

Responses to questions raised by Ofcom's letter of 19 December 2022.

Q1. Please provide information regarding:

a) Any mitigations that you might have in place to protect GSO networks e.g. angular avoidance of GSO arc.

Response:

Mangata will deploy mitigations to comply with the requirements set by the Article 22 of the Radio Regulations. These mitigations will protect GSO networks in general.

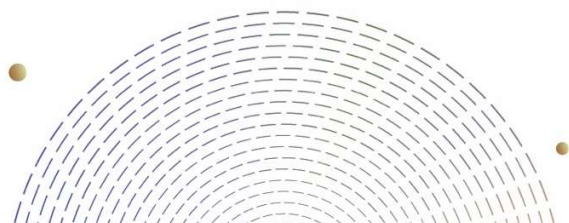
Uplink: Mangata with its Aristarchus filing has submitted required EIRP masks to demonstrate compliance with uplink EPFD limits given in RR No.22.5D / Table 22-2.

The approach for protecting the GSO satellite networks from transmissions of all earth stations operated by Mangata is to implement the exclusion zone angle coupled with minimum elevation angle at each earth station (gateways and user terminals) operated by Mangata. The exclusion zone angle is 3 degrees as specified with the Aristarchus filing. The minimum elevation angle is 15 degrees. In addition, the EIRP off-axis emission masks will be deployed with earth stations. These masks were submitted to the ITU and verified by the ITU¹, will also ensure the protection of the GSO. Mangata satellites carry independently steerable spot beams and these allow a given satellite to assign a spot beam to an earth station operating within the constraints set by EPFD compliance. For example, it will allow required reduction in earth station EIRP by a setting lower spectral density.

Downlink: Mangata with its Aristarchus filing has submitted required PFD masks to demonstrate compliance with downlink PFD limits given in RR No.22.5C / Tables 22-1A to 22-1E.

The approach for protecting the GSO satellite networks from transmissions of all space stations operated by Mangata is to implement the GSO arc avoidance / exclusion zone avoidance about the geostationary satellite orbit. The GSO arc avoidance specified by Mangata for the Aristarchus filing is 3 degrees. Mangata will suppress transmissions from satellites or individual spot beams within the GSO avoidance angle as the individual spotbeam coverage dynamically moves across the surface of the earth.

¹ See details of the Aristarchus satellite filing provided with the response to Question 1 b)



b) How you will ensure compliance with the EPFD limits in Article 22 of the ITU-R Radio Regulations (single entry and aggregate interference)

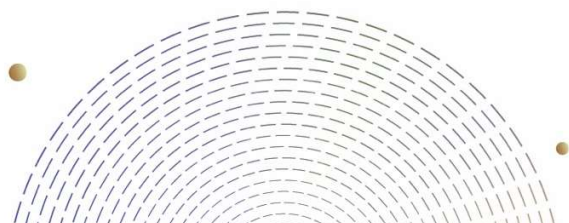
Response:

In our response to the above question, we demonstrated that we offer protection to GSO networks by complying with EPFD limits in Article 22. For avoidance of doubt, we detail below our EPFD compliance for both single entry and aggregate interference.

Relevant regulatory provisions:

- As per Article 22.2 of Radio Regulations, non-geostationary-satellite systems shall not cause unacceptable interference to and, shall not claim protection from geostationary satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations.
- As per 22.5C of the Radio Regulations, the equivalent power flux-density, EPFD (down), at any point on the Earth's surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Tables 22-1A to 22-1E, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in Tables 22-1A to 22-1E for the given percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Tables 22-1A to 22-1E, for all pointing directions towards the geostationary-satellite orbit. (WRC-03)
- As per 22.5D, the equivalent power flux-density, EPFD (up), produced at any point in the geostationary-satellite orbit by emissions from all the earth stations in a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Table 22-2, for all conditions and for all methods of modulation, shall not exceed the limits given in Table 22-2 for the specified percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Table 22-2, for all pointing directions towards the Earth's surface visible from any given location in the geostationary-satellite orbit.

