas (DAS-IV), now digital, the frequencies in these bands are fully used for broadband and digital TV. With nearly 800 channels including HD channels and 50-100 Mbps of broadband delivered to homes, the use of the spectrum till 850 MHz is an essential need for the cable TV industry.

Considering the significance of the matter for the broadcast sector, we request your humble selves to grant us a meeting to present our views and also convey these to the WPC.

Look forward to your kind confirmation.

Best Regards,

K. Madhavan
President

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---------- Forwarded message ----------
From: "IBDF ." <ibdf@ibdf.com>
To: secy.inb@nic.in
Cc: cabinetsy@nic.in, chairman@isro.gov.in, Chairman TRAI <cp@trai.gov.in>, secy-dot@nic.in
Bcc: Siddharth Jain <siddharth.jain@ibdf.com>
Date: Mon, 2 May 2022 14:13:56 +0530
Subject: Urgent follow-up actions needed post TRAI's Recommendations on 5G Auctions

Shri Apurva Chandra
Secretary,
Ministry of Information & Broadcasting,
Government of India,
A Wing, Shastri Bhawan,
New Delhi.

Dear Sir,

Further to our earlier letters to the Ministry of Information & Broadcasting (MIB) dated 10 March 2021, 31 March 2021 and 13 April 2021 (copy enclosed), IBDF would like to draw your kind attention to the TRAI recommendations on 5G Auctions which have been released on 11 April 2022. Based on these recommendations, the auction of Spectrum for 5G services is the next logical step followed by the launch of 5G services. We expect these to happen expeditiously in the next few months.

TRAI in its recommendations (which inter-alia contains recommendations for the auction of the 3300-3670 MHz band) has specifically outlined the actions on part of the MIB based on the realization that the proposed auction of the 3300-3670 MHz bands will cause serious interference in C&S services.

TRAI has accepted the following (vide Paras 2.48 to 2.64 of the recommendations):

- That there will be interference in the Bands of 3700-4200 MHz which is used by C&S industry;
- That there will be issues of Low Noise Block (LNB) overdrive
- That there is need to use filters with sharp cut-off in Headends to eliminate interference
- That MIB needs to sensitize MSOs, DTH Operators and Other C&S users on this subject and implications.

With this letter we would like to reiterate the concerns of IBDF members regarding impinging on the use of C-Band spectrum, specifically 3.6-4.2 GHz and Government's plans to allocate part of this to International Mobile Telecommunications/5G services as part of the Department of Telecom, WPC's ten-year spectrum planning exercise.

The C-band spectrum is the only spectrum allocated and being utilized by the broadcast industry today (between 3700 MHz – 4200 MHz) will be rendered incapacitated if the immediately adjoining frequencies between 3300MHz – 3670/ 3700 MHz are used for 5G services. This is because 5G signals are at least 10 times stronger as compared to the satellite transmitted RF frequency signals and as accepted by the TRAI, there will be disruption in adjoining services. This has already played out in the UAE, Singapore, EU and USA where satellite reception has been adversely affected due to 5G roll out in the adjoining frequencies. As a consequence, there will be huge disruption in the cable and satellite industry and thousands of cable operators and hence millions of consumers stand to be affected.

As MIB is aware, the broadcasting industry has been voicing its concern over the disruption of satellite services due to the reduction of the guard band. In this regard, we have had several meetings with MIB, DOT/WPC, TRAI and other senior Government officials and submitted various representations highlighting our concerns. These have now culminated in clear acceptance and recognition by the TRAI that the interference will indeed disrupt the C-band broadcast TV signals.

In view of the TRAI's recommendations, IBDF requests MIB to take following measures immediately:

- Standardize and make widely available high-quality near lossless bandpass filters operating in the 3700-4200 MHz range as the IMT emissions in the 3300-3670 MHz may saturate the Low Noise Block (LNB) of the FSS earth station which traditionally operates in the 3400-4200 MHz.
- Work out a mechanism to fund the Distribution Platforms Operators, if necessary, from the Spectrum Auction proceeds via Inter-ministerial arrangement. This has also been done in other countries.
- MIB by virtue of being licensing authority controlling MSOs/LCOs must ensure the use of appropriate bandpass filters and carry out mandatory exercise synchronising with the roll out of 5G services.
- MIB should impress upon DoT to follow the TRAI recommendations to prescribe emission filters having a sharp Spectrum Mask for IMT transmitters with an out-of-band PFD limit.
- Request DoT and WPC to institute an oversight mechanism to ensure that the TSPs use sharp cut-off filters and emission masks as per TRAI recommendations to ensure that the C&S industry is not adversely impacted.
- MIB, being guardian ministry of broadcast industry, must play an active role in coordinating with DOT/Concerned ministry/department for defining the operating parameters for TSP towards 5G operations.
- MIB and all connected decision-making organizations/authorities/departments must finalize this plan and ensure implementation by the C&S Headends at least 6 months before the first implementation of 5G
- Provide a National Escalation Help Desk to report serious incidents of Interference and their quick suppression via verification of emission masks to avoid continued disruptions
- Publish data/reports on the outcome of the 5G trials recently conducted by all potential players along with operating parameters.

We request your urgent intervention in this matter to prevent potential disruption to the cable & satellite industry and the millions of TV consumers / viewers.

In case you require any further information on this issue, we would be happy to meet you along with our subject matter experts.

Look forward to hearing from you.

Yours sincerely,

Siddharth Jain
Secretary General

Copy to:
1. Shri Rajiv Gauba, Cabinet Secretary, Government of India
2. Shri S. Somanath, Chairman, ISRO and Secretary, Department of Space
3. Dr. P. D. Vaghela, Chairman, TRAI
4. Shri K. Rajaraman, Chairman, DCC & Secretary (T), Department of Telecommunications

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& Digital Foundation
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---------- Forwarded message ----------
From: President IBF <president@ibfindia.com>
To: secy.inb@nic.in
Cc: IBF India <ibf@ibfindia.com>, asmib.inb@nic.in, jspna-moib@gov.in
Bcc:
Date: Wed, 10 Mar 2021 10:10:19 +0530

Subject: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services- Request for Intervention

Shri Amit Khare
Secretary,
Ministry of Information & Broadcasting,
Shastri Bhawan, A Wing,
New Delhi – 110 001

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The use of part (or full) C-Band spectrum has been done in other countries by compensating satellite operators as well as C&S industry by tens of billions of dollars using which, the ground networks are being fitted with 5G terrestrial filters, and new satellites which do not use the part of C-Band spectrum now being used for 5G are being developed and launched. In case of India in the absence of availability of space resources, any decision to subsume the C-Band will be catastrophic. Half of all channels on satellites will become unserviceable in the current bands, and most of satellites including INSAT/GSAT satellites will become partially defunct.

Of equal importance is the uplink band of 5900-6400 MHz which is the paired uplink band for 3700-4200 MHz downlink C-Band. In case this band is allocated to any wide area public services including Public wi-Fi, these will interfere with the satellite uplinks and downlinks.

While as IBF we understand the need to provide resources for 5G, we believe that a very studied and transparent approach needs to be followed to ensure continuity of Services and growth in these sectors. As a background, prior to 2008, the entire band of 3400-4200 MHz had been reserved for Fixed C-Band Satellite Services (Space to Earth). This is divided into two parts- the Normal C-Band (3700-4200 MHz) and the Lower extended C-Band (3400-3700 MHz). In 2007, the satellite services in the lower extended C-Band were asked to shift to the normal C-Band vide No. L-14035/02/2007-LR Dated 16.01.2007 (Shifting of existing satellite based operation in the band 3.4GHz to 3.7GHz to normal 'C' band (3700-4200) or Ku band.

This leaves only the band of 3700 MHz to 4200 MHz now the sole band which is used for C-band downlinks on which the entire broadcasting and C&S services industry in India is based. This entire bandwidth from 3700MHz to 4200MHz is required to cater to the transmission needs of approx. 1000 channels. Using this frequency band in part or full will also lead to creation of bandwidth crisis for C-band Cable and Satellite which can be very much avoided by proper planning. We would like to flag these issues in advance for appropriate actions and directions to ensure the sustenance and growth of M&E industry in India.

Spectrum Auctions in the 700 MHz-900 MHz Bands

We have noted that the DoT has issued notification for Spectrum Auctions to be held in March 2021 for the 700-900 MHz bands. As per the notification a single auction process will be carried out for assigning spectrum blocks in various bands, viz. 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands.

However, it will herald serious problems for the C&S sector in India, the magnitude of which is fully yet to be appreciated.

Cable TV services have been using the spectrum up to about 900 MHz in both analog and digital implementation and Cable Internet is one of the preferred mediums for urban and rural broadband.

Impact on the C&S Industry and Digitalization Plans

The band identified is APT700 band plan (698-806 MHz) with FDD based 2x45 MHz frequency arrangement. In essence, there is a spectrum band of 108 MHz (698-806) MHz which TRAI has proposed be adopted for use of LTE and be auctioned. The problem is that the use of these very bands is critical for Cable TV and rural broadband, to be delivered by LCOs and MSOs as recommended by the TRAI.

The 700 MHz is called the upper UHF band, and, the band in various countries has only been given after following a due process of consultation and providing alternative transmission mechanisms and safeguards for the Digital, Analog and cable TV Transmissions in these respective countries.

The VHF, UHF and upper UHF bands which span from 300 MHz to 850 MHz are extensively used for Cable TV in India which remains coaxial or hybrid coaxial. In most areas (DAS-IV), now digital, the frequencies in these bands are fully used for broadband and digital TV. With nearly 800 channels including HD channels and 50-100 Mbps of broadband delivered to homes, the use of the spectrum till 850 MHz is an essential need for the cable TV industry.

Considering the significance of the matter for the broadcast sector, we request your humble selves to grant us a meeting to present our views and also convey these to the WPC.

Look forward to your kind confirmation.

Best Regards,

K. Madhavan
President

INDIAN BROADCASTING FOUNDATION
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9 attachments

Annexure-Office Memorandum_NFAP-2018 Review dated 26.02.2021.pdf
461K

IBDF letter dated 10 Mar 2021_Urgent_ C-Band Spectrum Threat in Broadcast and Cable Services-Request for Intervention.eml
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IBDF letter to Minister I&B dated 31 Mar 2021.pdf
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IBDF letter to MIB dated 13 Apr 2021.pdf
1822K

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3916K

Annexure 2

From : IBDF . <ibdf@ibdf.com> Mon, May 02, 2022 02:13 PM

Subject : Urgent follow-up actions needed post TRAI's Recommendations on 5G Auctions 3 attachments

To : secy inb <secy.inb@nic.in>

Cc : cabinetsy@nic.in, chairman@isro.gov.in, Chairman TRAI <cp@trai.gov.in>, secy-dot@nic.in

Bcc : Siddharth Jain <siddharth.jain@ibdf.com>

Shri Apurva Chandra
Secretary,
Ministry of Information & Broadcasting,
Government of India,
A Wing, Shastri Bhawan,
New Delhi.

Dear Sir,

Further to our earlier letters to the Ministry of Information & Broadcasting (MIB) dated 10 March 2021, 31 March 2021 and 13 April 2021 (copy enclosed), IBDF would like to draw your kind attention to the TRAI recommendations on 5G Auctions which have been released on 11 April 2022. Based on these recommendations, the auction of Spectrum for 5G services is the next logical step followed by the launch of 5G services. We expect these to happen expeditiously in the next few months.

TRAI in its recommendations (which inter-alia contains recommendations for the auction of the 3300-3670 MHz band) has specifically outlined the actions on part of the MIB based on the realization that the proposed auction of the 3300-3670 MHz bands will cause serious interference in C&S services.

TRAI has accepted the following (vide Paras 2.48 to 2.64 of the recommendations):

- That there will be interference in the Bands of 3700-4200 MHz which is used by C&S industry;
- That there will be issues of Low Noise Block (LNB) overdrive
- That there is need to use filters with sharp cut-off in Headends to eliminate interference
- That MIB needs to sensitize MSOs, DTH Operators and Other C&S users on this subject and implications.

With this letter we would like to reiterate the concerns of IBDF members regarding impinging on the use of C-Band spectrum, specifically 3.6-4.2 GHz and Government's plans to allocate part of this to International Mobile Telecommunications/5G services as part of the Department of Telecom, WPC's ten-year spectrum planning exercise.

The C-band spectrum is the only spectrum allocated and being utilized by the broadcast industry today (between 3700 MHz – 4200 MHz) will be rendered incapacitated if the immediately adjoining frequencies between 3300MHz – 3670/ 3700 MHz are used for 5G services. This is because 5G signals are at least 10 times stronger as compared to the satellite transmitted RF frequency signals and as accepted by the TRAI, there will be disruption in adjoining services. This has already played out in the UAE, Singapore, EU and USA where satellite reception has been adversely affected due to 5G roll out in the adjoining frequencies. As a consequence, there will be huge disruption in the cable and satellite industry and thousands of cable operators and hence millions of consumers stand to be affected.

As MIB is aware, the broadcasting industry has been voicing its concern over the disruption of satellite services due to the reduction of the guard band. In this regard, we have had several meetings with MIB, DOT/WPC, TRAI and other senior Government officials and submitted various representations highlighting our concerns. These have now culminated in clear acceptance and recognition by the TRAI that the interference will indeed disrupt the C-band broadcast TV signals.

In view of the TRAI's recommendations, IBDF requests MIB to take following measures immediately:

- Standardize and make widely available high-quality near lossless bandpass filters operating in the 3700-4200 MHz range as the IMT emissions in the 3300-3670 MHz may saturate the Low Noise Block (LNB) of the FSS earth station which traditionally operates in the 3400-4200 MHz.
- Work out a mechanism to fund the Distribution Platforms Operators, if necessary, from the Spectrum Auction proceeds via Inter-ministerial arrangement. This has also been done in other countries.
- MIB by virtue of being licensing authority controlling MSOs/LCOs must ensure the use of appropriate bandpass filters and carry out mandatory exercise synchronising with the roll out of 5G services.
- MIB should impress upon DoT to follow the TRAI recommendations to prescribe emission filters having a sharp Spectrum Mask for IMT transmitters with an out-of-band PFD limit.
- Request DoT and WPC to institute an oversight mechanism to ensure that the TSPs use sharp cut-off filters and emission masks as per TRAI recommendations to ensure that the C&S industry is not adversely impacted.
- MIB, being guardian ministry of broadcast industry, must play an active role in coordinating with DOT/Concerned ministry/department for defining the operating parameters for TSP towards 5G operations.
- MIB and all connected decision-making organizations/authorities/departments must finalize this plan and ensure implementation by the C&S Headends at least 6 months before the first implementation of 5G
- Provide a National Escalation Help Desk to report serious incidents of Interference and their quick suppression via verification of emission masks to avoid continued disruptions
- Publish data/reports on the outcome of the 5G trials recently conducted by all potential players along with operating parameters.

We request your urgent intervention in this matter to prevent potential disruption to the cable & satellite industry and the millions of TV consumers / viewers.

In case you require any further information on this issue, we would be happy to meet you along with our subject matter experts.

Look forward to hearing from you.

Yours sincerely,

Siddharth Jain
Secretary General

Copy to:
1. Shri Rajiv Gauba, Cabinet Secretary, Government of India
2. Shri S. Somanath, Chairman, ISRO and Secretary, Department of Space
3. Dr. P. D. Vaghela, Chairman, TRAI
4. Shri K. Rajaraman, Chairman, DCC & Secretary (T), Department of Telecommunications

Indian Broadcasting
& Digital Foundation
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From : President IBF <president@ibfindia.com> Wed, Mar 10, 2021 10:10 AM

Subject : Urgent: C-Band Spectrum Threat in Broadcast and Cable Services- Request for Intervention

1 attachment

To : secy inb <secy.inb@nic.in>

Cc : IBF India <ibf@ibfindia.com>, asmib inb <asmib.inb@nic.in>, jspna-moib@gov.in

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Annexure-Office Memorandum_NFAP-2018 Review dated 26.02.2021.pdf
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IBDF letter to Minister I&B dated 31 Mar 2021.pdf
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IBDF letter to MIB dated 13 Apr 2021.pdf
2 MB

Government of India
Ministry of Communications
Wireless Planning and Coordination Wing
6th Floor, Sanchar Bhawan, New Delhi-110001

T-11012/03/2020-Conf　　　　　　　　　　　　　　Dated: 26.02.2021

OFFICE MEMORANDUM

A committee to Review/Revise National Frequency Allocation Plan (NFAP)-2018 is constituted with approval of competent authority under the Chairmanship of Wireless Adviser to the Government of India.

2. The constitution of the Committee- Chairmen of Working Groups is as follows:

Working Group	**Chairmen**	**Designation**	**Email**
Working Group-1: for frequency bands upto 1 GHz	Sh. V.J. Christopher	Joint Wireless Adviser, Regional Licensing Office, Mumbai	vj.christhopher@nic.in
Working Group-2: for frequency bands 1 GHz to 6 GHz	Sh. R.K. Saxena	Director, Wireless Monitoring Organisation	rk.saxena62@gov.in
Working Group-3: for frequency bands beyond 6 GHz	Sh. Sukhpal Singh	Joint Wireless Adviser, WPC Wing (Headquarter)	singh.sukhpal@nic.in

3. Chairmen of Working Groups may carry out consultations with stakeholders within four weeks from the date of issue of this OM.

4. The Committee will review and revise the NFAP 2018 taking into consideration the recommendations of World Radiocommunication Conference 2019 as available in Radio Regulations 2020, national requirements, latest developments in the radiocommunication technologies.

5. The Committee may consider proposals received from all stakeholders while reviewing and revising NFAP-2018.

(Sachin Kumar)
Assistant Wireless Adviser (Conference)
WPC Wing, DoT
Ph: +91 11 23326829

To: All concerned

31 March 2021

Shri Prakash Javadekar
Hon'ble Union Minister of Information & Broadcasting,
Government of India,
A Wing, Shastri Bhawan,
New Delhi – 110 001

Sub: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services - Request for Intervention

Dear Sir,

With this letter we would like to express the concerns of IBF members using C-Band spectrum, specifically 3.6-4.2 GHz and Government's potential plans to allocate this to International Mobile Telecommunications as part of the Department of Telecom, WPC's ten-year spectrum planning exercise.

The normal C-band spectrum being utilized by the broadcast industry today (between 3700 MHz – 4200 MHz) may be rendered incapacitated if the immediately adjoining frequencies between 3400 MHz – 3600 / 3700 MHz are used for 5G services. This is because 5G signals are very strong compared to satellite generated frequencies and there is likely to be disruption in adjoining services. This has already played out in the UAE, Singapore, EU and USA where satellite reception has been adversely affected due to 5G roll out in adjoining frequencies. As a consequence, there will be huge disruption in the cable and satellite industry and thousands of cable operators and as a result millions of television viewers stand to be affected.

In this regard, we have already submitted a detailed representation to Shri Amit Khare, Secretary, Ministry of Information and Broadcasting highlighting our concerns. The same is enclosed herewith for your reference.

Considering the significance of the matter, on behalf of the broadcasting fraternity, I request your kind and immediate intervention in this matter, otherwise it will herald serious problems for the Cable & Satellite sector in India, the magnitude of which is fully yet to be appreciated.

If you so desire, a small delegation of the IBF Board members can meet you through virtual mode to apprise you of the concerns in person.

Look forward to your kind support.

Yours sincerely,

K. Madhavan
President
Indian Broadcasting Foundation

Encl.: As above

Indian Broadcasting Foundation

B 304, Ansal Plaza, Khelgaon Marg, New Delhi – 110049 India
T: 91 11 43794400 F: 91 11 4379 4455
Email : ibf@ibfindia.com Website : www.ibfindia.com
CIN: U74899DL1999NPL101705

13 April 2021

Shri Amit Khare
Secretary
Ministry of Information and Broadcasting
A-Wing, Shastri Bhawan
New Delhi - 110 001

Sub: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services - Request for Intervention

Dear Sir,

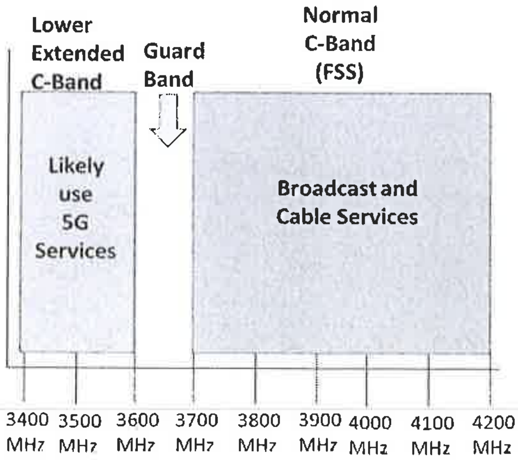
This has reference to our below communication dated 10 March 2021 and the subsequent meeting of the IBF delegation with Smt. Neerja Sekhar, Additional Secretary, MIB and Shri Vikram Sahay, Joint Secretary (P&A), MIB held on 7 April 2021 regarding the upcoming spectrum allocations for 5G services and their serious impact on the C&S Services. We would request and reiterate the submissions in the overall interests including that of effective 5G roll out and safeguarding of broadcast media industry as below –

a) C Band frequency band of 3.7 to 4.2 Ghz along with its associated uplink band of 5.9 to 6.4 Ghz be protected and kept for C&S Broadcast channels.
b) A guard band of not less than 100 Mhz be kept while allocating spectrum to 5G operators thereby restricting the frequency band upto 3.6Ghz
c) As a longer-term plan millimeter range (26Ghz and above) be allocated for 5G services that would help much higher spectrum utilisaton efficiency and effective large scale products and services roll out for the India

Further, in continuation with our communication sent earlier and the points submitted during the meeting as cited above, we would like to provide for additional data on the emerging scenarios and the potential disruption likely to be caused to the C&S sector in support of our submissions -

1. Base case of Allocation of 5G Spectrum up to 3600 MHz

The base case for allocation and subsequent auction of 5G spectrum is for 3300-3600, which with a guard band of 100 MHz will have no transmissions between 3600-3700 MHz and the broadcast services will continue to use 3700 MHz to 4200 MHz as is the case today.



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CIN : U74899DL1999NPL101705

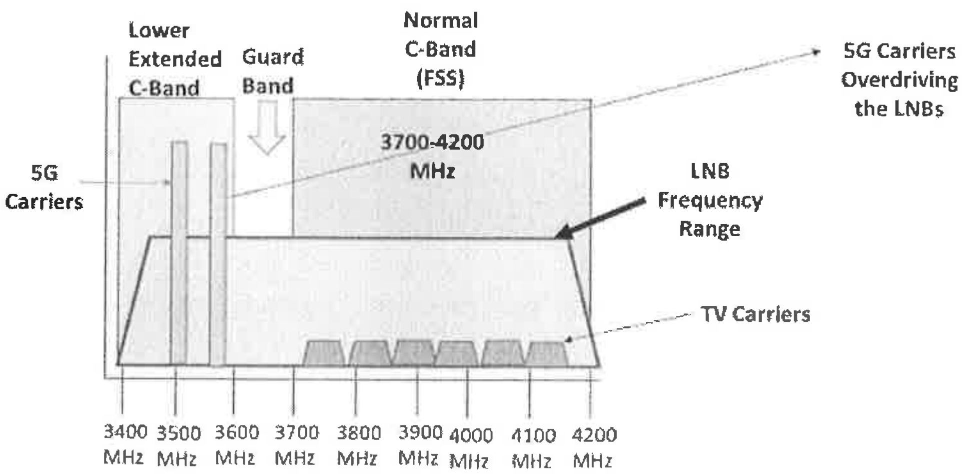
The TRAI recommendations on Spectrum Auction also is only for this band with no reference to any possible extension into the guard band. The band of 3300-3600 MHz is vacant today and hence the services in the 3700-4200 MHz (Regular C-Band) do not face any interference.

