18 April 2016

Via Email

Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA
United Kingdom
MSS_CGC@ofcom.org.uk

Re: EchoStar Mobile Limited's Comments in Response to Consultation on Licensing of 2 GHz Complementary Ground Component (CGC) for Air to Ground Use

Dear Sir or Madam:

EchoStar Mobile Limited (EML), a licensed operator of 2 GHz mobile satellite services (MSS) in the United Kingdom and one of two operators of pan-European Mobile Satellite services (MSS) with a complementary ground component (CGC), is pleased to provide its comments to the above-referenced consultation. EML's innovative MSS satellite, Echostar XXI, is scheduled for launch in June 2016 and will provide MSS services throughout the European Union, including the UK. In addition, EML has recently filed its CGC application with Ofcom. Consequently, EML has a direct interest in the outcome of this consultation, and in a continued ability to deliver service in an interference free environment. Below EchoStar provides its detailed comments in response to the Consultation to ensure that it is able to offer its soon to be launched 2 GHz advanced mobile satellite service utilizing EchoStar XXI throughout the United Kingdom.

Question 1: Do you have comments on Inmarsat's planned use of the spectrum, our planned approach to authorising the overall MSS and CGC system, the availability of the Network and Spectrum Access 2 GHz Licenses, or any other aspect of the scope and purpose of this document?

Answer 1: EML agrees with Ofcom that the proposed Inmarsat MSS/air to ground (ATG) network is consistent with the EU-wide MSS/CGC regulatory regime. EML also supports the Ofcom proposal to allow the deployment and operation of CGC once the MSS satellite is launched, in a manner consistent with EU-regulations.

We believe there are two issues that warrant further consideration. These are:

i. Ofcom's proposed technical rules do not ensure that EML's adjacent operations for MSS/CGC will be protected, and
ii. The fee structures proposed for Ofcom's Spectrum Access and Network Licenses for CGC vary significantly. EML generally has no objections to the proposed fee structure for the Network Licenses, and as we refine our business case for CGC deployment, we trust Ofcom will be willing to work with EML, as it has with Inmarsat, to craft a regulatory fee mechanism which is fair and which promotes spectrum efficiency.

Question 2: Do you have any comments on the technical conditions we propose to include in the Network 2 GHz License?

Answer 2: EML has been actively engaged in CEPT consideration of 2 GHz Air-To-Ground (ATG) services to ensure interference free operation for adjacent band services, including EML's 2 GHz operations. However, to date EML does not have access to the specific technical detail necessary to determine unquestionably whether Inmarsat's planned ATG services will result in harmful interference to EML's adjacent band services. EML has made numerous requests of Inmarsat to provide this information, but none has been provided. Instead, EML has had to rely on generalized information which may or may not reflect Inmarsat's planned operations. And just last week, Inmarsat has requested MSS coordination in the S band, despite the higher priority of the EML ITU filings.

EML has evaluated potential interference scenarios and adjacent channel use cases, investigating various parameters of frequency, space, time and power to achieve compatible operation. EML's compatibility analysis results and impact analysis showed the following, for one of the use cases. Considering EML's MSS station as the victim (2185-2200 MHz) and Inmarsat's ATG CGC base stations as the aggressor (2170-2185 MHz), compatibility could be achieved most clearly with a guard band from Inmarsat's spectrum resource. The amount of a guard band would need to be analyzed further. However, since Inmarsat is the aggressor and is operating under lower ITU priority, it is clear that any required guard band to protect the primary mobile satellite service must come from Inmarsat's spectrum allocation. The reasons for interference included but were not limited to: a high gain (14 dBi) directional Rx antenna is employed by the victim station; and the EML antenna is generally pointed upward in the direction of interfering ATG CGC base stations in the worst case. Therefore, compatibility is not achieved and would require improvement with significant mitigation techniques or restrictions. Inmarsat's system technical parameters and planned operations are extremely important for evaluating and ultimately controlling potential interference into EML's system. We urge Ofcom to seek additional information from Inmarsat on their system so that the required technical analysis could be completed.

