ESOA response to EETT public consultation on granting rights of use of radio frequencies (700 MHz, 2 GHz, 3.6 GHz, 26 GHz) for the establishment and operation of networks of electronic communications for providing electronic communications services

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As a trade association, the EMEA Satellite Operator's Association (ESOA) welcomes the opportunity to provide responses to the Greek regulator EETT on its consultation on assigning spectrum for 5G.[1]

ESOA is a non-profit organisation established with the objective of serving and promoting the common interests of EMEA satellite operators. The Association is the reference point for the European, Middle Eastern, and African satellite industry and today represents the interests of 30 members, including satellite operators who deliver information communication services across the globe as well as EMEA space industry stakeholders and insurance brokers.[2]

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 extending the reach of terrestrial networks, and by connecting remote places on land, at sea and in the air that could not otherwise be connected by terrestrial options. Satellite communications are to remain essential for an invisible and resilient overlay for terrestrial networks to help realise a society in which millions of connections between people, devices and things will require inter-connectivity and stability at unprecedented levels that terrestrial networks alone cannot deliver for citizens of modern societies.

ESOA understands that the objective of the EETT consultation is to define the conditions under which the three frequency bands defined as 5G pioneer spectrum by the European Union (700 MHz, 3400-3800 MHz and 24.25-27.5 GHz) plus the 2 GHz band (1920-1980 MHz and 2110-2170 MHz) will be used to enforce the 5G Action Plan adopted by the EU in 2016.

5G is not a standalone terrestrial solution. It is most definitely the result of adding different services to provide the most effective connectivity to the up raising use cases, as was acknowledged in several

[1] Available from: https://www.eett.gr/opencms/opencms/admin/News_new/news_1149.html

[2] www.esoa.net

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reference documents such as the 2018 CEPT Report on Satellite Solutions for 5G or the 2019 ITU Report on the integration of satellite systems in next generation technologies.[3]

ESOA is convinced that in order to realise a viable 5G ecosystem and ubiquitous coverage, the integration of satellites into 5G networks at an early stage will be critical to make it seamless. As well as extending the reach of 5G terrestrial systems, satellite communications will be essential to an invisible and resilient overlay for terrestrial networks to realise the EU vision for the 'Gigabit Society'; a society in which millions of connections between people, devices, and things will require inter-connectivity and stability at unprecedented levels that terrestrial networks alone cannot deliver for Europe's citizens.

ESOA therefore expects that the Greek regulator will involve actors of all technologies to contribute to the building of the 5G ecosystem, whether for Fixed or Mobile connectivity, whether by wireless or wireline means.

As regards the specific role of satellite on 5G, ESOA is pleased to reference our White Paper available from: https://www.esoa.net/cms-data/positions/ESOA5G%20Ecosystem.pdf

In this context, ESOA is submitting the following specific comments on the granting of rights of use in the 2 GHz, 3.6 GHz and 26 GHz bands where there are allocations to the Mobile-Satellite Service (MSS) and Fixed Satellite Service (FSS).

ESOA remains at the EETT's disposal for any further discussion in relation to our comments.

[3] See https://www.ecodocdb.dk/download/e1f5f839-ba17/ECCRep280.pdf and https://www.itu.int/en/ITU-R/space/workshops/2019-SatSymp/PublishingImages/Pages/Programme/R-REP-M.2460-2019-PDF-E.pdf

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ESOA Responses to EETT's Questions

Concerning the 1920-1980 MHz and 2110-2170 MHz bands

The 1920-1980 MHz and 2110-2170 MHz bands are adjacent to the "2 GHz MSS bands", i.e. the 1980-2010 MHz and 2170-2200 MHz bands. The 2 GHz bands are licensed on an EU wide-basis for mobile satellite service (MSS) with a Complimentary Ground Component including in Greece by EchoStar Mobile Limited ("EML") and Inmarsat. Today EML and Inmarsat are operating their systems, including in Greece. Accordingly, any use of the adjacent bands by MFCN systems should be limited so as not to cause interference into the MSS/CGC's licensed operations. Today these systems are providing both MSS data services as well as broadband passenger connectivity to passengers on European aircraft, utilising an MSS satellite and complementary ground component (CGC).