In the Indian Cable Sector most RECIEVERS ARE "Block LNBs" i.e. LNA and downconverter combined and these devices have a receive range of 3400-4200 MHz.

Till today, these devices have operated with little interference owing to no transmissions happening in the 3300-3600 MHz bands. The only exceptions have been sites near some Wi-Max stations (3300 MHz) where this interference has been observed. However, WI-Max being very sparsely used and have lower power, because of which serious disruptions have not happened.

Post the activation of carriers in the 3300-3600 MHz band, there will be carriers which will be in the LNB range, which are very strong, and will, in all cable headends located near 5G towers, get overdriven by the strong signals in the 3300-3600 MHz range.

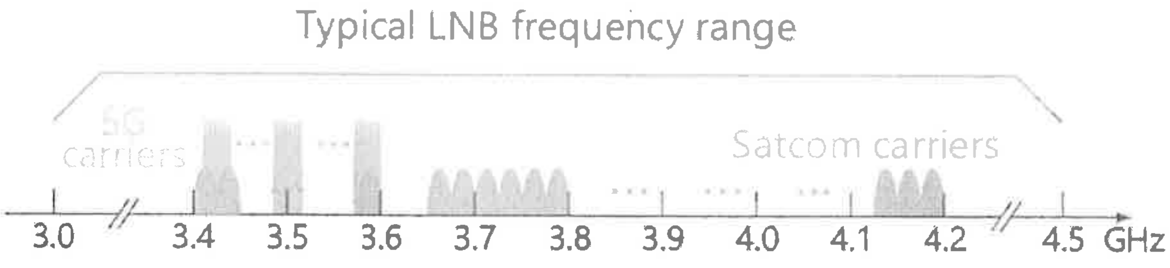
5G carriers will fall in LNB Reception Range



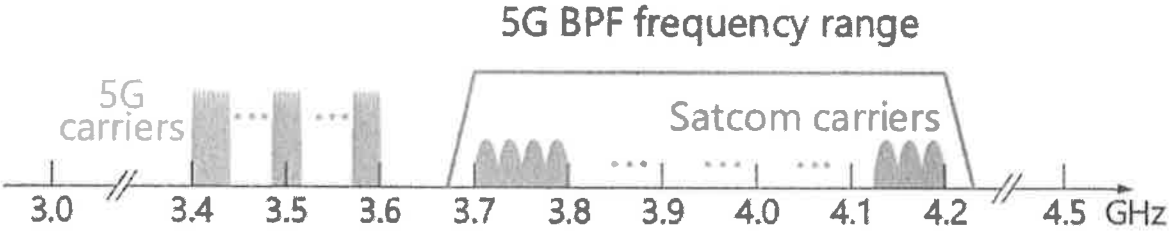
This has been proven by many studies as well as the field data. One such paper is enclosed in Annex1. These adverse effects, which may be experienced even if the interfering signal is out of band, include:

— Gain compression and saturation
— Noise floor degradation
— Unwanted Intermodulation products

The overdrive caused by out of Band carriers in LNBs has been noted duly in the OFCA(Hongkong) Studies. It shows that despite the 5G signals remaining below 3600 MHz, C-Band filters (3700-4200 MHz) are needed for Interference free reception.



(a)



(b)

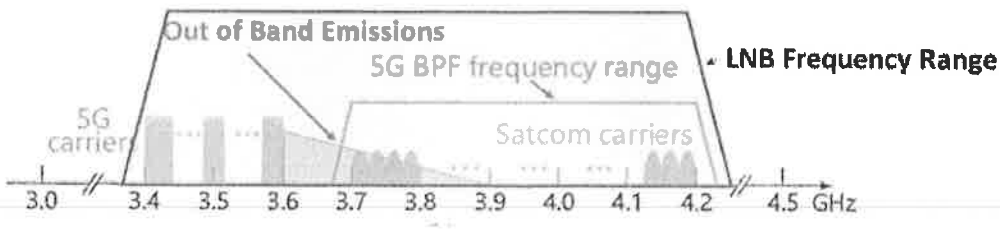
In the current implementations in India, the Cable headends do not deploy LNBs with 5G filters, and hence even if a guard band of 100 Mhz is retained, the headends near the 5G towers will face significant interference and will need to be retrofitted with C-Band filters.

Despite the best filters with sharpest cutoffs, the out of band emissions are so high that these can be eliminated only if the distance of the 5G transmitters is a certain distance away from the headend Antennas. More Information on LNB Overdrive issues is given in Annex-3.

In many cases where the Feed and LNB are fused together, it is not possible to install filters as a retrofit. In such cases the only solution is the replacement of entire LNB block.

2. Expected allocations extending into the Guard Band

There have been some discussions as to whether the 5G allocations could be extended till 3670 MHz with only 30 MHz guard band. **It is also being surmised that a possible scenario could be envisaged that the satellite carriers do not use the band of 3700-3800 MHz which could be left as guard band, moved up in frequency**. There are large number of channels using the first transponder particularly the Indian Satellite GSAT 30 and GSAT10 and this assumption is misplaced and needs to be refuted. However, from the above discussion it is abundantly clear that the 5G carriers still lie in the **LNB band,** and further that the extension of the 5G band to 3670 MHz would mean that the out of Band emissions would still fall not only within the LNB band but also the C-Band filter guard band and will this affect the reception by the LNBs in the entire band.



To quote directly from Paper in Annexure-1:

" Even if the satellite signals received by the C-band terminal are limited to 3.8 to 4.2 GHz, there is still a risk of 5G signal interference. The satellite signal received at the ground terminal is usually several orders of magnitude weaker than the cellular signal. The receiver equipment of a satellite terminal is usually chosen or designed to detect these extremely low power levels in the 3.4 to 4.2 GHz range and the presence of any strong carrier may affect the performance of its receiving system including the LNB and the modem. These adverse effects, which may be experienced even if the interfering signal is out of band"

Hence the moving up of satellite carriers above 3800 MHz is not at all a solution. This is also the reason why countries which have subsumed part of C-Band have needed to use advanced filters and give a time of 2 years or more for transition.

In addition to the technical rationale of the interference in spite of filters being used, there is constraint with respect to availability of transponder space and hence moving up to higher band is absolutely not an acceptable proposition.

It should be noted that the 5G signals will be very strong and widespread due to a large number of towers and a new disruptive situation will emerge.

3. Impact Analysis of 5G Allocation of Frequencies

An analysis of the impact of allotting 5G services beyond 3600 MHz till say 3670 MHz will be immense. While this document tries to quantify the figures, the quantification in terms of disruptions will be immense and can only be estimated.

3.1 Channels Impacted

A list of Channels which will be directly impacted is given in Annexure-2. For the purpose of this document only channels between 3600-3790 MHz have been considered. It may be seen that nearly 200 channels, including HD channels will be directly impacted. The breakup is as follows:

	Summary channels below 3800 MHz		
S.No	**Satellite Name**	**channels below 3800 MHz**	**Details**
1	GSAT-30	80	Annex-2
2	Asiasat-7	58	Annex-2
3	IS-20	45	Annex-2
4	GSAT-10	5	Annex-2
5	Other satellites	12	
	Total Channels	200	

It may be seen that about 25% of the Indian Channel universe will be directly and immediately impacted with sever disruption, while the next 50 MHz (about 100 channels) will also be affected based onsite locations even after using the filters.

The channels on foreign satellites need to be available on the very same satellites owing to the following issues:

(i) **Footprint and distribution related issues.** The distribution needs include Africa, Russia, Eastern Europe, Japan, Far East including Australia and New Zealand.

(ii) **Television Communities Overseas**

Foreign Cable and DTH operators spread out in over 140 countries of Interest in Asia Pacific, Gulf, Africa, MENA and Eastern Europe have Antennas looking at only specific satellites, which are called the TV Hot satellites. They are not willing to put up additional dishes on any new satellites just for one or two channels.

While these channels need to remain on these very satellites due to footprint as well as distribution related issues, these satellites have no capacity to move channels to any higher frequencies.

(iii) Additional Teleport Antenna – If the frequency band is not available on the same satellite, then it implies setting up of additional Teleport on the new satellite which has costs, feasibility and process adverse implication.

3.2 Customer Disruption

There are an estimated over 230 Million customers of C&S services. The entire sector has gone through very turbulent times which has made the very survival at stake due to the following reasons:

(i) NTO 2.0 implementation- has been bogged down by court cases, and even when implemented, there has been customer resistance due to inability of broadcasters to form cost effective bouquets. Many customers have given up on nearly 50% of channels.

(ii) COVID-19 problems- A lot of on ground problems have been faced during the past full year due to COVID and these issues still continue. These relate to production of Films and Shows, Ground events, Sports with spectator attendance and a host of others. The inability to have fresh and engaging content has pushed customers towards OTT services.

(iii) **Any change in current C-Band spectrum allocation would require compensation either from the Government or may increase consumer pay-outs:** Any change to current allocation of C-band spectrum would either force B&CS sector to shift to a different spectrum or would require introduction of filters. This would require huge investment in billions which would need to be compensated either by the Government or through TV subscribers' monthly pay-outs that would eventually lead to increasing subscribers' cost for accessing satellite TV channels.

(iv) **Expected Disruption due to 5G:** The expected interference on channels, degradation of signals are expected to continue for a full 2 years till all mitigating measures including Filters are implemented on the ground. The inferior quality of experience caused will hasten up the migration of consumers from traditional TV to OTT thereby having long term implication and perhaps advancing the sun-set of C & S TV Industry.

3.3 Disruption of cable Headends

There are an estimated 1700 Licensed MSOs with 2-4 headends each and in addition about 100,000 Cable Headends (TRAI data 25-July 2019). These headends, together with 12 Antennas on the average constitute a total of 15,00,000 (1.5 Million) installed dishes which will require to be protected with filters. At an average cost of USD 300 per RF Filter with bulk pricing (3700-4200) with sharp cut-off, the total cost of filters comes to $450 Million (Rs 3375 Crores). Also, the installation/ replacement cost per dish will work out to Rs 2000 per installation. In many cases where the feed and LNB are fused together the entire installation will need to be changed.

4 **Impact on employment**

The B&CS sector contributes significantly in creation of jobs and generates direct and indirect employment for around 1.81 Mn people. Such drastic change in spectrum allocation could impact the employment prospective of the B&Cs sector.

5 **Loss to VSAT, DSNGs, Emergency communication and Marine Services**

C-Band is resistant to rain fade and other signal degradation issues due to weather, and has consequently formed a backbone of VSATs, DSNGs, Emergency communication and Marine Services. Where 5G transmitters operate in vicinity, which is expected to be ubiquitous, the interference will seriously affect these services. These terminals are in many cases proprietary and modifications with external filters etc are not possible.

6 **India requires a special and unique approach that protects the B&Cs and which is different from its Global counterpart while unleashing 5G potential through spectrum allocation:** The B&Cs sector in India caters to 230 million TV subscribers having diverse content preferences via 900+ licensed TV channels broadcasted across 10 genres and over 15 languages. These channels play an important role in informing, educating and entertaining the TV homes. Due to fierce competition amongst stakeholders, television remains the affordable medium for consumers for range of genres which include, news & current affairs, entertainment, sports, movies and kids-entertainment. Therefore, it requires a different, unique and calibrated approach towards protecting the interest of consumers while unleashing 5G's true potential than those taken globally including countries like US and European Union. Comparing can only be made with countries having similar statistics and demography such as China where telecom operators acquired spectrum in 2.5 GHz, 3.5 GHz and 4.8 GHz (n41, n78 and n79) bands only.

7 **Global Best Practices-5G Spectrum Limited to 3600 MHz**

In order to avoid severe disruption many countries have adopted the base case of 5G spectrum being limited to upper limit of 3600 MHz. This has been done based on their extensive studies after public consultations which have been well documented. Even where higher bands till 3700 MHz have been used, the following practices have been adopted:

(i) Assessment of the extent of disruption based on use of C-Band for Various services
(ii) Compensation provided to affected operators
(iii) Time period 2-4 years granted to operators to do the migration

7.1 China

China's Ministry of Industry and Information Technology (MIIT) held the auction for 5G spectrum bands in December 2018. Country's telecom operators acquired spectrum in 2.5 GHz, 3.5 GHz and 4.8 GHz (n41, n78 and n79) bands.

China has allocated the following frequency bands for 5G in C-Band:

[1] MPA-Deloitte Report on "Economic impact of the film, television, and online video services industry in India, 2019" dated May 2020

Band	Frequency	Auction Status	Operator
n41	2.515 - 2.675 GHz	Auctioned	China Mobile
n78	3.4 - 3.5 GHz	Auctioned	China Telecom
n78	3.5 - 3.6 GHz	Auctioned	China Unicom
n79	4.8 - 4.9 GHz	Auctioned	China Mobile

In addition in Dec 2020, China also commenced auctioning the the mmWave Bands for 5G.

7.2 Russia

In Russia, the 3.5 GHz range is not currently available for mobile networks, mainly due to its use for satellite services. An alternative under consideration is the 4.8–4.99 GHz range (the 4.8 GHz band). However, international regulation of this band for 5G is still in flux, with no certainty expected in the next three years at least. By the time of the next World Radiocommunication Conference (WRC) in 2023, it will be clearer as to whether sufficient scale has been realised to allow for affordable mass-market 5G deployments using this band.Russia has limited 5G auctions to 3600 MHz only.

8 Global Best Practices where Band beyond 3600 MHz was allocated and Disruptions

8.1 Korea is one of the countries which has auctioned spectrum till 3700 MHz. Ministry of Science and ICT auctioned spectrum licences in 3.5 GHz (3420-3700 MHz) and 28 GHz (26.5 - 28.9 GHz) in June 2018. Auction results are presented in a table below.

3GPP Band Number	Frequency Range	Duplex Mode	Bandwidth	Operator
n78	DL: 3.42-3.5 GHz UL: 3.42-3.5 GHz	TDD	80 MHz	LG Uplus
n78	DL: 3.5-3.6 GHz UL: 3.5-3.6 GHz	TDD	100 MHz	KT
n78	DL: 3.6-3.7 GHz UL: 3.6-3.7 GHz	TDD	100 MHz	SKT
n257	DL: 26.5-27.3 GHz UL: 26.5-27.3 GHz	TDD	800 MHz	KT
n257	DL: 27.3-28.1 GHz UL: 27.3-28.1 GHz	TDD	800 MHz	LG Uplus
n257	DL: 28.1-28.9 GHz UL: 28.1-28.9 GHz	TDD	800 MHz	SKT

The following facts are noteworthy:

(i) The spectrum in mmWave Bands is 800 MHz each Vs. 100 MHz in C-Band.

(ii) (ii) Korea is a special case as they do not use the satellite C-Band extensively for C&S services.

8.2 Australia -Disruptions and moving to mmWave Bands

Australia had previously allocated 3425 MHz to 3492 MHz and 3542 to 3575 MHz. In Dec 2018, it further allocated spectrum up to 3700 MHz (i.e 3575 to 3700 MHz). The operators of TV and other C-Band services faced severe disruption post the allocation to 5G, including the denial of services in the entire C-Band of 3700-4200 MHz.

https://www.avcomm.com.au/c-band-and-5g-interference/

Australia has now further planned to auction the mmWave bands. In April 2021, it has scheduled a spectrum tender to award high-band 5G spectrum (in the 26 GHz band), which will enable fast, high-capacity services. In the second half of 2021, the government will allocate low-band 5G spectrum (in the 850/900 MHz band), which will be key for broader geographic coverage of 5G services.

9 Auctions in mmWave Bands

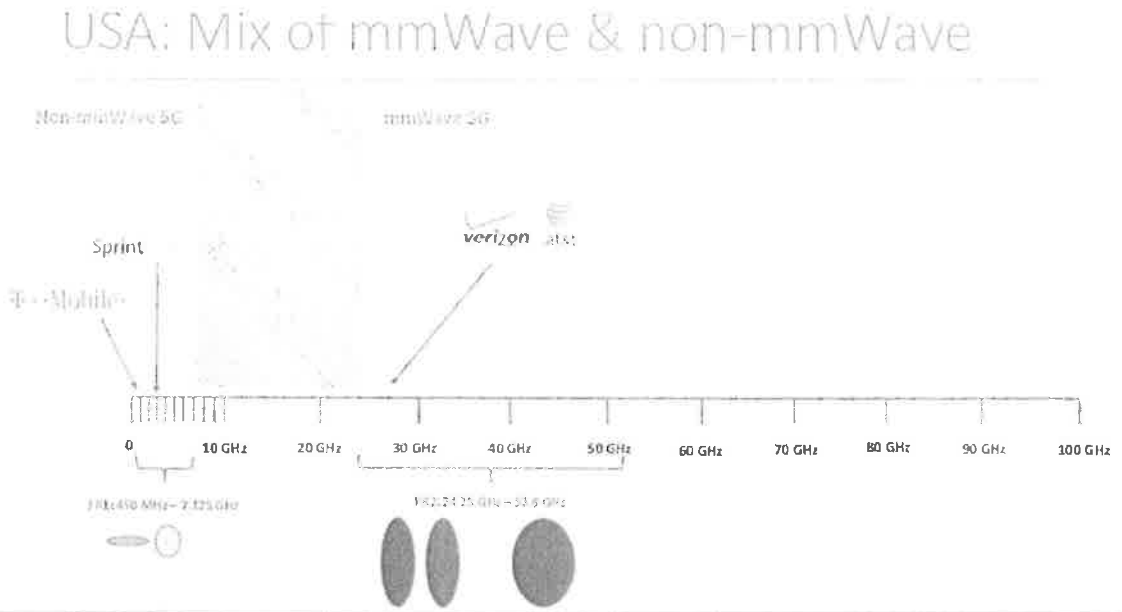
All emerging 5G leaders globally have quickly moved to auction off spectrum in the mmWave Bands. Key statistics for 5G mmWave bands are as below:

Key statistics:

- ninety-seven operators in 17 countries/territories hold public licences (many of them regional) enabling operation of 5G networks using mmWave spectrum.
- twenty-two operators are known to be already deploying 5G networks using mmWave spectrum.
- thirteen countries/territories have announced formal (date-specified) plans for assigning frequencies above 24 GHz between now and end-2021.
- eighty-four announced 5G devices explicitly support one or more of the 5G spectrum bands above 24 GHz (though note that details of spectrum support are patchy for pre-commercial devices), up from 59 at the end of November 2019. Twenty-seven of those devices are understood to be commercially available.

In USA, the FCC in July 2019 FCC announced procedures for the largest mmWave auction. The auction started on Dec. 10th ,2019 and included 37.6 38.6 GHz and 47.2 48.2 GHz across the US and some licenses for 38.6 40 GHz. In March 2020, auctions of 37 GHz, 39 GHz, and 47 GHz were successfully completed. FCC is considering rules for 70/80/90 GHz, and has opened spectrum above 95 GHz.

While the operators in many countries relied initially on the use of Mid-band spectrum, the ultimate move has been to High bands and mmWave bands to achieve 5G speeds needed.



10 Auction Proceeds Vs Media and Ent Industry case

TRAI has recommended a price of INR 490 Crores ($65 million) per megahertz for spectrum in the 3.3-3.6 GHz band. TRAI has not recommended extending auctions beyond the 3600 MHz band.

The IMT lobby is working on two fronts- one to ask Govt. to reduce the Per MHz price, and the second to extend the band to 3670 MHz or even beyond.

The argument which would seem attractive to the Govt, and frequently touted by the IMT lobby would be the additional funds received for the extra 70 MHz which if auctioned at the same rate (Rs 490 Crore Per MHZ) will amount to Rs 34,300 Crores. This will be realized over 10 years, or Rs 3430 Crores per year.

As per market estimates, India broadcasting and cable TV market was valued USD 11.61 Billion (Rs 87,075 Crores) in FY2020 and the market is forecast to reach USD 19.06 Billion (Rs 142,950 Crores) in FY2026.

https://www.techsciresearch.com/report/india-broadcasting-and-cable-tv-market/3281.html

A 30% impairment of the C&S market, which is imminent with increased allocation with 5G will lead to a loss of Rs 42,885 Crores per year based on 2026 revenue projections (Rs 27,000 Crores per year as per 2021 data).

This is over 10 times the auction proceeds on a yearly basis (Auction proceeds of Rs 3430 Crores per year Vs impairment of C&S sector of Rs 27,000 Crores per year increasing to Rs 42,885 Crores per year by 2026.

No doubt in computation of the costs, the costs of impairment of space of Space assets of the Dept of Space (DoS) must also be considered and put in record. A loss of 100 MHz amounts to an impairment of 20% of all C-Band satellites (500 MHz capacity per satellite 3700-4200 MHz).

For 10 satellites serving this band at Rs 800 Crores each (Total value 8000 Crores) the impairment will amount to Rs 800 Crores. There will also be a loss of 100% of Assets in lower extended C-Band (3400-3600 MHz) amounting to about 200 Crores.

The approach of permitting more spectrum beyond 3600 MHz, when alternatives are available in mmWave Bands with 800 MHz per Operator is thus highly short sighted. It will decimate the C&S sector while imparting no benefit to the IMT sector as they need to move to mmWave bands in near future for realizing 5G speeds needed with allocations of 800 MHz per operator being the norm in the higher bands.

Considering the significance of the matter, on behalf of the broadcasting fraternity, we request your kind and immediate intervention in this matter, otherwise it will herald serious problems for the Cable & Satellite sector in India, the magnitude of which is fully yet to be appreciated.

Yours sincerely,

Radhakrishnan
Secretary

CC: Dr. P. D. Vaghela, Chairman, TRAI
CC: Smt. Neerja Sekhar, Additional Secretary, MIB
CC: Shri S. K. Gupta, Secretary, TRAI
CC: Shri Vikram Sahay, Joint Secretary (P&A), MIB
CC: Shri Arvind Kumar, Advisor (B&CS)- I & III, TRAI

Mitigating 5G Interference Signals In The C-Band
By Mehdi Ardavan, RF Design Engineer, Norsat International

The coverage and capacity band of the new 5G cellular network will operate mostly at 3.3 to 3.6 GHz posing interference concerns with the C-band satellite communication terminals which receive Space-to-Earth signals in the 3.4 to 4.2 GHz band. In this article, we prove that the interference signal, in a worst-case scenario, could be orders of magnitude higher than what the C-band terminal can tolerate.