One possible proposal to mitigate risk in terms of potential harmful interference from Inmarsat's ATG CGC network into EML's CGC network is for Ofcom to require Inmarsat to comply with the technical conditions on aeronautical CGC described in CEPT ECC Report 233, with regards to the transmission characteristics of Aeronautical CGC ground stations. While this will address this risk it will not address the risk imposed by Inmarsat's MSS or CGC ATG service into EML's MSS service. That Report concludes that the following technical conditions on Aeronautical CGC ground stations are necessary to ensure that unwanted emissions from these stations will not cause interference to mobile networks in the adjacent bands or to conventional CGCs of MSS systems in the 2 GHz MSS band. The statement from CEPT ECC Report 233, "conventional CGCs of MSS systems in the 2 GHz MSS band," refers to

EML's CGCs.[1] Therefore, the conditions of CEPT ECC Report 233 should be applied and will likely assist in protecting EML's adjacent channel operations (both MSS and CGC) from Inmarsat's ATG operations. We recapitulate them here:

1. Maximum Output power at antenna connector: **47 dBm**
2. Directional sector antenna with Maximum Antenna Gain: **15 dBi**
3. Channel Bandwidth: **2 x 10 MHz (FDD)**
    - Requirements analysis performed in Report 233 assume aeronautical CGC signal is a 10 MHz carrier.
4. Therefore from #1 - #3 above, each sector is to have a maximum EIRP of**: 62 dBm / 10 MHz**
5. Antenna up-tilt (minimum): **10°**
    - ECC Report 233 is based on antenna up-tilt of 10 degrees. Therefore the antenna should not be pointed closer to the horizon (ground) as it might lead to an increase in interference on the ground in the adjacent band.
6. The vertical Antenna pattern in **Figure 5 of ECC Report 233 should be adhered to.**[2]
    - Relaxing the antenna pattern in the direction of the ground will result in a significant increase in interference on the ground.

In addition, the following requirements from ECC Report 233 for the CGC Aeronautical Terminal must be adopted:

1. Maximum Transmit power at antenna connector: **37 dBm**
    - Note: In ETSI EN 302 574-2 V1.1.5, undergoing Public Enquiry
2. Omni-directional antenna with Maximum Antenna Gain: **3 dBi**
3. Channel Bandwidth: **2 x 10 MHz (FDD)**
    - Requirements analysis performed in Report 233 assume aeronautical CGC signal is a 10 MHz carrier.
4. Therefore from #1 - #3 above, the UT EIRP must be limited to **40 dBm / 10 MHz**
5. Minimum altitude above ground level for operation: **1000 meters**
    - The terminal must not be allowed to operate below this altitude
    - Note: 1000 meters in ETSI EN 302 574-2 V1.1.5, undergoing Public Enquiry
6. Antenna Type: **Figure 6 of ECC Report 233 should be adhered to.**[3]
7. The ECC 233 report identifies two PFD masks for aeronautical terminals: one in the band 1920-1980 MHz to protect ECN base stations (that can also be applied to protect conventional CGCs of other MSS systems in the 2 GHz MSS band), and another one in the band 2010-2025 MHz to protect DA2GC base stations.
    - Require compliance of PFD mask

To summarize the above proposed conditions of CEPT ECC Report 233, the Ofcom technical conditions in the license proposal do not include the following, key requirements necessary to protect adjacent

[1] See ECC Report 233, page 2, EXECUTIVE SUMMARY.
[2] See ECC Report 233, page 15, Section 5.1.1, Aeronautical Complementary Ground Component characteristics.
[3] See ECC Report 233, page 16, Section 5.1.2, Aeronautical Terminal parameters.

services. Deviating and not requiring the conditions of ECC Report 233 not only invalidate the reports analysis, but potentially could cause additional, unacceptable interference to adjacent services.