Q2. Do you think additional measures are needed beyond what is specified in the revised Decision ECC / DEC / (06) 01 on coexistence between MFCNs in the 2 GHz band and systems in the adjacent bands? If so, please document in detail.

The frequency arrangements and emissions limits included in Decision (06)01 are not adequate on their own to cover all adjacent band compatibility issues, and additional measures are needed.

Firstly, it is important to highlight that revised Decision (06)01 gives administrations the option of retaining the current frequency arrangements, which provide a 300 kHz guard band with respect to the services in the adjacent frequency bands. ESOA understands that the current frequency arrangements in Greece comply with the harmonised CEPT arrangements based on the 300 kHz guard band and, furthermore, that currently the uppermost MFCN channels are not licensed. ESOA recommends that EETT retains the frequency arrangements based on the 300 kHz guard band for new MFCN systems, which are quite compatible with new 5G systems that are planned for these bands. The 300 kHz guard band helps in providing compatibility amongst MSS systems operating above 1980 MHz and above 2170 MHz, so a transition to the alternative frequency arrangement eliminating the guard bands would potentially harm compatibility, leading to additional constraints on the MFCN operator, on the MSS operator, or on both.

Secondly, it is important to note that some protection measures are in any case required with respect to MSS/CGC operations in the adjacent bands at some locations. As is identified in ECC Report 298 (section A2.4): "The MSS allocation directly adjacent to MFCN above 2170 MHz is used for EAN applications. Therefore, the only possible interference from MFCN base stations may occur while the MSS receiver in an aeroplane 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." Consistent with this conclusion of the CEPT studies, MFCN operators may be required to take action to mitigate interference to MSS terminals on aircraft at certain airports in Greece. This will require coordination between the MFCN operators and the MSS operator, and it is recommended that EETT establishes regulations or licence conditions for the new MFCN operators to ensure that such

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coordination occurs before new MFCN systems are deployed. This requirement is also particularly important in Greece given that EETT proposes no limits on the power of mobile base stations.

Q3. Do you agree with the proposed bandwidth design in the 2 GHz band (see section 5.3)? If not, please explain the reasons and suggest alternatives. If so, indicate any difficulties and / or delays (e.g. for switching to existing networks) that you think will bring about the adoption of the new frequency plan.

ESOA does not agree with the proposed band design in section 5.3, in particular with regard to the proposed adoption of new frequency arrangements which would eliminate the 300 KHz guard band. Such a change is not necessary for compliance with the EU and CEPT Decisions and could lead to new compatibility issues with respect to MSS operations in the 2 GHz MSS bands. If, contrary to ESOA's recommendation, EETT were to proceed with the new frequency arrangements, that would require more onerous constraints on the new MFCN operators to protect MSS operations in the adjacent bands.

Concerning the 3400-4200 MHz band

Q5. Do you agree with EETT's assessment of the requirement for new restriction of rights in the 3400-3800 MHz band?

ESOA notes the EETT's intention to auction the 3400-3800 MHz band and enable new 5G licenses using this spectrum. We see that the EETT conducted compatibility studies between the fixed service, fixed satellite service and mobile service in the band.

The Consultation document however seems to indicate that the whole 400 MHz (up to 3800 MHz) will be assigned to mobile operators, without indication of any guard band to protect satellite users above 3800 MHz from OOB emissions from 5G IMT operations below 3800 MHz.

C-band satellite operations in Greece will need preserved access to the 3400-3800 MHz and 3800-4200 MHz bands. ESOA's ultimate objective is to ensure that all satellite services operating in the C-band downlink in Europe are fully protected while, at the same time, not placing overly restrictive limitations on 5G deployment that would inhibit it from achieving its full potential.

Massive MIMO technology will be a key and necessary component to enable 5G networks. When used in terrestrial 5G deployments and radio network management, it could allow for higher overall base station EIRP levels while limiting power levels in the direction of FSS earth stations, for example, by creating nulls in antenna patterns in specific directions or by preventing beams from pointing in the direction of the FSS earth stations.

