GSMA
Floor 2
The Walbrook Building
25 Walbrook
London EC4N 8AF
United Kingdom
Tel: +44 (0) 20 7356 0600
gsma.com

9 August 2019

The Chairman
Malaysian Communications and Multimedia Commission
MCMC Tower 1
Jalan Impact, Cyber 6
63000 Cyberjaya
Selangor Darul Ehsan
Malaysia
npwg-19.sec@mcmc.gov.my

Chairman, Malaysian Communications and Multimedia Authority

GSMA recommendations on the positions for IMT related agenda items at the upcoming WRC-19

We would like to thank MCMC for inviting comments from industry on the inputs of Malaysia to WRC-19. Particularly, we would like to highlight MCMC's inclusive and collaborative approach in developing its future spectrum strategy through consultative processes that encourage industry participation in the allocation and assignment of the vital mobile spectrum. The national 5G Task Group is an example for the ASEAN region on government-industry collaboration.

WRC-19 is extremely important for the mobile industry of Malaysia, as the Conference will decide on the issues being studied for the last three years – millimetre wave spectrum for mobile services is at the heart of the upcoming WRC. This spectrum range is important for the development of 5G, which requires very large bandwidths and extremely low latency for superior mobile broadband performance. Millimetre wave will deliver the necessary capabilities to meet these requirements.

Malaysia has continuously outpaced many of its regional counterpart markets in ASEAN (and in the wider Asia Pacific). We believe 5G mobile networks will give Malaysia enhanced capabilities to continue positioning itself as a regional market leader, particularly benefiting from industrial automation, Internet of Things and enhanced mobile broadband. WRC-19 will provide the platform to bring the necessary spectrum to the emerging 5G world. We are pleased to provide below (and in the Annex format provided by MCMC) our recommendations for Malaysia's participation at WRC-19 in support of its mobile industry.

Agenda Item 1.13

The GSMA supports the identification of the following bands for IMT:

- **24.25-27.5 GHz (26 GHz band)**
- **37-43.5 GHz (40 GHz range)**
- **45.5-52.6 GHz**
- **66-71 GHz**

Sharing and compatibility studies have been carried out in ITU-R between IMT and other services allocated in the bands being considered. These have shown that some additional conditions are necessary for protection of certain services (in particular EESS (passive)). However, the studies have shown that for other services there is already sufficient protection margin between the level of emissions expected from an IMT network and the level that could potentially cause interference. In these cases, no extra conditions are necessary.

For the 26 GHz band, a lot of work has focused on the co-existence with passive services in the band 23.6-24 GHz. While it is important to protect passive services, a pragmatic and investment friendly approach is required in order to allow APAC countries to make their industries leaders in 5G. With exception of Europe, most of the other regions are favoring less restrictive conditions to protect EESS (passive), including unwanted emissions limits in the range -32 to -37 dBW/200 MHz.

In particular we propose that:

1. The limit for unwanted emissions from outdoor IMT-2020 base stations into 23.6-24 GHz should be in the range -32 to -37 dBW/200 MHz.
2. We do not believe there is a need to include other technical conditions / restrictions on IMT-2020 (e.g. EIRP mask).

With regard to the 40 GHz range, a globally harmonised frequency range at 37-43.5 GHz is also important as the wider tuning range will allow for the greatest possible economies of scale and bring the widest benefits of harmonisation to consumers. This can create a mutually advantageous 'win-win' situation at WRC-19, providing flexibility for different countries/regions to achieve their required objectives, whilst enabling harmonisation and economies of scale.

The CPM Report for Agenda Item 1.13 is a complex compendium of every possible condition. It is possible, through the current text, to identify a band for IMT on paper, but effectively render it unusable on the ground. There is a risk at WRC-19 that, unless only the optimal technical conditions are applied, the IMT use of the bands will be severely limited. Further details are provided in the annex document.

Agenda item 1.5

WRC-19 agenda item 1.5 considers the use of the frequency bands 17.7-19.7 GHz (space-to-Earth) and 27.5-29.5 GHz (Earth-to-space) by earth stations in motion (ESIM) communicating with geostationary space stations in the fixed-satellite service (FSS). This agenda item has studied three types of ESIM: aeronautical, maritime and land, depending on which vehicle they are installed.