- CGC BS EIRP in 10 MHz Bandwidth – Ofcom value not equivalent to the value used in ECC Report 233 (see below)
- CGC BS Antenna up-tilt (minimum): 10°
- CGC BS Vertical Antenna pattern in Figure 5
- Aeronautical Terminal EIRP
- Aeronautical Terminal Antenna in Figure 6
- PFD Masks

Ofcom proposes to include technical conditions in the license that take into account compatibility studies undertaken by CEPT (ECC Report 233) to safeguard adjacent users, both in-band and adjacent, from harmful interference. Below, EML summarizes and comments on the technical license conditions proposed by Ofcom.

Ofcom proposes to include in the license:

1. Maximum Permissible Transmitted Power (The maximum mean power transmitted in the permitted assigned frequency block shall not exceed the more stringent of:
    a. 62 dBm/5 MHz EIRP
    b. 55dBm / MHz EIRP

		Ofcom - Technical License conditions			
		Maximum Permissible Transmitted Power			
Proposed	→	**62 dBm/5 MHz**	**(5 MHz RBW)**		
	→	55 dBm/1 MHz	(1 MHz RBW)		
		Converted below to 1 and 10 MHz RBW		*Formula:*	
Converted	→	**65.0**	**(10 MHz RBW)**	*=(62 dBm)+10*LOG10(10000000/5000000)*	
	→	55.0	(1 MHz RBW)	*=(62 dBm)-10*LOG10(5000000/1000000)*	
		CEPT - ECC Report 233 Requirements			
		47	dBm	Maximum Output power at antenna connector	
		15	dBi	Directional sector antenna with Maximum Antenna Gain	
		10	MHz	Channel Bandwidth	
	→	**62.0**	**dBm/10 MHz**	EIRP Maximum (10 MHz RBW)	
		Converted below to 1 and 5 MHz RBW			*Formula:*
		59.0	dBm	(5 MHz RBW)	*=(62 dBm)-10*LOG10(10000000/5000000)*
		52.0	dBm	(1 MHz RBW)	*=(62 dBm)-10*LOG10(10000000/1000000)*

- The proposed "Maximum Permissible Transmitted Power" of 62 dBm/5 MHz EIRP is equivalent to 65 dBm/10 MHz EIRP and 3 dB higher than ECC Report 233.
- The proposed limit of 65 dBm/10 MHz EIRP increase the Emissions into the adjacent bands and exceed the conditions of CEPT ECC Report 233.
- EML recommends the limit and conditions of CEPT ECC Report 233.

2. Permissible out-of-block emissions - The permissible out-of-block emission limit for the downlink use of frequencies is provided in the Table below:

a. Where:
   i. frequency offset is from the relevant block edge (in MHz);
   ii. the lower block edge is the lower frequency of the "permitted assigned frequency block"; and
   iii. the upper block edge is the upper frequency of the "permitted assigned frequency block"."

Offset from relevant block edge	**Maximum mean EIRP for out-of-block emissions**
-1.5 to -10 MHz (lower block edge)	+3.5 dBm/MHz
-1 to –1.5 MHz (lower block edge)	-9.5 dBm/30 kHz
–1 to –0.2 MHz (lower block edge)	Linear from -9.5 dBm/30 kHz to +2.5 dBm/30 kHz
–0.2 to 0.0 MHz (lower block edge)	+2.5 dBm/30 kHz
0.0 to +0.2 MHz (upper block edge)	+2.5 dBm/30 kHz
+0.2 to +1.0 MHz (upper block edge)	Linear from +2.5 dBm/30 kHz to -9.5 dBm/30 kHz
+1.0 to +1.5 MHz (upper block edge)	-9.5 dBm/30 kHz
+1.5 to +10 MHz (upper block edge)	+3.5 dBm/MHz