Possible solutions are investigated and the products presented that can mitigate the interference. These products include LNBs with built-in filters and waveguide filters each of which may be a standalone solution or be combined to provide greater rejection of the interference. Guidelines on how to locate the C-band terminals are also presented.

Introduction
Satellite communication terminals operate in different frequency bands, one of which is called C-band. Terminals operating in C-band normally receive signals in the range of 3.4 to 4.2 GHz and transmit signals in the range of 5.85 GHz to 6.425 GHz. Until recently, there was no other well-established terrestrial technology operating in this band.

Although some WiMAX and other terrestrial networks operated at similar bands, they were never widespread and did not raise serious interference concerns. However, 5G cellular technology is expected to be ubiquitous and will share the same spectrum. The 5G interference signals will be powerful enough to saturate the sensitive C-band satellite receiving systems, causing a potential for total loss of service.

To support the efficient coexistence of 5G and LTE operating in the same licensed frequency band, the 3.3 to 3.8 GHz band has gained popularity for developing the 5G network in the coverage and capacity layer [1], [2]. However, in many regions and countries the spectrum of the 5G networks will be limited to below 3.6 GHz such as in Russia, MENA, China, Africa. Some of these countries will also use the range 4.8 GHz to 5.0 GHz or frequencies above 4.4 GHz. In Europe, most countries are planning to use the 3.4 GHz to 3.8 GHz range [2].

As the above mentioned 5G frequency bands fall in the C-band receive spectrum of 3.4 GHz to 4.2 GHz, the receiver of a C-band terminal operating at the same frequency as the 5G signal will face interference. Even if the satellite signals received by the C-band terminal are limited to 3.8 to 4.2 GHz, there is still a risk of 5G signal interference. The satellite signal received at the ground terminal is usually several orders of magnitude weaker than the cellular signal. The receiver equipment of a satellite terminal is usually chosen or designed to detect these extremely low power levels in the 3.4 to 4.2 GHz range and the presence of any strong carrier may affect the performance of its receiving system including the LNB and the modem. These adverse effects, which may be experienced even if the interfering signal is out of band, include...

— *Gain compression and saturation*
— *Noise floor degradation*
— *Unwanted Intermodulation products*

Gain compression occurs when the total power at the input of the LNB reaches or passes its input P1dB. For example, an LNB with an output P1dB = 5 dBm and a gain of Gss = 60 dB will have an output at P1dB if the interfering signal is -54 dBm. This will occur even though the received satellite signal is very small and would not normally cause gain compression. An LNB operating with gain compression will lead to a non-linear distortion at the input of the modem which may affect the modulation error ratio (MER) and Eb/N0 and thus the bit error rate. In a worst-case scenario, the modem may lose the receive lock.

Saturation happens when the power in the interfering signal is too strong and forces the receiver into saturation. In the above example if the interference has a power of around -45 dBm or above, the LNB could be blocked and may not be able to receive any signals.

Noise floor degradation is another effect which may be either uniform across the entire receiving band of the LNB or only present at portions of it. If the noise floor is raised, the signal to noise ratio (C/N) and Eb/N0 will be reduced leading to an increase in the bit error rate.

Intermodulation will occur between the interfering signal and the satellite receive signal or between the interfering signal and the LO of the LNB. The frequency of the resulting intermodulation products could fall into, or close to the operating spectrum of the LNB and cause further interference or simply reduce the linearity of the LNB.

Although this article focuses on a specific interference problem which occurs at 3.6 GHz, the generality of this method remains intact and the reader can apply it to any frequency.

In this article, the received interference power in one near-field and one far-field worst case scenario are calculated and estimated and solutions are recommended to overcome the issue. Multiple interferers are not considered. The effects of multi-path are not considered.

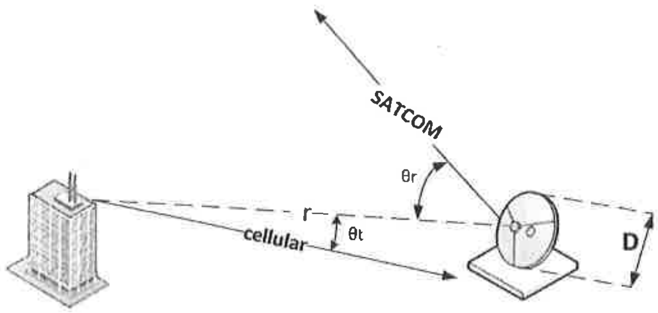


Figure 1. The dashed line shows the distance, r, between the cellular and SATCOM antennas. The line named "SATCOM" shows the boresight of the C-band reflector antenna, making angle with the dashed line. The line titled "cellular" shows the boresight of the cellular antenna making an angle with the dashed line. For simplicity and without loss of generality, all three lines are assumed to be on the same plane. The size of the dish is denoted by D.

5th Gen Cell Signal Interference with C-band SATCOM Terminals

Two worst-case scenarios are now presented wherein the interference from a 5G cellular antenna seems to be significant. The first case occurs at the distance from the antenna known as the far-field distance and the second case takes place when the interferer is closer to the antenna and thus the far-field approximations no longer apply. For simplicity, not accounted for are the multiple sources and the multipath effects.

The field values are calculated assuming 40 W radiation from a cellular antenna with a gain of 18 dBi [5]. Field values and power densities are calculated using standard far-field approximations and some near-field approximations [3] and [4]. The summary of the results are presented in the main body of this article, while the detailed calculations can be found in the *Appendix*.

As seen in *Figure 1*, the transmitting antenna in the defined problem is a cellular antenna whose radiation pattern is usually omnidirectional in the horizontal plane, meaning that its gain is not dependent on ϕt. This is usually achieved by using several sector antennae, each of them covering a region. To be conservative, we assume that the receiving antenna is on the boresight of the transmitting antenna, making $\theta t = 0$, and thus maximizing the transmitted power density. The cellular antenna is in the far field region of the C-band SATCOM terminal if the distance r is greater that the distance to the boundary of the far-field region denoted by Rf which is dependent on the size of the antenna and the wavelength.

The free space loss and the power received by the C-band terminal is computed for different distances. According to [3] the highest power density in the near field occurs at Rf /10 and so this is considered the worst-case scenario and is one of the distances we use for received power, Pr , calculation. We also calculate Pr at Rf and $2Rf$.

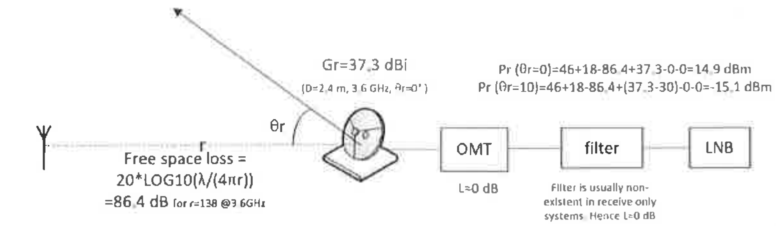


Figure 2. Link budget calculation for the interference caused by a cellular antenna and received by a 2.4- m reflector antenna at 138 meters away.

For a 2.4-m antenna at 3.6 GHz, Rf is equal to 138 meters, therefore Pr is calculated at 13.8 m, 138 m and 276 m. These calculations are performed assuming that the cellular antenna is at the boresight of C-band SATCOM terminal, that is $\theta r = 0$ which is an unlikely scenario as it may cause blockage to the line of sight to the satellite. However, they provide a baseline for further calculations such as when the cellular antenna is not at the boresight of the reflector antenna. The calculations are repeated for an offset angle of $\theta r = 10$ degrees.

All the calculations for a 2.4 m antenna at 3.6 GHz are summarized and illustrated in *Figure 2.*

The far-field distance Rf, free space loss, and Pr are calculated again for different antenna sizes, both at boresight and at $\theta r = 10$ degrees. The results are summarized in *Table 1.*

The last two columns in Table 1 show the received interference levels for different antenna sizes at different distances, assuming both the unlikely case of $\theta r = 0$ and more likely case of $\theta r = 10$ deg. The boresight assumption is unlikely to occur as it may cause satellite blockage. The gain at 10-degree offset angle is obtained from the mask provided in FCC 25.209(a)..

SATCOM Reflector size (m)	Distance (m)	Free Space Loss (dB)	Interferer on Boresight $\theta_r = 0$ degrees (dBm)	Interferer at 10-deg offset angle $\theta_r = 10$ degrees (dBm)
2.4	$R_f/10$=13.8	n/a	31.23	1.23
2.4	R_f=138	86.4	14.9	-15.1
2.4	$2R_f$=276	92.4	8.9	-21.1
3	$R_f/10$=21.6	n/a	29.3	-0.7
3	R_f=216	90.3	12.9	-19.3
3	$2R_f$=432	96.3	6.9	-25.3
3.7	$R_f/10$=32.9	n/a	27.5	-2.5
3.7	R_f=329	93.9	11.1	-22.9
3.7	$2R_f$=658	100.0	5.1	-28.9
9	$R_f/10$=194.4	n/a	19.6	-10.4
9	R_f=1944	109.4	3.4	-38.3
9	$2R_f$=3888	115.4	-2.6	-44.3

Table 1. Interference level received by reflector antennas of different sizes at 3.6 GHz caused by a 40 W cellular antenna with a gain of 18 dBi.

If the assumption is made that the interferer is always at least 10 degrees offset from reflector antenna bore-site and in the far field of the reflector antenna, i.e., ignoring the $Rf/10$ distances, it is seen that the interference level at the LNB input is always below -15 dBm.

Sensitivity of Standard C-band LNBs

Norsat conducted a series of tests to determine the immunity level of typical C-band LNBs which work in the 3.4 to 4.2 GHz range and hence innately susceptible to interference at 3.6 GHz.

The gain and noise floor of a standard LNB was measured, across the 3.8 to 4.2 GHz range with and without an interference signal at 3.6 GHz.

Figure 3 shows the standard LNB output when no interference signal is present. A -50-dBm signal at 3.6 GHz is used as the interference the output is presented in *Figure 4* which shows intermodulation products.

Figure 1. The dashed line shows the distance, r, between the cellular and SATCOM antennas. The line named "SATCOM" shows the boresight of the C-band reflector antenna, making angle with the dashed line. The line titled "cellular" shows the boresight of the cellular antenna making an angle with the dashed line. For

simplicity and without loss of generality, all three lines are assumed to be on the same plane. The size of the dish is denoted by D.

Figure 2. Link budget calculation for the interference caused by a cellular antenna and received by a 2.4- m reflector antenna at 138 meters away .

The intermodulation products almost disappear when the strength of the interference is below -55 dBm. Therefore, this is considered as the sensitivity of the standard LNB.

Unfortunately, all interference levels shown in *Table 1* are above -55 dBm which indicates that a standard LNB will experience performance problems due to interference from a 5G cellular tower.

All the strategies that can be used to tackle the interference problem are reviewed in the following section.

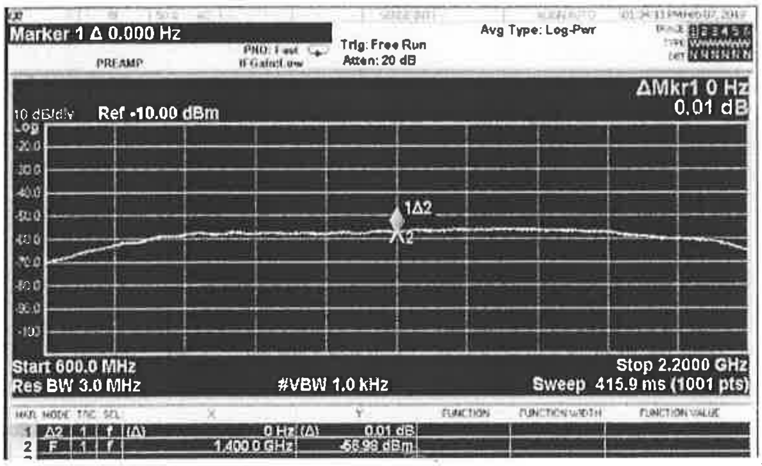


Figure 3. Output of a standard LNB with no interference.

Mitigating the Risk of Interference

To eliminate or control any electromagnetic interference one must focus on three major fronts -the transmitter, the medium of propagation and the receiver.

Transmitter

The power, the radiation pattern or the location of the 5G base station antenna cannot be controlled. Moreover, the antenna array of the 5G base station is usually designed to provide an omnidirectional radiation pattern in the horizontal plane. However, in the vertical plane, the radiation pattern is not uniform and has about 15 dB less gain at an offset of 15 degrees. As base station antennas are usually on buildings, the radiation patterns typically have a down-tilt to provide better coverage at ground level. If the satellite antenna can be located higher than the 5G antennas, it may be possible to benefit from the reduced gain of the 5G antenna in the direction of the satellite antenna. These estimates are dependent on the manufacturer of the sector antenna, its exact radiation pattern, the base station site and RF planning.

Medium of Propagation

The 5G signal power received by the satellite antenna decreases with the distance between the antennas. Assuming interferer is in the far field region of the satellite antenna, the received power density is reduced 7 6 dB each time the distance between the antennas is doubled. So whenever possible, choose the farthest distance from the base station antenna.

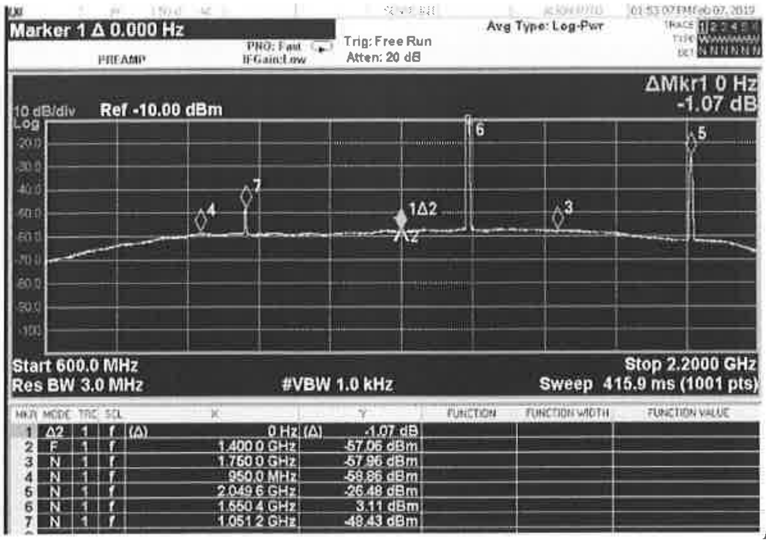


Figure 4. Output of a standard LNB with input CW interference at 3.6 GHz and power of -50 dBm.

Solutions at the Receiver

Position

Sometimes it is possible to locate the C-band terminal such that the base station antenna is at the widest possible offset angle from its boresight. The site of the C-band terminal can be analyzed to provide instructions as how to position the terminal in order to reduce the interference. The last column in *Table 1* is an example of the effect of a 10-degree offset angle in reducing interference.

Interference Mitigating LNBs

A typical LNB tolerated an interference of -55 dBm at 3.6 GHz with minimal intermodulation or gain compression. However as shown previously, it is expected interfering signals may be as high as -15 dBm. A current design for an interference-mitigating LNB is expected to tolerate an interference of -20 dBm without any significant spurious or intermodulation products at the output. The cost of this additional interference tolerance is that the noise temperature is expected to increase from about 40 K to about 54 K.

Unfortunately using the interference-mitigating LNB does not eliminate the interference problem in all cases and some additional filtering before the LNB may be required. Table 2 summarizes the additional filtering that is required for various scenarios using a 2.4m antenna and the interference levels provided in *Table 1.*

	Additional Rejection Required (dB)			
Distance Between Antennas	At Boresight	At 5-deg Offset Angle	At 10-deg Offset Angle	at 25-deg Offset Angle
13.8	51.23	39.23	21.23	n/a
138	34.9	12.2	4.9	-5.3
276	28.9	6.2	-1.1	-11.3
552	22.9	0.2	-7.1	-17.3
1104	16.9	-5.8	-13.1	-23.3

Table 2. Amount of additional rejection required (dB) in order to mitigate the interference while using a new interference-mitigating LNB. The green cells indicate the positions at which the new interference-mitigating LNB will definitely work as a standalone solution, assuming the conditions explained in the paper. The yellow cells indicate the positions at which the new interference-mitigating LNB will probably work at the actual gain pattern is usually several dB below the mask. The red cells indicate the situations where a waveguide filter is necessary.

It is seen in *Table 2,* that at a more likely 25-degree offset angle, at all far field distances the new interference-mitigating LNB is sufficient to mitigate the risk of interference. The gain at offset angles are obtained from the mask provided in FCC 25.209(a)..

The actual radiation pattern of an antenna will usually have a gain of several dB lower than the mask at wide offset angles. Hence when the additional rejection required is about 6 dB or less, (*i.e.*, the yellow cells in *Table 2*) it is expected that the interference-mitigating LNB by itself will be sufficient.

The red cells in *Table 2* indicate the amount of additional rejection required when the interference-mitigating LNB does not mitigate the interference by itself. In these situations, a waveguide filter will be necessary.

Waveguide Filter
A waveguide filter can be used to suppress the frequency content at the interference band. The benefit of this method is that the interference is rejected before it enters the LNB and so it becomes possible to use conventional LNBs which also operate in the 3.3 to 3.8 GHz band. The disadvantage of this method is that the waveguide filter loss before the LNB, will significantly impact the G/T of the antenna. The waveguide filters in C-band are usually large in size and occupy more space as their rejection increases.

A C-band waveguide filter can offer more than 55 dB of rejection below 3.6 GHz with a passband of 3.8 to 4.2 GHz. This method is suitable for customers who have bought standard LNBs. Also, customers who are in close vicinity of an interferer and are exposed to large amounts of radiation may need a waveguide filter in addition to the interference-mitigating LNB.

Using A Combination of Strategies in Different Scenarios

In some cases, as shown in *Table 2*, several different strategies must be employed to mitigate the effects of a5G interference signal. Pre-defined positioning of the satellite terminal, use of interference -mitigating LNBs and waveguide filters may be used.

In the worst case near field scenario, the interfering signal will need to be reduced by about 86 dB to ensure the interfering signal at the input to the LNB is less than -55 dBm. This is the maximum allowable interfering signal for a standard LNB. In this scenario the distance between the base station antenna and the terminal is about 13.8 meters and hence elevating the C-band terminal to achieve a 15-degree offset angle and thus 15 dB reduction in the interfering signal could be feasible.

If it is possible to position the C-band terminal such that its boresight is at least 10 degrees away from the base station antenna, another 30 dB reduction can be achieved according to [4].

An interference-mitigating LNB will provide an additional 35 dB of improvement, which means a total reduction of 15 dB + 30 dB + 35 dB = 80 dB. Unfortunately, this does not meet the 86 dB reduction required.

In this case, a waveguide filter offering at least 41 dB rejection at 3.6 GHz would provide sufficient interference mitigation to use with a standard LNB. (15 dB reduction due to position of 5G antenna, 30 dB reduction due to position of satellite antenna and 41 dB rejection from filter provides 86 dB reduction in the interference signal.) Waveguide filters providing 55 dB rejection at 3.6 GHz with a passband at 3.6-4.2 GHz are available.

Hence the worst-case scenario in near field can be mitigated by using a waveguide filter with a standard LNB given that the position and the height of the C-band terminal can be slightly changed. If the change in the position and height is not possible, a combination of the interference-mitigating LNB and waveguide filter will be able to provide up to 55+35=90 dB in rejection, mitigating the risk of interference.

In the far-field worst-case scenario, the interfering signal needs to be reduced by about 70 dB to ensure that the interfering signal at the input to the LNB is less than -55 dBm, the maximum allowable interfering signal for a standard LNB. If the cellular antenna is exactly at the boresight or very close to it, the line of sight to the satellite can be blocked and hence it is assumed that the satellite terminal is placed at a 3-degree offset angle which means at least 20-dB gain reduction for this C-band terminal assuming it is compliant with FCC 25-209. This means that a 50-dB waveguide filter at 3.6 GHz could solve the problem without the need for a new interference-mitigating LNB.

Conclusion
The frequency bands of C-band for satellite communication and the cover and capacity layer of the upcoming 5G network were reviewed and it was determined that there is significant potential for interference to C-Band satellite communication. The multipath effect and existence of multiple interferers were not considered.

Using typical parameters, two worst case scenarios were analyzed, one in the near field and another in the far field region. To be able to conduct the analysis in the near field some approximations found in the literature were used. The analysis revealed that the received interference strength at the C-band terminal could be up to several orders of magnitude higher than the maximum level it can tolerate to operate normally while using a standard LNB.

The new interference-mitigating C-band LNBs have higher tolerance levels. At an offset angle of 25 degrees, the new interference-mitigating LNB can work as a standalone solution to mitigate the risk of interference at all far-field distances. If the offset angle is 10 degrees, the new interference-mitigating LNB is expected to be a sufficient solution for distances larger than twice the far-field boundary. Since the gain patterns are usually well below the FCC masks, the new LNB will probably work well at the far-field distance.

However, in the near-field, at about 14 meters, with a 10-degree offset angle, a combination of the new interference-mitigating LNB and waveguide filter is required to mitigate the risk of interference.

Appendix

It this section we describe how to determine the field values in far and near fields.

Interferer at the Far-Field Distance
Antenna radiation patterns and other specifications are usually determined assuming the far-field criterion which ensure that

1- the propagating field is a good approximation of a plane wave,
2- there is no reactive field
3- the electric and magnetic fields decay by 1/r, where r is the distance from the radiating antenna.

$$R_f = \frac{2D^2}{\lambda}$$

The first requirement is satisfied when the distance from the antenna, r, is both—
a- greater than the far-field distance $Rf = 2D^2 \div \lambda$,where λ is the wavelength and D is the largest dimension of the antenna, and
b- much greater than λ.

$$r > \frac{2D^2}{\lambda}$$

When D is more than two or three wavelengths, if $r > 2D^2 \div \lambda$ then the requirement $r \gg \lambda$ is automatically satisfied, which is the case in our problem. In this problem, we assume that the reflector antenna is 2.4 meters in diameter and the frequency of interest is 3.6 GHz where the wavelength is 8.3 cm, so the far field distance for the reflector antenna is $R_{f,ref} = 2D^2 \div \lambda = 138.24$ m (1)

$$R_{f,ref} = \frac{2D^2}{\lambda} = 138.24 \text{ m}$$

$$P_r = \frac{P_t G_t(\theta_t, \phi_t) G_r(\theta_r, \phi_r) \lambda^2}{(4\pi r)^2}$$

The goal is to determine the power received by a receiver antenna with a gain of $Gr(\theta r, \phi r)$ where θr and ϕr are the offset elevation and azimuth angles with respect to boresight. If the receiver antenna transmits Pt

and has a gain of $Gt(\theta t, \phi t)$, where θt and ϕt are the offset elevation and azimuth angles with respect to boresight of the transmitter, the received power is determined by $P_r = P_t Gt(\theta_t, \phi_t) G_r(\theta_r, \phi_r) \lambda^2 \div (4\pi r)^2$ (2)

$$P_r = \frac{P_t G_t(\theta_t, \phi_t) A_{e,r}(\theta_r, \phi_r)}{4\pi r^2}$$

Considering that the effective aperture of antenna – usually a receiving one – is given by $Ae = \lambda$ 2G 4π the above equation can be rewritten as $Pr = PtGt(\theta t, \phi t) Ae,r(\theta r, \phi r)$ 4πr 2 where $Ae,r(\theta r, \phi r) = \lambda$ 2$Gr(\theta r, \phi r)$ 4π is the effective aperture of the receiving antenna in the $(\theta r, \phi r)$ direction.

$$\frac{P_t G_t(\theta_t, \phi_t)}{4\pi r^2}$$

On the other hand $PtGt(\theta t, \phi t)$ 4πr 2 is the power density of the radiation at the $(\theta t, \phi t)$ direction usually denoted by $St(\theta t, \phi t)$.

$$P_r = S_t(\theta_t, \phi_t) A_{e,r}(\theta_r, \phi_r)$$

Hence eq. (2) can be rewritten as $Pr = St(\theta t, \phi t) Ae,r(\theta r, \phi r)$ (3) 11

As it is seen in Figure 1, the transmitting antenna in our problem is a cellular antenna whose radiation pattern is usually omnidirectional, meaning that its gain is not dependent on ϕt. This is usually achieved by using several sector antennae each of them covering a region. To be conservative, we assume that the receiving antenna is at the boresight of the transmitting antenna, making $\theta t = 0$, and thus maximizing St.

