29 December 2020

For the Attention of:
Mr U Myo Swe
Director General
Directorate of Telecommunications
Ministry of Posts and Telecommunications
Nay Pyi Daw Union Territory
Myanmar

Email: spectrumresource.ptd@gmail.com

Re: ESOA/GSC response to Myanmar Consultation - Spectrum Roadmap (2020): Facilitate the Sustainable Growth of Industry

Dear Director General,

On behalf of the Global Satellite Industry Association – now recognized as the Global Satellite Coalition (GSC), we would like to convey our best wishes to you and to the staff at the Directorate and wish you all a very successful 2021.

The GSC is comprised of national, regional and global satellite operators worldwide and has been formed through a coalition of regional representative organizations. This includes, the EMEA Satellite Operators Association (ESOA), a non-profit trade association for the European, African and Middle East satellite industry and today represents the interests of 34 members, including satellite operators who deliver both information and critical communication services across the globe. In the case of Asia Pacific, both the Asia Video Industry Association (AVIA) and the Asia Pacific Satellite Communications Council (APSCC) represent the satellite operators in the region.

Satellite-enabled services have enriched the daily life of millions of people around the globe for decades, by broadcasting news and events worldwide, by cost-effectively providing broadband services to urban, suburban and rural areas at fixed locations and on the move on land, at sea or in the air. The GSC and its regional bodies are actively engaged in highlighting advances in both space and ground segment technologies including an increasing portfolio of satellite-based services to users within the region. The GSC is keen to carry out knowledge transfer on the latest developments in satellite technologies including the impact of High Throughput Satellites (HTS), Very High Throughput Satellites (VHTS) and the roll of satellite in the 5G ecosystem.

ESOA/GSC welcomes the opportunity to respond to the Post and Telecommunications Department (PTD) on its consultation on the Spectrum Roadmap (2020) to Facilitate the Sustainable Growth of Industry in the Republic of the Union of Myanmar ("consultation"). The GSC members are part of the discussions on spectrum identification for terrestrial IMT/5G systems because several frequency bands being pursued by the terrestrial IMT/5G industry at a regional level, like the Asia Pacific Telecommunity (APT), or at the global level, at the International Telecommunications Union (ITU), are essential for satellite broadband communications.

The GSC recognises the PTD initiatives "Spectrum Roadmap: Meet the Needs Over the Next 5 Years" and "Review of IMT Aspects of Myanmar's Spectrum Roadmap" of 2016 and 2019, respectively, and supports the desire to make more spectrum available for terrestrial services as long as this is balanced with the

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need for spectrum to grow for other critical broadband services, including the satellite industry. This will allow multiple technologies to be used to meet Myanmar's desire to build a digital economy and improve connectivity. The GSC also applauds the PTD on supporting competition and promoting innovation by continuing to embrace technology neutrality and ensuring cross border spectrum co-ordination.

Importantly, GSC notes that 5G is a network of networks comprising *all* technologies, including satellite. Hence, realising a viable 5G ecosystem with ubiquitous coverage, and inclusion of satellites as part of the 5G Roadmap at an early stage is critical to achieving a digital society transformation. As well as providing satellite-powered connectivity to the benefit of end users as part of the 5G ecosystem. Satellite communications are critical for providing a competitive environment to terrestrial services, including in a society in which millions of connections between people, devices, and things requires inter-connectivity and stability at unprecedented levels.

Satellite Role in the 5G Ecosystem

5G includes both satellite and terrestrial technologies, as was acknowledged in the 2019 ITU Report on the integration of satellite systems into next-generation access technologies.[1] In its latest report on '5G via Satellite: Impacts, Demand and Revenue Potential' (October 2020),[2] Northern Sky Research NSR forecasts that 5G will generate $21 Billion in 2019-2029 cumulative capacity revenue for the satellite communications sector alone. Satellite broadband is also playing an essential role in the global 5G ecosystem, by directly powering broadband connectivity to users and devices at fixed locations or on the move. It is also providing connectivity for IoT, M2M, media services, connected transport networks, multicasting and many other services. GSC is convinced that to realise a viable and ubiquitous 5G ecosystem, satellites are an essential component of every Asian nation's 5G development plans and for deployment of state-of-the-art connectivity solutions.

The primary use cases of satellite 5G made possible with today's HTS and VHTS satellites is well recognized and explained in the CEPT Report dated 18 May 2018 entitled Satellites in 5G[3]. Both geostationary (GSO) and non-geostationary (NGSO) satellite networks have specific characteristics that can contribute to satellite-based solutions in 5G deployment. Those use cases include mobile and fixed broadband connectivity to consumers, businesses and governments. Hybrid and network extension cases are also being presented where multiple networks are combined to achieve cost-effective and high-quality services. Some of the 5G performance expectations can already be met by today's HTS satellites (*e.g.*, for a global reach of multicast or M2M services), whilst others will depend on the launch of the next generations of VHTS GSO as well as NGSO. In fact, the O3b NGSO system operating in the 27.5-29.5 GHz band is being used today to extend 4G-LTE networks into northern Myanmar.