There are several ways of ensuring an adequate protection of FSS earth stations and links in the 3400-3800 MHz band, including separation distances.

ITU-R Reports M.2109 and S.2368, which the EETT references in its consultation, provide studies to assess the technical feasibility of deploying IMT systems in the 3.4 – 3.8 GHz band used by FSS. These reports

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clearly state that to provide protection of the FSS receive earth stations, some separation distance relative to the stations of the terrestrial mobile network is required. However the magnitude of this separation distance depends on the parameters of the networks and the deployment of the two services.

ECC Report 254[4] which the EETT also references provides guidance on enabling administrations to protect incumbent use of the band with exclusion zones, whilst also facilitating its use by new entrants.

Q13. Do you agree with EETT's proposal on coexistence measures between MFCN networks and terrestrial satellite stations in the 3400-4200 MHz band?

The EETT states that "existing terrestrial satellite stations that have been allocated the right to use radio frequencies in the 3600–4200 MHz band at the Nemea and Thermopylae sites shall be protected from MFCN networks' interference."

A. In-band protection

ESOA is pleased that the EETT is committed to grant protection in the 3600-3800 MHz band for two sites in Nemea, Corinthia, and Thermopylae, Fthiotida for both existing and future FSS earth stations. It is indeed very important that continuation and potential development of these satellite operations is well ensured.

ESOA has several comments to make in relation to the EETT's proposed approach.

1. ESOA recommends that EETT extends the same protection to the FSS earth stations of these two locations when using the 3400-3600 MHz band.

2. ESOA has noted that "the operation of new FSS earth stations within the satellite centres of Nemea and Thermopylae in the 3600–3800 MHz band (space to earth) is to require the consent of MFCN providers. The providers of satellite networks must document with EETT and MFCN providers why the 3800–4200 MHz band cannot be used instead. Operation of new ground satellite stations within Nemea and Thermopylae in the 3600–3800 MHz band is also done *on a secondary basis*." However, EETT also explains that protection will be afforded to existing and new FSS earth stations in 3600-3800 MHz within these two geographical locations, through the -131 dBm and -60 dBm limits on MFCN networks and the use of bandpass filters for FSS earth stations, which seems contradictory.

   The suggestion of operation on a secondary basis and subject to the consent of MFCN operators overall seems to be at odds with EETT's intention to ensure continued protection of satellite operations at these two locations. Continued protection of FSS earth stations at Nemea and

[4] ECC Report 254 on *Operational guidelines for spectrum sharing to support the implementation of the current ECC framework in the 3600-3800 MHz range*, approved 18 November 2016

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Thermopylae will, on the contrary, require MFCN operators to meet the prescribed protection measures under a *co-primary* status with the mobile service.

Protection of FSS operations in 3600-3800 MHz at these two locations should not significantly impact on MFCN deployment. ESOA therefore requests that EETT review this part of the proposals to provide a robust mechanism and ensure long-term protection at Nemea and Thermoplyae that is not at the will of MFCN operators.

3. ESOA understands that the EETT is proposing protection against interference: "MFCNs operating in the 3600–3800 MHz frequency band should not cause interference greater than -131 dBmW / MHz at the antenna output of FSS earth stations operating in the 3600–3800 MHz band (space to earth)." This is satisfactory as a *long-term* protection criterion, but a *short-term* criterion is also needed, as described in e.g. Report ITU-R S.2368.

4. In order to ensure greater flexibility for deployment of 5G services while ensuring continued protection of FSS earth stations, ESOA finally believes that additional measures are needed beyond those specified in EC Decision 2019/235. We would recommend that the EETT adopts in-band power limits as stringent as those proposed last year by **Sweden** (Swedish PTS) along these lines: "*in 3420-3800 MHz, PTS intends to set the limit value for base station transmitter and repeater in the downlink direction within the license holder's own frequency block to 47 dBm / 5 MHz TRP for BS with AAS and 68 dBm / 5 MHz eirp for BS without AAS (…) PTS intends to set reasonable conditions for protecting other uses within and outside the frequency bands 2.3 GHz and 3.4-3.8 GHz.*" [5]

For other geographical locations, it is noted that there will be no protection in the 3400-3800 MHz band, which underlines the need to establish robust and long-term protection measures for satellite operations occurring in the 3800-4200 MHz band, *anywhere* in Greece (as explained below).