Backhaul costs are having an increasing impact on the cost of mobile services to consumers and demand on backhaul spectrum in the fixed service is increasing with the move from 3G to 4G. This will become more acute with the advent of 5G if new ubiquitous satellite services are introduced into important fixed service bands such as those under discussion in this Agenda Item.

The band 27.5-29.5 GHz or parts there of is being implemented for both mobile broadband and FWA (Fixed Wireless Access). The band 17.7-19.7 GHz is used for backhaul applications under the co-primary allocation to fixed service. Studies carried out in WP4A have concluded that there would be potential interference to terrestrial services from all types of ESIM transmitters in the band 27.5-29.5 GHz, while in the band 17.7-19.7 GHz ESIMs receivers would receive interference from terrestrial networks.

In order to enable coexistence between ESIMs and terrestrial systems, technical limitations are being defined on aeronautical and maritime ESIMs, however land ESIM cannot share the same spectrum with stations of the fixed or mobile service in the same geographical area. As such, allowing land ESIM use in the frequency 27.5-29.5 GHz is a risk to both the fixed and the mobile services to which it is already allocated and must be considered only on the basis of no interference from land ESIMs in 27.5-29.5 GHz and no protection to the land ESIMs in 17.7-19.7 GHz.

The operation of ESIMs bring additional complexity as stations could move from authorizing country‘s territory (land, water, and space) to another country where they might not have authorisation to operate. Regulatory provisions need to address these situations. Further details are provided in the annex.

Agenda item 10

WRC-19 will, for the first time, seek to identify mmWave spectrum for IMT. These frequencies will play a key role in enabling high-performance, high-capacity 5G. However, due to the propagation characteristics of these mmWave frequencies and in order to ensure 5G is available in all areas, additional spectrum below 24 GHz must also be found.

It is increasingly difficult to find frequency bands that are available for mobile/IMT use on a global basis. Hence, it may be necessary to identify frequency bands/ranges from within which different portions may be used in different countries/regions according to their particular situations and needs.

Additional spectrum between 3 and 24 GHz will be required for IMT to provide additional capacity for future 5G expansion and widespread provision of innovative 5G services with better propagation characteristics than above 24 GHz. The process for identification of spectrum in ITU-R is long and complex; hence there is a need to address already now the future IMT spectrum needs. It is therefore proposed to consider a new agenda item for WRC-23 to study spectrum below 24 GHz for IMT, including reviewing spectrum for IMT in the range 3.3/3.4 - 3.8 GHz. Further details are provided in the annex document.

The GSMA would appreciate the opportunity to discuss the details of our views with you. We believe that Government and industry working together will maximise the opportunities 5G mobile will bring to Malaysia. 5G is more than a new generation of mobile infrastructure – it will transform the digital ecosystem as we know it, bringing new applications to consumers and enterprises. We look forward to working with you in paving a successful path to 5G through the upcoming WRC decisions.

Yours Sincerely,

Brett Tarnutzer
Head of Spectrum, GSMA

About the GSMA

The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with almost 300 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences.

For more information, please visit the GSMA corporate website at www.gsma.com. Follow the GSMA on Twitter: @GSMA.

GSMA Response, MCMC Annex Document

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
Working Party 2: Broadband Applications in the Mobile Service		
5.	1.13	The GSMA suggests MCMC to support a new IMT footnote for the **26 GHz range** such as: ***5.A113b*** *The frequency band 24.25-27.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolutions* ***[A113-IMT 26 GHZ] (WRC-19)*** *and* ***750 (Rev.WRC-19)*** *apply. (WRC-19)* The GSMA believes the following methods for the band 24.25-27.5 GHz are the most appropriate: 1. The limit for unwanted emissions from outdoor IMT-2020 base stations into 23.6-24 GHz should be in the range -32 to -37 dBW/200 MHz. 2. We do not believe there is a need to include other technical conditions / restrictions on IMT-2020 (e.g. EIRP mask) The GSMA suggests MCMC to support creation of a new IMT footnote for the **40 GHz range** along the following lines: ***5.B113X*** *The frequency band 37-43.5 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations.* *Resolution* ***[B113-IMT 40/50 GHZ] (WRC-19)*** *applies. (WRC-19)* **2.1 37-40.5 GHz** Suggested methods: • Method C2, Alternative 2: identification to terrestrial component of IMT in 37-40.5 GHz (in the mobile service) For the conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. It is not necessary to specify any tighter IMT unwanted emissions limits to protect EESS in 36-37 GHz than those that are currently specified in 3GPP. This is because, inter alia, the protection criterion for EESS in this band is significantly less stringent than those for EESS (passive) in other bands, and 36-37 GHz is used for active as well as passive services. It is also not necessary to impose additional technical conditions on IMT in 37-43.5 GHz to protect other services such as FSS. Such conditions would

