27 February 2019

Managing Director, Telecommunications and Postal Services Division
Austrian Regulatory Authority for Broadcasting and Telecommunications (RTR)
Mariahilfer Str. 77-79
1060 Wien, Austria

TRANSMITTED VIA EMAIL: tkfreq@rtr.at

Dear Managing Director of Telecommunications and Postal Services Division,

Inmarsat hereby respectfully submits the attached contribution to the Austrian Regulatory Authority (RTR) Consultation regarding the upcoming multi-band award process, which includes the 1500 MHz band and 2100 MHz band. Inmarsat applauds the Authority's decision to solicit contributions on this consultation; RTR will reach a critical conclusion by the end of this process, and Inmarsat sincerely appreciates the opportunity to comment. According to Inmarsat's understanding of the consultation, the Authority is contemplating a proposed award process applicable to the 700 MHz, 1500 MHz and 2100 MHz band. Specific to the 1.5 GHz range, Inmarsat comments here to share its concern on the level of protection to be applied for Mobile Satellite Services (MSS) operating in the 1518-1559 MHz band. This band is directly adjacent to the 1427-1518 MHz (1500 MHz band) frequencies identified in the consultation, making it highly susceptible to harmful interference without appropriate protections. Given the importance of MSS operations to various key communications services in Austria, including critical safety operations, this potential for harmful interference should be an important consideration for RTR in this proceeding.

Interference to MSS operations in the band 1518-1559 MHz could be problematic in Austria, given the breadth of MSS operations, especially aviation services, active across the country – and the high dependence of these services on reliable, unencumbered connectivity. Absent the appropriate protections being applied for MSS terminals, disruption to satellite communications operations risks serious consequences to important aviation and maritime-based safety services. Land use of MSS services, such as the Inmarsat BGAN services and handheld satellite phone could also be disrupted in Austria. As such, Inmarsat respectfully requests the RTR consider adopting the appropriate technical measures for mobile systems in the 1500 MHz band in accordance with CEPT and EC decisions, required to guard against interference to MSS operations. In the comments below, Inmarsat further outlines the suggested scope of these protections, in the hopes the RTR fully considers the critical uses associated with this band in Austria.

Regarding the 2100 MHz band (1920-1980 MHz paired with 2110-2170 MHz), the two parts of this band are adjacent to the MSS bands (1980-2010 MHz and 2170-2200 MHz). The lower parts of these bands are assigned to Inmarsat and are used by the European Aviation Network (EAN) in Austria and other European countries. The RTR is proposing to remove the existing guard band between the MSS bands and the terrestrial mobile bands, which could lead to interference to EAN operations. Conditions on the new mobile licensee are required to avoid such interference.

Once again, Inmarsat appreciates RTR offering the opportunity to contribute to this consultation. Inmarsat looks forward to continuing to participate in future phases of RTR's important spectrum management activities.

Respectfully submitted,

/s Donna Bethea-Murphy

Donna Bethea-Murphy
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Inmarsat Comments

Introduction

As a global provider of wireless broadband communications, Inmarsat understands the importance of adopting appropriate policies, and making sufficient spectrum available, to enable the full benefits of broadband connectivity, including 5G. Inmarsat is the leader in mobile satellite communications, and currently operates a global system of 13 satellites and associated ground infrastructure that offers a wide range of communications solutions to customers on land, in the air, and at sea in L-band, S-band and Ka-band spectrum. Inmarsat's L-band MSS, which operates in the 1518-1559 MHz (space-to-earth) and 1626.5-1660.5 and 1668-1675 MHz (earth-to-space) frequency bands, is used for safety of life communications and mission-critical voice and data services around the globe.