B. Adjacent band protection

The EETT consultation document addresses the issue of "coexistence of MFCN stations that operate in the 3600-3800 MHz band and satellite terrestrial stations that operate in the 3400-4200 MHz band". "In the 3800-4200 MHz band, 4 radio frequency usage rights are in force for four ground stations of the Fixed Satellite Service" in the 3 geographical locations of Attica, Corinthia (Nemea) and Fthiotida (Thermopylae), as the document further indicates. Again, it is critical that continuation of these operations and potential development are both ensured, with appropriate protection of FSS earth stations. **It is also critical that in the 3800-4200 MHz band, new FSS earth stations can be deployed *elsewhere in the country*, under the same technical conditions.**

[5] See pages (13)35 of: https://www.pts.se/globalassets/startpage/dokument/icke-legala-dokument/remisser/2019/radio/konsultation-35-ghz/1.-konsultation-23-och-35.pdf

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FSS earth stations are very sensitive to terrestrial interference as 5G signals in adjacent bands can interfere with FSS receive earth stations in two ways:

- Saturate the LNB of the earth station, even if the 5G signal is adjacent to the satellite signal
- Out-of-Band-Emissions (OOBE) of the 5G signal can cause in-band interference to FSS signals

The OOBE levels specified in 3GPP standards do not protect FSS signals in adjacent bands. Using a guard band around 3800 MHz and imposing strict OOBE limits on 5G are therefore necessary. Table 1, below, summarizes some of the tools which can be deployed by mobile network operators on a localized, case-by-case, basis to ensure the interference to FSS stations is at or below the OOBE threshold level.

	Mobile Network Operator Tools to Reduce OOBE
1	Using Multiple-Input Multiple-Output (MIMO) technology to null the radiation pattern in the direction of earth stations.
2	Lowering the transmit power levels for the base station or user equipment.
3	Force user equipment to roam to non-C-Band frequencies near FSS earth stations.
4	Deploying microcells near FSS earth stations which have lower transmit powers.
5	Install better transmit OOBE mask for select base stations near FSS earth stations.

Table 1: MNO Tools to Reduce OOBE

This leads ESOA to have the following comments:

1. ESOA understands that the EETT is already proposing protection of FSS earth stations against MFCN OOBE: "MFCNs operating in the 3600–3800 MHz frequency band should not cause interference greater than -131 dBm / MHz at the antenna output of satellite earth stations operating in the 3800 - 4200 MHz band (space to earth)." This proposal is much welcome and ought to be extended to existing *and* future earth station deployment anywhere in the country.

2. ESOA also takes good note of a "blocking protection for the 3600-4200 MHz band", subject to the following condition: "The FSS earth stations operating in the 3800–4200 MHz band should be provided with a bandpass filter [i.e. a rejection filter mask ensuring high attenuation] in order to avoid blocking phenomena at the LNA / LNB level." With this blocking protection, "MFCNs operating in the 3600–3800 MHz frequency band should not cause blocking type interference greater than -60 dBmW at the LNA / LNB entry of FSS earth stations operating in the 3600–4200 MHz band (space to earth)." ESOA agrees that such protection should be applied. Although this may require some constraints on MFCN base stations that would be located close to FSS earth stations, separation distances are expected to be relatively small (e.g. hundreds of meters to a few kilometers according to ITU Reports). It is to be noted that additional filtering will also need to be installed in FSS earth station receivers, with cost implications for satellite operators.