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
		unnecessarily constrain implementation and deployment of 5G. Annex 2 of this input contribution contains additional information related to 37-43.5 GHz. **2.2 40.5-42.5 GHz** The GSMA suggests MCMC to support: • Method D2, Alternative 2: identification to terrestrial component of IMT in 40.5-42.5 GHz (in the mobile service), including upgrade of the existing secondary allocation to the MS in the frequency band 40.5-42.5 GHz to a primary allocation. For the conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following should be applied: o Condition D2a: Option 5 – no condition necessary o Condition D2b: Option 3 – no condition necessary o Condition D2c: Option 3 - no condition necessary **2.3 42.5-43.5 GHz** The GSMA suggests APT Members to support: • Method E2, Alternative 2: identification to terrestrial component of IMT in 42.5-43.5 GHz (in the mobile service) For the conditions associated with this band, no action is necessary due to results of sharing and compatibility studies. In detail, the following should be applied: o Condition E2a: Option 7 – no condition necessary o Condition E2b: Option 3 – no condition necessary o Condition E2c: Option 4 - no condition necessary **C. 50 GHz range** **3.1 45.5-47 GHz** Studies were contributed to CPM19-2 which clearly indicate that sharing between IMT and MSS in the 45.5-47 GHz band is feasible and no conditions are necessary to protect MSS. For MSS (Earth-to-space), there is a large protection margin between the aggregate interference from IMT and the level that could potentially cause interference to an MSS space station. For MSS (space-to-Earth), required separation distances between IMT and MSS earth stations are small, and this matter can be treated on a national basis. **3.2 47.2-50.2 GHz** For 47.2-50.2 GHz, sharing studies between IMT and FSS indicate that sharing is feasible. For FSS uplink, there is a large positive margin between aggregate interference from IMT and FSS protection criteria, and for FSS downlink,

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
		separation distances are small and protection of FSS earth stations can be addressed on a national / case-by-case basis. The adjacent band 50.2-50.4 GHz is a passive band with no active services in the band, and IMT unwanted emissions limits will need to be included in WRC Resolution 750 for protection of EESS (passive) in this band. **D. 66-71 GHz** The GSMA suggests MCMC to support a new IMT footnote for the **66-71 GHz** range along the following lines: ***5.J113b*** *The frequency band 66-71 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. [Resolution **[C113-IMT 66/71 GHZ] (WRC-19)** applies.] (WRC-19)* The following methods for the band 66-71 GHz should be adopted: • Method J2, Alternative 2: identification to terrestrial component of IMT in 66-71 GHz (in the mobile service) and removal of the frequency band from RR No. 5.553 For the conditions associated with this band the following should be applied: ○ Condition J2a: Option 1 ▪ to take into account the latest technical characteristics of IMT and MGWS/WAS and ▪ to invite ITU-R to develop Recommendations and Reports that will assist administrations in ensuring that applications and services in the band 66-71 GHz can utilize the band efficiently including the development of appropriate sharing protocols between IMT and MGWS/WAS where needed ○ Condition J2b: No conditions necessary ○ Condition J2c: Option 3 – no condition necessary
7.	9.1 (Issue 9.1.1)	The GSMA suggests MCMC to support no change to the RRs