Key L-band MSS applications are deployed throughout the land, skies, and seas. Land-based mobile earth terminals are relied upon by emergency responders, military users, and diverse industries including the transportation, energy, and agriculture sectors for mission-critical voice and data applications. These terminals are used for essential coordination and communications after natural and man-made disasters. While 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 are key to important economic sectors on a daily basis. Energy production and distribution, transportation, construction, and other industries use MSS terminals to provide mobile communications with a level of reliability and ubiquity not delivered over terrestrial networks.

Inmarsat's L-band MSS system also supports essential communications for the maritime and aeronautical sectors. For example, Inmarsat communications services such as Fleet Broadband and Swift Broadband are used to provide broadband connectivity to ships and aircraft wherever they operate. Inmarsat's L-band MSS system also provide vital safety-related communications. L-Band MSS terminals are a means of complying with International Maritime Organisation (IMO) Safety-of-Life At Sea (SOLAS) communications equipment requirements (including GMDSS) in all sea areas, and in some areas they are the only permissible equipment. MSS terminals are also relied upon for compliance with EU-specific monitoring and reporting requirements, such as CERS and VMS. Ships from around the world rely upon MSS terminals to meet these obligations, including vessels traversing the Danube.

Regarding aviation use, satellite communications in this band supports the Aeronautical Mobile Satellite (Route) Service (AMS(R) S) and is important for ensuring flight safety. A satellite communications terminal is required to fly in high-capacity oceanic airspace such as the North Atlantic organised tracks, and operators must ensure the equipment is operable prior to dispatching the flight. Airlines are also expecting to make greater use of L-band MSS in the future to support the "GADSS", and the MSS in this frequency band is a key component of the "Iris" next generation air traffic management system being developed by the European Space Agency.

Regarding the S-band specifically, Inmarsat has deployed an integrated satellite and terrestrial system which is now commercially available, for the provision of broadband connectivity to aircraft in Europe. The system provides service to aircraft across Europe, including in Austria. It is composed of a space segment and a terrestrial complementary network ("complementary ground component"). The system is called the European Aviation Network (EAN), which provides European aircraft passengers with high quality broadband Internet connectivity. The Inmarsat S-band satellite,

"Europasat" is currently in operation in these bands, a Europe-wide ground station network has been deployed, and aircraft equipment has being installed.

The equipment installed on the aircraft includes terminals which communicate with the ground stations and equipment which communicates with the satellite. This equipment, which receives in the band 2170-2200 MHz is vulnerable to interference from mobile base stations operating in the adjacent band 2110-2170 MHz, particularly if base stations are deployed at airports. The interference potential is exacerbated if the current 300 kHz guard band that exists between the mobile band and MSS band is removed, as RTR proposes.

The potential interference can be managed provided that operators seeking to deploy base stations in or near to airports coordinate conduct coordination with Inmarsat. The CEPT is finalising a new ECC Report on this subject, Report 298, which includes the following in its conclusion:

> "an updated band plan for the 1920-1980 MHz and 2110-2170 MHz band and that it is up to each administration to decide, based on its requirements, and considering the impact on existing authorizations in its country within the band and services in adjacent bands, whether and how to migrate from the band plan in previous revisions of ECC Decision (06)01 to the new band plan, and any associated conditions"

As indicated in this conclusion, there is no need for Austria to change the current frequency arrangements based on channels of 4.8 MHz and 5 MHz to accommodate 5G. However, if RTR does proceed with a new arrangement based on 5 MHz channels, leaving no guard band with respect to the MSS band, it is necessary to consider the impact on existing authorisations, such as the MSS use of the band 2170-2200 MHz.

Responses to Questions

1. Question 3.1 asks "Do you have any comments about the spectrum to be awarded"

Regarding the 2100 MHz band, as noted above, Inmarsat recommends that RTR retains the current channel arrangements, which include the 300 kHz guard band adjacent to the MSS bands at 1980 MHz and 2170 MHz. CEPT has concluded that those frequency arrangements are suitable for 5G systems and so there is no need for RTR to change the arrangements.