Satellite services are enabling communications on the move, direct to premises connectivity, direct connectivity to end user devices, content distribution, and satellite-powered connectivity to the benefit

1 *See* Report ITU-R M.2460, *Key elements for integration of satellite systems into Next Generation Access Technologies* (07/2019), https://www.itu.int/en/ITU-R/space/workshops/2019-SatSymp/PublishingImages/Pages/Programme/R-REP-M.2460-2019-PDF-E.pdf.

2 *See* NSR, 5G via Satellite: Impacts, Demand and revenue Potential to 2029 (published November 2020).

3 *See* ECC Report 280, *Satellite Solutions for 5G* (approved 18 May 2018) at https://www.ecodocdb.dk/download/e1f5f839-ba17/ECCRep280.pdf.

of end users[4] as part of the 5G ecosystem. Satellites also support the three main use cases identified by the ITU:
Satellites can provide enhanced mobile broadband applications by powering 5G networks to consumers in urban, suburban and rural areas. Satellites already play this role today in 3G and 4G networks and are now starting to do the same in 5G networks with the advancement of Very High Throughput Satellite (VHTS) technologies and systems.

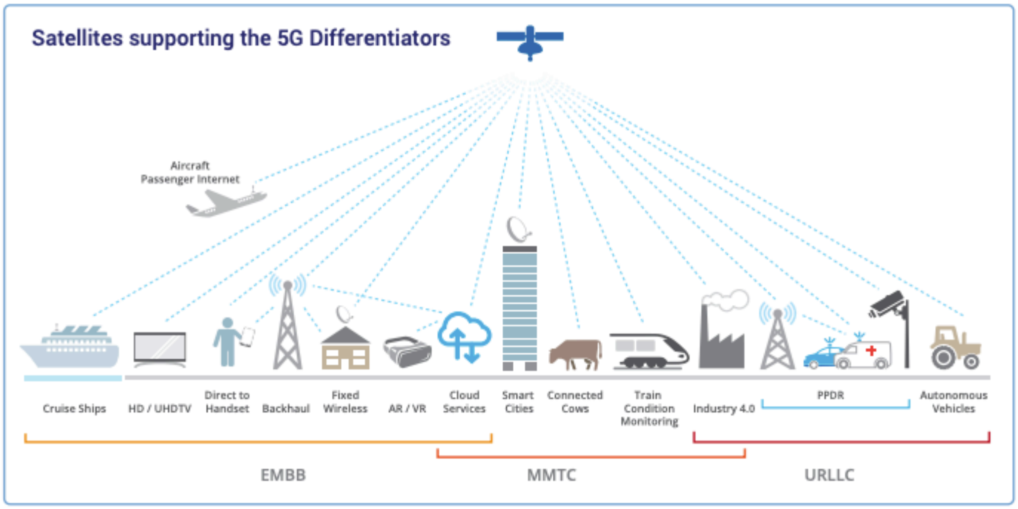
Satellites can also support ultra-reliable, low-latency 5G applications. Broadcasters and governments today count on the reliability of satellite services for their most sensitive applications. For some of the newest 5G applications that require the lowest latencies, satellites can also distribute content to the network edge for quick access by user devices. Satellites, with their broad coverage, are particularly well-suited for such "multi-casting" applications. Edge caching of such content is essential for meeting 5G latency requirements. GSC members have, for instance, partnered with global IT firms like IBM for direct delivery of IBM Cloud services via satellite[5] as well as with cloud computing giant, Microsoft, not only to connect enterprise and government sites to Azure but also develop a broadcast-grade managed cloud service to provide end-to-end, media delivery services covering the entire video value chain on Azure.[6] [7]

Finally, satellites can support massive machine-type communications or IoT applications. They already do so today. Various GSC members host weather sensor networks that provide early warning of tsunamis and other weather events in the Pacific and others have partnered with Microsoft Azure to deliver "Industrial IoT-based solutions to the agriculture, mining, transportation and logistics sectors, supporting digitalisation and visibility across the global supply chain."[8]

Satellite operators are also involved in the work of 3GPP, the international body that develops 5G standards. The 3GPP 5G work has adopted two items dedicated to ensuring satellite integration into the 5G ecosystem.[9] More information on the satellite standards is available from an ESOA brochure: "Satellite Action Plan on 5G Standards."[10]
Also, satellite operators have well progressed in adopting the norms and specifications that ensure virtualisation and full integration into the Cloud environment, as a significant driver for 5G services over satellite networks. The inclusion of satellite networks in the Cloud standards is directly connected to the satellite industry's ability to deliver 5G services in terms of spectrum and bandwidth flexibility, reliability