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
Working Party 3: Satellite Services		
11.	1.5	The draft new resolution on ESIMs [A15], proposed under this Agenda Item, is the subject of ongoing work at WP 4A with significant areas of discussion about how ESIMs will be regulated. This relates to different technical measures (pfd limits and separation distances) and very different regulatory measures (related to defining the ultimate responsible party for mitigating harmful interference). This work should also be viewed in the context of the band being assigned differently in different sub-regions, with segmentation of the band (i.e. entirely blocking ESIMs use of parts of the band) being put into place by some regions. Different regional positions on technical limits can be better understood within the context of whether band segmentation is in place. There are currently no proposals for band segmentation of the band 27.5-29.5 GHz in Region 3. This is the band in which ESIMs will cause interference to existing primary terrestrial allocations. As such, it is vital that technical and regulatory measures are put in place across the whole band that will assure the protection of existing services and their future development without undue constraint. The existing primary services are fixed and mobile and there are various elements that need to be considered in order to protect these, dependent on the type of ESIM involved. **1 Aeronautical ESIMs** The most efficient way to ensure that aeronautical ESIMs do not interfere with terrestrial services is to separate the two services by altitude. However, failing that, a PFD limit that protects the existing allocations to the fixed and mobile services must be put in place. WP4A is still considering the most appropriate limit. • For those administrations wishing to protect all existing primary services, limits in the draft new Resolution Annex 2, Part 2.1 **Option 2** should be used. **2 Maritime ESIMs** Maritime ESIMs should comply with a mandatory minimum distance from the low-water mark of a coastal state and an associated maximum ESIM e.i.r.p spectral density limit towards that coastal state. • Based on the ITU-R studies, with a minimum distance is required (CPM report is TBD and has [60/70/120]km at present) to protect terrestrial services, a maximum maritime ESIM e.i.r.p. spectral density towards the horizon of 12.98 dB(W/1 MHz) should be applied. This value is written in the CPM Report, Annex 2 Part 1 and should be adhered to, and not reduced, in order to protect existing terrestrial allocations. **3 Land ESIMs** Land ESIMs should operate under the condition of not causing unacceptable interference into receiving terrestrial stations in neighbouring countries. How

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
		this will be defined is the subject of debate in large amounts of the current draft resolution, so we only outline some key points below. Crucially, there cannot be any opt-out to the above statement regarding not causing unacceptable interference. While WP 4A continues to draft methodologies for the coordination of these issues between countries, this work is not yet complete. There must be a clear legal path towards mitigating interference in all cases which must be the responsibility of the ESIM operator's flag state. Definition of the clear legal path to mitigating interference between new, ubiquitous mobile satellite services and terrestrial is ongoing at the ITU. The GSMA believes that, given the fact that ESIMs should operate on no-interference basis, the burden of resolving any interference to existing or future terrestrial systems should be on the ESIM authorising Administration. However, it should be simultaneously noted that the process of identifying the cause of interference into fixed and mobile networks is extremely complex and in the case of Land ESIM causing interference into fixed networks in Region 3 will be very hard to track. The likeliest outcome is that the source of interference will never be properly ascertained and the result will be dropped connections and lower quality of service. Other important factors also require consideration. In CPM Report Draft New Resolution *Resolves* 1.2.2 and 1.2.3, there are different views regarding whether to delete the phrase "**and shall not affect the future development of these services**" regarding terrestrial services. The future development of terrestrial services was incorporated into Resolution 158 (WRC-15) and should be retained as there are other aspects beyond the imposition of a pfd mask that should be considered regarding the future development of services. With respect to the Draft New Resolution *Resolves* 1.2.5, option 1 is preferred as the other options incorporate language such as "**shall be deemed to have met its obligation to terrestrial stations**" The GSMA believes that such language should not be considered as it would eliminate many responsibilities of new services such as coordination and interference resolution. This would set a new and challenging precedent not just in this Agenda Item but throughout the Radio Regulations. However, particularly in developing countries, an exact legal framework which paths the route to resolving interference is a small part of the problem. The fact remains that, even where the legal route to mitigation is clear, the source of interference will not be. Foreign-registered satellite terminals will pass through domestic terrestrial networks and cause interference and lost quality of service for consumers.

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
		Proposal If Method B is to be considered for this Agenda Item: • The GSMA proposes that, for the bands 17.7-19.7 GHz and 27.5-29.5 GHz APT members **ensure the protection of existing services and their future development without undue constraint**. Doing so will require the adoption of specific technical and regulatory measures currently under ongoing discussion at WP 4A. • It is further proposed that Region 3n countries continue to monitor the progress of WP 4A and the development of Draft New Resolution [A15] both at WP 4A and at WRC-19 before ascertaining whether this contains sufficient certainty that existing primary services will be protected. Furthermore, any position on this issue should: 1. Protect existing services and their future development without undue constraints to which the 17.7-19.7 GHz and 27.5-29.5 GHz frequency bands are allocated. 2. Have the flexibility to ensure Region 3 can harmonise with other regions on technical and regulatory conditions going into WRC-19.
Working Party 6: General Issues		
31.	10	GSMA supports consideration of the following agenda item that has been proposed for WRC-23: • Consideration of additional spectrum for IMT below 24 GHz. This agenda item should include consideration of possible regulatory actions for 3.4 - 3.8 GHz, based on local market conditions and current regulatory status, including the following: • 3.4 - 3.6 GHz: Based on the current IMT identifications for Regions 1, 2 and 3 in RR Nos. 5.430A, 5.431B, 5.432A, 5.432B and 5.433A, consider relaxing the conditions referring to Article 9 procedures in those footnotes; • 3.4 - 3.6 GHz: Based on the current IMT identification for certain countries in Region 3 in RR Nos. 5.432A, 5.432B and 5.433A, consider adding further countries to those footnotes or revising those footnotes to apply to the entire Region 3 (as is the case already for Regions 1 and 2) and consider possible changes to the corresponding MS allocations as appropriate; • 3.6 - 3.8 GHz: Consider upgrading the secondary MS allocation in Region 1 to a co-primary MS allocation;