In any case, it is important that RTR requires that the new licensee will not cause interference to Inmarsat EAN operations in the adjacent band. This is consistent with the advice provided in section A2.4 of draft Report 298: "The MSS allocation directly adjacent to MFCN above 2 170 MHz is used for EAN applications. Therefore, the only possible interference from MFCN base stations may occur while the MSS receiver in an airplane is on the ground. If an additional protection is still needed, it can be granted by applying coordination procedures for MFCN base stations around airports, instead of a mandatory guard band for CEPT countries."

2. Question 3.2 asks about expected usage for SDL in the 1500 MHz range. The question reads: "Do you share our opinion that the 1500 MHz range should be used for SDL (LTE band 75, NR band n75)? If not, why not? (Please give reasons for your answer)."

The European Commission's Implementing Decision (EU) 2018/661 has designated the 1500 MHz band for SDL operation on a harmonized basis across Europe. This sort of harmonization is

important to ensure the creation of an affordable equipment ecosystem as well as to facilitate roaming and movement of people across Europe. It is nevertheless essential for RTR to make a reasoned decision about the right amount SDL spectrum to make available in the 1500 MHz band and appropriate conditions to apply to operations in this band, based upon the best interests of the Austrian people. This is entirely consistent with the recognition of EC Decision 2018/661 that "further measures may be needed at national level to enhance coexistence with services in the adjacent . . . 1 518-1 559 MHz frequency bands." Indeed, such further measures are necessary due to the substantial risk of harmful interference posed to L-Band MSS operations from adjacent SDL deployments.

In this respect, it is important to keep in mind the definition of SDL. As explained in CEPT Report 65: "Supplemental downlink is downlink-only use whereby spectrum within the bands is used for unidirectional base station transmission providing electronic communications services, in combination with use of spectrum in another frequency band." The key characteristic of SDL is that it is "supplemental." This means that it is always deployed to provide additional capacity or capability for an existing network using another frequency band. If an area had no existing coverage, by definition, it would not be a candidate for SDL deployment.

When thinking about use cases and coverage needs for SDL in the context of promoting the deployment of 5G in Austria, it should be noted that SDL will never be the only, or even the primary, band for wireless connectivity and coverage in an area. SDL will always be deployed on top of another network. This means that if the need to protect other services ever means that SDL cannot be deployed – or that it must be deployed at lower power, in smaller cells, or only indoors, etc. – this will not reduce mobile coverage in the country by any amount. There will never be a place at which limiting 1500 MHz SDL means reducing mobile broadband coverage. Furthermore, any capacity constraints might be overcome using spectrum in other frequency bands and advanced techniques like carrier aggregation. Inmarsat respectfully suggests that RTR should consider this fact as it develops solutions for compatibility between 1500 MHz SDL and other services.

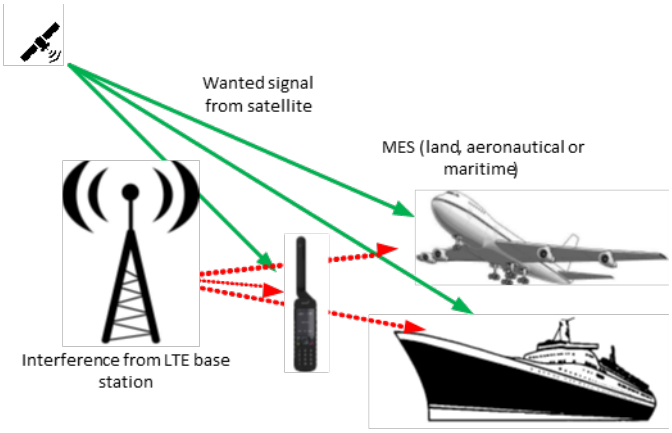
SDL deployment poses a serious risk to MSS operations above 1518 MHz because of the susceptibility of MSS terminals to harmful interference from out-of-band emissions and receiver overload. The technical parameters contained in EC Decision 2018/661 alone will not be sufficient to protect MSS terminals from harmful interference caused by the deployment of mobile SDL in the 1.5 GHz band, unless additional conditions are applied to the mobile SDL licenses. The EC Decision also acknowledges that further national measures may be needed to enhance coexistence with services in the adjacent frequency bands, such as around airports and seaports. As is discussed further below, a report is currently under development at the ECC (ECC Report 299), that provides guidance for administrations in how they might craft these technical measures. One approach included in that report is the application of PFD limits at ports and airports. Other approaches to promoting compatibility might include a combination of protective measures applied to SDL operations, such as in-band and out-of-band power limits, increased frequency separation, and restrictions on outdoor deployment. The fact that the band has been designated for SDL, and thus is dedicated to providing additional capacity in specific areas and not to providing robust coverage, should give RTR additional flexibility in considering such measures.

