Met Office response to Ofcom Consultation:

Future demand for mobile broadband spectrum and consideration of potential candidate bands: WRC-15 Agenda Item 1.1

The Met Office, as the UK's National Meteorological Service, is responsible for providing a wide range of weather forecast and warning services to the public, emergency responders, defence, aviation, industry and a range of other stakeholders across Government, underpinning the protection of life and property. Reliable access to key radio frequencies is essential for the remote sensing and communication of the global environmental information upon which operational meteorology and the monitoring of climate change depend. Indeed, almost all of the observational data that is received and used by the Met Office involves the use of the radio spectrum, with examples including data from meteorological satellites, weather radar, radiosondes, ocean buoys and windprofilers - all of which are coordinated within internationally agreed spectrum bands. As a result, the Met Office and the wider meteorological community (through the World Meteorological Organisation, WMO) are strongly engaged on this ITU-R WRC Agenda Item through both the national and international frameworks to ensure that any proposed changes to current allocations are properly considered for compatibility with existing services and thus that key meteorological access to spectrum is protected.

Please find below the Met Office's response to the specific questions raised relating to the section "Frequency ranges under discussion" of this consultation (Questions 8-10). Please note that we offer no comment on Questions 1-7 in relation to the "Spectrum requirements forecasts" section.

Question 8. What are your views about the pros and cons of the frequency ranges in Table A6.1 in Annex 6 for mobile broadband and for existing applications using this spectrum? Do you have views on other bands that are not in Table A6.1?

470-694 MHz – No comment.

1300-1400 MHz – Potential use of this band for mobile broadband should be thoroughly assessed for compatibility with meteorological services operated in adjacent bands. The Met Office, in common with many national meteorological services internationally, operate Doppler wind profiling radars below 1300 MHz (alongside other aviation radiolocation applications), and these would need to be protected from harmful levels of any Out-Of-Band (OOB) emissions from services above 1300 MHz. Similarly, and even more importantly, satellite-borne passive sensors in the upper adjacent exclusive passive band above 1400 MHz must be protected from OOB emissions (see below).

1400-1427 MHz – This band is for exclusive passive use (no transmissions permitted as denoted in RR5.340), primarily for remote sensing by international meteorological satellite programmes. This band is used for space-borne observation of environmental parameters essential to operational meteorological and climatological monitoring and modelling, including soil moisture and ocean salinity (eg – European SMOS Satellite, NASA AQUARIUS). Such "spectral windows" as denoted by RR5.340 have been identified because of the specific fundamental physical properties of emission or absorption by atmospheric and surface constituents and thus remote sensing of a given environmental parameter cannot be undertaken in alternative bands. Such passive bands must therefore be protected against harmful levels of interference from both in-band and OOB emissions. It should be noted that low levels of interference can be even more damaging than higher levels, as data corrupted by high levels of interference can sometimes be identified by quality control and rejected (albeit resulting in the loss of important data), whereas low levels of interference can result in wrong, but plausible measurements that cannot be detected and which are then ingested into numerical models. The need to protect passive bands from in and out-of-band interference is likely to require the use of guard bands and impose very stringent requirements on devices using adjacent bands, something that may be difficult to achieve for what would need to be low-cost, mass

market products. The current WMO, EUMETSAT, ESA and EUMETNET positions on WRC-15 AI1.1 oppose consideration of this band for mobile broadband and state that the satellite instruments operated within this band must also be protected from unwanted emissions from any mobile applications considered for the adjacent 1375-1400 MHz or 1427-1452 MHz bands. The Met Office strongly endorses the view that this band is not to be considered for mobile applications under any circumstances, and that all measures are taken to ensure that no harmful levels of OOB emissions from adjacent bands affect the 1.4 GHz band.

1427-1527 MHz – As above, we call on all parties to ensure that any new services considered for this band do not cause (OOB) interference to passive sensors in the lower adjacent exclusive passive band.