In a coordinate system placed at the center of the receiving antenna with the z-axis in the direction of the cellular antenna, shown by the dashed line in Figure 1, the gain of the receiver antenna, and thus $Ae,r(\theta r, \phi r)$, is maximum for, $\theta r = 0$. Assuming a symmetric center-fed antenna, the gain is not dependent on ϕr.

$$P_r = S_t(\theta_t) A_{e,r}(\theta_r)$$

So eq. (3) is reduced to $Pr = St(\theta t) Ae,r(\theta r)$ (4)

$$P_r = S_t A_{e,r}$$

When the boresight of both antennas lie on the dashed line in Figure 1 and $\theta t = \theta r = 0$, Eq (4) simply reduces to $Pr = StAe,r$ (5) where St and Ae,r and maximum values of $St(\theta t)$ and $Ae,r(\theta r)$ respectively.

Assuming an aperture efficient, eA, of 65%, the gain of the reflector antenna is calculated as $Gref = eA(\pi D$

$$A_{e,ref} = \frac{\lambda^2 G_{ref}}{4\pi} = 2.94\ \text{m}^2$$

$\lambda)$ 2 = 5316 = 37.3 dB The effective aperture, Ae,ref, for this reflector antenna is $Ae,ref = \lambda$ 2$Gref$ 4π = 2.94 m2

In [5] it is stated that the maximum EIRP of an LTE antenna is 64 dBm per antenna and the gain is 18 dBi, which means that the transmitted power if 46 dBm or 40 W.

The size of a cellular sector antenna at 3.6 GHz will be smaller than the size of our reflector, leading to a smaller far field boundary distance at the same frequency according to $Rf = 2D^2 \div \lambda$. So whenever the farfield criterion for the C-band terminal is satisfied it is also satisfied for the sector antenna.

$$G_{ref} = e_A \left(\frac{\pi D}{\lambda}\right)^2 = 5316 = 37.3 \text{ dB}$$

$$S_t = \frac{10^{\frac{64-30}{10}}}{4\pi \times (138.24)^2} = 0.010465 \text{ W/m}^2$$

Assuming both antennas are at the boresight of each other, the power spectral density of the cellular antenna at the position of the reflector antenna is computed as follows: St = 10 64−30 10 4π × (138.24) 2 = 0.010465 W/m^2

$$P_r = S_t A_{e,ref} = 0.010465 \times 2.94 = 0.03076 \text{ W} = 14.9 \text{ dBm}$$

The power received by the reflector antenna is computed by $Pr = StAe,ref$ = 0.010465 × 2.94 = 0.03076 W = 14.9 dBm

These boresight-to-boresight interference levels are summarized in Table 1.

It is worth noting that this level of interference assumes that both antennas are in the boresight of each other which is an extremely unlikely scenario. It also assumes that they are in the closest far-field distance of each other. This scenario was analyzed to gain an understanding of the worst interference in the farfield region. In a more likely scenario, the cellular antenna would be away from the boresight of the Cband terminal by for example 10 degrees that is θr = 10 deg. An FCC-compliant terminal cannot have a gain of more than 7 dB which, for our C-band terminal, means about a 30 dB gain reduction from boresight. In this scenario the interference power would be approximately -15 dBm. Some C-band operators have mentioned similar values as what they prefer the tolerance level of the LNB would be.

Interferer at the Near Field Region of the VSAT Terminal

If the distance to the reflector antenna is smaller than $Rf,ref = 2D^2 \div \lambda$ = 138.24 m, the far field approximations do not apply, and one must use different solutions. Phase front and reactive fields are two issues to be considered.

Determining the Power Received by the VSAT Terminal Caused by a 5G Interferer at its Near Field

In this section we determine the power received by the C-band VSAT terminal when the 5G interference is at its near field.

At this distance, it is assumed that the C-band terminal is in the far-field region of the cellular sector antenna. A direct solution would be to compute the power density caused by the cellular antenna and then calculate the received power by the satellite terminal. Unfortunately, since we are in the near field of the satellite terminal, we cannot use the far-field approximations to quickly compute the received power. The method described in [3], presents a way for predicting the power density when the parabolic antenna itself is radiating P_t. Assuming the far-field conditions for the cellular antenna one can easily determine the power received by the cellular antenna, P_r. Then the reciprocity theorem is used in this passive system to conclude that if the cellular antenna was transmitting P_t, the parabolic antenna would receive the same P_r. So instead of starting from the interferer and going to the receiver we will start from the receiver as if it were the transmitter and we calculate the power received by the cellular antenna.

However, we digress in this paragraph to point out the fact that the cellular antennas are usually an array of patch antennas and hence their far-field criterion is only about the phase front. If the distance is smaller than their far field, the actual gain will be smaller than the far-field gain and hence our computations from this point on will be even more conservative.

The cellular antenna has a gain of 18 dBi and transmits about 40 W [5].

$$S = \frac{40 \times 10^{\frac{37.26}{10}}}{4\pi \times (138.24)^2} = 0.886\ \frac{\text{W}}{\text{m}^2}$$

We assume that the reflector antenna is transmitting 40 W. At its far-field distance i.e. at 138.24 m, the power density is $S = 40 \times 10x37.26 \div 10 \div 4\pi \times (138.24)\ 2 = 0.886\ \text{W} \div \text{m}^2$

According to [3], the strongest power density in the near field on boresight happens when the distance from the antenna is one tenth of the far-field distance and will be about 43 times stronger than the power density on the boresight at the far-field distance. So the highest near field power density will occur at 13.8 m and will equal 43*0.886=38.1 W/m2.

$$A_{e,LTE} = \frac{0.083^2 \times 10^{18/10}}{4\pi} = 0.035\ \text{m}^2$$

The next step is to determine the power input to the cellular antenna which has an effective aperture of $Ae,LTE = 0.0832 \times 10^{18/10} \div 4\pi = 0.035\ \text{m}^2$

The power input to the cellular antenna is 0.035 × 0.886 = 1.33 W = 31.23 dBm.

Using the reciprocity theorem, one can conclude that if the 40 W was being transmitted at the cellular antenna, the reflector antenna would receive the same 31.23 dBm.

References

[1] ITU-R, Recommendation ITU-R M.2083-0 IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond, 2015.

[2] Huawei Technologies Co LTD; 5G Spectrum - Public Policy Position, 2018

[3] A. Farrar and E. Chang, Procedures for Calculating Field Intensities of Antennas, Figure 4-2(b), 1987

[4] Herbert K. Kobayashi, Procedure for Calculating the Power Density of a Parabolic Circular Reflector Antenna, Fig 3-9(b), 1990

[5] National Telecommunications and Information Administration, "LTE (FDD) Transmitter Characteristics" https://www.ntia.doc.gov/files/ntia/meetings/lte_technical_characteristics.pdf, accessed February 2019.

Annexure-II

List of Channels in C-Band within 3600-< 3800 MHz band

Channels on GSAT-30 Satellite

Sr. No	Satellite	Frequency Band	Channel Name
1	GSAT-30	3707-3743 MHz	News 18 Madhya Pradesh & Chhattisgarh
2	GSAT-30	3707-3743 MHz	News 18 Rajasthan
3	GSAT-30	3707-3743 MHz	News 18 Bihar & Jharkhand
4	GSAT-30	3707-3743 MHz	News 18 Urdu
5	GSAT-30	3707-3743 MHz	News 18 Odia
6	GSAT-30	3707-3743 MHz	Colors Bangla
7	GSAT-30	3707-3743 MHz	Colors Marathi
8	GSAT-30	3707-3743 MHz	Colors Kannada
9	GSAT-30	3707-3743 MHz	Colors Infinity
10	GSAT-30	3707-3743 MHz	VH1 India
11	GSAT-30	3707-3743 MHz	Colors Cineplex
12	GSAT-30	3707-3743 MHz	Colors Infinity
13	GSAT-30	3707-3743 MHz	Colors Gujarati Cinema
14	GSAT-30	3707-3743 MHz	Colors Bangla Cinema
15	GSAT-30	3707-3743 MHz	Nick HD+
16	GSAT-30	3707-3743 MHz	MTV Beats
17	GSAT-30	3707-3743 MHz	Colors Cineplex
18	GSAT-30	3707-3743 MHz	VH1 India
19	GSAT-30	3707-3743 MHz	Colors Odia
20	GSAT-30	3707-3743 MHz	Colors Gujarati
21	GSAT-30	3738-3774 MHz	Grace TV (India)
22	GSAT-30	3738-3774 MHz	Siddarth Bhakti
23	GSAT-30	3738-3774 MHz	A1 TV
24	GSAT-30	3738-3774 MHz	Bada Khabar
25	GSAT-30	3738-3774 MHz	National Voice
26	GSAT-30	3758-3794 MHz	Ishwar Bhakti TV
27	GSAT-30	3758-3794 MHz	Rongeen TV
28	GSAT-30	3758-3794 MHz	Manoranjan Grand
29	GSAT-30	3758-3794 MHz	Manoranjan TV
30	GSAT-30	3758-3794 MHz	Nandighosha TV
31	GSAT-30	3758-3794 MHz	News Daily 24
32	GSAT-30	3758-3794 MHz	6 TV Telugu
33	GSAT-30	3758-3794 MHz	Popular TV
34	GSAT-30	3758-3794 MHz	Sanskriti 24x7
35	GSAT-30	3758-3794 MHz	Fateh TV
36	GSAT-30	3758-3794 MHz	Channel Divya
37	GSAT-30	3758-3794 MHz	Nepal 1
38	GSAT-30	3758-3794 MHz	Enterr 10 Movies
39	GSAT-30	3758-3794 MHz	Dangal TV
40	GSAT-30	3758-3794 MHz	Khushboo TV Bangla

Channels on GSAT-30 Satellite (contd)

Sr. No	Satellite	Frequency Band	Channel Name
41	GSAT-30	3758-3794 MHz	Kalinga TV
42	GSAT-30	3787-3823 MHz	Nation First
43	GSAT-30	3787-3823 MHz	Hindi Khabar
44	GSAT-30	3787-3823 MHz	Dillagi
45	GSAT-30	3787-3823 MHz	Naaptol Telugu
46	GSAT-30	3787-3823 MHz	Rose TV
47	GSAT-30	3787-3823 MHz	Pitaara
48	GSAT-30	3787-3823 MHz	Bharat Samachar
49	GSAT-30	3787-3823 MHz	R9 TV
50	GSAT-30	3787-3823 MHz	Sudarshan News
51	GSAT-30	3787-3823 MHz	Khabrain Abhi Tak
52	GSAT-30	3787-3823 MHz	INH
53	GSAT-30	3787-3823 MHz	Prajaa TV Kannada
54	GSAT-30	3787-3823 MHz	Saam TV
55	GSAT-30	3787-3823 MHz	Music India
56	GSAT-30	3787-3823 MHz	Sangeet Bangla
57	GSAT-30	3787-3823 MHz	Sangeet Bhojpuri
58	GSAT-30	3787-3823 MHz	9XM
59	GSAT-30	3787-3823 MHz	9X Jhakaas
60	GSAT-30	3787-3823 MHz	Mastiii
61	GSAT-30	3787-3823 MHz	Naaptol
62	GSAT-30	3787-3823 MHz	Naaptol Tamil
63	GSAT-30	3787-3823 MHz	Naaptol Malayalam
64	GSAT-30	3787-3823 MHz	Naaptol Kannada
65	GSAT-30	3787-3823 MHz	Wow Cinema One
66	GSAT-30	3787-3823 MHz	Cinema TV (India)
67	GSAT-30	3787-3823 MHz	News 11
68	GSAT-30	3787-3823 MHz	Channel WIN
69	GSAT-30	3787-3823 MHz	Jinvani Channel
70	GSAT-30	3787-3823 MHz	Ind 24
71	GSAT-30	3787-3823 MHz	Dhamaal
72	GSAT-30	3787-3823 MHz	Maiboli
73	GSAT-30	3787-3823 MHz	Dabangg
74	GSAT-30	3787-3823 MHz	9X Jalwa
75	GSAT-30	3787-3823 MHz	B4U Kadak
76	GSAT-30	3787-3823 MHz	Network 10
77	GSAT-30	3787-3823 MHz	Bangla Bharat
78	GSAT-30	3787-3823 MHz	Sadhna TV
79	GSAT-30	3787-3823 MHz	Shemaroo TV
80	GSAT-30	3787-3823 MHz	Puthuyugam TV

	Channels on Asiasat-7 Satellite		
Sr. No	Satellite	Frequency Band	Channel Name
1	Asiasat-7	3634-3670 MHz	Sahara One
2	Asiasat-7	3634-3670 MHz	Samay National
3	Asiasat-7	3634-3670 MHz	Samay Rajasthan
4	Asiasat-7	3634-3670 MHz	Samay Maharashtra/Gujarat
5	Asiasat-7	3634-3670 MHz	Samay UP/Uttarakhand
6	Asiasat-7	3634-3670 MHz	Samay Bihar/Jharkhand
7	Asiasat-7	3634-3670 MHz	Aalami Samay
8	Asiasat-7	3634-3670 MHz	Samay MP/Chhattisgarh
9	Asiasat-7	3634-3670 MHz	Filmy
10	Asiasat-7	3634-3670 MHz	Firangi
11	Asiasat-7	3721-3729 MHz	ABP News India
12	Asiasat-7	3721-3729 MHz	ABP Ananda
13	Asiasat-7	3721-3729 MHz	ABP Majha
14	Asiasat-7	3721-3729 MHz	ABP Asmita
15	Asiasat-7	3721-3729 MHz	ABP Sanjha
16	Asiasat-7	3727V-3737 MHz	ZEE CAFÉ
17	Asiasat-7	3727V-3737 MHz	& FLIX
18	Asiasat-7	3727V-3737 MHz	ZEE BANGLA INT
19	Asiasat-7	3727V-3737 MHz	ZEE CINEMA ME
20	Asiasat-7	3762-3798 MHz V	National Geographic India English/ Hindi
21	Asiasat-7	3762-3798 MHz V	National Geographic India Bengali/ Tamil
22	Asiasat-7	3762-3798 MHz V	Fox Life India English/ Hindi
23	Asiasat-7	3762-3798 MHz V	Fox Life India HD
24	Asiasat-7	3762-3798 MHz V	Fox Life India HD Hindi
25	Asiasat-7	3762-3798 MHz V	Fox Life India HD Bengali
26	Asiasat-7	3762-3798 MHz V	Fox Life India HD Tamil
27	Asiasat-7	3762-3798 MHz V	National Geographic Wild HD
28	Asiasat-7	3762-3798 MHz V	National Geographic Wild HD Hindi
29	Asiasat-7	3762-3798 MHz V	National Geographic Wild HD Tamil
30	Asiasat-7	3762-3798 MHz V	National Geographic India HD
31	Asiasat-7	3762-3798 MHz V	National Geographic India HD Hindi
32	Asiasat-7	3762-3798 MHz V	National Geographic India HD Telugu
33	Asiasat-7	3762-3798 MHz V	National Geographic India HD Bengali
34	Asiasat-7	3762-3798 MHz V	National Geographic India HD Tamil
35	Asiasat-7	3762-3798 MHz V	Fox Life India English/ Hindi
36	Asiasat-7	3762-3798 MHz V	Fox Life India Br=engali/ Tamil
37	Asiasat-7	3762-3798 MHz V	National Geographic India Hindi
38	Asiasat-7	3762-3798 MHz V	National Geographic Wild Asia
39	Asiasat-7	3782-3818 MHz H	Marvel HQ
40	Asiasat-7	3782-3818 MHz H	Disney Junior India
41	Asiasat-7	3782-3818 MHz H	UTV Movies
42	Asiasat-7	3782-3818 MHz H	Star Vijay India HD
43	Asiasat-7	3782-3818 MHz H	Star Vijay India HD
44	Asiasat-7	3782-3818 MHz H	Asianet HD
45	Asiasat-7	3782-3818 MHz H	Asianet HD
46	Asiasat-7	3782-3818 MHz H	Star Maa
47	Asiasat-7	3782-3818 MHz H	Star Maa Music
48	Asiasat-7	3782-3818 MHz H	Star Maa Movies
49	Asiasat-7	3782-3818 MHz H	Star Maa Gold
50	Asiasat-7	3782-3818 MHz H	Star Utsav Movies
51	Asiasat-7	3782-3818 MHz H	Star World Premiere HD
52	Asiasat-7	3782-3818 MHz H	Star World Premiere HD
53	Asiasat-7	3782-3818 MHz H	Star Pravah HD
54	Asiasat-7	3782-3818 MHz H	Star Pravah HD
55	Asiasat-7	3782-3818 MHz H	Star Jalsha HD
56	Asiasat-7	3782-3818 MHz H	Star Jalsha HD
57	Asiasat-7	3782-3818 MHz H	Jalsha Movies HD
58	Asiasat-7	3782-3818 MHz H	Jalsha Movies HD

	Channels on IS-20 Satellite		
Sr. No	Satellite	Frequency Band	Channel Name
1	IS-20	3705-3741 MHz V	TV 9 Telugu
2	IS-20	3705-3741 MHz V	Mojo TV
3	IS-20	3705-3741 MHz V	TV 9 Kannada
4	IS-20	3705-3741 MHz V	TV 9 Marathi
5	IS-20	3705-3741 MHz V	TV 9 Gujarati
6	IS-20	3705-3741 MHz V	TV 9 Bharatvarsh
7	IS-20	3705-3741 MHz V	Mahaa News
8	IS-20	3705-3741 MHz V	Shubhsandesh TV
9	IS-20	3721-3757 MHz H	Discovery Channel India
10	IS-20	3721-3757 MHz H	DTamil
11	IS-20	3721-3757 MHz H	Animal Planet India
12	IS-20	3721-3757 MHz H	Investigation Discovery India
13	IS-20	3721-3757 MHz H	Investigation Discovery India
14	IS-20	3721-3757 MHz H	Discovery Science India
15	IS-20	3721-3757 MHz H	Discovery Turbo India
16	IS-20	3721-3757 MHz H	TLC India
17	IS-20	3721-3757 MHz H	Discovery HD World India
18	IS-20	3721-3757 MHz H	Discovery Kids India
19	IS-20	3721-3757 MHz H	TLC HD India
20	IS-20	3721-3757 MHz H	Animal Planet HD World India
21	IS-20	3761-3770 MHZ V	Arihant TV
22	IS-20	3761-3770 MHZ V	Aastha Tamil
23	IS-20	3761-3770 MHZ V	Aastha Telugu
24	IS-20	3761-3770 MHZ V	Aastha Kannada
25	IS-20	3763-3772 MHz H	&TV
26	IS-20	3763-3772 MHz H	Zee Zest
27	IS-20	3763-3772 MHz H	Zee Chitramandir
28	IS-20	3772-3776 MHZ V	Aastha India
29	IS-20	3772-3779 MHz V	Aastha TV
30	IS-20	3772-3779 MHz V	Aastha Bhajan India
31	IS-20	3772-3779 MHz V	Vedic
32	IS-20	3777-3813 MHz H	Times Now
33	IS-20	3777-3813 MHz H	Zoom (India)
34	IS-20	3777-3813 MHz H	ET Now
35	IS-20	3777-3813 MHz H	Movies Now
36	IS-20	3777-3813 MHz H	Movies Now +
37	IS-20	3777-3813 MHz H	Romedy Now
38	IS-20	3777-3813 MHz H	Mirror Now
39	IS-20	3777-3813 MHz H	Times Now World
40	IS-20	3777-3813 MHz H	MNX
41	IS-20	3777-3813 MHz H	Movies Now
42	IS-20	3777-3813 MHz H	Romedy Now
43	IS-20	3777-3813 MHz H	MNX
44	IS-20	3777-3813 MHz H	ET Now
45	IS-20	3777-3813 MHz H	Times Now

	Channels on GSAT-10 Satellite		
Sr. No	Satellite	Frequency Band	Channel Name
1	GSAT-10	3750 V	DD Uttarakhand
2	GSAT-10	3753 V	DD Chhattisgarh
3	GSAT-10	3757 V	DD Jharkhand
4	GSAT-10	3762 V	(DD feeds)
5	GSAT-10	3769 V	DD Hissar

Annexure-III

Information on LNB Overdrive Issues

Information on LNB Overdrive Issues

1. LNB Overdrive

To counter the LNB overdrive, adding rejection and/or bandpass filtering to the receiver of fixed FSS earth stations could be attempted. This technique however, would not help to mitigate interference due to unwanted emissions of IMT stations in adjacent bands or emissions of IMT stations operating in overlapping bands. Many earth station antennas, in particular receive only antennas, LNB and antenna feedhorn, are moulded together in one unit until it is physically impossible to insert a filter in between. Moreover, insertion of a filter reduces earth station figure of merit (G/T) and may require use of or change to larger antennas. Introducing such filters in receive installations is expensive, so use of LNB bandpass filters can only be considered for some few, large earth stations.