No.	Agenda Item	Proposed Malaysia (MLA) Views and Positions
		• 3.6 - 3.8 GHz: Based on the current IMT identification in RR No. 5.434 (for 3.6 - 3.7 GHz in some Region 2 countries), consider extending the IMT identification per Region and relaxing the conditions referring to Article 9 procedures in those footnotes. The agenda item could also consider and review IMT identifications in 3.3 - 3.4 GHz (a new agenda item for WRC-23 "to consider identification of frequency bands within the range 3300 - 3800 MHz for IMT" is expected to be proposed by ASMG). Consideration of spectrum in 3.8 - 4.2 GHz, which is expected to be an important band for 5G in some parts of the world, should also be included in this agenda item, including to: • Consider upgrading the secondary MS allocation in Region 1 to a co-primary MS allocation; • Consider possible IMT identifications for countries in Regions 1, 2 and 3. This new agenda item should also consider and study other potential bands below 24 GHz that may be possibilities for IMT use in the future. It is already clear that it will be very difficult to find frequency bands that are suitable for IMT use in all parts of the world, and current usage of different bands varies between different countries/regions, hence it is likely to be necessary to consider frequency bands/ranges from within which different portions may be used in different countries/regions according to their particular situations and needs. Bands that have been discussed within GSMA to date include: • 3800 - 4200 MHz • 5925/6425 - 7125 MHz • 7125 - 8500 MHz • 10.7 - 11.7 GHz • 14.3/14.5 - 15.35 GHz.

AGENDA ITEM 1.13: further discussion of technical conditions for the 26 GHz band

Unwanted emissions limits

Although there is clearly a need to protect EESS (passive) operations in 23.6-24 GHz, it is important not to over-protect EESS in such a way that would unnecessarily restrict 5G networks and services. 3GPP has been studying the feasibility of meeting more stringent unwanted emissions limits than the baseline requirement that is currently specified in 3GPP. Preliminary results from these studies indicate that, for example, with an emissions limit for base stations of -37 dBW/200 MHz there would be a substantial impact on performance, throughput and costs of 5G networks and services in the 26 GHz band. This would also require a large frequency separation of around 1 - 1.5 GHz between the 5G transmissions and the EESS (passive) band, resulting in the lower part of the 26 GHz band not being usable for outdoor 5G base stations.

The value of -37 dBW/200 MHz for unwanted emissions limit from IMT-2020 base stations would thus have significant adverse implications for 5G networks and services. Although some parties are

arguing that a tighter limit is needed in order to protect EESS, based on compatibility studies they have performed, we believe that a value in the range -32 to -37 dBW/200 MHz is more than sufficient, and is supported by other compatibility study results. Main differences between these study results are due to different assumptions for aspects such as antenna patterns, apportionment of interference between services, IMT station densities, and interpretation of EESS protection criteria. Considering each of these aspects in turn:

(i) it is clear that a beamforming antenna model is more accurate for such studies than a 'single element' model;

(ii) a recent study into apportionment has demonstrated that the fixed service requires only a small fraction of the margin given to it in apportionment schemes;

(iii) we believe that assumptions about 5G/IMT-2020 deployment densities provided by the expert group in ITU-R are realistic, and higher density values used in some other studies would result in excessive margin at the start of 5G deployments when excessively tight emissions limits could potentially curtail development of 5G in the 26 GHz band below 26.5 GHz; and

(iv) there is a lack of clarity regarding how protection criteria for EESS (passive) should be interpreted and applied in studies, and uncertainty regarding whether existing compatibility studies have implemented them in the right way. The Arab Spectrum Management Group (ASMG) recently decided to specify an unwanted emissions limit for IMT-2020 base stations in the 26 GHz band of -32 dBW/200 MHz, and the same -32 dBW/200 MHz is also agreed within relevant ATU working groups.