3. A subset of Question 3.2 adds, "Which concrete specifications (e.g. guard bands, synchronisation or duplex distances) would be necessary from your point of view?"

In Section 3.2, RTR notes that because of the neighbouring passive band at 1400-1427 MHz, the bottom two channels of the1500 MHz band (1427-1432 MHz and 1432-1437 MHz) will have very limited use. As a result, RTR does not expect to offer these frequencies in the initial auction. However, the Consultation does not address issues related to compatibility with existing and planned Mobile Satellite Services in the 1.5 GHz band. Inmarsat believes that these compatibility issues may affect the timing and scope of spectrum availability for IMT in the 1427-1518 MHz band, and therefore these issues should be considered by RTR as it plans authorisation of the 1500 MHz band.

As described in the Introduction to this submission, a wide range of important uses of MSS in the 1518-1559 MHz band are active today, in Austria and around the world. Disruption to these services would have severe consequences that could affect disaster response and military operations, the safety and efficiency of air travel for the nearly 1 billion people who fly in the European Union each year, and the many Austrian industries that depend upon reliable satellite communications on a daily basis. Accordingly, harmful interference to these MSS operations should be avoided.

Technical analysis and testing confirm that introducing high-powered SDL base stations in the adjacent frequency bands could cause harmful interference to MSS operations in 1518-1559 MHz. MSS terminals are designed to receive relatively weak 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. When IMT 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 SDL 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 SDL transmissions from just outside the MSS band can overload MSS terminal receivers, blocking the terminals from being able to connect to the satellite network. The susceptibility of the terminals to interference varies across different devices.



The interference range varies depending on mobile and MSS characteristics, but can be as much as 20 km from the SDL base station. If deployed without mitigations, interference from SDL transmissions in the 1427-1518 MHz spectrum will cause substantial disruption to MSS operations. Without appropriate conditions in place to protect MSS, base stations deployed near to ports, coastlines, and inland waterways could prevent ships from using their satellite terminals, including the mandatory testing of 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 from being able to perform vital equipment checks before take-off. If the terminal is not able to be successfully tested at the airport prior to takeoff, a plane will have to adjust its route, resulting in travel delays and unforetold economic impacts.

Measures Necessary to Ensure Compatibility

The technical conditions for SDL base stations were driven primarily by compatibility with land MSS terminals, based on assumed next generation devices with improved resilience to blocking interference. While next generation devices will be designed with increased blocking performance, it could take many years for next generation terminals to replace current equipment through commercial replacement cycles. Unlike consumer mobile phones that are disposable and expected to be replaced every 12-24 months, users of satellite equipment such as emergency responder handsets and IOT/Smart City devices, purchase a solution expecting a much longer functional life without harmful interference. Given that it is not possible to define specific areas where land MSS terminals are not used, it would not be practical to identify geographic areas where constraints on SDL base stations would be needed. The only practical means to provide compatibility with land MSS terminals would be to provide a greater frequency separation between new SDL and existing MSS operations, and to ensure sufficient time for users to replace their terminals with next generation devices before SDL is deployed in the adjacent band.