[4] *See* https://www.esoa.net/services/mobile-backhaul.asp.
[5] *See* https://www.ses.com/press-release/ses-networks-enables-direct-connectivity-ibm-cloud-global-satellite-network.
[6] *See* https://www.businesswire.com/news/home/20190908005052/en/SES-Deliver-Premium-Broadcast-Grade-Cloud-Service-Media.
[7] *See* https://www.viasat.com/news/viasat-introduces-direct-cloud-connect-new-service-providing-fast-secure-private-connections.
[8] *See https://www.inmarsat.com/en/news/latest-news/enterprise/2019/inmarsat-and-microsoft-azure-iot-join-forces-to-deliver-cloud-services-via-satellite.html*
[9] *See* 3GPP TR 38.811 v0.3.0 *Study on New Radio (NR) to support non terrestrial networks (Release 15)" and 3GPP TR 22.822 "Technical Specification Group Services and System Aspects; Study on using Satellite Access in 5G Stage 1 (Release 16)*".
[10] *See* https://www.esoa.net/cms-data/positions/1771%20ESOA%205G%20standards.pdf.

and security/privacy.[11] This comes on top of the natural ability of satellite networks to offer more resilience than terrestrial networks.
For more information on the role of satellite in 5G, GSC invites PTD to review its "White Paper on Satellite, an Integral Part of the 5G Ecosystem"[12] which ESOA recently updated. Below is an infographic depicting the various satellite 5G differentiators.



Source: ESOA 5G White Paper.

GSC agrees that making spectrum available to match demand is important for *all* services. With this context in mind, GSC submits this response to the consultation for consideration by PTD.

Please accept, Director General, the assurances of our highest consideration.

Sincerely,

Aarti Holla-Maini
ESOA Secretary General

[11] Forbes has predicted that, as most enterprises use cloud today, 83% of enterprise workloads would be in the cloud by the end of 2020. Satellite operators move towards the extension of network services and activation of virtualised network functions (VNFs) to manage and automate the provisioning of access connections at distance and in real time, in a way that dramatically improves communications network resiliency and service availability. Some ESOA members are also adopting the software system Adaptive Resource Control (ARC) to enable the dynamic control and optimisation of power, throughput, beams and also frequency allocation of their platforms.

[12] *See* https://www.esoa.net/5g

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GSC comments on the Spectrum Roadmap (2020): Facilitate the Sustainable Growth of Industry (Draft)

Section 2: Release of More IMT Spectrum in Myanmar

Myanmar released 400 MHz of terrestrial IMT/5G spectrum last year; this is a substantial amount of spectrum for terrestrial use in the bands below 1 GHz and 1-3 GHz. And as per the consultation document this is more terrestrial IMT/5G spectrum than is being made available in Vietnam, Cambodia, and Lao PDR.

With regard to: i) the necessity for contiguous blocks of IMT spectrum and ii) total spectrum needed by each individual mobile operator:

The GSC refers PTD to research published by Ofcom, the communications regulator in the United Kingdom[13], on the ability of operators to launch terrestrial IMT/5G services with 40 MHz of spectrum. Ofcom found that:

> "*there was no evidence that 5G could not be delivered with smaller* [e.g. 40 MHz blocks] *or non-contiguous carriers in other frequency bands* [i.e. spectrum other than C-band]."

To support its finding that 40 MHz of C-band is sufficient to provide terrestrial IMT/5G services, Ofcom developed a theoretical cell site throughput model to estimate network performance based on various assumptions on the type of antenna used, the bandwidth of C-band carrier, and signal strength received by the user.

Figure 1 and Figure 2 below show the results of Ofcom's analysis for both downlink and uplink, respectively. The results demonstrate that terrestrial IMT/5G operators will be able to deliver all of the main services anticipated under 5G – including but not limited to connected cars, virtual reality cloud broadband and live 4K streaming – with 40 MHz of spectrum.

[13] *See* Para A7.39 from: https://www.ofcom.org.uk/data/assets/pdffile/0017/192410/annexes-award-700mhz-3.6-3.8ghz-spectrum.pdf.

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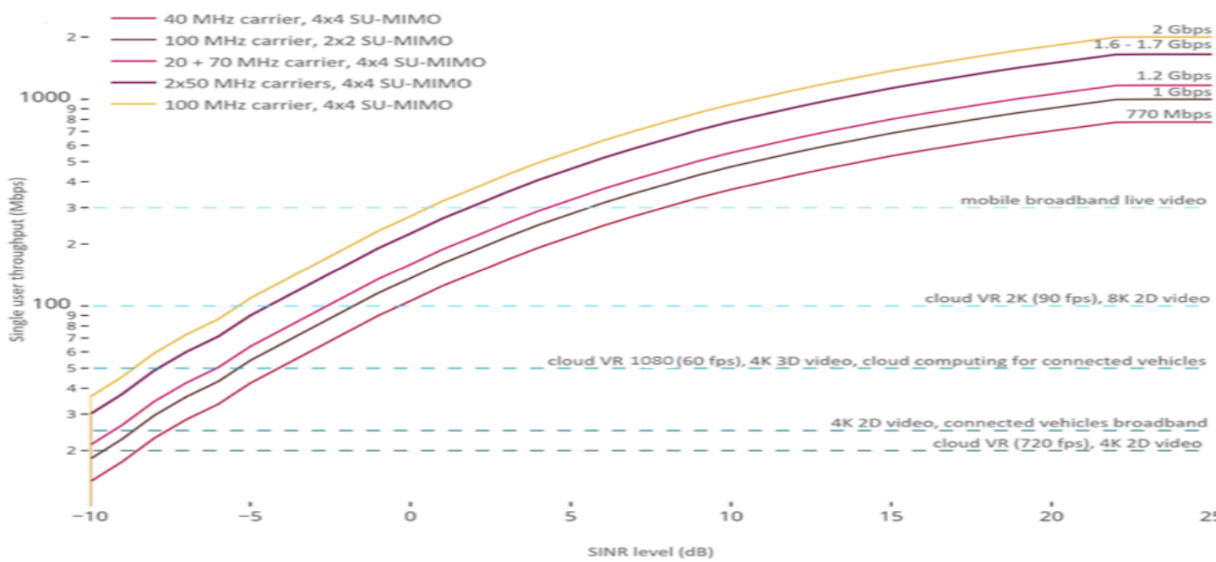