1452-1492 MHz; 1518-1559 MHz; 1626.5-1660.5 MHz; and **1668-1675 MHz** – No comment.

1695-1700 MHz – This band is part of an important international metsat downlink band (1690-1710 MHz) for meteorological satellite systems, with earth stations operated by almost all National Meteorological & Hydrological Services (NMHSs) and many other users. Meteorological forecast accuracy is driven by both the quality and quantity of the meteorological data produced and delivered by satellite technology and the Met Office is currently dependant on this downlink frequency for receipt of such time-critical operational information. It should be noted that the UK has and is investing many £100 millions in the satellites that use this band (EUMETSAT, ESA) and globally several £billions equivalent has been spent. The data gathered by these satellites provides essential environmental information and also has very significant economic value in its own right. As a result of all of this, access to this band by the Met Office for passive meteorological satellite reception is protected in the UK though RSA (Recognised Spectrum Access. The RSA covering this band is based on coordination with assigned fixed links, but studies would be expected to show that compatibility of mobile broadband with either fixed or direct satellite reception services, particularly low-earth-orbiting satellites, would not be possible. Longer-term use of this band by other services may in future be possible as the newer generations of meteorological satellites will be designed to use X-band instead of L-band. However, the existing series of satellites using L-band are expected to be in operation for around 15 to 20 more years and the future use of 1690-1710 MHz by meteorological satellites may also depend upon the continued reliable availability of those X-band frequencies. The current WMO, EUMETSAT and EUMETNET positions on WRC-15 AI1.1 oppose the allocation of frequencies to mobile broadband in the range 1675-1710 MHz; in addition, the CEPT has considered that the frequency band would not be suitable as a candidate band anyway due to limited bandwidth available and current use by meteorological satellite receiving Earth stations. In conclusion, the Met Office strongly urges that this band is not considered at this time as a proposal that the UK should support.

2025-2110 MHz and **2200-2290 MHz** – These bands are essential for use by systems operating in the space research, Earth Exploration Satellite (EESS) and space operation services. Due consideration should be given to preserving present meteorological satellite use of this band both within the UK and globally, given the significant contribution by the UK to international meteorological satellite programmes in Europe (as outlined above) and the benefit received from that investment. Previous studies have shown that these satellite operations are not compatible with high density mobile applications (see RR5.391 and Recommendation ITU-R SA.1154) and thus the current WMO, EUMETSAT, ESA and EUMETNET positions on WRC-15 AI1.1 oppose consideration of this band for mobile broadband. Whilst meteorological satellites are not currently controlled directly from facilities in the UK (EUMETSAT operations are centred in Europe), this may change in the future and thus the Met Office is supportive of the current consensus that these bands should not be considered under AI1.1.

2700-2900 MHz – This band is used globally for meteorological and aviation radars. This band was previously considered for use by mobile service systems at WRC-2000 and WRC-07 and on both occasions compatibility was not deemed achievable (adjacent band interference problems have also been experienced in practice); indeed, Report ITU-R M.2112 outlines the non-compatibility of sharing between IMT and radars in the 2.7-2.9 GHz frequency band. If this band were again to be investigated for mobile broadband, this would require significant and expensive re-farming of existing radiolocation use with sufficient provision needing to be made for guard bands. The current WMO and EUMETNET positions on WRC-15 AI1.1 oppose consideration of this band for mobile broadband. Whilst the UK Weather Radar Network is currently operated at the only other suitable alternative available frequency band at 5.6 GHz, interference problems experienced by the current sharing of that band with

license-exempt use mean that the Met Office also retains a strong interest in the 2.7-2.9 GHz band (with a view to moving the weather radar network to this frequency should interference problems at 5 GHz become too great). As such the Met Office continues to engage in programmes of work investigating re-farming of the S-band in the UK and does not, as a result, ultimately favour use of this band for mobile broadband.