Because the technical conditions for SDL were developed with a focus on next generation land-based terminals, they did not sufficiently account for maritime and aeronautical terminals, which, by definition, are subject to stringent and lengthy type approval procedures in relation to safety services operations by the competent national and international bodies such as IMO and ICAO etc. With regard to these operations, the CEPT studies and the EC Decision acknowledge that additional measures may be necessary to ensure their protection from SDL base stations, including in the areas near airports, ports, and navigable waterways.

To protect MSS operations from harmful interference, Inmarsat recommends that the RTR focus first on issuing spectrum licenses only for the "core band" frequency range 1452-1492 MHz. This spectrum was made available for mobile networks earlier than the rest of the band, and these frequencies pose a lower threat of harmful interference. In the future, if there is demand for additional spectrum in this frequency range, RTR could consider making additional frequencies available. RTR has already decided not to auction the lowest blocks B00 and B0 on the basis of constraints necessary for protection of adjacent band services. Inmarsat recommends that RTR begin with the channels closest to the middle of the band first (i.e., channels B4 to B11). Ideally, RTR should avoid assigning licenses in the top channels for the foreseeable future (i.e., channels B12 to B16), as they pose the greatest risk of harmful interference to critical MSS operations.

If however RTR takes future action to make available channels B12 to B16, these frequencies should be subject to protective measures. As the RTR is aware, CEPT's Electronic Communications Committee (ECC) has developed a report ("ECC Report 299") to provide guidance to regulators on such measures. The draft Report is due to be finally approved by the ECC meeting in March 2019. It includes information to help administrations define the airports, ports and waterways where additional protection is needed. PFD values are proposed that would be applied to the boundary of such areas to ensure that the emissions from SDL base stations remains below unacceptable levels. Studies of the interference scenarios shows that the measures necessary to enable compatibility are more restrictive on SDL operations in the channels closer to MSS. The PFD values contained in section A2.2 of ECC Report 299 would provide additional protection to aeronautical and maritime MSS operations in Austria.

Inmarsat notes that several international organisations representing the aviation and maritime sectors, including ICAO, Eurocontrol, and IMSO, submitted responses to the consultation on ECC Report 299 in which they express concern that the protections identified in the draft Report for airports and ports were not sufficient. Therefore, considering the importance of aviation

communications in Austria, RTR should apply the measures in ECC Report 299, specifically the pfd limits section A2.2, before authorising SDL operation in the 1492-1517 MHz band.

RTR will need to carefully define the critical areas for protection of MSS operations (including airports and navigable waterways) and the protection requirements may need to be specified in the mobile operator's licence conditions.

The future consultation should also consider timing considerations, ensuring that enough protection is provided for MSS operations throughout the life of currently deployed terminals. Inmarsat notes that the natural replacement cycle for aircraft and ship MSS terminals is typically in excess of 20 years. Inmarsat recommends that RTR engage with the organisations responsible for aeronautical and maritime safety operations, i.e. the IMO and ICAO. It is also recommended that the user community be consulted, e.g. IATA in the case of the aviation industry.

Any measures adopted by RTR should be specified as conditions applied to the eventual license authorising SDL operations in these channels. Inmarsat notes that the spectrum regulators in France (ARCEP), and Malta (MCA) both have made similar proposals recently. These countries have suggested they would make only the "core band" SDL channels available at first, and consider additional action on the rest of the frequencies in the future.

This approach will provide the best result for Austria, Austrian industry, and the Austrian people. As explained above, MSS operations are essential to public safety, national defence, and many important economic sectors in Austria. Satellite communications will provide a key component to future 5G systems as well. Adopting reasonable limitations on new SDL deployments for a limited time will ensure that MSS users who have relied upon continued availability of satellite services for years will have sufficient time to transition naturally to new terminals. At the same time, mobile broadband coverage will not be negatively affected, and SDL operators can begin to deploy supplemental service in the 1.5 GHz band in areas removed from MSS protection zones or using techniques like small cells and indoor deployment to satisfy the PFD limits.