Figure 1: Downlink Single User Throughput (SUT) across different signal strengths in a cell compared with the minimum data rate requirements for some 5G Services (Ofcom)[14].

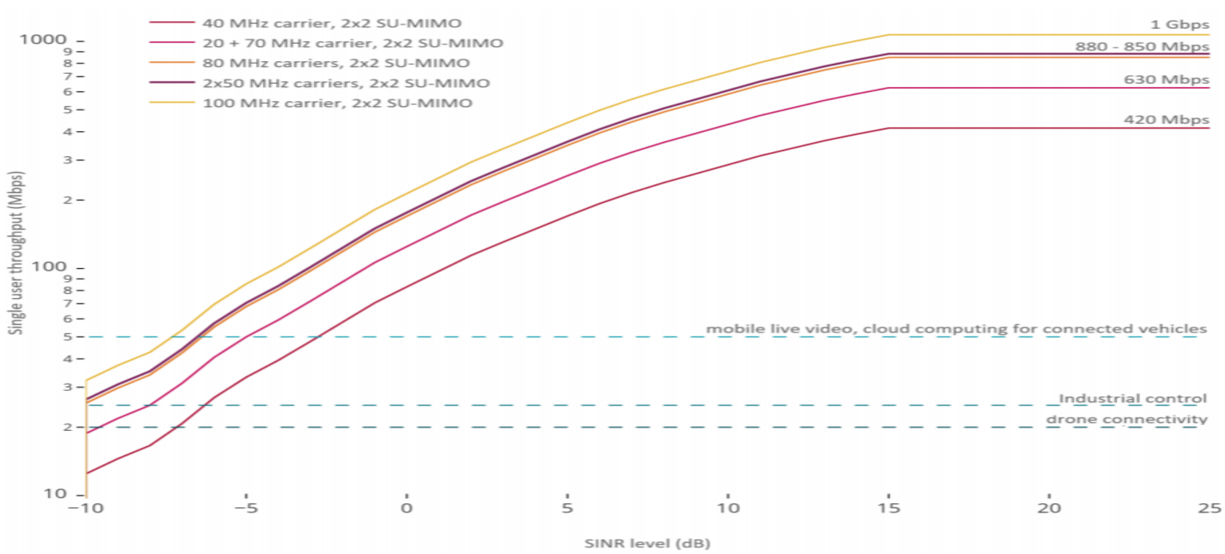

Figure 2: Uplink Single User Throughput (SUT) across different signal strengths in a cell compared with the minimum data rate requirements for some 5G services.

Several substantiated reports (not only from UK Ofcom but also from the CEPT[15]) have explained that there is no need for contiguous spectrum for terrestrial IMT/5G.

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14 Source: Ofcom, Figure A7.26, *Award of the 700 MHz and 3.6-3.8 GHz spectrum bands: Annexes*, 13 March 2020.

15 *See* ECC Report 287: "Current 5G NR specifications support channel bandwidths up to 100 MHz, but this should not preclude administrations allowing operators to obtain smaller bandwidths for lower throughput 5G applications on a national basis as required. According to CEPT Report 67, the spectrum should be provided in

With regard to iii) making long term investments in digital infrastructure:

Satellite plays a vital role in communications and broadband services deployment. Besides the countless applications of satellite communications, satellite broadband and satellite-powered services benefiting end users in particular represent significant investments in broadband infrastructure. The GSC emphasizes that satellite networks require substantial up-front investment and may take up to five years from contract signing, to entry into service.

Satellites are also designed to have an operational life of approximately 15 years. Therefore, reliable access to adequate spectrum is critical to the viability of existing and planned satellite services. Certainty about spectrum allocations and exclusive access to core spectrum are all essential requirements for the satellite industry to thrive and remain viable considering the substantial up-front cost and the long lifecycle of satellite systems. Without access to adequate spectrum, there is less competition and fewer choices for consumers and governments. These requirements are the same as for the terrestrial industries.