It should also be noted that regulatory limits for unwanted emissions will usually be significantly higher than emissions that will be seen from mobile networks in practice. In order to be able to reliably satisfy such limits, suppliers of mobile equipment need to design their products such that unwanted emissions are typically at least several dBs below the limit, in order to achieve good yields from their manufacturing processes and conformity testing under extreme conditions at reasonable cost. This is another factor that causes results from compatibility studies to be conservative.

Other technical conditions

In addition to unwanted emissions limits, other technical conditions on use of 5G in the 26 GHz band have also been proposed. These are being justified on the basis of being needed to protect other services in the 26 GHz band (in particular satellite services), however sharing studies for these services show there is a large protection margin between the level of emissions that would be expected from a 5G network and level that could potentially cause interference to a satellite.

The proposals include for an "in-band power limit" and/or "EIRP mask for positive elevation angles" for 5G base stations (essentially, restrictions on emissions in directions above horizontal). Any such conditions are likely to have a negative impact on the deployment, operation and performance of 5G networks and services, and should be avoided. We believe there is no need to include such technical conditions/restrictions.

We believe that imposition of a strict "EIRP mask" or "in-band power limit" for transmissions from 5G base stations, or other restrictions on antenna pointing, would be over-restrictive, impractical and unnecessary, and would further restrict the development and implementation of 5G in the 26 GHz band. In an IMT-2020 network in this band, beamforming will be used to direct the main beam from a base station in the direction of each user equipment (UE) to be served, and a restriction on emissions at positive elevation angles is likely to be impractical to implement. The vast majority of UEs will be located below the height of the base station to which they are connected, and hence

elevation angles greater than 0° will be atypical, and are unlikely to have significant impact on interference into other services. Imposition of an EIRP mask would place unnecessary constraints on a 5G network operator's ability to provide 5G services in an efficient and effective manner.

More generally, there is an inherent logical problem with the idea of taking parameter values from sharing/compatibility studies and using them as regulatory limits. Sharing and compatibility studies such as those that are being performed for the 26 GHz band should use parameter values that are realistic and represent typical/representative values, rather than worst-case values that would lead to results that predict levels of interference much greater than would be experienced in practice. Taking parameter values from such studies and using them as maximum limits will inherently lead to technical conditions that are unnecessarily restrictive.

It should also be noted that almost all of the sharing studies that have been conducted into potential interference from 5G networks into satellite space station receivers in the 26 GHz band indicate that there is a substantial margin between the level of interference calculated and level that could potentially cause interference at the satellite receiver.

Further discussion of technical conditions for the 37-43.5 GHz range

Coexistence between IMT and EESS (passive) in 36-37 GHz

The band 36-37 GHz is allocated to EESS (passive) and SRS (passive), however unlike other 'passive' bands such as 23.6-24 GHz, it is also allocated to and shared on a co-primary basis with active services (Fixed and Mobile), in accordance with FN 5.550A and Resolution 752 (WRC-07).

A key factor in determining correct conclusions from compatibility studies between IMT and EESS (passive) is interpretation of protection criteria in Recommendation ITU-R RS.2017. For the 36-37 GHz band, RS.2017 gives a "maximum interference level" of -166 dBW with a reference bandwidth of 100 MHz. However, there is also a "percentage of area or time permissible interference level may be exceeded" of 0.1 %, with associated "measurement area" of 10,000,000 km^2. For the most sensitive EESS sensor (H3), which has a satellite footprint ('pixel') area of 151 km^2, this corresponds to an 'exclusion area' of 10,000 km^2 or 66 pixels in which the interference level of -166 dBW/100 MHz can be exceeded without the protection criterion for EESS in this band being contravened/not being satisfied. Compared with corresponding criteria for 23.6-24 GHz, the area/time percentage is 10 times greater, the measurement area 5 times larger, and the bandwidth is half (hence the criterion for 36-37 GHz is substantially less restrictive).