3. ESOA believes that, in addition to these welcome protection measures, a guard band of at least 50 MHz is required to effectively ensure protection of FSS operations from adjacent high powered

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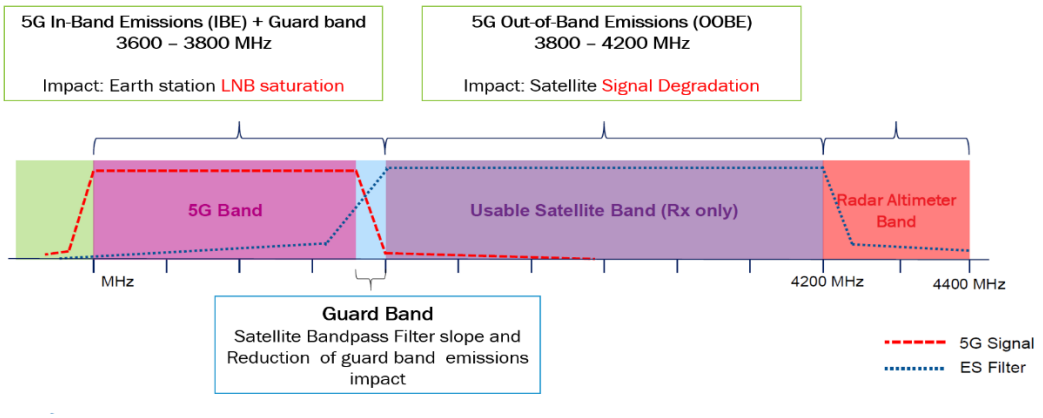
terrestrial 5G transmissions when used in conjunction with a purpose-designed filter to be fitted on FSS earth stations, noting that other countries are implementing similar protection.[6] It should be noted that the implementation of a guard band does not mean that these frequencies cannot be used at all by MFCN networks, but their use would need to be subject to the same restrictions as for co-frequency operations.

Below is an example of how FSS services within the 3800-4200 MHz would be impacted by unwanted signals of MFCN networks operating in the adjacent band, that justifies such measures.



Impact on Satellite Spectrum

4. Finally, ESOA recommends that the EETT requires in their proposed regulations/ licences to MFCN operators, a Block Edge Mask (BEM) for protection of FSS earth stations above 3800 MHz, noting that such BEM should be in accordance with the in-band limits proposed - i.e. 9 dB below the BEM of the CEPT Decision ECC/DEC(11)06 and of the corresponding EC Decision 2019/ 235, consistent with the applicable 3GPP BEM.

Concerning the 24.25-27.5 GHz band

ESOA fully understands the interest of the 26 GHz band for the mobile industry, and in particular to deploy 5G in dense urban areas. WRC-19 identified the frequency band 24.25-27.5 GHz for IMT, subject to specific conditions (Resolution 242 (WRC-19)).
ESOA notes the EETT's welcome intentions to adopt technical restrictions of use and licence conditions for the 26 GHz band usage in accordance with EU Commission Implementing Decision (EU) 2019/784. Indeed, the introduction of new technologies should not be at the expense of, either some other industries, or incumbent users. As a consequence, ESOA expects that the EETT is to fully take into

[6] **Germany** has e.g. reserved the 3700-3800 MHz band to private local networks which power and deployment characteristics are strictly limited, whist **Luxembourg** is planning to do the same in the 3750-3800 MHz band

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consideration the prescriptions of ECC Decision (18)06,[7] from which the following requirement is extracted: "*Furthermore, administrations need to maintain the possibility of existing and future earth stations (EESS/SRS and FSS) to operate*".

ECC Decision (18)06 stipulates the following (Considering's):

- ✓ *"j) that the technical conditions related to coexistence with other services attached to this Decision have been developed on the assumption of **an individual authorisation framework**; any other assumption on the authorisation framework, such as general authorisation or a combined individual/general authorisation regime may require different and/or supplementary technical conditions;*

- ✓ *n) that a **regular assessment of the evolution of MFCN system characteristics**, including network deployments, in a timeline consistent with the 5 years review process of the Decision, or sooner if necessary, will provide additional confidence that these LRTC (Least Restrictive Technical Conditions) ensure adequate protection of other services, in particular space services;*

- ✓ *o) that appropriate provisions are needed in the authorisation for MFCN to define precisely how to **safeguard in a proportionate way the use of existing EESS/SRS receiving earth stations and the possibility for future earth station deployments** in the 25.5-27 GHz frequency band*