The number of satellites has increased by 77% over the last five years (2014-2019), and there are more than 30 geostationary (GSO) satellites (currently under contract) and up to 4,000 non-geostationary (NGSO) satellites to be built and launched between 2020 and 2024.[16] The increased constellation of satellites will add 6.5+ Tbps of GSO capacity which is nearly two times today's in-orbit GSO satellite capacity, and up to 25 Tbps of NGSO capacity which is around 100 times 2019 NGSO capacity.

With regard to possible use of the 3.5 GHz band

The draft Roadmap as shown in Exhibit 5 considers a plan to release 3400 – 3520 MHz in 2023 for terrestrial 5G services. With the additional 120 MHz of C-band spectrum in addition to the 400 MHz of spectrum below 3 GHz, the amount of mid-band spectrum plan to be allocated for the deployment of terrestrial 5G services by 2023 will be more than enough considering the above Ofcom's findings and there are 4 MNOs (Mobile Network Operators) operating in Myanmar.

GSC supports the implementation of the 105 MHz guard band to protect the existing C-band FSS operations in the adjacent band (i.e. above 3600 MHz). Such guard band are needed to protect the existing C-band FSS operations from the OOBE (Out of Band Emissions) of the terrestrial 5G services. The policy changes on how much guard band will be used after 2024 should be well technically justified by doing necessary field test in order to protect the existing C-band FSS operations operating in the adjacent band above 3600 MHz.

a manner allowing for at least 3x50 MHz of contiguous spectrum." From https://docdb.cept.org/document/7245.

16 *See* State of the Satellite Industry Report 2020; by The Satellite Industry Association (SIA): https://sia.org/news-resources/state-of-the-satellite-industry-report/.

In addition to the above technical considerations, GSC urges PTD to manage the supply and demand of IMT/5G spectrum carefully. With the availability of 420 MHz of IMT/5G spectrum in Myanmar, PTD need to avoid inappropriate imbalance supply and demand of IMT/5G spectrum. Oversupply of IMT/5G spectrum would result in inefficient use of spectrum and lower auction proceeds. GSC believes that by doing the audit and review on the deployment of 5G services in Myanmar after at least 2 years whether there is a need for additional IMT/5G spectrum, PTD would be able to manage the supply and demand balance of IMT/5G spectrum.

<u>With regard to possible use of the 1500 MHz band</u>

The draft Roadmap considers a plan to release the 1500 MHz band in 2023 or earlier. The 1500 MHz band (1427-1518 MHz) is adjacent to the L-band MSS downlink band 1518-1559 MHz, which is used by Inmarsat and a number of other satellite operators. Use of the 1500 MHz band by terrestrial IMT/5G or other mobile systems could cause interference to MSS operations.

The MSS band provides safety-of-life communications and mission-critical voice and data services in Myanmar and around the globe, to users on land, in the skies, and on the seas. Emergency responders, military users, and diverse industries including the transportation, energy, and agriculture sectors rely upon land-based mobile Earth terminals for mission-critical voice and data applications.

L-Band MSS terminals enable those in the maritime industry to comply with International Maritime Organisation (IMO) Safety-of-Life At Sea (SOLAS) communications equipment requirements (including Global Maritime Distress and Safety System (GMDSS) requirements), which are mandatory for many vessels. Ships from around the world rely upon MSS terminals to meet these obligations, including Myanmar ships and foreign commercial vessels that come to Myanmar.

For aviators, L-band MSS satellite communications support the Aeronautical Mobile Satellite (Route) Service (AMS(R)S) and are important for ensuring flight safety. The aeronautical industry requires satellite communications terminals to fly in high-capacity, oceanic airspace such as the Indian Ocean, organized tracks, and operators must ensure these terminals are operable prior to departure. Airlines expect to make greater use of L-band MSS in the future to support the Global Aeronautical Distress and Safety System (GADSS). This will result in a wider range of aircraft using L-band MSS communications and using those communications routinely for operations in continental airspace.

L-band MSS terminals also support essential public protection and disaster response coordination and communications. When terrestrial infrastructure is overloaded or unreliable, these terminals ensure that life-saving services are delivered when and where they are needed. Additionally, land-based MSS services support important economic sectors daily. Energy production and distribution, transportation, construction, and other industries use MSS terminals to provide mobile communications with a level of ubiquity and reliability not available over terrestrial networks.

Studies conducted at the ITU and CEPT have demonstrated that mobile broadband systems in the 1492-1517 MHz band pose a serious risk to MSS operations above 1518 MHz, because of the susceptibility of MSS terminals to harmful interference from out-of-band emissions and receiver overload. MSS terminals are designed to receive relatively faint signals from geostationary satellites ~36,000 km above Earth, while in motion. They must be extremely sensitive in order to receive such a distant signal.