The EESS protection criterion in RS.2017 will therefore not be contravened unless there are more than 66 pixels where the 'maximum interference level' of -166 dBW/100 MHz is exceeded (in one pass of the satellite). If we are using (say) 50% probability that this interference level is exceeded in a single pixel, then there will need to be 132 pixels within the measurement area where sufficient interference can be produced in order for the EESS protection criterion in Rec. RS.2017 to be contravened. The calculations for an individual pixel are based on a dense city/urban area (such as Paris or London), and there will only be a limited number of such cities within the 'measurement area'. Therefore, even with IMT unwanted emissions limit of -13 dBm/MHz as in current 3GPP specs, the EESS protection criterion for this band in RS.2017 will not be contravened (since there are not enough large dense cities to do so) and there is no need to specify any tighter IMT emissions limit(s).

Another factor to consider is that 36-37 GHz is not a 'passive' band in the same sense as (e.g.) 23.6-24 GHz, since, in addition to EESS and SRS (passive), there are also co-primary allocations to Fixed and Mobile in the band, and hence in-band emissions are allowed from active services in the same band (in accordance with Resolution 752 (WRC-07)). The unwanted emissions limit of -13 dBm/MHz currently specified for IMT is tighter than the maximum transmitter power for mobile systems specified in Resolution 752 (-10 dBW), and therefore that condition in Res. 752 is already satisfied by IMT.

Notwithstanding the above arguments that no (additional) conditions are necessary to protect EESS (passive) in 36-37 GHz, there may be a requirement from some administrations for IMT unwanted emissions limits to be inserted in new WRC Resolution for the 37-40.5 GHz band. In this event, the values of IMT unwanted emissions limits used should not be based on overly-conservative studies that disregard the criterion in RS.2017, but on values such as those in Study C in relevant Annex of the TG 5/1 Chairman's report (i.e. -28 dBW/100 MHz for IMT BS and -23 dBW/100 MHz for IMT UEs). Furthermore, it is important to recognise that these values are calculated for the 'maximum interference level' of -166 dBW being exceeded in a single pixel, and the EESS protection criterion in RS.2017 will not be contravened unless this level is exceeded simultaneously in more than 66 pixels (i.e. within a single sweep over the measurement area). In the event that it is decided that unwanted

emissions limits should be inserted in new WRC Resolution, we propose that these limits should be no tighter than -23 dBW/100 MHz.

Other technical conditions

In addition to unwanted emissions limits, other technical conditions on IMT are also proposed in various conditions/options in the CPM Report. These are claimed to be justified on the basis of being necessary to protect other services in the same band. For example, various options under Condition E2a for 42.5-43.5 GHz ("protection measures for FSS (Earth-to-space)") include proposals for maximum TRP levels for IMT base stations, EIRP masks, and requirements for IMT base station antennas to not point above the horizon. However sharing studies have shown that there is a large protection margin between the level of emissions that would be expected from an IMT network and the level that could potentially cause interference to a satellite receiver. And any such technical conditions would likely have a significant negative impact on the deployment, operation and performance of 5G networks and services, and should be avoided unless they are absolutely necessary. Hence, since such technical conditions are not necessary for protection of other services in the 40 GHz band and would have a negative effect on 5G/IMT, they should be avoided.

The imposition of a strict TRP limit, EIRP mask, or restriction on IMT base station antennas pointing above the horizon would be over-restrictive and unnecessary. A restriction on emissions at positive elevation angles is likely to be impractical, and would place unnecessary constraints on a licensee's ability to provide 5G services in an efficient and effective manner, and restrict the development and implementation of 5G. In an IMT-2020 network, beamforming will be used to direct the main beam from a base station in the direction of each user equipment (UE) to be served. The vast majority of UEs will be located below the height of the base station to which they are connected, and hence elevation angles greater than 0° will be atypical. Even if there is a positive elevation angle, the antenna beam will in most cases not be pointing directly towards a satellite (e.g. there will often be a building in the way), and there is unlikely to be any significant impact on aggregate interference.

There is also an inherent logical problem with the concept of taking parameter values from sharing/compatibility studies and using them as regulatory limits. Sharing and compatibility studies such as those performed for Agenda Item 1.13 should use parameter values that are realistic and represent typical/representative values, rather than worst-case values that would lead to results that predict levels of interference much greater than would be experienced in practice. Values of technical parameters will usually in reality be lower than regulatory limits. Taking parameter values from such studies and using them as basis for strict regulatory conditions will inherently lead to conditions that are unnecessarily restrictive.