An example is shown here from a cellular operator in Asia operating in spectrum centered at 3450 MHz which is well below the C-Band of 3700-4200 MHz. The 5G signal is displayed in figure below

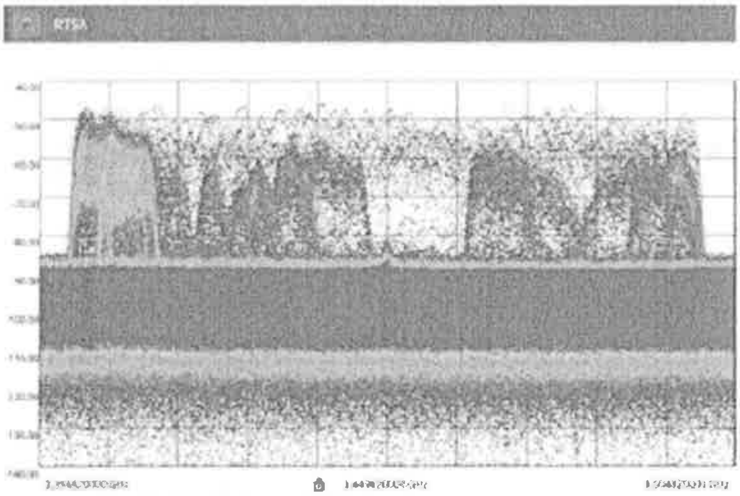


Figure-1 5 G carrier at 3450 MHz

The out of Band emissions for this 5G carrier at 3900 MHz which is well within the C-band, and more that 450 MHz away is depicted in the figure below:

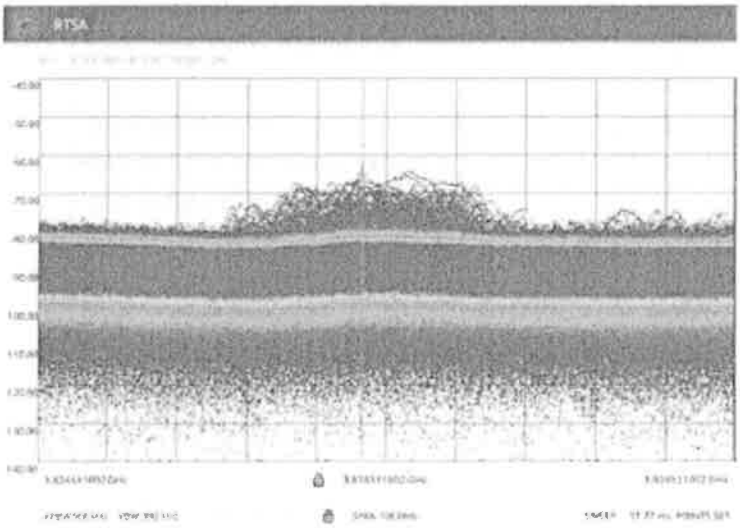


Figure-2- 5G Interference in the C-Band at 3900 MHz

With such high Out of Band emission, distortion occurs at the satellite receiver. Satellite LNA/LNBs are optimized for reception of very low-level satellite signals. Geostationary satellites orbit at a distance from earth of 36,000 km (22,400 miles).

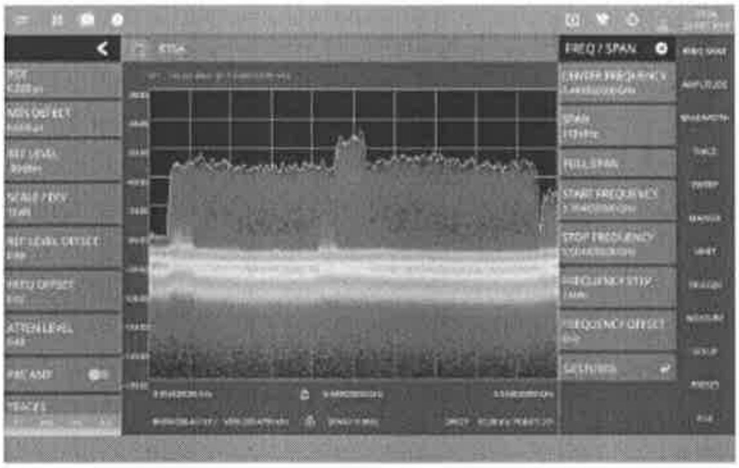


Figure-3- Display of Interference Signal on Meter

Typically, the LNA/LNB will be saturated with a total input power of approximately -50 dBm, depending on equipment used. The LNA/LNB would then begin to show non-linear behaviour at about -60 dBm input into the receiver system. The international standards body publication, "Studies on Compatibility of Broadband Wireless Access Systems and Fixed-Satellite Service Networks in the 3 400-4 200 MHz band" (ITU-RS.2199-0), therefore recommends a maximum power into to the LNB of no higher than -60 dBm.

2. Site shielding of earth stations

Site shielding techniques would reduce the interference from IMT transmitters, either by shielding the receiving earth station or the transmitting IMT station in a particular direction. However, this may involve a significant cost and depending on the conditions for specific cases, have limited effect.

As headends in India are ubiquitously deployed mitigation techniques will be less effective.

IBF

13 April 2021

Shri Amit Khare
Secretary
Ministry of Information and Broadcasting
A-Wing, Shastri Bhawan
New Delhi - 110 001

Sub: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services - Request for Intervention

Dear Sir,

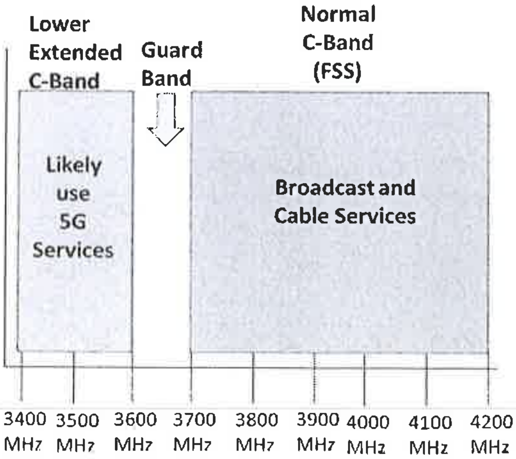
This has reference to our below communication dated 10 March 2021 and the subsequent meeting of the IBF delegation with Smt. Neerja Sekhar, Additional Secretary, MIB and Shri Vikram Sahay, Joint Secretary (P&A), MIB held on 7 April 2021 regarding the upcoming spectrum allocations for 5G services and their serious impact on the C&S Services. We would request and reiterate the submissions in the overall interests including that of effective 5G roll out and safeguarding of broadcast media industry as below –

a) C Band frequency band of 3.7 to 4.2 Ghz along with its associated uplink band of 5.9 to 6.4 Ghz be protected and kept for C&S Broadcast channels.
b) A guard band of not less than 100 Mhz be kept while allocating spectrum to 5G operators thereby restricting the frequency band upto 3.6Ghz
c) As a longer-term plan millimeter range (26Ghz and above) be allocated for 5G services that would help much higher spectrum utilisaton efficiency and effective large scale products and services roll out for the India

Further, in continuation with our communication sent earlier and the points submitted during the meeting as cited above, we would like to provide for additional data on the emerging scenarios and the potential disruption likely to be caused to the C&S sector in support of our submissions -

1. Base case of Allocation of 5G Spectrum up to 3600 MHz

The base case for allocation and subsequent auction of 5G spectrum is for 3300-3600, which with a guard band of 100 MHz will have no transmissions between 3600-3700 MHz and the broadcast services will continue to use 3700 MHz to 4200 MHz as is the case today.



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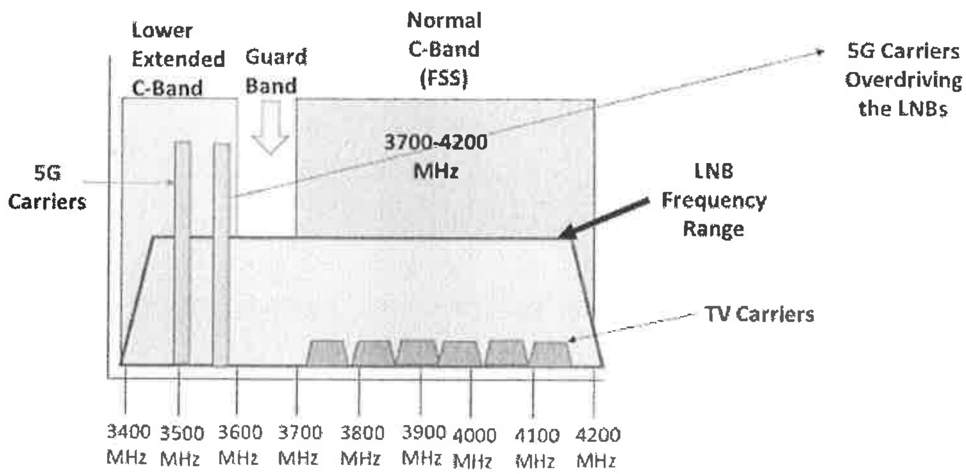
The TRAI recommendations on Spectrum Auction also is only for this band with no reference to any possible extension into the guard band. The band of 3300-3600 MHz is vacant today and hence the services in the 3700-4200 MHz (Regular C-Band) do not face any interference.

In the Indian Cable Sector most RECIEVERS ARE "Block LNBs" i.e. LNA and downconverter combined and these devices have a receive range of 3400-4200 MHz.

Till today, these devices have operated with little interference owing to no transmissions happening in the 3300-3600 MHz bands. The only exceptions have been sites near some Wi-Max stations (3300 MHz) where this interference has been observed. However, WI-Max being very sparsely used and have lower power, because of which serious disruptions have not happened.

Post the activation of carriers in the 3300-3600 MHz band, there will be carriers which will be in the LNB range, which are very strong, and will, in all cable headends located near 5G towers, get overdriven by the strong signals in the 3300-3600 MHz range.

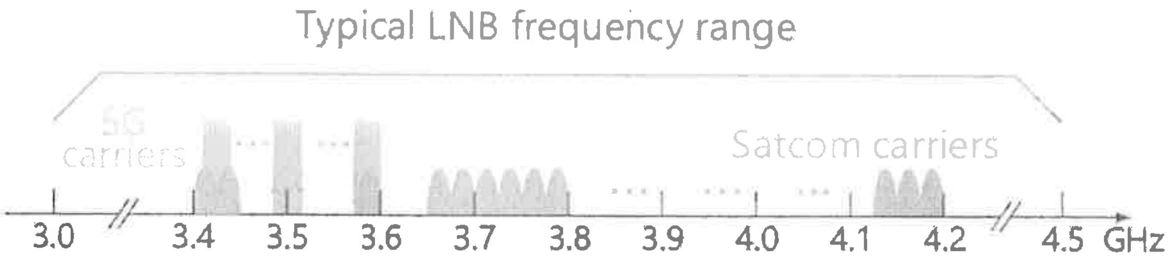
5G carriers will fall in LNB Reception Range



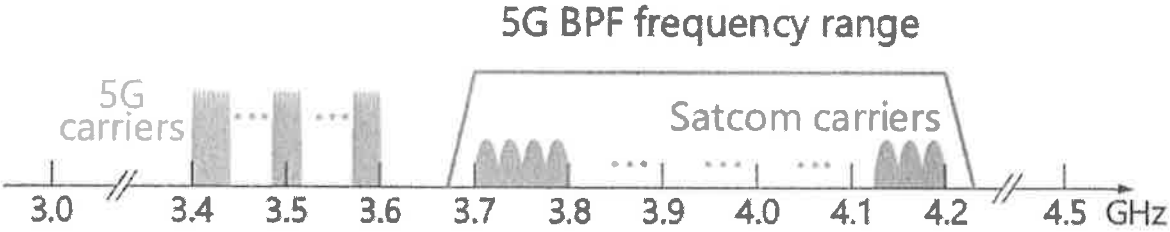
This has been proven by many studies as well as the field data. One such paper is enclosed in Annex1. These adverse effects, which may be experienced even if the interfering signal is out of band, include:

— Gain compression and saturation
— Noise floor degradation
— Unwanted Intermodulation products

The overdrive caused by out of Band carriers in LNBs has been noted duly in the OFCA(Hongkong) Studies. It shows that despite the 5G signals remaining below 3600 MHz, C-Band filters (3700-4200 MHz) are needed for Interference free reception.



(a)



(b)

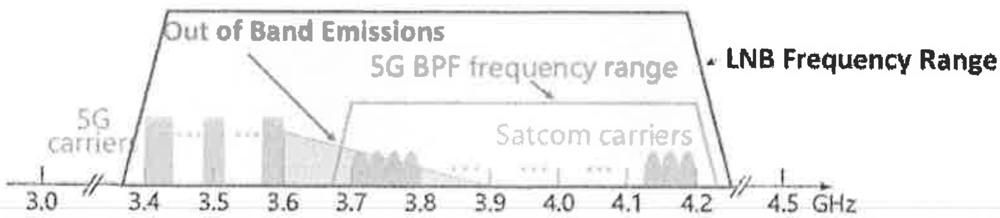
In the current implementations in India, the Cable headends do not deploy LNBs with 5G filters, and hence even if a guard band of 100 Mhz is retained, the headends near the 5G towers will face significant interference and will need to be retrofitted with C-Band filters.

Despite the best filters with sharpest cutoffs, the out of band emissions are so high that these can be eliminated only if the distance of the 5G transmitters is a certain distance away from the headend Antennas. More Information on LNB Overdrive issues is given in Annex-3.

In many cases where the Feed and LNB are fused together, it is not possible to install filters as a retrofit. In such cases the only solution is the replacement of entire LNB block.

2. Expected allocations extending into the Guard Band

There have been some discussions as to whether the 5G allocations could be extended till 3670 MHz with only 30 MHz guard band. **It is also being surmised that a possible scenario could be envisaged that the satellite carriers do not use the band of 3700-3800 MHz which could be left as guard band, moved up in frequency**. There are large number of channels using the first transponder particularly the Indian Satellite GSAT 30 and GSAT10 and this assumption is misplaced and needs to be refuted. However, from the above discussion it is abundantly clear that the 5G carriers still lie in the **LNB band,** and further that the extension of the 5G band to 3670 MHz would mean that the out of Band emissions would still fall not only within the LNB band but also the C-Band filter guard band and will this affect the reception by the LNBs in the entire band.



To quote directly from Paper in Annexure-1:

" Even if the satellite signals received by the C-band terminal are limited to 3.8 to 4.2 GHz, there is still a risk of 5G signal interference. The satellite signal received at the ground terminal is usually several orders of magnitude weaker than the cellular signal. The receiver equipment of a satellite terminal is usually chosen or designed to detect these extremely low power levels in the 3.4 to 4.2 GHz range and the presence of any strong carrier may affect the performance of its receiving system including the LNB and the modem. These adverse effects, which may be experienced even if the interfering signal is out of band"

Hence the moving up of satellite carriers above 3800 MHz is not at all a solution. This is also the reason why countries which have subsumed part of C-Band have needed to use advanced filters and give a time of 2 years or more for transition.

In addition to the technical rationale of the interference in spite of filters being used, there is constraint with respect to availability of transponder space and hence moving up to higher band is absolutely not an acceptable proposition.

It should be noted that the 5G signals will be very strong and widespread due to a large number of towers and a new disruptive situation will emerge.

3. Impact Analysis of 5G Allocation of Frequencies

An analysis of the impact of allotting 5G services beyond 3600 MHz till say 3670 MHz will be immense. While this document tries to quantify the figures, the quantification in terms of disruptions will be immense and can only be estimated.

3.1 Channels Impacted

A list of Channels which will be directly impacted is given in Annexure-2. For the purpose of this document only channels between 3600-3790 MHz have been considered. It may be seen that nearly 200 channels, including HD channels will be directly impacted. The breakup is as follows:

	Summary channels below 3800 MHz		
S.No	**Satellite Name**	**channels below 3800 MHz**	**Details**
1	GSAT-30	80	Annex-2
2	Asiasat-7	58	Annex-2
3	IS-20	45	Annex-2
4	GSAT-10	5	Annex-2
5	Other satellites	12	
	Total Channels	200	

It may be seen that about 25% of the Indian Channel universe will be directly and immediately impacted with sever disruption, while the next 50 MHz (about 100 channels) will also be affected based onsite locations even after using the filters.

The channels on foreign satellites need to be available on the very same satellites owing to the following issues:

(i) **Footprint and distribution related issues.** The distribution needs include Africa, Russia, Eastern Europe, Japan, Far East including Australia and New Zealand.

(ii) **Television Communities Overseas**

Foreign Cable and DTH operators spread out in over 140 countries of Interest in Asia Pacific, Gulf, Africa, MENA and Eastern Europe have Antennas looking at only specific satellites, which are called the TV Hot satellites. They are not willing to put up additional dishes on any new satellites just for one or two channels.
While these channels need to remain on these very satellites due to footprint as well as distribution related issues, these satellites have no capacity to move channels to any higher frequencies.

(iii) Additional Teleport Antenna – If the frequency band is not available on the same satellite, then it implies setting up of additional Teleport on the new satellite which has costs, feasibility and process adverse implication.

3.2 Customer Disruption

There are an estimated over 230 Million customers of C&S services. The entire sector has gone through very turbulent times which has made the very survival at stake due to the following reasons:

(i) NTO 2.0 implementation- has been bogged down by court cases, and even when implemented, there has been customer resistance due to inability of broadcasters to form cost effective bouquets. Many customers have given up on nearly 50% of channels.

(ii) COVID-19 problems- A lot of on ground problems have been faced during the past full year due to COVID and these issues still continue. These relate to production of Films and Shows, Ground events, Sports with spectator attendance and a host of others. The inability to have fresh and engaging content has pushed customers towards OTT services.

(iii) **Any change in current C-Band spectrum allocation would require compensation either from the Government or may increase consumer pay-outs:** Any change to current allocation of C-band spectrum would either force B&CS sector to shift to a different spectrum or would require introduction of filters. This would require huge investment in billions which would need to be compensated either by the Government or through TV subscribers' monthly pay-outs that would eventually lead to increasing subscribers' cost for accessing satellite TV channels.

(iv) **Expected Disruption due to 5G:** The expected interference on channels, degradation of signals are expected to continue for a full 2 years till all mitigating measures including Filters are implemented on the ground. The inferior quality of experience caused will hasten up the migration of consumers from traditional TV to OTT thereby having long term implication and perhaps advancing the sun-set of C & S TV Industry.

3.3 Disruption of cable Headends

There are an estimated 1700 Licensed MSOs with 2-4 headends each and in addition about 100,000 Cable Headends (TRAI data 25-July 2019). These headends, together with 12 Antennas on the average constitute a total of 15,00,000 (1.5 Million) installed dishes which will require to be protected with filters. At an average cost of USD 300 per RF Filter with bulk pricing (3700-4200) with sharp cut-off, the total cost of filters comes to $450 Million (Rs 3375 Crores). Also, the installation/ replacement cost per dish will work out to Rs 2000 per installation. In many cases where the feed and LNB are fused together the entire installation will need to be changed.

4 Impact on employment

The B&CS sector contributes significantly in creation of jobs and generates direct and indirect employment for around 1.81 Mn people. Such drastic change in spectrum allocation could impact the employment prospective of the B&Cs sector.

5 Loss to VSAT, DSNGs, Emergency communication and Marine Services

C-Band is resistant to rain fade and other signal degradation issues due to weather, and has consequently formed a backbone of VSATs, DSNGs, Emergency communication and Marine Services. Where 5G transmitters operate in vicinity, which is expected to be ubiquitous, the interference will seriously affect these services. These terminals are in many cases proprietary and modifications with external filters etc are not possible.

6 **India requires a special and unique approach that protects the B&Cs and which is different from its Global counterpart while unleashing 5G potential through spectrum allocation:** The B&Cs sector in India caters to 230 million TV subscribers having diverse content preferences via 900+ licensed TV channels broadcasted across 10 genres and over 15 languages. These channels play an important role in informing, educating and entertaining the TV homes. Due to fierce competition amongst stakeholders, television remains the affordable medium for consumers for range of genres which include, news & current affairs, entertainment, sports, movies and kids-entertainment. Therefore, it requires a different, unique and calibrated approach towards protecting the interest of consumers while unleashing 5G's true potential than those taken globally including countries like US and European Union. Comparing can only be made with countries having similar statistics and demography such as China where telecom operators acquired spectrum in 2.5 GHz, 3.5 GHz and 4.8 GHz (n41, n78 and n79) bands only.

7 Global Best Practices-5G Spectrum Limited to 3600 MHz

In order to avoid severe disruption many countries have adopted the base case of 5G spectrum being limited to upper limit of 3600 MHz. This has been done based on their extensive studies after public consultations which have been well documented. Even where higher bands till 3700 MHz have been used, the following practices have been adopted:

(i) Assessment of the extent of disruption based on use of C-Band for Various services
(ii) Compensation provided to affected operators
(iii) Time period 2-4 years granted to operators to do the migration

7.1 China

China's Ministry of Industry and Information Technology (MIIT) held the auction for 5G spectrum bands in December 2018. Country's telecom operators acquired spectrum in 2.5 GHz, 3.5 GHz and 4.8 GHz (n41, n78 and n79) bands.

China has allocated the following frequency bands for 5G in C-Band:

[1] MPA-Deloitte Report on "Economic impact of the film, television, and online video services industry in India, 2019" dated May 2020

Band	Frequency	Auction Status	Operator
n41	2.515 - 2.675 GHz	Auctioned	China Mobile
n78	3.4 - 3.5 GHz	Auctioned	China Telecom
n78	3.5 - 3.6 GHz	Auctioned	China Unicom
n79	4.8 - 4.9 GHz	Auctioned	China Mobile

In addition in Dec 2020, China also commenced auctioning the the mmWave Bands for 5G.

7.2 Russia

In Russia, the 3.5 GHz range is not currently available for mobile networks, mainly due to its use for satellite services. An alternative under consideration is the 4.8–4.99 GHz range (the 4.8 GHz band). However, international regulation of this band for 5G is still in flux, with no certainty expected in the next three years at least. By the time of the next World Radiocommunication Conference (WRC) in 2023, it will be clearer as to whether sufficient scale has been realised to allow for affordable mass-market 5G deployments using this band.Russia has limited 5G auctions to 3600 MHz only.

8 Global Best Practices where Band beyond 3600 MHz was allocated and Disruptions

8.1 Korea is one of the countries which has auctioned spectrum till 3700 MHz. Ministry of Science and ICT auctioned spectrum licences in 3.5 GHz (3420-3700 MHz) and 28 GHz (26.5 - 28.9 GHz) in June 2018. Auction results are presented in a table below.

3GPP Band Number	Frequency Range	Duplex Mode	Bandwidth	Operator
n78	DL: 3.42-3.5 GHz UL: 3.42-3.5 GHz	TDD	80 MHz	LG Uplus
n78	DL: 3.5-3.6 GHz UL: 3.5-3.6 GHz	TDD	100 MHz	KT
n78	DL: 3.6-3.7 GHz UL: 3.6-3.7 GHz	TDD	100 MHz	SKT
n257	DL: 26.5-27.3 GHz UL: 26.5-27.3 GHz	TDD	800 MHz	KT
n257	DL: 27.3-28.1 GHz UL: 27.3-28.1 GHz	TDD	800 MHz	LG Uplus
n257	DL: 28.1-28.9 GHz UL: 28.1-28.9 GHz	TDD	800 MHz	SKT

The following facts are noteworthy:

(i) The spectrum in mmWave Bands is 800 MHz each Vs. 100 MHz in C-Band.

(ii) (ii) Korea is a special case as they do not use the satellite C-Band extensively for C&S services.