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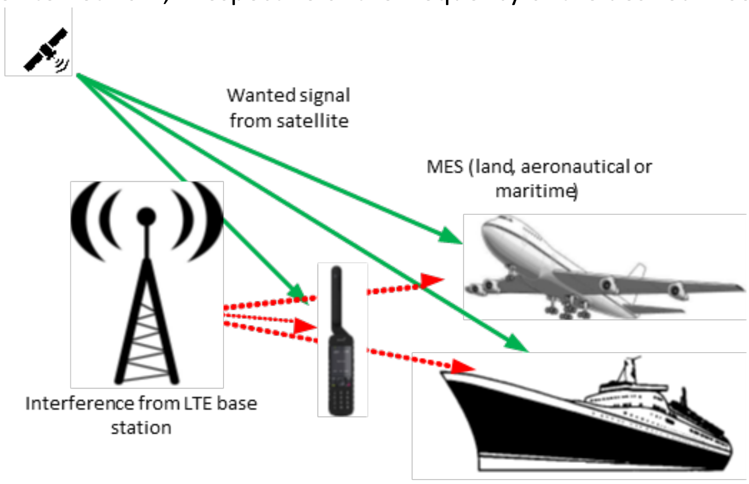
When mobile broadband base stations are deployed geographically much closer to these terminals in adjacent spectrum, the MSS terminals can receive two different types of interference. First, out-of-band emissions from mobile broadband base stations into the MSS band can cause harmful interference to MSS terminals at power levels that are much lower than would typically cause interference to terrestrial mobile broadband terminals. Second, high-powered mobile broadband transmissions from just outside the MSS band can overload MSS terminal receivers, blocking the terminals from being able to connect to the satellite network, irrespective of the frequency of the desired MSS signal.



The distance within which interference occurs varies depending on system characteristics, but it can be as much as 20 km from the mobile broadband base station.

If deployed without mitigations, interference from mobile broadband transmissions 1492-1518 MHz spectrum will cause substantial disruption to MSS operations in Myanmar. Without appropriate conditions in place to protect MSS, base stations deployed near to ports, coastlines, and inland waterways could prevent vessel operators from using their satellite terminals, including use to complete mandatory testing of safety-enabled terminals before departure. If the terminal is unable to pass a required systems test, the ship cannot legally sail. Similarly, mobile base stations deployed near to airports could prevent aircraft operators from being able to perform vital aviation- safety equipment checks before take-off.

The simplest way to avoid interference to MSS operations is to limit use of the 1500 MHz band only in the range 1427-1492 MHz, and to leave aside the upper part of the 1500 MHz band (1492-1518 MHz) for other applications which are compatible with MSS operations in the adjacent band. This approach has been taken by a number of regulators in Europe, including The Netherlands, Malta and Germany as well as APT member countries. If Myanmar does intend to consider use of the band 1492-1518 MHz for mobile use, significant restrictions on mobile system deployment would be necessary to provide compatibility with MSS operations. These restrictions include EIRP limits on base stations, a guard band below 1518 MHz, PFD limits at ports, inland waterways and airports.

The GSC recommends that any use of the 1500 MHz band in Myanmar should be limited to the band 1427-1492 MHz.

GSC Comments on PTD consideration to identify 200 to 400 MHz of mmWave spectrum under the 3GPP n257 Standard for Terrestrial IMT/5G:

GSC notes that n257 is the 3GPP standard frequency range. That is the 26.5-29.5 GHz band. Unfortunately, this is not a globally harmonized band for terrestrial IMT/5G. The ITU World Radio Conference in 2019 identified instead the 24.25-27.5 GHz band (3GPP n258 band) globally for terrestrial IMT/5G. As discussed below, the 27.5-29.5 GHz is used extensively around the world for broadband satellite services, including in Myanmar for the extension of 4G/LTE services to the northern parts of the country.

Accordingly, GSC recommends that PTD satisfy its terrestrial IMT/5G requirements using the n258 band, or only that portion of the n257 frequency range that is below 27.5 GHz. That would provide at least one gigahertz of spectrum that spans both the n257 and n258 equipment ecosystems. If PTD also uses frequencies down to the 24.25 GHz band edge, that would open up 3.25 gigahertz of spectrum. This would eliminate the need to identify any spectrum above 27.5 GHz and allow Myanmar to enjoy the benefits of satellite broadband services in the 27.5-29.5 GHz band and terrestrial IMT/5G below 27.5 GHz complementing the 5G ecosystem.

mmWave Spectrum for Terrestrial IMT/5G

Over 17 gigahertz of spectrum have been identified for terrestrial IMT/5G in the mmWave frequencies above 24 GHz at the ITU World Radio Conference in 2019, including the 24.25-27.5 GHz, 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2 GHz and 66-71 GHz bands.[17] This comes in addition to large amounts of spectrum identified or made available to terrestrial IMT/5G in low and mid-bands. Accordingly, there is no need to look at additional spectrum for terrestrial IMT/5G, such as the 27.5-29.5 GHz band, which is used extensively by satellite today, in order to satisfy terrestrial IMT/5G spectrum requirements.

WRC-19 identified the frequency band 24.25-27.5 GHz (so-called 26 GHz band) for terrestrial IMT/5G, subject to specific conditions (Resolution 242 (WRC-19)). This band corresponds to 3GPP n258 band for terrestrial IMT/5G and provides more than three (3) gigahertz of globally harmonized, contiguous spectrum for the terrestrial IMT/5G industry.

