Huawei response to the Ofcom call for input: "*Fixed Wireless Spectrum Strategy*"

Summary

Huawei welcomes the opportunity to comment on this important consultation on use of Fixed wireless access.

We consider that lower traditional frequencies, lower than 24 GHz, should keep current use, while applications currently supported by current scarcely used higher RF bands, below 60 GHz, could migrate to higher frequency, benefit from high BW provided by the E-band, allowing industry and operators better focus on main target of capacity and quality.

New possibilities available by technology in short – mid time, such as aggregation of channels in same or different RF bands, will be available to increase capacity.
Active antennas, allowing additional capabilities to the ones associated to mechanical antennas used up to now, will also be available soon.

Such devices allow additional capabilities to current use, and proper considerations will be necessary to identify the best framework to use them, from point of view of use cases, performance capabilities and authorization regimes.

The densification of networks that is expected to result from an ever increasing use of devices, needing high capacity backhauling, will probably open use of even higher mm frequencies (W and D-band), for which major RF manufactures are conduction studies or prototypes..

Proper consideration for licensing, authorization and normative context for these frequencies will be necessary before large scale use.

Consultation questions and our responses

Question 1:
a) Please indicate which user type given in Table 1 best describes your use of fixed wireless links?
b) If you are a telecom network operator or an organisation providing wireless solutions for different user types, please indicate where possible, a breakdown of the percentage of fixed wireless links used to support the different user types i.e. mobile network operator, emergency services etc.k.

Not applicable

Question 2:
a) Please indicate the applications provided by your use of fixed wireless links and the benefits these provide to citizens and consumers.
b) For each application, please indicate the frequency band used and the rationale for choosing that band, i.e. the application specific characteristics that affect your specific choice of frequency band. c) For each link, please provide details of the application supported.

Not applicable

Question 3:
a) How do you envisage the current and future applications provided by your use of fixed wireless links to change in the next 5-10 years?
b) What market trends and drivers will affect the use of fixed wireless links to deliver the relevant applications in the future?
c) What bands will be relevant to support the future changes?
d) Could your use of fixed wireless links be provided by alternative solutions? If so please give details of alternatives..

Not applicable

Question 4:
a) How will Fixed Service equipment continue to evolve to meet the increasing capacity requirements?

We think that further increase of modulation schemes compared to the modulations already available (1024 / 2048 QAM) could provide only limited advantages, due to increased complexity of equipment and consequent reduction of link budget, only partially compensated by higher transmission power by using new semiconductors like GaN, with a poor improvement in terms of spectral efficiency.

Higher capacity could be achieved by using wider channels employing:

- Channel aggregation in "traditional" microwave spectrum,
- Band aggregation (i.e. E-Band + traditional microwave band as 15, 18 or 23 GHz),
- More effective use of the available spectrum in the millimeter-wave (V-Band and E-Band)
- New spectrum in the sub-millimeter-wave ranges (W-Band and D-Band).

In particular the aggregation of two equipment in different RF bands exploiting in a complementary the diverse propagation characteristics and licensing, one in traditional bands

– limited capacity, high availability, the other at E-Band (high capacity, less availability) could allow coverage of significant wider areas with the guarantee of high availability (>99.99x%) for the highest QoS traffic, and allowing an order of magnitude higher capacity with an availability around 99.9%.

Several trials have been conducting around the world demonstrating the validity of this approach.

Full duplex technique, consisting in using same frequency for simultaneous continuous transmission for both direction of a link, potentially enabling doubling of capacity, should be available within the time frame scope of this consultation. Such systems will need the of use two separate antennas for transmission and reception in addition to algorithms for the cancellation of the transmitter in order to reach the proper isolation. Full Duplex is particularly interesting at millimeter-wave thanks to the small size of antennas and the proper isolation that can be achieved even with digital cancellation. With the current available bands Full Duplex could be in practice used only in the V-Band being unlicensed.

LoS MIMO is available in "traditional" microwave bands even if large scale deployment can be limited by installation constraints (room on the tower, optimum separation of the antennas).

b) What is the timescale for implementation in equipment?

Band aggregation is available while flexible channel aggregation will be made available in short-mid term.

FD functionality is expected in the medium - longer time base, necessitating proper regulations and licensing.

Question 5:

What capacity enhancing techniques are you deploying or intend to deploy?