MANGATA has filed with the ITU, the relevant uplink EIRP masks and the downlink PFD masks along with other relevant data elements listed in the Annex-2 of Appendix 4 of the Radio Regulations. Subsequently, BR examined this data and published the EPFD examination results in the CR/C Special Section 5412 (ID 320520273) in BR IFIC 2967 dated 22nd March 2022. This BR publication is an indication of the compliance with the EPFD limits.



In addition, we provide the results of our own EPFD verification by using EPFD Tool of Transfinite software. The summary of “runs” is produced below. This clearly demonstrates that we have achieved EPFD compliance with filed parameters, specifically the EIRP and PFD masks. The EPFD compliance is with the limits given in Article 22 Tables 22-1B, 22-1C, 22-2, 22-3.

Run Summary

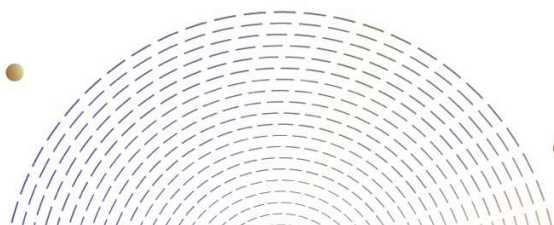
Result	Type	Frequency	Antenna	Service	Gain	Pattern	Bandwidth	non-GSO	Earth Station
Pass	Up	27.500	1.550	FSS	ITU-R S.672, Ls -10		40.000	ARISTARCHUS	Ref. ES
Pass	Up	29.500	1.550	FSS	ITU-R S.672, Ls -10		40.000	ARISTARCHUS	Ref. ES
Pass	Down	17.800	1.000	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	17.800	2.000	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	17.800	5.000	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	17.800	1.000	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	Down	17.800	2.000	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	Down	17.800	5.000	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	Down	19.700	0.700	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	19.700	0.900	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	19.700	2.500	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	19.700	5.000	FSS	ITU-R S.1428		40.000	ARISTARCHUS	Ref. ES
Pass	Down	19.701	0.700	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	Down	19.701	0.900	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	Down	19.701	2.500	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	Down	19.701	5.000	FSS	ITU-R S.1428		1000.000	ARISTARCHUS	Ref. ES
Pass	IS	17.800	4.000	FSS	ITU-R S.672, Ls -20		40.000	ARISTARCHUS	Ref. ES

All operational parameters, including transmission parameters of the space stations and earth stations (gateways and user terminals) will be controlled by the Mangata’s Network Operations Centre (NOC). One aspect of such control managed by the NOC is to ensure compliance with the EPFD limits, including the EIRP and PFD masks submitted to the ITU.

Q2. Please provide further information regarding alternative methods to mitigate harmful interference?

Interference situations involving the Mangata satellite system relate mainly to those other satellite networks affected by the Mangata satellite system. In addition, there will be a need to coordinate with terrestrial networks that may be affected by Mangata gateways and user terminals. In the latter case such interference issues will be managed separately as a part of the licensing process.

The ITU CR/C special section 5412 (IFIC 2942) identified the other satellite networks, both GSO and NGSO, affected by the Aristarchus network of Mangata. As mentioned above, frequency bands utilised by GSO networks subject to EPFD limits will not require further investigations. Mangata will coordinate with GSO networks with frequency bands not subject to EPFD limits. Mangata has already initiated such frequency coordination with GSO networks.





Mangata will coordinate with affected NGSO networks, as described in the annex to the application made to Ofcom by Mangata. When undertaking coordination, Mangata will consider mitigation measures such as:

- Lookaside of Mangata terminals
- Avoiding overlapping frequencies
- Taking into account the cross polarisation to provide further isolation

The mitigation measures can only be finalised following frequency coordination discussions with each of the other NGSO operators, and the arrangements to deploy such mitigation measures will vary on a case-by-case basis. Mangata has already initiated such coordination and plans to exchange ephemeris data with other operators so that all interference scenarios can be analysed in detail and appropriate mitigation measures can be put in place to ensure interference managed operations for the systems concerned.

Mangata has already mentioned in its notes to the application that such interference avoidance measures could also be deployed to ensure coexistence with future NGSO systems.