GSC recommends that when identifying any portion of the 26 GHz band that PTD apply *resolves 2.2* of Resolution 242 (WRC-19) and impose conditions that require terrestrial IMT/5G base stations operating an e.i.r.p. per beam exceeding 30 dB (W/200 MHz) to be prohibited from pointing their antenna beams upward at the geostationary satellite orbit and maintain a minimum separation angle of ≥ ±7.5 degrees. Also, as a minimum, terrestrial IMT/5G stations should be required to comply with out-of-band emission limits in the frequencies above 27.5 GHz as described in Recommendations ITU-R SM.1541-6 and ITU-R SM.329. In the case of ITU-R SM.329, the category B limits should apply.

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[17] *See* ITU News, *WRC-19 identifies additional frequency bands for 5G* (22 November 2019), https://www.itu.int/en/myitu/News/2020/01/24/14/40/WRC19-identifies-additional-frequency-bands-for-5G.

The 27.5-29.5 GHz Band is Best Used for Satellite Broadband Services in Myanmar

The latest commercial satellite broadband networks currently use the 27.5-29.5 GHz spectrum (part of the "Ka-band" spectrum) to provide broadband internet service to millions of end users, and hundreds of millions of personal electronic devices each year, around the world, whether at home, at work, or traveling in vehicles, on ships, or on aircraft. As with all other successful services, satellite broadband spectrum requirements expand as user demand continues to grow. In fact, over 120 GSO Ka band satellites are now in orbit around the world, providing a wide range of services to individuals, businesses and governments. Many more Ka band GSO satellites are under construction to meet the growing demand for service and need to use the entire 27.5-29.5 GHz spectrum, in addition to the rest of the Ka band, to meet this expanding demand.

Ka band satellite systems provide services that are competitive with, and in some cases superior to, terrestrial service. Ka band spectrum enables satellite broadband services that:

- Can be offered at speeds of 100 Mbit/s and higher.
- Can be deployed to a given location almost immediately through a small antenna that can be mobile, transportable, or fixed in place, depending on end-user requirements, and that does not need to be individually licensed or coordinated.
- Are extendable to anyone near that satellite antenna by using a 4G base station or WiFi hot spot to distribute the satellite connection—whether to entire communities or everyone on an airplane, ship, train or bus.
- Meet needs that no other technology now addresses, or will address, including:
    - Connecting otherwise unserved and underserved families, communities, and small businesses around the world, many of whom are located in pockets of heavily populated areas;
    - Connecting widely-dispersed government facilities;
    - Connecting passengers and crew on trains, buses, ferries, ships and aircraft;
    - Supporting emergency responders, national defense and security;
    - Enabling disaster recovery and relief operations; and
    - Providing always-available global communications capabilities.
- Further important policy goals, such as enabling telemedicine and connecting healthcare facilities, facilitating precision farming, monitoring critical infrastructure, extending access to education and libraries, supporting the development of e-commerce, access to banking, and the creation of new jobs.

Today, the 27.5-29.5 GHz band on the O3b NGSO system is already being used to extend mobile 4G-LTE networks into the northern parts of Myanmar. In addition, the band is being used worldwide for mobile satellite broadband services using innovative antenna designs for Earth Station in Motion (ESIM) service to aircraft, ships and land-based users. For example, passengers and crew on aircraft demand gate-to-gate, high-speed broadband for communications and entertainment, cabin support, and fleet digitization and maintenance. Global shipping and passenger vessels rely on the 27.5-29.5 GHz band for navigation and broadband communications benefiting passengers and crew and facilitating the transportation of cargo. Satellite broadband services are also available for trains, buses and other land- based vehicles, supporting passenger connectivity, operations and maintenance support, and fleet tracking.

The spectrum needs of the satellite industry have long been recognized by the International Telecommunication Union (ITU). Consistent with the primary ITU allocation of the entire 27.5-29.5 GHz band to the FSS globally, GSC members of the satellite industry have made significant investments in satellite infrastructure that has already been deployed, and more is being designed and constructed for deployment in the next couple of years, including in Myanmar for both fixed and mobile satellite connectivity.

Both WRC-15 and WRC-19 determined that ESIM fulfil essential global mobile broadband goals. For this reason, WRC-15 opened the 29.5-30 GHz and 19.7-20.2 GHz parts of the Ka band for ESIM as a part of the existing longstanding FSS allocation. WRC-15 also decided that further expansion of ESIM in the 27.5-29.5 GHz and 17.7-19.7 GHz portions of the Ka band would be considered at WRC-19 as a further means to extend global mobile connectivity. WRC-19's adoption of Footnote 5.517A recognized ESIM as part of the FSS to which the 27.5-29.5 GHz and 17.7-19.7 GHz bands already were allocated. In doing so, WRC-19 made more Ka-band FSS spectrum available to ESIM and enabled ubiquitous ESIM connectivity throughout the 27.5-29.5 GHz and 17.7-19.7 GHz bands for aeronautical, maritime, and land-based satellite earth station operations.