Band aggregation is available while flexible channel aggregation will be made available in short-mid term.

FD functionality is expected in the medium- longer time base, necessitating proper regulations and licensing.

b) How does this affect your future demand for spectrum?

Not applicable

c) Do you see any barriers in the current authorisation approaches preventing use of such technology? If so, please indicate the changes you consider would be required to facilitate this?

We think that, concerning channel aggregation, proper consideration on license scheme is considered necessary.

In particular, for band aggregation (channel aggregation in different RF bands), the baseband signal transported by the two RF channels has to be regarded as a single signal with an overall

availability target. It is not possible to impose minimum guaranteed availability to the E-Band link, as it were a single link, without considering it together wth the link at lower frequency.

For FD, considerations will also be necessary, since, at the moment, only FDD or TDD are considered. FD could be considered a special case of TDD, with 100% transmit time direction, or a special case of FDD with no Go/Return shift.

In the future, active antennas are also to be considered, since currently adopted ETSI RPE classes are expected not to be suitable to them.

In particular, the view expressed today by most Administrations, consisting in accepting, for FS, only RPEs at least equal to current ETSI class 2, should be reconsidered.

Question 6:

a) How do you expect future mobile backhaul network architecture to evolve as part of the 5G ecosystem?

The main trends (very summarized) that we already see with 4G and 4.5G, to be further emphasized by 5G are the following ones:

- Higher capacity to be backhauled from Macro BS (urban, sub-urban and rural) due to:
  - RAN sharing and/or Mobile Operator consolidation
  - More access spectrum available
- Increase of capacity by densification of the networks
- The penetration of fiber with Points of Presence closer to the tail sites will make the backhaul network "shorter", resulting in a topology making less use of chains of wireless PtP links and more "stars".

Densification of the network and higher capacity will push the use of millimeter-wave and sub-millimeter-wave both for Macro and Small Cell BS's.

For sub-urban and rural areas, possibility to use band and channel aggregation systems will be useful to guarantee high availability of high priority traffic and making available very high capacity for high percentage of time.

Notwithstanding the advanced digital techniques researched for the wireless transmission of large CPRI signals in more efficient way (5 to 6 time higher than traditional), the foreseen increase of the front-haul capacity still presents technical and economic challenges such that we don't foresee wireless front-haul to be deployed save for few limited applications.

Two aspects, peculiar to 5G, that can have deep impact on backhaul, are under research:

- Self-backhaul
- New architecture in which there will be no longer distinction between backhaul and front-haul

b) How would this impact on future demand for fixed wireless links as a backhaul solution in the next 5-10 years and beyond? Please explain in terms of specific frequency bands i.e. which bands will be important for macro and small cell backhaul and why.

Considering the current worldwide split by frequency band of the deployed microwave links and the applications foreseen with 4G, 4.5G and 5G, we see the use of FS to continue

- in RF bands allowing mid-long link lengths, such as RF bands lower than about 24 GHz
- in RF bands allowing very wide channels in the millimeter-wave (V-Band, E-Band) and sub-millimeter-wave ranges (W-Band, D-Band).

It is possible that applications in the 26 GHz and in the scarcely used 28 and 32 GHz bands, could be covered by 23 GHz.

It is possible that applications in the 38 GHz and in the scarcely used 42 GHz band, could be covered by E-Band.

Densification of networks for 5G will push to move small cells towards higher mm RF bands, such the D-band, which could be seen as an expansion of current V-band, with capacity and quality capability.

c) What is the most appropriate authorisation regime to facilitate this?

In principle, in order to guarantee required quality, the individual approach is felt as the most appropriate. In some frequency bands (i.e. V-Band) or in portions of them, for certain applications unlicensed regime can be suitable to reduce operational aspects and application procedure provided that the systems are equipped with mechanisms to mitigate potential interference.

Possible license schemes, including block license (useful to facilitate interference management in urban streets, where interference calculation can be difficult for every link) and open to link-by-link (possible rural-addressed backhaul applications, where density are expected to be lower) are considered appropriate.

Licensing should specifically address the combined use of Channels in same or different RF bands, as required by channel aggregation systems.

Question 7:

For each Fixed Service band currently identified for study for 5G under WRC-15 Agenda Item 1.13 and 3.6–3.8 GHz band, please explain the impact on your backhaul use should the bands be identified and be repurposed for 5G given that the viability of in-band sharing between mobile access and backhaul is currently being studied.