Ofcom - Technical License conditions		
Permissible out-of-block emissions		**Draft ETSI EN 302 574-1 V2.1.0 (2016-03)**
Offset from relevant block edge	**Maximum mean EIRP for out-of-block emissions**	**Table 28**: Spectrum emission mask values for Aeronautical CGC for 5 MHz, 10 MHz and 15 MHz channel bandwidth
-1.5 to -10 MHz (lower block edge)	+3.5 dBm/MHz	-11.5 dBm/MHz
-1 to –1.5 MHz (lower block edge)	-9.5 dBm/30 kHz	-24.5 dBm/30 kHz
–1 to –0.2 MHz (lower block edge)	Linear from -9.5 dBm/30 kHz to +2.5 dBm/30 kHz	$-12.5\text{dBm} - 15 \times \left[f\_offset - \left(\frac{CBw}{2} + 0.215 \right) \right] \text{dB}$
–0.2 to 0.0 MHz (lower block edge)	+2.5 dBm/30 kHz	-12.5 dBm/30 kHz
0.0 to +0.2 MHz (upper block edge)	+2.5 dBm/30 kHz	-12.5 dBm/30 kHz
+0.2 to +1.0 MHz (upper block edge)	Linear from +2.5 dBm/30 kHz to -9.5 dBm/30 kHz	$-12.5\text{dBm} - 15 \times \left[f\_offset - \left(\frac{CBw}{2} + 0.215 \right) \right] \text{dB}$
+1.0 to +1.5 MHz (upper block edge)	-9.5 dBm/30 kHz	-24.5 dBm/30 kHz
+1.5 to +10 MHz (upper block edge)	+3.5 dBm/MHz	-11.5 dBm/MHz
		*Extrapolated values - see actual Table below

Table 28: Spectrum emission mask values for Aeronautical CGC for 5 MHz, 10 MHz and 15 MHz channel bandwidth

Frequency offset of measurement filter -3 dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Maximum level	Measurement bandwidth
$\frac{CBw}{2} \le \Delta f < \frac{CBw}{2} + 200kHz$	$\frac{CBw}{2} + 15kHz \le f\_offset < \frac{CBw}{2} + 215kHz$	-12,5 dBm	30 kHz
$\frac{CBw}{2} + 200kHz \le \Delta f < \frac{CBw}{2} + 1MHz$	$\frac{CBw}{2} + 215kHz \le f\_offset < \frac{CBw}{2} + 1,015MHz$	$-12,5dBm - 15 \times \left[f\_offset - (\frac{CBw}{2} + 0,215) \right] dB$	30 kHz
$\frac{CBw}{2} + 1\ MHz \le \Delta f < \frac{CBw}{2} + 1,5\ MHz$	$\frac{CBw}{2} + 1,015MHz \le f\_offset < \frac{CBw}{2} + 1,5MHz$	-24,5 dBm	30 kHz
$\frac{CBw}{2} + 1,5\ MHz \le \Delta f < \Delta f_{max}$	$\frac{CBw}{2} + 1,5MHz \le f\_offset < f\_offset_{max}$	-11,5 dBm	1 MHz

Table 28, Draft ETSI EN 302 574-1 V2.1.0 (2016-03)

- Ofcom's proposed permissible out-of-block emission limit for the downlink use of frequencies is not correlating to the ETSI EN 302 574-1.
- The "Maximum mean EIRP for out-of-block emissions" appears to be 15 dB difference from ETSI EN 302 574-1, which is equivalent to the Inmarsat's CGC base stations antenna gain.
- EML proposes to revise Ofcom's Table and require the spectrum emission mask values of ETSI EN 302 574-1 and adhere to requirements of ETSI EN 302 574-1, Sections 6, Table 28. Table 28 is similar to Table 46 of ETSI EN 302 574-1 for technical requirements specifications for conventional CGC E-UTRA.

EML has concluded that the requirements from ECC Report 233 are necessary to address potential interference issues. For example the ECC Report 233 found with regard to the aeronautical terminals operating in the aeronautical CGC system, that in some cases (for example when the aeronautical terminal is transmitting with high power at low altitudes) interference issues could potentially occur in to DA2GC ground stations, ECN base stations in adjacent bands, or in conventional CGCs of MSS systems in the 2 GHz MSS band. Therefore, mitigation techniques and /or specific planning are needed to provide compatibility between the services and the systems studied.