In identifying possible spectrum for IMT/5G, WRC-15 expressly rejected consideration of the 27.5-29.5 GHz band because of the existing use of that spectrum for satellite broadband services. Instead, WRC-15 directed that the 27.5-29.5 GHz band be considered for use by ESIM, in order to extend global mobile connectivity by satellite.

WRC-19 not only decided that the 27.5-29.5 GHz band should be considered for use by ESIM in order to extend global mobile connectivity by geostationary satellites, WRC-19 further requested studies on the use of parts of the 27.5-29.5 GHz band for both ESIM operating with non-geostationary systems under Agenda Item 1.16 and satellite-to-satellite links under Agenda Item 1.17.

Given the results of WRC-15 and WRC-19, most countries are preserving the 27.5-29.5 GHz band for satellite broadband services. Most countries also are opting to allow satellite broadband services, including ESIM, to operate across the entire band on a primary basis. This is happening throughout Latin America and the Caribbean, and similar approaches are being adopted in countries in Africa, and the Arab and Asia-Pacific regions.

The band 27.5-29.5 GHz is *not* internationally harmonised for terrestrial IMT/5G mobile services, as ITU Member States did not include it in the bands identified for terrestrial IMT/5G during WRC-19, and this is in recognition of the satellite deployments in this band that have and will continue to take place.

GSC urges Myanmar to follow the WRC-19 outcomes and not consider the 27.5-29.5 GHz band for terrestrial IMT/5G. This band is already in use for satellite services around the world, and it is one of the key uplink bands for current and future commercial Ka-band satellites, including the high-throughput (HTS) and very-high-throughput (VHTS) satellite networks and some non-geostationary low earth orbit (LEO) and medium earth orbit (MEO) systems. Nearly thirty satellite networks already using this band have

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been launched in just the last five years, including in the Asia-Pacific.[18] More satellites have been procured for launch soon.[19]

Several companies, including Viasat, Inmarsat, OneWeb, Telesat, Amazon (Project Kuiper) and SpaceX, have also announced next-generation, geostationary and non-geostationary satellite systems using the 27.5-29.5 GHz band. All of this represents tens of billions of dollars of sustained, expanding, and planned investments in the 27.5-29.5 GHz band, including on HTS and VHTS designs that will support broadband connectivity as part of the 5G ecosystem.

The satellite industry urges PTD to make every effort to avoid disrupting such investments, especially when there is ample other spectrum under consideration that is already globally harmonised. It is important that PTD look at *all* the bands that have been identified by the ITU for terrestrial IMT/5G, not just a small sub-set. There is over 3.25 gigahertz of spectrum available for IMT/5G in the 26 GHz band (24.25-27.5 GHz) alone, which is likely more than enough to accommodate Myanmar's terrestrial IMT/5G requirements for millimetre-wave spectrum. This band is well harmonised internationally, in particular in Europe and a number of Asia Pacific countries. This band is identified as "n258" in 3GPP and this is likely to be among the first millimetre wave bands for which equipment is available.

Furthermore, if for some reason the 24.25-27.5 GHz band is not available in Myanmar, the PTD should review the other millimetre bands identified at WRC-19 (i.e., 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2 and 66-71 GHz), but not the 27.5-29.5 GHz band.

Conclusion

The GSC urges the PTD *not* to pursue options to make available for terrestrial IMT/5G the bands 1492-1518 MHz, 3520-4200 MHz, or 27.5-29.5 GHz given the harm that would be caused to satellite operations in Myanmar and elsewhere. The GSC would also urge the PTD to preserve the 4500-4800 MHz portion of the 4.8 GHz, since those frequencies are part of the ITU Appendix 30B FSS Plan, which is intended to ensure that all countries (including Myanmar) have access to satellite spectrum and orbital resources. The frequencies below 3520 MHz and in the 24.25-27.5 GHz band, as well as frequencies in 2.6 GHz and above 37 GHz, provide plenty of spectrum options for terrestrial IMT/5G without having to disturb extensively used satellite bands. By protecting the bands used by satellite broadband services, and using other bands for terrestrial IMT/5G, Myanmar can enjoy the benefits of both terrestrial IMT/5G and current and future satellite services.

As explained above, there are many other options available to PTD that will allow Myanmar to meet its requirements for terrestrial IMT/5G spectrum for coverage and capacity without resort to these important satellite bands.

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[18] These include twenty O3b MEO satellites, SES-12, four Inmarsat F5 Global Xpress satellites, the ViaSat-2, Jupiter-2, Hylas-2, JCSat-16, Superbird 8, and Amazonas-3 satellites. This list is not exhaustive and does not include the many satellites that use the 27.5-29.5 GHz band that were launched before 2013, including ViaSat-1, Jupiter-1 and Spaceway 3, Hylas-1, Wildblue-1, Superbird, AMC-15 and -16, and several DIRECTV satellites.

[19] These include seven more O3b mPower MEO satellites, SES-17, Kacific-1/JCSAT 18, and the ViaSat-3 series of satellites.