8.2 Australia -Disruptions and moving to mmWave Bands

Australia had previously allocated 3425 MHz to 3492 MHz and 3542 to 3575 MHz. In Dec 2018, it further allocated spectrum up to 3700 MHz (i.e 3575 to 3700 MHz). The operators of TV and other C-Band services faced severe disruption post the allocation to 5G, including the denial of services in the entire C-Band of 3700-4200 MHz.

https://www.avcomm.com.au/c-band-and-5g-interference/

Australia has now further planned to auction the mmWave bands. In April 2021, it has scheduled a spectrum tender to award high-band 5G spectrum (in the 26 GHz band), which will enable fast, high-capacity services. In the second half of 2021, the government will allocate low-band 5G spectrum (in the 850/900 MHz band), which will be key for broader geographic coverage of 5G services.

9 Auctions in mmWave Bands

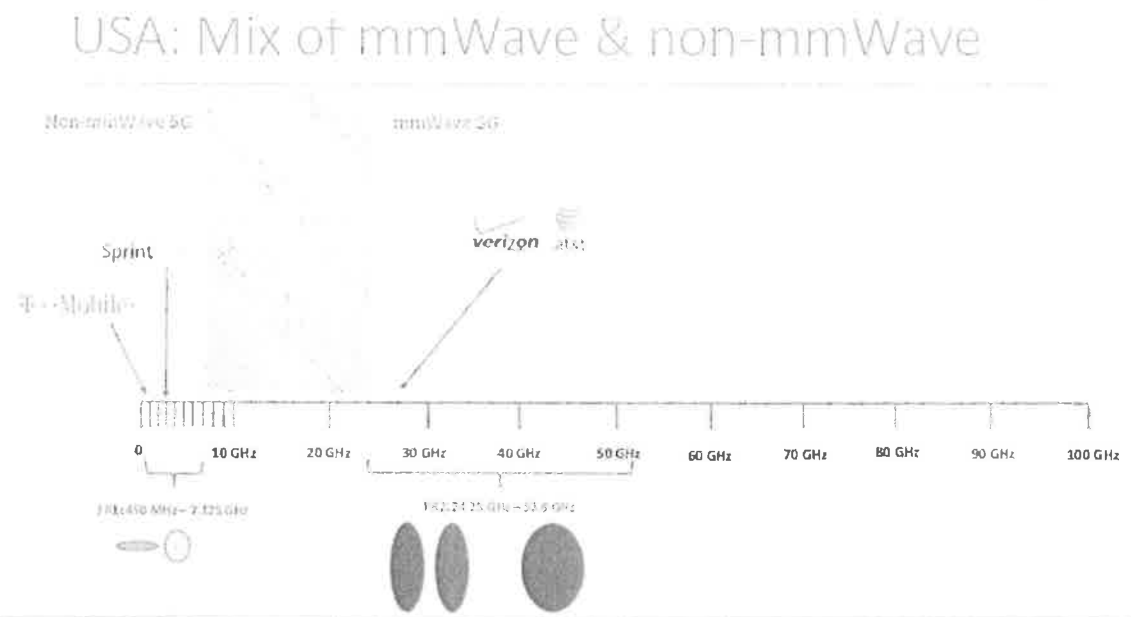
All emerging 5G leaders globally have quickly moved to auction off spectrum in the mmWave Bands. Key statistics for 5G mmWave bands are as below:

Key statistics:

- ninety-seven operators in 17 countries/territories hold public licences (many of them regional) enabling operation of 5G networks using mmWave spectrum.
- twenty-two operators are known to be already deploying 5G networks using mmWave spectrum.
- thirteen countries/territories have announced formal (date-specified) plans for assigning frequencies above 24 GHz between now and end-2021.
- eighty-four announced 5G devices explicitly support one or more of the 5G spectrum bands above 24 GHz (though note that details of spectrum support are patchy for pre-commercial devices), up from 59 at the end of November 2019. Twenty-seven of those devices are understood to be commercially available.

In USA, the FCC in July 2019 FCC announced procedures for the largest mmWave auction. The auction started on Dec. 10th ,2019 and included 37.6 38.6 GHz and 47.2 48.2 GHz across the US and some licenses for 38.6 40 GHz. In March 2020, auctions of 37 GHz, 39 GHz, and 47 GHz were successfully completed. FCC is considering rules for 70/80/90 GHz, and has opened spectrum above 95 GHz.

While the operators in many countries relied initially on the use of Mid-band spectrum, the ultimate move has been to High bands and mmWave bands to achieve 5G speeds needed.



10 Auction Proceeds Vs Media and Ent Industry case

TRAI has recommended a price of INR 490 Crores ($65 million) per megahertz for spectrum in the 3.3-3.6 GHz band. TRAI has not recommended extending auctions beyond the 3600 MHz band.

The IMT lobby is working on two fronts- one to ask Govt. to reduce the Per MHz price, and the second to extend the band to 3670 MHz or even beyond.

The argument which would seem attractive to the Govt, and frequently touted by the IMT lobby would be the additional funds received for the extra 70 MHz which if auctioned at the same rate (Rs 490 Crore Per MHZ) will amount to Rs 34,300 Crores. This will be realized over 10 years, or Rs 3430 Crores per year.

As per market estimates, India broadcasting and cable TV market was valued USD 11.61 Billion (Rs 87,075 Crores) in FY2020 and the market is forecast to reach USD 19.06 Billion (Rs 142,950 Crores) in FY2026.

https://www.techsciresearch.com/report/india-broadcasting-and-cable-tv-market/3281.html

A 30% impairment of the C&S market, which is imminent with increased allocation with 5G will lead to a loss of Rs 42,885 Crores per year based on 2026 revenue projections (Rs 27,000 Crores per year as per 2021 data).

This is over 10 times the auction proceeds on a yearly basis (Auction proceeds of Rs 3430 Crores per year Vs impairment of C&S sector of Rs 27,000 Crores per year increasing to Rs 42,885 Crores per year by 2026.

No doubt in computation of the costs, the costs of impairment of space of Space assets of the Dept of Space (DoS) must also be considered and put in record. A loss of 100 MHz amounts to an impairment of 20% of all C-Band satellites (500 MHz capacity per satellite 3700-4200 MHz).

For 10 satellites serving this band at Rs 800 Crores each (Total value 8000 Crores) the impairment will amount to Rs 800 Crores. There will also be a loss of 100% of Assets in lower extended C-Band (3400-3600 MHz) amounting to about 200 Crores.

The approach of permitting more spectrum beyond 3600 MHz, when alternatives are available in mmWave Bands with 800 MHz per Operator is thus highly short sighted. It will decimate the C&S sector while imparting no benefit to the IMT sector as they need to move to mmWave bands in near future for realizing 5G speeds needed with allocations of 800 MHz per operator being the norm in the higher bands.

Considering the significance of the matter, on behalf of the broadcasting fraternity, we request your kind and immediate intervention in this matter, otherwise it will herald serious problems for the Cable & Satellite sector in India, the magnitude of which is fully yet to be appreciated.

Yours sincerely,

Radhakrishnan
Secretary

CC: Dr. P. D. Vaghela, Chairman, TRAI
CC: Smt. Neerja Sekhar, Additional Secretary, MIB
CC: Shri S. K. Gupta, Secretary, TRAI
CC: Shri Vikram Sahay, Joint Secretary (P&A), MIB
CC: Shri Arvind Kumar, Advisor (B&CS)- I & III, TRAI

Mitigating 5G Interference Signals In The C-Band
By Mehdi Ardavan, RF Design Engineer, Norsat International

The coverage and capacity band of the new 5G cellular network will operate mostly at 3.3 to 3.6 GHz posing interference concerns with the C-band satellite communication terminals which receive Space-to-Earth signals in the 3.4 to 4.2 GHz band. In this article, we prove that the interference signal, in a worst-case scenario, could be orders of magnitude higher than what the C-band terminal can tolerate.

Possible solutions are investigated and the products presented that can mitigate the interference. These products include LNBs with built-in filters and waveguide filters each of which may be a standalone solution or be combined to provide greater rejection of the interference. Guidelines on how to locate the C-band terminals are also presented.

Introduction

Satellite communication terminals operate in different frequency bands, one of which is called C-band. Terminals operating in C-band normally receive signals in the range of 3.4 to 4.2 GHz and transmit signals in the range of 5.85 GHz to 6.425 GHz. Until recently, there was no other well-established terrestrial technology operating in this band.

Although some WiMAX and other terrestrial networks operated at similar bands, they were never widespread and did not raise serious interference concerns. However, 5G cellular technology is expected to be ubiquitous and will share the same spectrum. The 5G interference signals will be powerful enough to saturate the sensitive C-band satellite receiving systems, causing a potential for total loss of service.

To support the efficient coexistence of 5G and LTE operating in the same licensed frequency band, the 3.3 to 3.8 GHz band has gained popularity for developing the 5G network in the coverage and capacity layer [1], [2]. However, in many regions and countries the spectrum of the 5G networks will be limited to below 3.6 GHz such as in Russia, MENA, China, Africa. Some of these countries will also use the range 4.8 GHz to 5.0 GHz or frequencies above 4.4 GHz. In Europe, most countries are planning to use the 3.4 GHz to 3.8 GHz range [2].

As the above mentioned 5G frequency bands fall in the C-band receive spectrum of 3.4 GHz to 4.2 GHz, the receiver of a C-band terminal operating at the same frequency as the 5G signal will face interference. Even if the satellite signals received by the C-band terminal are limited to 3.8 to 4.2 GHz, there is still a risk of 5G signal interference. The satellite signal received at the ground terminal is usually several orders of magnitude weaker than the cellular signal. The receiver equipment of a satellite terminal is usually chosen or designed to detect these extremely low power levels in the 3.4 to 4.2 GHz range and the presence of any strong carrier may affect the performance of its receiving system including the LNB and the modem. These adverse effects, which may be experienced even if the interfering signal is out of band, include...

— *Gain compression and saturation*
— *Noise floor degradation*
— *Unwanted Intermodulation products*

Gain compression occurs when the total power at the input of the LNB reaches or passes its input P1dB. For example, an LNB with an output P1dB = 5 dBm and a gain of Gss = 60 dB will have an output at P1dB if the interfering signal is -54 dBm. This will occur even though the received satellite signal is very small and would not normally cause gain compression. An LNB operating with gain compression will lead to a non-linear distortion at the input of the modem which may affect the modulation error ratio (MER) and Eb/N0 and thus the bit error rate. In a worst-case scenario, the modem may lose the receive lock.

Saturation happens when the power in the interfering signal is too strong and forces the receiver into saturation. In the above example if the interference has a power of around -45 dBm or above, the LNB could be blocked and may not be able to receive any signals.

Noise floor degradation is another effect which may be either uniform across the entire receiving band of the LNB or only present at portions of it. If the noise floor is raised, the signal to noise ratio (C/N) and Eb/N0 will be reduced leading to an increase in the bit error rate.

Intermodulation will occur between the interfering signal and the satellite receive signal or between the interfering signal and the LO of the LNB. The frequency of the resulting intermodulation products could fall into, or close to the operating spectrum of the LNB and cause further interference or simply reduce the linearity of the LNB.

Although this article focuses on a specific interference problem which occurs at 3.6 GHz, the generality of this method remains intact and the reader can apply it to any frequency.

In this article, the received interference power in one near-field and one far-field worst case scenario are calculated and estimated and solutions are recommended to overcome the issue. Multiple interferers are not considered. The effects of multi-path are not considered.

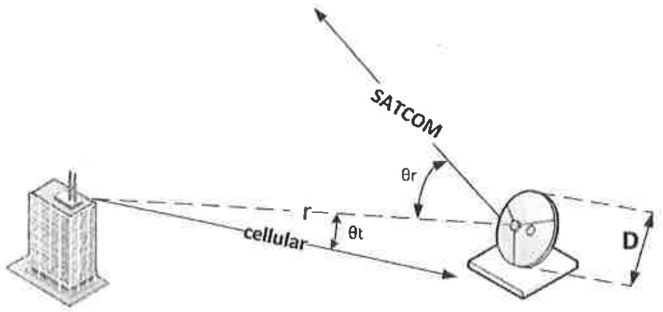


Figure 1. The dashed line shows the distance, r, between the cellular and SATCOM antennas. The line named "SATCOM" shows the boresight of the C-band reflector antenna, making angle with the dashed line. The line titled "cellular" shows the boresight of the cellular antenna making an angle with the dashed line. For simplicity and without loss of generality, all three lines are assumed to be on the same plane. The size of the dish is denoted by D.

5th Gen Cell Signal Interference with C-band SATCOM Terminals

Two worst-case scenarios are now presented wherein the interference from a 5G cellular antenna seems to be significant. The first case occurs at the distance from the antenna known as the far-field distance and the second case takes place when the interferer is closer to the antenna and thus the far-field approximations no longer apply. For simplicity, not accounted for are the multiple sources and the multipath effects.

The field values are calculated assuming 40 W radiation from a cellular antenna with a gain of 18 dBi [5]. Field values and power densities are calculated using standard far-field approximations and some near-field approximations [3] and [4]. The summary of the results are presented in the main body of this article, while the detailed calculations can be found in the *Appendix*.

As seen in *Figure 1*, the transmitting antenna in the defined problem is a cellular antenna whose radiation pattern is usually omnidirectional in the horizontal plane, meaning that its gain is not dependent on ϕt. This is usually achieved by using several sector antennae, each of them covering a region. To be conservative, we assume that the receiving antenna is on the boresight of the transmitting antenna, making $\theta t = 0$, and thus maximizing the transmitted power density. The cellular antenna is in the far field region of the C-band SATCOM terminal if the distance r is greater that the distance to the boundary of the far-field region denoted by Rf which is dependent on the size of the antenna and the wavelength.

The free space loss and the power received by the C-band terminal is computed for different distances. According to [3] the highest power density in the near field occurs at $Rf\ /10$ and so this is considered the worst-case scenario and is one of the distances we use for received power, Pr , calculation. We also calculate Pr at Rf and $2Rf$.

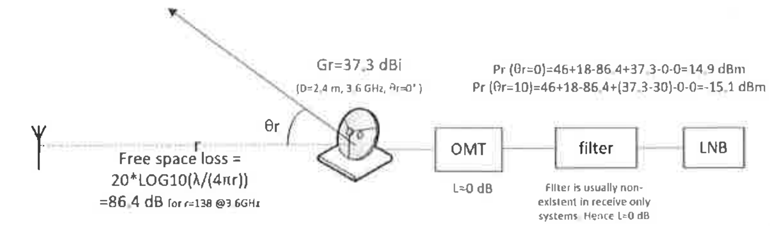


Figure 2. Link budget calculation for the interference caused by a cellular antenna and received by a 2.4- m reflector antenna at 138 meters away.

For a 2.4-m antenna at 3.6 GHz, Rf is equal to 138 meters, therefore Pr is calculated at 13.8 m, 138 m and 276 m. These calculations are performed assuming that the cellular antenna is at the boresight of C-band SATCOM terminal, that is $\theta r = 0$ which is an unlikely scenario as it may cause blockage to the line of sight to the satellite. However, they provide a baseline for further calculations such as when the cellular antenna is not at the boresight of the reflector antenna. The calculations are repeated for an offset angle of $\theta r = 10$ degrees.

All the calculations for a 2.4 m antenna at 3.6 GHz are summarized and illustrated in *Figure 2*.

The far-field distance Rf, free space loss, and Pr are calculated again for different antenna sizes, both at boresight and at $\theta r = 10$ degrees. The results are summarized in *Table 1*.

The last two columns in Table 1 show the received interference levels for different antenna sizes at different distances, assuming both the unlikely case of $\theta r = 0$ and more likely case of $\theta r = 10$ deg. The boresight assumption is unlikely to occur as it may cause satellite blockage. The gain at 10-degree offset angle is obtained from the mask provided in FCC 25.209(a)..

SATCOM Reflector size (m)	Distance (m)	Free Space Loss (dB)	Interferer on Boresight $\theta_r = 0$ degrees (dBm)	Interferer at 10-deg offset angle $\theta_r = 10$ degrees (dBm)
2.4	$R_f/10$=13.8	n/a	31.23	1.23
2.4	R_f=138	86.4	14.9	-15.1
2.4	$2R_f$=276	92.4	8.9	-21.1
3	$R_f/10$=21.6	n/a	29.3	-0.7
3	R_f=216	90.3	12.9	-19.3
3	$2R_f$=432	96.3	6.9	-25.3
3.7	$R_f/10$=32.9	n/a	27.5	-2.5
3.7	R_f=329	93.9	11.1	-22.9
3.7	$2R_f$=658	100.0	5.1	-28.9
9	$R_f/10$=194.4	n/a	19.6	-10.4
9	R_f=1944	109.4	3.4	-38.3
9	$2R_f$=3888	115.4	-2.6	-44.3

Table 1. Interference level received by reflector antennas of different sizes at 3.6 GHz caused by a 40 W cellular antenna with a gain of 18 dBi.

If the assumption is made that the interferer is always at least 10 degrees offset from reflector antenna bore-site and in the far field of the reflector antenna, i.e., ignoring the $Rf/10$ distances, it is seen that the interference level at the LNB input is always below -15 dBm.

Sensitivity of Standard C-band LNBs

Norsat conducted a series of tests to determine the immunity level of typical C-band LNBs which work in the 3.4 to 4.2 GHz range and hence innately susceptible to interference at 3.6 GHz.

The gain and noise floor of a standard LNB was measured, across the 3.8 to 4.2 GHz range with and without an interference signal at 3.6 GHz.

Figure 3 shows the standard LNB output when no interference signal is present. A -50-dBm signal at 3.6 GHz is used as the interference the output is presented in *Figure 4* which shows intermodulation products.

Figure 1. The dashed line shows the distance, r, between the cellular and SATCOM antennas. The line named "SATCOM" shows the boresight of the C-band reflector antenna, making angle with the dashed line. The line titled "cellular" shows the boresight of the cellular antenna making an angle with the dashed line. For

simplicity and without loss of generality, all three lines are assumed to be on the same plane. The size of the dish is denoted by D.

Figure 2. Link budget calculation for the interference caused by a cellular antenna and received by a 2.4- m reflector antenna at 138 meters away .

The intermodulation products almost disappear when the strength of the interference is below -55 dBm. Therefore, this is considered as the sensitivity of the standard LNB.

Unfortunately, all interference levels shown in *Table 1* are above -55 dBm which indicates that a standard LNB will experience performance problems due to interference from a 5G cellular tower.

All the strategies that can be used to tackle the interference problem are reviewed in the following section.

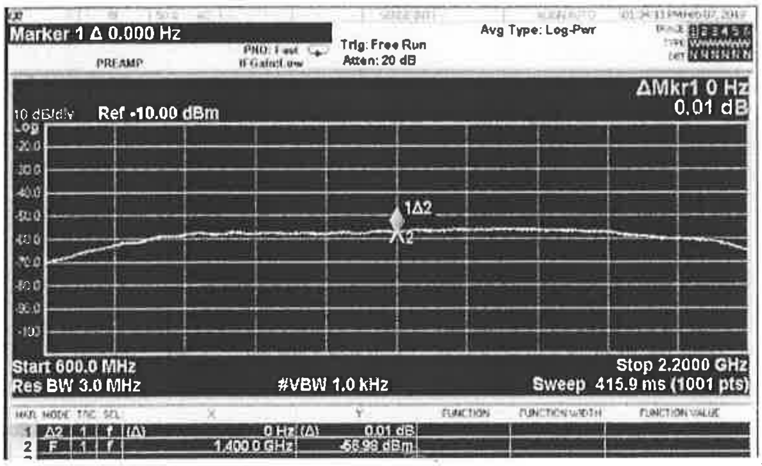


Figure 3. Output of a standard LNB with no interference.

Mitigating the Risk of Interference

To eliminate or control any electromagnetic interference one must focus on three major fronts -the transmitter, the medium of propagation and the receiver.

Transmitter
The power, the radiation pattern or the location of the 5G base station antenna cannot be controlled. Moreover, the antenna array of the 5G base station is usually designed to provide an omnidirectional radiation pattern in the horizontal plane. However, in the vertical plane, the radiation pattern is not uniform and has about 15 dB less gain at an offset of 15 degrees. As base station antennas are usually on buildings, the radiation patterns typically have a down-tilt to provide better coverage at ground level. If the satellite antenna can be located higher than the 5G antennas, it may be possible to benefit from the reduced gain of the 5G antenna in the direction of the satellite antenna. These estimates are dependent on the manufacturer of the sector antenna, its exact radiation pattern, the base station site and RF planning.

Medium of Propagation
The 5G signal power received by the satellite antenna decreases with the distance between the antennas. Assuming interferer is in the far field region of the satellite antenna, the received power density is reduced 7 6 dB each time the distance between the antennas is doubled. So whenever possible, choose the farthest distance from the base station antenna.

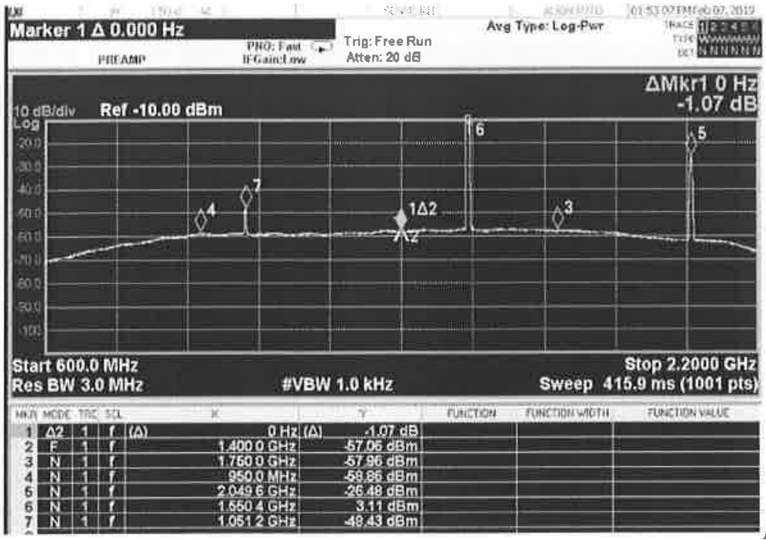


Figure 4. Output of a standard LNB with input CW interference at 3.6 GHz and power of -50 dBm.

Solutions at the Receiver

Position

Sometimes it is possible to locate the C-band terminal such that the base station antenna is at the widest possible offset angle from its boresight. The site of the C-band terminal can be analyzed to provide instructions as how to position the terminal in order to reduce the interference. The last column in *Table 1* is an example of the effect of a 10-degree offset angle in reducing interference.

Interference Mitigating LNBs

A typical LNB tolerated an interference of -55 dBm at 3.6 GHz with minimal intermodulation or gain compression. However as shown previously, it is expected interfering signals may be as high as -15 dBm. A current design for an interference-mitigating LNB is expected to tolerate an interference of -20 dBm without any significant spurious or intermodulation products at the output. The cost of this additional interference tolerance is that the noise temperature is expected to increase from about 40 K to about 54 K.