4. Questions 4.1 and 4.2 ask about the proposed structure for the 1500 MHz, including , "Do you share the view that in the 1500 MHz band the core band and extension bands should be awarded jointly?" and "How do you estimate the value differences within the 1500 MHz band?", respectively.

As explained in the previous section Inmarsat believes that RTR should not include the upper extension band frequencies in its initial 1500 MHz auction, focusing instead on the core band and lower extension band frequencies, while it evaluates the need for further action on the upper extension band. EC Decision 2018/661 states that further measures are needed at the national level to ensure compatibility between SDL and MSS. Because the harmful interference to MSS caused by SDL will take the form of both out-of-band emissions and receiver overload from emissions in the adjacent frequency range, the additional measures required in this case necessarily will entail greater restriction on the upper extension band frequencies closest to the MSS allocation at 1518 than on the "core band". ECC Report 299 is exploring some of those measures, as described above. Appropriate measures may include PFD limits, but could also mean additional frequency separation, in-band and out-of-band EIRP limits, and restrictions on outdoor deployment. In this case, it would be logical for RTR to treat the upper extension band differently from the core band and lower extension band, so that RTR can proceed with an auction of the core band and lower extension band frequencies in the nearer term. Because of the measures necessary to protect MSS, it may be best for RTR to not auction the upper extension band frequencies at this time, at least until it has been able to conduct an

additional consultation to fully evaluate the types of measures that might be needed at a national level to ensure protection.

Should RTR decide to proceed with an auction of the upper extension band jointly with the core band and lower extension band, RTR should expect that the auction value of these upper frequencies will be significantly lower than the others. The required MSS protections, and the differing treatment for these frequencies among various administrations (who may choose disparate levels of MSS protection) both will make these upper extension band frequencies less desirable to potential bidders. As such, delaying an auction of the upper extension band frequencies would best serve RTR's stated objective of ensuring efficient utilisation of spectrum.

5. Question 5.1 asks "What is your opinion of the band-specific obligations for ensuring the use of frequencies?"

RTR proposes a population coverage obligation of 5-10% for the 1500 MHz band. As described above, the 1500 MHz band is designated for SDL, which means that it is not intended to be coverage spectrum. It will only be deployed where networks are already operating. Additionally, it may be necessary for RTR to place restrictions on portions of the upper extension band that may limit where those portions can be deployed efficiently for SDL. As a result, Inmarsat feels that coverage obligations defined based on population are not most appropriate for this band. However, Inmarsat understands the need for RTR to achieve its objectives of efficient utilisation of spectrum. In this respect, RTR's proposal to set a performance benchmark of 10 Mbps DL for a 20 MHz authorisation seems an appropriate approach to ensuring the spectrum is put to efficient use.

ANNEX 1

The proposed PFD limits in this section are based on the blocking measurements of the most susceptible terminal performed by some Satcom manufacturers.

Table 1: PFD limits on MFCN BS transmitting a single channel

Phase	Phase 1			Phase 2		
	PFD limit for BS emissions in the band 1492-1502 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1502-1512 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1512-1517 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1492-1502 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1502-1512 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1512-1517 MHz (dBW/m^2)
Ports and inland waterways	-60.9	-75.9	-83.9	No limit required	-27.9	-37.9
Airports	-28.9	-42.9	-58.2	No limit required	-27.9	-37.9

Table 2: PFD limits on MFCN BS transmitting multiple channels

Phase	Phase 1		Phase 2	
	PFD limit for BS emissions in the band 1492-1512 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1512-1517 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1492-1512 MHz (dBW/m^2)	PFD limit for BS emissions in the band 1512-1517 MHz (dBW/ m^2)
Ports and inland waterways	-74.9	-85.9	-30.9	-40.9
Airports	-53.5	-63.4	-30.9	-40.9