- ✓ *p) that appropriate provisions are needed in the authorisation for MFCN to define precisely how to **safeguard in a proportionate way the use of existing FSS transmitting earth stations and the possibility for future earth station deployments** in the 24.65-25.25 GHz frequency band*

- ✓ *q) that methodologies will be developed to support coordination/coexistence between MFCN and earth stations in the 26 GHz band (receiving EESS/SRS and transmitting FSS earth stations) through the definition of suitable separation/coordination areas and/or any other solutions as part of appropriate provisions mentioned in considerings o) and p));*

- ✓ *r) that most sharing studies have shown that Fixed-Satellite Service (FSS) and the Inter-Satellite Service (ISS) would be protected with a margin of more than 12 dB, based on agreed assumptions, and **it will be necessary to ensure that these services remain protected** (see considering n);*

- ✓ *s) that the pointing elevation of the main beam (electrical and mechanical) should normally be **below the horizon** for outdoor base stations;"*

With respect to *Considering j)* above, ESOA reminds the EETT that the technical conditions provided in CEPT Report 68[8] for the use of the 26 GHz frequency band are based on the assumption of an authorisation

[7] ECC Decision on *Harmonised technical conditions for Mobile/Fixed Communications Networks (MFCN) in the band 24.25-27.5 GHz* available from: https://www.ecodocdb.dk/download/5e74d0b8-fbab/ECCDec1806.pdf

[8] CEPT Report 68 on *Harmonised technical conditions for the 24.25-27.5 GHz ('26 GHz') frequency band*, also named "Report B" from CEPT to the European Commission in response to the Mandate "to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union"

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regime based exclusively on individual rights of use, which is also conducive to ensuring appropriate co-existence with current band usage. Any other authorisation framework such as general authorisation or a combined individual/general authorisation regime would require additional technical conditions in order to ensure appropriate coexistence of terrestrial systems capable of providing wireless broadband electronic communications services with other services in the band, in particular taking due account of continued deployment of FSS, EESS and SRS FSS earth stations.

With respect to *Considering p)* above, ESOA also notes that ECC PT1 recently delivered a new draft ECC Recommendation (20)01 on "Guidelines to support the introduction of 5G while ensuring, in a proportionate way, the use of existing and planned FSS transmitting earth stations in the frequency band 24.65-25.25 GHz and the possibility for future deployment of these earth stations." [9]

With respect to *Considering s)* above, ESOA would like to emphasize the fact that the compatibility studies at 26 GHz were only conducted for base stations that do not transmit above the horizon. Yet, 5G base stations in these frequencies will leverage smart antennas which adapt their emission characteristic to the location of the end users. This presents a specific risk as antenna panels, irrespective of their physical downtilt, could start transmission with the main beam above the horizon through beamforming. Such cases are very realistic, for example a lamppost-mounted base station transmitting to an end user located on the top floor of a building. This kind of scenario would most likely result in significant interference to the satellite service. As a result, ESOA recommends the EETT to adopt power limits (e.g. PFD limits) for emissions above the horizon in order to guarantee an interference free coexistence in the band.

ESOA further recommends to apply, in accordance with *resolves 2.2* of Resolution 242 (WRC-19), regulatory conditions that MFCN base stations that would operate an e.i.r.p. per beam exceeding 30 dB(W/200 MHz) are selected so that the direction of maximum radiation of any antenna will be separated from the geostationary-satellite orbit, within the line-of-sight of the IMT base station, by ±7.5 degrees.

ESOA finally welcomes the EETT's inclination to define appropriate operational and technical conditions for a predictable spectrum sharing environment and a viable ecosystem for all users of the 26 GHz band in the long term. Only by the inclusion of explicit terms and conditions in the authorisation regime for 5G/IMT will the usage of this band by space services be protected from interference, enabling the future sustainability of EESS/SRS earth stations in 25.5-27.0 GHz and FSS/ISS space stations in 24.65-25.25 GHz.

Conclusion

ESOA thanks the EETT for this opportunity to comment on their spectrum plans. ESOA will be very pleased to respond to any question the EETT may have in relation to our comments.

[9] See: https://www.cept.org/ecc/groups/ecc/ecc-pt1/client/meeting-documents/file-history/?fid=56630

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