Unfortunately using the interference-mitigating LNB does not eliminate the interference problem in all cases and some additional filtering before the LNB may be required. Table 2 summarizes the additional filtering that is required for various scenarios using a 2.4m antenna and the interference levels provided in *Table 1.*

	Additional Rejection Required (dB)			
Distance Between Antennas	At Boresight	At 5-deg Offset Angle	At 10-deg Offset Angle	at 25-deg Offset Angle
13.8	51.23	39.23	21.23	n/a
138	34.9	12.2	4.9	-5.3
276	28.9	6.2	-1.1	-11.3
552	22.9	0.2	-7.1	-17.3
1104	16.9	-5.8	-13.1	-23.3

Table 2. Amount of additional rejection required (dB) in order to mitigate the interference while using a new interference-mitigating LNB. The green cells indicate the positions at which the new interference-mitigating LNB will definitely work as a standalone solution, assuming the conditions explained in the paper. The yellow cells indicate the positions at which the new interference-mitigating LNB will probably work at the actual gain pattern is usually several dB below the mask. The red cells indicate the situations where a waveguide filter is necessary.

It is seen in *Table 2,* that at a more likely 25-degree offset angle, at all far field distances the new interference-mitigating LNB is sufficient to mitigate the risk of interference. The gain at offset angles are obtained from the mask provided in FCC 25.209(a)..

The actual radiation pattern of an antenna will usually have a gain of several dB lower than the mask at wide offset angles. Hence when the additional rejection required is about 6 dB or less, (*i.e.*, the yellow cells in *Table 2*) it is expected that the interference-mitigating LNB by itself will be sufficient.

The red cells in *Table 2* indicate the amount of additional rejection required when the interference-mitigating LNB does not mitigate the interference by itself. In these situations, a waveguide filter will be necessary.

Waveguide Filter

A waveguide filter can be used to suppress the frequency content at the interference band. The benefit of this method is that the interference is rejected before it enters the LNB and so it becomes possible to use conventional LNBs which also operate in the 3.3 to 3.8 GHz band. The disadvantage of this method is that the waveguide filter loss before the LNB, will significantly impact the G/T of the antenna. The waveguide filters in C-band are usually large in size and occupy more space as their rejection increases.

A C-band waveguide filter can offer more than 55 dB of rejection below 3.6 GHz with a passband of 3.8 to 4.2 GHz. This method is suitable for customers who have bought standard LNBs. Also, customers who are in close vicinity of an interferer and are exposed to large amounts of radiation may need a waveguide filter in addition to the interference-mitigating LNB.

Using A Combination of Strategies in Different Scenarios

In some cases, as shown in *Table 2*, several different strategies must be employed to mitigate the effects of a5G interference signal. Pre-defined positioning of the satellite terminal, use of interference -mitigating LNBs and waveguide filters may be used.

In the worst case near field scenario, the interfering signal will need to be reduced by about 86 dB to ensure the interfering signal at the input to the LNB is less than -55 dBm. This is the maximum allowable interfering signal for a standard LNB. In this scenario the distance between the base station antenna and the terminal is about 13.8 meters and hence elevating the C-band terminal to achieve a 15-degree offset angle and thus 15 dB reduction in the interfering signal could be feasible.

If it is possible to position the C-band terminal such that its boresight is at least 10 degrees away from the base station antenna, another 30 dB reduction can be achieved according to [4].

An interference-mitigating LNB will provide an additional 35 dB of improvement, which means a total reduction of 15 dB + 30 dB + 35 dB = 80 dB. Unfortunately, this does not meet the 86 dB reduction required.

In this case, a waveguide filter offering at least 41 dB rejection at 3.6 GHz would provide sufficient interference mitigation to use with a standard LNB. (15 dB reduction due to position of 5G antenna, 30 dB reduction due to position of satellite antenna and 41 dB rejection from filter provides 86 dB reduction in the interference signal.) Waveguide filters providing 55 dB rejection at 3.6 GHz with a passband at 3.6-4.2 GHz are available.

Hence the worst-case scenario in near field can be mitigated by using a waveguide filter with a standard LNB given that the position and the height of the C-band terminal can be slightly changed. If the change in the position and height is not possible, a combination of the interference-mitigating LNB and waveguide filter will be able to provide up to 55+35=90 dB in rejection, mitigating the risk of interference.

In the far-field worst-case scenario, the interfering signal needs to be reduced by about 70 dB to ensure that the interfering signal at the input to the LNB is less than -55 dBm, the maximum allowable interfering signal for a standard LNB. If the cellular antenna is exactly at the boresight or very close to it, the line of sight to the satellite can be blocked and hence it is assumed that the satellite terminal is placed at a 3-degree offset angle which means at least 20-dB gain reduction for this C-band terminal assuming it is compliant with FCC 25-209. This means that a 50-dB waveguide filter at 3.6 GHz could solve the problem without the need for a new interference-mitigating LNB.

Conclusion

The frequency bands of C-band for satellite communication and the cover and capacity layer of the upcoming 5G network were reviewed and it was determined that there is significant potential for interference to C-Band satellite communication. The multipath effect and existence of multiple interferers were not considered.

Using typical parameters, two worst case scenarios were analyzed, one in the near field and another in the far field region. To be able to conduct the analysis in the near field some approximations found in the literature were used. The analysis revealed that the received interference strength at the C-band terminal could be up to several orders of magnitude higher than the maximum level it can tolerate to operate normally while using a standard LNB.

The new interference-mitigating C-band LNBs have higher tolerance levels. At an offset angle of 25 degrees, the new interference-mitigating LNB can work as a standalone solution to mitigate the risk of interference at all far-field distances. If the offset angle is 10 degrees, the new interference-mitigating LNB is expected to be a sufficient solution for distances larger than twice the far-field boundary. Since the gain patterns are usually well below the FCC masks, the new LNB will probably work well at the far-field distance.

However, in the near-field, at about 14 meters, with a 10-degree offset angle, a combination of the new interference-mitigating LNB and waveguide filter is required to mitigate the risk of interference.

Appendix

It this section we describe how to determine the field values in far and near fields.

Interferer at the Far-Field Distance
Antenna radiation patterns and other specifications are usually determined assuming the far-field criterion which ensure that

1- the propagating field is a good approximation of a plane wave,
2- there is no reactive field
3- the electric and magnetic fields decay by 1/r, where r is the distance from the radiating antenna.

$$R_f = \frac{2D^2}{\lambda}$$

The first requirement is satisfied when the distance from the antenna, r, is both—
a- greater than the far-field distance $Rf = 2D^2 \div \lambda$,where λ is the wavelength and D is the largest dimension of the antenna, and
b- much greater than λ.

$$r > \frac{2D^2}{\lambda}$$

When D is more than two or three wavelengths, if $r > 2D^2 \div \lambda$ then the requirement $r \gg \lambda$ is automatically satisfied, which is the case in our problem. In this problem, we assume that the reflector antenna is 2.4 meters in diameter and the frequency of interest is 3.6 GHz where the wavelength is 8.3 cm, so the far field distance for the reflector antenna is $R_{f,ref} = 2D^2 \div \lambda = 138.24$ m (1)

$$R_{f,ref} = \frac{2D^2}{\lambda} = 138.24 \text{ m}$$

$$P_r = \frac{P_t G_t(\theta_t, \phi_t) G_r(\theta_r, \phi_r) \lambda^2}{(4\pi r)^2}$$

The goal is to determine the power received by a receiver antenna with a gain of $Gr(\theta r, \phi r)$ where θr and ϕr are the offset elevation and azimuth angles with respect to boresight. If the receiver antenna transmits Pt

and has a gain of $Gt(\theta t, \phi t)$, where θt and ϕt are the offset elevation and azimuth angles with respect to boresight of the transmitter, the received power is determined by $P_r = P_t Gt(\theta_t, \phi_t) G_r(\theta_r, \phi_r) \lambda^2 \div (4\pi r)^2$ (2)

$$P_r = \frac{P_t G_t(\theta_t, \phi_t) A_{e,r}(\theta_r, \phi_r)}{4\pi r^2}$$

Considering that the effective aperture of antenna – usually a receiving one – is given by $Ae = \lambda\ 2G\ 4\pi$ the above equation can be rewritten as $Pr = PtGt\ (\theta t, \phi t) Ae,r\ (\theta r, \phi r)\ 4\pi r\ 2$ where $Ae,r\ (\theta r, \phi r) = \lambda\ 2Gr\ (\theta r, \phi r)\ 4\pi$ is the effective aperture of the receiving antenna in the $(\theta r, \phi r)$ direction.

$$\frac{P_t G_t(\theta_t, \phi_t)}{4\pi r^2}$$

On the other hand $PtGt\ (\theta t, \phi t)\ 4\pi r\ 2$ is the power density of the radiation at the $(\theta t, \phi t)$ direction usually denoted by $St(\theta t, \phi t)$.

$$P_r = S_t(\theta_t, \phi_t) A_{e,r}(\theta_r, \phi_r)$$

Hence eq. (2) can be rewritten as $Pr = St(\theta t, \phi t) Ae,r\ (\theta r, \phi r)$ (3) 11

As it is seen in Figure 1, the transmitting antenna in our problem is a cellular antenna whose radiation pattern is usually omnidirectional, meaning that its gain is not dependent on ϕt. This is usually achieved by using several sector antennae each of them covering a region. To be conservative, we assume that the receiving antenna is at the boresight of the transmitting antenna, making $\theta t = 0$, and thus maximizing St.

In a coordinate system placed at the center of the receiving antenna with the z-axis in the direction of the cellular antenna, shown by the dashed line in Figure 1, the gain of the receiver antenna, and thus $Ae,r\ (\theta r, \phi r)$, is maximum for , $\theta r = 0$. Assuming a symmetric center-fed antenna, the gain is not dependent on ϕr.

$$P_r = S_t(\theta_t) A_{e,r}(\theta_r)$$

So eq. (3) is reduced to $Pr = St(\theta t) Ae,r\ (\theta r)$ (4)

$$P_r = S_t A_{e,r}$$

When the boresight of both antennas lie on the dashed line in Figure 1 and $\theta t = \theta r = 0$, Eq (4) simply reduces to $Pr = StAe,r$ (5) where St and Ae,r and maximum values of $St(\theta t)$ and $Ae,r\ (\theta r)$ respectively.

Assuming an aperture efficient, eA, of 65%, the gain of the reflector antenna is calculated as $Gref = eA\ (\pi D\ \lambda)\ 2 = 5316 = 37.3$ dB

$$A_{e,ref} = \frac{\lambda^2 G_{ref}}{4\pi} = 2.94\ \text{m}^2$$

The effective aperture, Ae,ref, for this reflector antenna is $Ae,ref = \lambda\ 2Gref\ 4\pi = 2.94$ m2

In [5] it is stated that the maximum EIRP of an LTE antenna is 64 dBm per antenna and the gain is 18 dBi, which means that the transmitted power if 46 dBm or 40 W.

The size of a cellular sector antenna at 3.6 GHz will be smaller than the size of our reflector, leading to a smaller far field boundary distance at the same frequency according to $Rf = 2D^2 \div \lambda$. So whenever the farfield criterion for the C-band terminal is satisfied it is also satisfied for the sector antenna.

$$G_{ref} = e_A \left(\frac{\pi D}{\lambda}\right)^2 = 5316 = 37.3 \text{ dB}$$

$$S_t = \frac{10^{\frac{64-30}{10}}}{4\pi \times (138.24)^2} = 0.010465 \text{ W/m}^2$$

Assuming both antennas are at the boresight of each other, the power spectral density of the cellular antenna at the position of the reflector antenna is computed as follows: St = 10 64−30 10 4π × (138.24) 2 = 0.010465 W/m^2

$$P_r = S_t A_{e,ref} = 0.010465 \times 2.94 = 0.03076 \text{ W} = 14.9 \text{ dBm}$$

The power received by the reflector antenna is computed by $Pr = StAe{,}ref$ = 0.010465 × 2.94 = 0.03076 W = 14.9 dBm

These boresight-to-boresight interference levels are summarized in Table 1.

It is worth noting that this level of interference assumes that both antennas are in the boresight of each other which is an extremely unlikely scenario. It also assumes that they are in the closest far-field distance of each other. This scenario was analyzed to gain an understanding of the worst interference in the farfield region. In a more likely scenario, the cellular antenna would be away from the boresight of the Cband terminal by for example 10 degrees that is $\theta r = 10$ deg. An FCC-compliant terminal cannot have a gain of more than 7 dB which, for our C-band terminal, means about a 30 dB gain reduction from boresight. In this scenario the interference power would be approximately -15 dBm. Some C-band operators have mentioned similar values as what they prefer the tolerance level of the LNB would be.

Interferer at the Near Field Region of the VSAT Terminal

If the distance to the reflector antenna is smaller than $Rf{,}ref = 2D^2 \div \lambda = 138.24$ m, the far field approximations do not apply, and one must use different solutions. Phase front and reactive fields are two issues to be considered.

Determining the Power Received by the VSAT Terminal Caused by a 5G Interferer at its Near Field

In this section we determine the power received by the C-band VSAT terminal when the 5G interference is at its near field.

At this distance, it is assumed that the C-band terminal is in the far-field region of the cellular sector antenna. A direct solution would be to compute the power density caused by the cellular antenna and then calculate the received power by the satellite terminal. Unfortunately, since we are in the near field of the satellite terminal, we cannot use the far-field approximations to quickly compute the received power. The method described in [3], presents a way for predicting the power density when the parabolic antenna itself is radiating P_t. Assuming the far-field conditions for the cellular antenna one can easily determine the power received by the cellular antenna, P_r. Then the reciprocity theorem is used in this passive system to conclude that if the cellular antenna was transmitting P_t, the parabolic antenna would receive the same P_r. So instead of starting from the interferer and going to the receiver we will start from the receiver as if it were the transmitter and we calculate the power received by the cellular antenna.

However, we digress in this paragraph to point out the fact that the cellular antennas are usually an array of patch antennas and hence their far-field criterion is only about the phase front. If the distance is smaller than their far field, the actual gain will be smaller than the far-field gain and hence our computations from this point on will be even more conservative.

The cellular antenna has a gain of 18 dBi and transmits about 40 W [5].

$$S = \frac{40 \times 10^{\frac{37.26}{10}}}{4\pi \times (138.24)^2} = 0.886\ \frac{\text{W}}{\text{m}^2}$$

We assume that the reflector antenna is transmitting 40 W. At its far-field distance i.e. at 138.24 m, the power density is $S = 40 \times 10x37.26 \div 10 \div 4\pi \times (138.24)\ 2 = 0.886\ \text{W} \div \text{m}^2$

According to [3], the strongest power density in the near field on boresight happens when the distance from the antenna is one tenth of the far-field distance and will be about 43 times stronger than the power density on the boresight at the far-field distance. So the highest near field power density will occur at 13.8 m and will equal 43*0.886=38.1 W/m2.

$$A_{e,LTE} = \frac{0.083^2 \times 10^{18/10}}{4\pi} = 0.035\ \text{m}^2$$

The next step is to determine the power input to the cellular antenna which has an effective aperture of $Ae,LTE = 0.0832 \times 10^{18/10} \div 4\pi = 0.035\ \text{m}^2$

The power input to the cellular antenna is $0.035 \times 0.886 = 1.33$ W = 31.23 dBm.

Using the reciprocity theorem, one can conclude that if the 40 W was being transmitted at the cellular antenna, the reflector antenna would receive the same 31.23 dBm.

References

[1] ITU-R, Recommendation ITU-R M.2083-0 IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond, 2015.

[2] Huawei Technologies Co LTD; 5G Spectrum - Public Policy Position, 2018

[3] A. Farrar and E. Chang, Procedures for Calculating Field Intensities of Antennas, Figure 4-2(b), 1987

[4] Herbert K. Kobayashi, Procedure for Calculating the Power Density of a Parabolic Circular Reflector Antenna, Fig 3-9(b), 1990

[5] National Telecommunications and Information Administration, "LTE (FDD) Transmitter Characteristics" https://www.ntia.doc.gov/files/ntia/meetings/lte_technical_characteristics.pdf, accessed February 2019.

Annexure-II

List of Channels in C-Band within 3600-< 3800 MHz band

Channels on GSAT-30 Satellite

Sr. No	Satellite	Frequency Band	Channel Name
1	GSAT-30	3707-3743 MHz	News 18 Madhya Pradesh & Chhattisgarh
2	GSAT-30	3707-3743 MHz	News 18 Rajasthan
3	GSAT-30	3707-3743 MHz	News 18 Bihar & Jharkhand
4	GSAT-30	3707-3743 MHz	News 18 Urdu
5	GSAT-30	3707-3743 MHz	News 18 Odia
6	GSAT-30	3707-3743 MHz	Colors Bangla
7	GSAT-30	3707-3743 MHz	Colors Marathi
8	GSAT-30	3707-3743 MHz	Colors Kannada
9	GSAT-30	3707-3743 MHz	Colors Infinity
10	GSAT-30	3707-3743 MHz	VH1 India
11	GSAT-30	3707-3743 MHz	Colors Cineplex
12	GSAT-30	3707-3743 MHz	Colors Infinity
13	GSAT-30	3707-3743 MHz	Colors Gujarati Cinema
14	GSAT-30	3707-3743 MHz	Colors Bangla Cinema
15	GSAT-30	3707-3743 MHz	Nick HD+
16	GSAT-30	3707-3743 MHz	MTV Beats
17	GSAT-30	3707-3743 MHz	Colors Cineplex
18	GSAT-30	3707-3743 MHz	VH1 India
19	GSAT-30	3707-3743 MHz	Colors Odia
20	GSAT-30	3707-3743 MHz	Colors Gujarati
21	GSAT-30	3738-3774 MHz	Grace TV (India)
22	GSAT-30	3738-3774 MHz	Siddarth Bhakti
23	GSAT-30	3738-3774 MHz	A1 TV
24	GSAT-30	3738-3774 MHz	Bada Khabar
25	GSAT-30	3738-3774 MHz	National Voice
26	GSAT-30	3758-3794 MHz	Ishwar Bhakti TV
27	GSAT-30	3758-3794 MHz	Rongeen TV
28	GSAT-30	3758-3794 MHz	Manoranjan Grand
29	GSAT-30	3758-3794 MHz	Manoranjan TV
30	GSAT-30	3758-3794 MHz	Nandighosha TV
31	GSAT-30	3758-3794 MHz	News Daily 24
32	GSAT-30	3758-3794 MHz	6 TV Telugu
33	GSAT-30	3758-3794 MHz	Popular TV
34	GSAT-30	3758-3794 MHz	Sanskriti 24x7
35	GSAT-30	3758-3794 MHz	Fateh TV
36	GSAT-30	3758-3794 MHz	Channel Divya
37	GSAT-30	3758-3794 MHz	Nepal 1
38	GSAT-30	3758-3794 MHz	Enterr 10 Movies
39	GSAT-30	3758-3794 MHz	Dangal TV
40	GSAT-30	3758-3794 MHz	Khushboo TV Bangla

Channels on GSAT-30 Satellite (contd)

Sr. No	Satellite	Frequency Band	Channel Name
41	GSAT-30	3758-3794 MHz	Kalinga TV
42	GSAT-30	3787-3823 MHz	Nation First
43	GSAT-30	3787-3823 MHz	Hindi Khabar
44	GSAT-30	3787-3823 MHz	Dillagi
45	GSAT-30	3787-3823 MHz	Naaptol Telugu
46	GSAT-30	3787-3823 MHz	Rose TV
47	GSAT-30	3787-3823 MHz	Pitaara
48	GSAT-30	3787-3823 MHz	Bharat Samachar
49	GSAT-30	3787-3823 MHz	R9 TV
50	GSAT-30	3787-3823 MHz	Sudarshan News
51	GSAT-30	3787-3823 MHz	Khabrain Abhi Tak
52	GSAT-30	3787-3823 MHz	INH
53	GSAT-30	3787-3823 MHz	Prajaa TV Kannada
54	GSAT-30	3787-3823 MHz	Saam TV
55	GSAT-30	3787-3823 MHz	Music India
56	GSAT-30	3787-3823 MHz	Sangeet Bangla
57	GSAT-30	3787-3823 MHz	Sangeet Bhojpuri
58	GSAT-30	3787-3823 MHz	9XM
59	GSAT-30	3787-3823 MHz	9X Jhakaas
60	GSAT-30	3787-3823 MHz	Mastiii
61	GSAT-30	3787-3823 MHz	Naaptol
62	GSAT-30	3787-3823 MHz	Naaptol Tamil
63	GSAT-30	3787-3823 MHz	Naaptol Malayalam
64	GSAT-30	3787-3823 MHz	Naaptol Kannada
65	GSAT-30	3787-3823 MHz	Wow Cinema One
66	GSAT-30	3787-3823 MHz	Cinema TV (India)
67	GSAT-30	3787-3823 MHz	News 11
68	GSAT-30	3787-3823 MHz	Channel WIN
69	GSAT-30	3787-3823 MHz	Jinvani Channel
70	GSAT-30	3787-3823 MHz	Ind 24
71	GSAT-30	3787-3823 MHz	Dhamaal
72	GSAT-30	3787-3823 MHz	Maiboli
73	GSAT-30	3787-3823 MHz	Dabangg
74	GSAT-30	3787-3823 MHz	9X Jalwa
75	GSAT-30	3787-3823 MHz	B4U Kadak
76	GSAT-30	3787-3823 MHz	Network 10
77	GSAT-30	3787-3823 MHz	Bangla Bharat
78	GSAT-30	3787-3823 MHz	Sadhna TV
79	GSAT-30	3787-3823 MHz	Shemaroo TV
80	GSAT-30	3787-3823 MHz	Puthuyugam TV