3400-3600 MHz and **3600-4200 MHz** – The broad 3.4-4.2 GHz frequency band is used not only used for satellite communications related to safe operation of aircraft but also by the international meteorological community to distribute meteorological data (eg – EUMETCAST) through commercial fixed satellite systems (FSS). The Met Office use of the 3.6–4.4 GHz band in the UK is protected by RSA. Whilst the Met Office is not directly involved in determining the operational nature of such commercial FSS arrangements, it maintains an important requirement to maintain relevant reliable FSS capacity and availability in the 3.4-4.2 GHz frequency band.

4400-4900 MHz – No comment.

5350-5470 MHz – This band is used by EESS (active) satellite applications, such as ASCAT on Metop, Poseidon on Jason and Radarsat, with significant UK investment in these satellite technologies (it is also used by ground-based meteorological radars in some countries). As the conditions for sharing of EESS (active) applications and RLAN in the wider 5 GHz band are not considered suitable, a number of space agencies have selected the 5350-5470 MHz (no current allocation to the mobile service) to operate SAR (Synthetic Aperture Radars) instruments (including significant EC/GMES investment in C-band instruments for the forthcoming ESA Sentinel-1 mission). As such, the current WMO, EUMETSAT and ESA preliminary positions on WRC-15 AI1.1 oppose any allocation of this band for mobile broadband. The Met Office therefore urges that this band not be considered for mobile broadband unless compatibility can be clearly demonstrated. Indeed, should further consideration be given under AI1.1 to a broader interpretation of mobile application across the 5 GHz range, the Met Office would also strongly oppose proposals relating to the range 5.6-5.65 GHz (where the UK Weather Radar Network is currently operated).

5850-6425 MHz – We have no specific comment on this band as such, but (as above) should a broader consideration of mobile use in the 5 GHz range be undertaken in association with this agenda item, the Met Office would strongly oppose proposals relating to the 5.6-5.65 GHz band (weather radar allocation).

13.4-14 GHz – The lower half of this band (13.4-13.75 GHz) is used by EESS (active) satellite applications including altimetry and remotely sensing parameters such as ocean winds, with significant UK investment through ESA. It is difficult to see how any new allocation to mobile broadband here would be able to coexist in the band with existing uses, without the current EESS (active) primary allocation at 13.25-13.75 GHz becoming unusable in some or all Regions. As such, the Met Office does not favour use of this band for mobile broadband unless compatibility with EESS (active) can be demonstrably proven.

18.1-18.6 GHz – This frequency range is used internationally for reception of real-time operational data (18.1-18.3 GHz) and EESS (passive) between 18.3-18.6 GHz. Whilst the Met Office does not currently use the lower part of the band for its reception requirements in the UK, the impacts of any proposals for mobile broadband at these frequencies should be properly studied.

27-29.5 GHz – The upper part of this band (above 28.5 GHz) is used for EESS (space to earth) and data transfer applications and thus studies should be undertaken to fully understand impacts. The lower adjacent 25.5 – 27GHz band is expected to be used for the space-to-Earth transmission of meteorological data by the next generation of European geostationary meteorological satellites (MTG) and the reception of this data will need to be protected where it occurs (including from OOB emissions).

38-39.5 GHz – No comment.

Question 9: Are there any other bands that are not in Table A6.1 for which you think we should be considering their pros and cons for mobile broadband and for existing applications using this spectrum?
We do not at this time propose consideration of any other bands outside of the current list, but request that Ofcom consult further on specific additional proposals should they come to light. However, we advocate that no consideration should be given to mobile use of either passive remote sensing bands (notably those protected by footnote mandating exclusive passive use, ie – RR5.340, etc) or further exploitation of the 5 GHz bands key to meteorological exploitation (eg – 5.6-5.65 GHz weather radar band).

Question 10: What are your views on bands which should be a priority for consideration for mobile broadband?
We do not propose that any particular priority order is imposed upon the band list under current consideration, but suggest that it may also be prudent to re-assess wherever relevant whether spectrum already used or awarded to broadband mobile may already meet projected requirements.