A more specific example for requiring the ECC Report 233 conditions listed above would be the following. Relaxing the antenna pattern in the direction of the ground will result with a significant increase in interference on the ground. Combined with a deviation from the antenna up-tilt specification of 10 degrees pointed closer to the horizon (ground), this might lead to a significant increase in interference on the ground in the adjacent band. Ofcom's view is that if the antenna was pointed closer to the horizon it might lead to a small increase in interference on the ground in the adjacent band at large distances from the base station. Consequentially, EML concludes the technical conditions Ofcom is proposing on Inmarsat's 2 GHz network license will not be sufficient to protect against harmful interference.

As previously stated, however, these requirements in ECC Report 233 were derived without specific consideration of the interference impact of Inmarsat's ATG CGC operations on EML's adjacent band MSS and CGC, and only considered interference to adjacent band terrestrial services. Imposing these requirements may not be sufficient. Ultimately, this issue may conceivably be resolved through network

coordination, and EML therefore urges Ofcom to encourage Inmarsat to initiate coordination with EML for its MSS satellite. Ofcom should not act on the technical issues associated with this consultation until that coordination is successfully completed.

Barring such an approach, Ofcom should instead immediately initiate a new consultation on the required technical parameters for adjacent channel operations of MSS/CGC operators.

If, despite EML's strong concern of the potential for interference from Inmarsat's ATG CGC into EML's MSS and CGC operations, the issuance of the Inmarsat CGC license goes ahead, EML respectfully requests that Ofcom adopt rules that require Inmarsat immediately to cease operations should harmful interference occur into EML's MSS or CGC operations.

Question 3: Do you have any comments on our proposals for the fee level, fee structure and implementation of the location factor for the fee for the Network 2 GHz License?

Answer 3: EML appreciates Ofcom's proposed site specific fee structure for the CGC Network License product aimed at Air to Ground services with incentives to locate base stations in less developed parts of the United Kingdom. This fee structure may only be most appropriate for an ATG network, which currently is not the plan for EML. In addition, Ofcom's Spectrum Access authorisation assumes UK-wide coverage and imposes fees based on administrative incentive pricing (AIP).[4] However, the method applied by Ofcom to compute the AIP is not appropriate to CGC technology. The way Ofcom has computed the level of AIP does not take into account the unique constraints imposed on CGC business and operations by the spectrum award process and the network architecture. Specifically, it does not consider the unique costs associated with a CGC network: there is no operation of CGC in advance of the associated MSS (ergo no cash flow), no CGC operation beyond 18 months following the failure of the satellite component, the need for satellite redundancy, the necessity to provide MSS in all EU Member States, the necessity to have CGC operations under the same network and resource management systems as the satellite, and the cost of the satellite itself. We therefore consider using the same metrics to arrive at AIP costs for CGC as those used for GSM 1800 MHz to be inappropriate.

In summary of this point, Ofcom's network authorisation fee structure is currently derived from the UK-wide model but, in this case, would be applied to a site-specific model (where the fee paid for each site includes a location-based multiplier based on population density). This approach incentivises operators to install CGC base stations in areas with lower population densities, since doing so will be cheaper than making deployments in more populated areas. However, given our planned CGC mobile-broadband service offering which we recently applied for, there is a clear need for CGC deployment in more *densely* populated areas, to deliver a quality of service consistent with alternative LTE offerings.

In view of these considerations, the proposed spectrum access and network fees do not price our planned CGC service offering fairly, and inhibit the deployment that was foreseen by the original Decision. To address this regulatory imbalance, we ask Ofcom to consider, as part of this Air-to-Ground consultation, the fees appropriate for a terrestrial deployment of wireless broadband services, as it has done for air to ground CGC.

[4] Administrative Incentive Pricing – a structure whereby an operator is to pay a price for the bandwidth used which is valued upon its potential economic worth and not simply the administrative costs of licensing the operator.

If you need additional information or have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Jennifer A. Manner
Head, Regulatory Affairs