	Channels on Asiasat-7 Satellite		
Sr. No	Satellite	Frequency Band	Channel Name
1	Asiasat-7	3634-3670 MHz	Sahara One
2	Asiasat-7	3634-3670 MHz	Samay National
3	Asiasat-7	3634-3670 MHz	Samay Rajasthan
4	Asiasat-7	3634-3670 MHz	Samay Maharashtra/Gujarat
5	Asiasat-7	3634-3670 MHz	Samay UP/Uttarakhand
6	Asiasat-7	3634-3670 MHz	Samay Bihar/Jharkhand
7	Asiasat-7	3634-3670 MHz	Aalami Samay
8	Asiasat-7	3634-3670 MHz	Samay MP/Chhattisgarh
9	Asiasat-7	3634-3670 MHz	Filmy
10	Asiasat-7	3634-3670 MHz	Firangi
11	Asiasat-7	3721-3729 MHz	ABP News India
12	Asiasat-7	3721-3729 MHz	ABP Ananda
13	Asiasat-7	3721-3729 MHz	ABP Majha
14	Asiasat-7	3721-3729 MHz	ABP Asmita
15	Asiasat-7	3721-3729 MHz	ABP Sanjha
16	Asiasat-7	3727V-3737 MHz	ZEE CAFÉ
17	Asiasat-7	3727V-3737 MHz	& FLIX
18	Asiasat-7	3727V-3737 MHz	ZEE BANGLA INT
19	Asiasat-7	3727V-3737 MHz	ZEE CINEMA ME
20	Asiasat-7	3762-3798 MHz V	National Geographic India English/ Hindi
21	Asiasat-7	3762-3798 MHz V	National Geographic India Bengali/ Tamil
22	Asiasat-7	3762-3798 MHz V	Fox Life India English/ Hindi
23	Asiasat-7	3762-3798 MHz V	Fox Life India HD
24	Asiasat-7	3762-3798 MHz V	Fox Life India HD Hindi
25	Asiasat-7	3762-3798 MHz V	Fox Life India HD Bengali
26	Asiasat-7	3762-3798 MHz V	Fox Life India HD Tamil
27	Asiasat-7	3762-3798 MHz V	National Geographic Wild HD
28	Asiasat-7	3762-3798 MHz V	National Geographic Wild HD Hindi
29	Asiasat-7	3762-3798 MHz V	National Geographic Wild HD Tamil
30	Asiasat-7	3762-3798 MHz V	National Geographic India HD
31	Asiasat-7	3762-3798 MHz V	National Geographic India HD Hindi
32	Asiasat-7	3762-3798 MHz V	National Geographic India HD Telugu
33	Asiasat-7	3762-3798 MHz V	National Geographic India HD Bengali
34	Asiasat-7	3762-3798 MHz V	National Geographic India HD Tamil
35	Asiasat-7	3762-3798 MHz V	Fox Life India English/ Hindi
36	Asiasat-7	3762-3798 MHz V	Fox Life India Br=engali/ Tamil
37	Asiasat-7	3762-3798 MHz V	National Geographic India Hindi
38	Asiasat-7	3762-3798 MHz V	National Geographic Wild Asia
39	Asiasat-7	3782-3818 MHz H	Marvel HQ
40	Asiasat-7	3782-3818 MHz H	Disney Junior India
41	Asiasat-7	3782-3818 MHz H	UTV Movies
42	Asiasat-7	3782-3818 MHz H	Star Vijay India HD
43	Asiasat-7	3782-3818 MHz H	Star Vijay India HD
44	Asiasat-7	3782-3818 MHz H	Asianet HD
45	Asiasat-7	3782-3818 MHz H	Asianet HD
46	Asiasat-7	3782-3818 MHz H	Star Maa
47	Asiasat-7	3782-3818 MHz H	Star Maa Music
48	Asiasat-7	3782-3818 MHz H	Star Maa Movies
49	Asiasat-7	3782-3818 MHz H	Star Maa Gold
50	Asiasat-7	3782-3818 MHz H	Star Utsav Movies
51	Asiasat-7	3782-3818 MHz H	Star World Premiere HD
52	Asiasat-7	3782-3818 MHz H	Star World Premiere HD
53	Asiasat-7	3782-3818 MHz H	Star Pravah HD
54	Asiasat-7	3782-3818 MHz H	Star Pravah HD
55	Asiasat-7	3782-3818 MHz H	Star Jalsha HD
56	Asiasat-7	3782-3818 MHz H	Star Jalsha HD
57	Asiasat-7	3782-3818 MHz H	Jalsha Movies HD
58	Asiasat-7	3782-3818 MHz H	Jalsha Movies HD

	Channels on IS-20 Satellite		
Sr. No	Satellite	Frequency Band	Channel Name
1	IS-20	3705-3741 MHz V	TV 9 Telugu
2	IS-20	3705-3741 MHz V	Mojo TV
3	IS-20	3705-3741 MHz V	TV 9 Kannada
4	IS-20	3705-3741 MHz V	TV 9 Marathi
5	IS-20	3705-3741 MHz V	TV 9 Gujarati
6	IS-20	3705-3741 MHz V	TV 9 Bharatvarsh
7	IS-20	3705-3741 MHz V	Mahaa News
8	IS-20	3705-3741 MHz V	Shubhsandesh TV
9	IS-20	3721-3757 MHz H	Discovery Channel India
10	IS-20	3721-3757 MHz H	DTamil
11	IS-20	3721-3757 MHz H	Animal Planet India
12	IS-20	3721-3757 MHz H	Investigation Discovery India
13	IS-20	3721-3757 MHz H	Investigation Discovery India
14	IS-20	3721-3757 MHz H	Discovery Science India
15	IS-20	3721-3757 MHz H	Discovery Turbo India
16	IS-20	3721-3757 MHz H	TLC India
17	IS-20	3721-3757 MHz H	Discovery HD World India
18	IS-20	3721-3757 MHz H	Discovery Kids India
19	IS-20	3721-3757 MHz H	TLC HD India
20	IS-20	3721-3757 MHz H	Animal Planet HD World India
21	IS-20	3761-3770 MHZ V	Arihant TV
22	IS-20	3761-3770 MHZ V	Aastha Tamil
23	IS-20	3761-3770 MHZ V	Aastha Telugu
24	IS-20	3761-3770 MHZ V	Aastha Kannada
25	IS-20	3763-3772 MHz H	&TV
26	IS-20	3763-3772 MHz H	Zee Zest
27	IS-20	3763-3772 MHz H	Zee Chitramandir
28	IS-20	3772-3776 MHZ V	Aastha India
29	IS-20	3772-3779 MHz V	Aastha TV
30	IS-20	3772-3779 MHz V	Aastha Bhajan India
31	IS-20	3772-3779 MHz V	Vedic
32	IS-20	3777-3813 MHz H	Times Now
33	IS-20	3777-3813 MHz H	Zoom (India)
34	IS-20	3777-3813 MHz H	ET Now
35	IS-20	3777-3813 MHz H	Movies Now
36	IS-20	3777-3813 MHz H	Movies Now +
37	IS-20	3777-3813 MHz H	Romedy Now
38	IS-20	3777-3813 MHz H	Mirror Now
39	IS-20	3777-3813 MHz H	Times Now World
40	IS-20	3777-3813 MHz H	MNX
41	IS-20	3777-3813 MHz H	Movies Now
42	IS-20	3777-3813 MHz H	Romedy Now
43	IS-20	3777-3813 MHz H	MNX
44	IS-20	3777-3813 MHz H	ET Now
45	IS-20	3777-3813 MHz H	Times Now

	Channels on GSAT-10 Satellite		
Sr. No	Satellite	Frequency Band	Channel Name
1	GSAT-10	3750 V	DD Uttarakhand
2	GSAT-10	3753 V	DD Chhattisgarh
3	GSAT-10	3757 V	DD Jharkhand
4	GSAT-10	3762 V	(DD feeds)
5	GSAT-10	3769 V	DD Hissar

Annexure-III

Information on LNB Overdrive Issues

Information on LNB Overdrive Issues

1. LNB Overdrive

To counter the LNB overdrive, adding rejection and/or bandpass filtering to the receiver of fixed FSS earth stations could be attempted. This technique however, would not help to mitigate interference due to unwanted emissions of IMT stations in adjacent bands or emissions of IMT stations operating in overlapping bands. Many earth station antennas, in particular receive only antennas, LNB and antenna feedhorn, are moulded together in one unit until it is physically impossible to insert a filter in between. Moreover, insertion of a filter reduces earth station figure of merit (G/T) and may require use of or change to larger antennas. Introducing such filters in receive installations is expensive, so use of LNB bandpass filters can only be considered for some few, large earth stations.

An example is shown here from a cellular operator in Asia operating in spectrum centered at 3450 MHz which is well below the C-Band of 3700-4200 MHz. The 5G signal is displayed in figure below

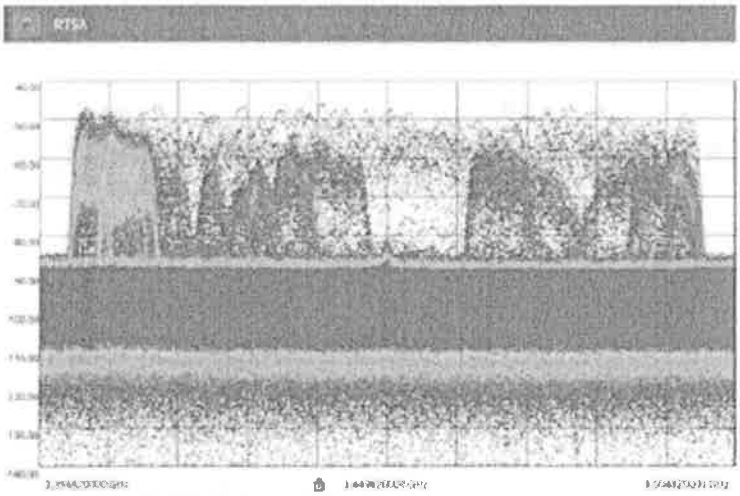


Figure-1 5 G carrier at 3450 MHz

The out of Band emissions for this 5G carrier at 3900 MHz which is well within the C-band, and more that 450 MHz away is depicted in the figure below:

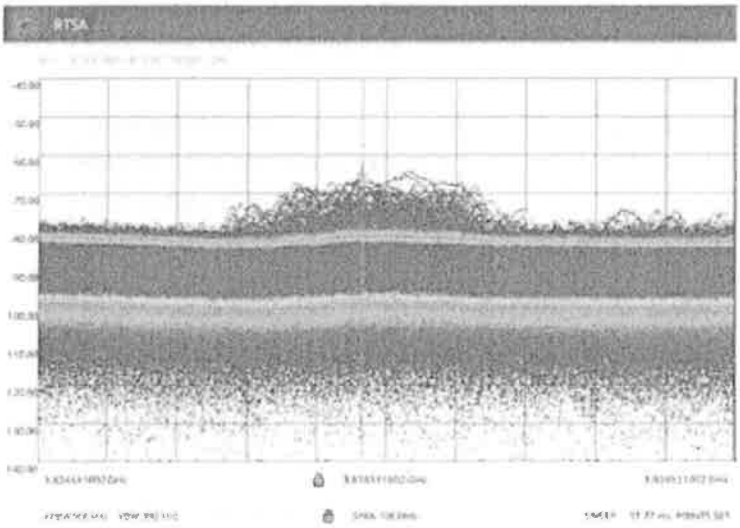


Figure-2- 5G Interference in the C-Band at 3900 MHz

With such high Out of Band emission, distortion occurs at the satellite receiver. Satellite LNA/LNBs are optimized for reception of very low-level satellite signals. Geostationary satellites orbit at a distance from earth of 36,000 km (22,400 miles).

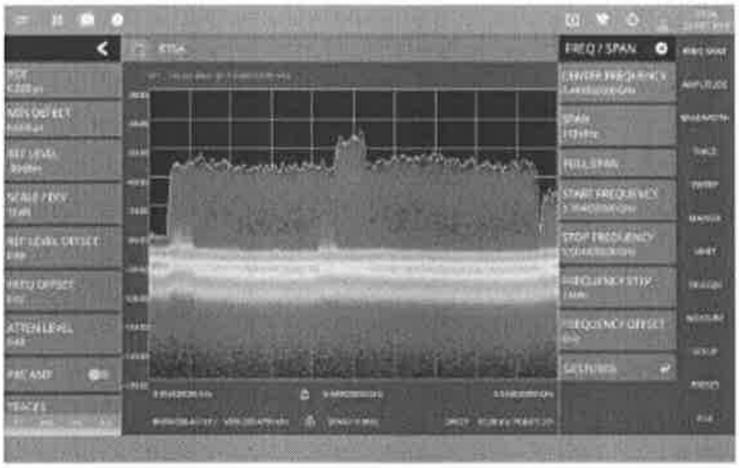


Figure-3- Display of Interference Signal on Meter

Typically, the LNA/LNB will be saturated with a total input power of approximately -50 dBm, depending on equipment used. The LNA/LNB would then begin to show non-linear behaviour at about -60 dBm input into the receiver system. The international standards body publication, "Studies on Compatibility of Broadband Wireless Access Systems and Fixed-Satellite Service Networks in the 3 400-4 200 MHz band" (ITU-RS.2199-0), therefore recommends a maximum power into to the LNB of no higher than -60 dBm.

2. Site shielding of earth stations

Site shielding techniques would reduce the interference from IMT transmitters, either by shielding the receiving earth station or the transmitting IMT station in a particular direction. However, this may involve a significant cost and depending on the conditions for specific cases, have limited effect.

As headends in India are ubiquitously deployed mitigation techniques will be less effective.

Annexure 4

IBF

31 March 2021

Shri Prakash Javadekar
Hon'ble Union Minister of Information & Broadcasting,
Government of India,
A Wing, Shastri Bhawan,
New Delhi – 110 001

Sub: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services - Request for Intervention

Dear Sir,

With this letter we would like to express the concerns of IBF members using C-Band spectrum, specifically 3.6-4.2 GHz and Government's potential plans to allocate this to International Mobile Telecommunications as part of the Department of Telecom, WPC's ten-year spectrum planning exercise.

The normal C-band spectrum being utilized by the broadcast industry today (between 3700 MHz – 4200 MHz) may be rendered incapacitated if the immediately adjoining frequencies between 3400 MHz – 3600 / 3700 MHz are used for 5G services. This is because 5G signals are very strong compared to satellite generated frequencies and there is likely to be disruption in adjoining services. This has already played out in the UAE, Singapore, EU and USA where satellite reception has been adversely affected due to 5G roll out in adjoining frequencies. As a consequence, there will be huge disruption in the cable and satellite industry and thousands of cable operators and as a result millions of television viewers stand to be affected.

In this regard, we have already submitted a detailed representation to Shri Amit Khare, Secretary, Ministry of Information and Broadcasting highlighting our concerns. The same is enclosed herewith for your reference.

Considering the significance of the matter, on behalf of the broadcasting fraternity, I request your kind and immediate intervention in this matter, otherwise it will herald serious problems for the Cable & Satellite sector in India, the magnitude of which is fully yet to be appreciated.

If you so desire, a small delegation of the IBF Board members can meet you through virtual mode to apprise you of the concerns in person.

B 304, Ansal Plaza, Khelgaon Marg, New Delhi – 110049 India
T: 91 11 43794400 F: 91 11 4379 4455
Indian Broadcasting Foundation
Email : ibf@ibfindia.com Website : www.ibfindia.com
CIN: U74899DL1999NPL101705

Look forward to your kind support.

Yours sincerely,

K. Madhavan
President
Indian Broadcasting Foundation

Encl.: As above

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Urgent: C-Band Spectrum Threat in Broadcast and Cable Services- Request for Intervention

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From :	President IBF <president@ibfindia.com>	Wed, Mar 10, 2021 10:10 AM
Subject :	Urgent: C-Band Spectrum Threat in Broadcast and Cable Services- Request for Intervention	1 attachment
To :	secy inb <secy.inb@nic.in>	
Cc :	IBF India <ibf@ibfindia.com>, asmib inb <asmib.inb@nic.in>, jspna-moib@gov.in	

Shri Amit Khare
Secretary,
Ministry of Information & Broadcasting,
Shastri Bhawan, A Wing,
New Delhi – 110 001

Sub: Urgent: C-Band Spectrum Threat in Broadcast and Cable Services - Request for Intervention

Dear Shri Khare,

The Indian Broadcasting Foundation (IBF) would like to seek your urgent intervention in the proposed set of actions on the anvil to make part of the C-Band Spectrum, now used by the Cable and Satellite (C&S) Industry unavailable.

These set of actions to use the Satellite downlink Spectrum used by broadcasters and Cable operators either unavailable or beset with severe interference issues to make services unviable.

As per the current National Frequency Allocation Plan 2018 (NFAP-2018) only spectrum outside this band of 3700-4200 MHz (which is used by used by Broadcasters and MSOs) i.e. 3300-3600 MHz is earmarked to be used by the 4G/5G services. While this band has been free over the years, potential auctions for 5G are likely to allocate it for 5G use. Various International studies including those affiliated with the ITU, IEEE and field trials conducted have concluded that the IMT and satellite services cannot co-exist in the same geographical area, and that the IMT operating in 3.4-3.6 MHz will have detrimental effects on satellite reception in the entire 3.4 - 4.2 GHz band. It will be required by regulations that the 5G operators use special filters to restrict any out of band emissions which may affect satellite signals.

However, the matter of concern for the industry is that the existing NFAP-18 is now proposed to be revised post-haste to include new bands for 5G use by DOT's arm, WPC wherein bands from 3400 to 3800 MHz or even beyond till 4000 MHz may be earmarked for 5G services. DoT has already constituted a Committee for this under WPC (Copy enclosed in Annexure).

If as a result of this revision, any allocation of frequencies to 5G services beyond the current NFAP-18 upper limit of 3600 MHz is done, it will lead to serious disruption of Satellite services for media and broadcast in the 3700-4200 MHz band. Today over 600 licensed satellite channels over India operate in this band.

The disruption occurs due to the following reasons:

(i) The power received from satellite at receiver LNBs is much lower (~60 dB lower) than that of 5G Terrestrial signals which operate at a very heavy power level. This leads to the overloading of the LNBs of satellite Antennas and no signal can then be received.

(ii) Simultaneous use of the band by Satellite and Terrestrial 5 G services is not possible.

As an example, in 2019, the Arab Spectrum Management Group (ASMG) had announced that it plans to allocate 3.3 to 3.8 GHz spectrum range for use by mobile broadband. Since the allocation of the 3.4 to 3.8 GHz band in 2020 the C-band downlinks operating even in the normal C-Band have been affected severely in Dubai. The same is the case in the EU, US and Singapore.

The entire Linear TV broadcasting industry revolves around the use of C-Band Spectrum where the downlinks by all broadcasters intended for reception by DPOs (Cable operators, MSOs, DTH operators) are in the band of 3700-4200 MHz as prescribed by the ITU and also governed by the downlink policy by the Govt of India.

So far as 5G services are concerned, there are many bands which are available for use, while the same is not the case for C-band Cable and Satellite Services. In fact, most of the new deployments in 5G networks are in the "mmWave bands" also termed as the 5G-nr-Bands (n-258-26 GHz, n260- 39 GHz, n261-28 GHz) where very large bandwidths are available. However, as these bands require higher number of towers, there is a profit motive towards subsuming the C-Band used by C&S services.

The use of part (or full) C-Band spectrum has been done in other countries by compensating satellite operators as well as C&S industry by tens of billions of dollars using which, the ground networks are being fitted with 5G terrestrial filters, and new satellites which do not use the part of C-Band spectrum now being used for 5G are being developed and launched. In case of India in the absence of availability of space resources, any decision to subsume the C-Band will be catastrophic. Half of all channels on satellites will become unserviceable in the current bands, and most of satellites including INSAT/GSAT satellites will become partially defunct.

Of equal importance is the uplink band of 5900-6400 MHz which is the paired uplink band for 3700-4200 MHz downlink C-Band. In case this band is allocated to any wide area public services including Public wi-Fi, these will interfere with the satellite uplinks and downlinks.

While as IBF we understand the need to provide resources for 5G, we believe that a very studied and transparent approach needs to be followed to ensure continuity of Services and growth in these sectors.
As a background, prior to 2008, the entire band of 3400-4200 MHz had been reserved for Fixed C-Band Satellite Services (Space to Earth). This is divided into two parts- the Normal C-Band (3700-4200 MHz) and the Lower extended C-Band (3400-3700 MHz). In 2007, the satellite services in the lower extended C-Band were asked to shift to the normal C-Band vide No. L-14035/02/2007-LR Dated 16.01.2007 (Shifting of existing satellite based operation in the band 3.4GHz to 3.7GHz to normal 'C' band (3700-4200) or Ku band.

This leaves only the band of 3700 MHz to 4200 MHz now the sole band which is used for C-band downlinks on which the entire broadcasting and C&S services industry in India is based. This entire bandwidth from 3700MHz to 4200MHz is required to cater to the transmission needs of approx. 1000 channels. Using this frequency band in part or full will also lead to creation of bandwidth crisis for C-band Cable and Satellite which can be very much avoided by proper planning. We would like to flag these issues in advance for appropriate actions and directions to ensure the sustenance and growth of M&E industry in India.

Spectrum Auctions in the 700 MHz-900 MHz Bands

We have noted that the DoT has issued notification for Spectrum Auctions to be held in March 2021 for the 700-900 MHz bands. As per the notification a single auction process will be carried out for assigning spectrum blocks in various bands, viz. 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands.

However, it will herald serious problems for the C&S sector in India, the magnitude of which is fully yet to be appreciated.

Cable TV services have been using the spectrum up to about 900 MHz in both analog and digital implementation and Cable Internet is one of the preferred mediums for urban and rural broadband.

Impact on the C&S Industry and Digitalization Plans

The band identified is APT700 band plan (698-806 MHz) with FDD based 2x45 MHz frequency arrangement. In essence, there is a spectrum band of 108 MHz (698-806) MHz which TRAI has proposed be adopted for use of LTE and be auctioned. The problem is that the use of these very bands is critical for Cable TV and rural broadband, to be delivered by LCOs and MSOs as recommended by the TRAI.

The 700 MHz is called the upper UHF band, and, the band in various countries has only been given after following a due process of consultation and providing alternative transmission mechanisms and safeguards for the Digital, Analog and cable TV Transmissions in these respective countries.

The VHF, UHF and upper UHF bands which span from 300 MHz to 850 MHz are extensively used for Cable TV in India which remains coaxial or hybrid coaxial. In most areas (DAS-IV), now digital, the frequencies in these bands are fully used for broadband and digital TV. With nearly 800 channels including HD channels and 50-100 Mbps of broadband delivered to homes, the use of the spectrum till 850 MHz is an essential need for the cable TV industry.

Considering the significance of the matter for the broadcast sector, we request your humble selves to grant us a meeting to present our views and also convey these to the WPC.

Look forward to your kind confirmation.

Best Regards,

K. Madhavan
President

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Annexure-Office Memorandum_NFAP-2018 Review dated 26.02.2021.pdf
460 KB

Government of India
Ministry of Communications
Wireless Planning and Coordination Wing
6th Floor, Sanchar Bhawan, New Delhi-110001

T-11012/03/2020-Conf Dated: 26.02.2021

OFFICE MEMORANDUM

A committee to Review/Revise National Frequency Allocation Plan (NFAP)-2018 is constituted with approval of competent authority under the Chairmanship of Wireless Adviser to the Government of India.

2. The constitution of the Committee- Chairmen of Working Groups is as follows:

Working Group	**Chairmen**	**Designation**	**Email**
Working Group-1: for frequency bands upto 1 GHz	Sh. V.J. Christopher	Joint Wireless Adviser, Regional Licensing Office, Mumbai	vj.christhopher@nic.in
Working Group-2: for frequency bands 1 GHz to 6 GHz	Sh. R.K. Saxena	Director, Wireless Monitoring Organisation	rk.saxena62@gov.in
Working Group-3: for frequency bands beyond 6 GHz	Sh. Sukhpal Singh	Joint Wireless Adviser, WPC Wing (Headquarter)	singh.sukhpal@nic.in

3. Chairmen of Working Groups may carry out consultations with stakeholders within four weeks from the date of issue of this OM.

4. The Committee will review and revise the NFAP 2018 taking into consideration the recommendations of World Radiocommunication Conference 2019 as available in Radio Regulations 2020, national requirements, latest developments in the radiocommunication technologies.

5. The Committee may consider proposals received from all stakeholders while reviewing and revising NFAP-2018.

(Sachin Kumar)
Assistant Wireless Adviser (Conference)
WPC Wing, DoT
Ph: +91 11 23326829

To: All concerned