Not applicable

Question 8:

a) What is the current use in the block assigned bands at 10 GHz, 28 GHz, 32 GHz and 42 GHz bands and how do you expect usage in these bands to evolve given that the 32 GHz and 42 GHz bands are also being considered for study for 5G globally?

b) For each band, please provide details including geographic location of each fixed wireless link deployed and the application it supports. Where these bands are used for fixed wireless links, please give details in terms of the capacity supported and total numbers of links deployed.

Not applicable

Question 9:

What impact does the change in the provision of national emergency service network have on both the future demand and supply of spectrum to support the backhaul requirement for the emergency service network? Please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz, 38 GHz bands?

Not applicable

Question 10:

a)How do you expect future public safety use of fixed wireless links to change in the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. If relevant, please explain in terms of frequency bands, particularly but not limited to 1.4 GHz, 26 GHz and 38 GHz?

Not applicable

Question 11:

Please indicate whether you consider that the guard band and centre gap of the 6 GHz band would be a suitable substitute for current and future 1.4 GHz applications, particularly in terms of costs to provide for like for like links and if not, the costs of alternative solutions. Please provide detailed evidence to support your answer.

No opinion

Question 12:

a) How do you expect the utility sector's future use of fixed wireless links to change in the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links, and whether your use could be provided by alternative solutions. For example, which part of the smart grid network will require fixed wireless links? If relevant, please explain in terms of frequency bands, particularly but not limited to the 1.4 GHz, 26 GHz and 38 GHz bands.

Not applicable

Question 13:

a) How do you expect the future requirements for fixed wireless links that support HFT applications to change over the next 5-10 years?

b) Please indicate the market and technology drivers affecting your future use of fixed wireless links. If relevant, please explain in terms of frequency bands, particularly the 70/80 GHz band

Not applicable

Question 14:

a) What is the future demand for HAPS in the UK both in terms of being a network provider and service provider? Please provide details including specific applications and envisaged deployment scenarios for HAPS

. b) How could sharing with existing fixed wireless links be facilitated? What would this mean in terms of the most appropriate authorisation regime to facilitate deployment of HAPS?

We have no specific position on the matter; current situation appears the following :

Identification of new bands for HAPS for WRC19 (38-39.5 GHz) includes the 38 GHz band, widely used in EU (more than 12000 in UK at time of publication of CEPT Rep. 173 – FS use and trends).

Band previously identified for HAPS by ITU-R (but never used) include 47.2–47.5 GHz and 47.9 48.2 GHz, 27.9-28.2 GHz and 31.0-31.3 GHz, 6 440-6 520 MHz and 6 560-6 640 MHz bands, appearing not widely used by FS at the time.

In conclusion, some sharing studies will be necessary to ensure correct operation on incumbents and new users.

Due to geometry, links belonging to HAPS appear quite "vertical", while FS links are quite "horizontal". Antenna discrimination is therefore felt as a fundamental element to counteract interference.

Question 15:

a) How could the 8 GHz band and narrowband channels within the guard bands and centre gaps of the existing channel plans for the 6 GHz band meet future demand for fixed wireless links if additional spectrum could be made available?

b) What types of applications do you consider would be of interest for these bands?

c) What is the status of fixed wireless links equipment availability in these bands?

Not applicable

Question 16:

a) What is the demand for a combined Lower and Upper 6 GHz channel plan that could provide wider channels at 112 MHz bandwidth?

b) What are the practical implications for existing equipment that operates under the existing band plans who wish to migrate to the new band plan?

c) What is the status of Fixed Service equipment availability for the wider 112 MHz channels in the combined Lower 6 GHz and Upper 6 GHz band?

Not applicable

Question 17:

a) What are the applications envisaged in the W and D bands?

Applications for 5G mobile backhauling, links with capacity of several Gbit/s over few hundred meters should cover important part of applications for D- band.

Considering the ongoing discussion, aimed to a possible new use of V-band by high capacity, wide band systems based on SRD, leading to possible interference conditions difficult to be controlled, D-band could be seen as a possible future alternative band.

W-band, due to propagation characteristics similar to E-band, and considering the fragmentation of band, could be efficiently used in future as an expansion of the applications offered by E-band, when congestion is reached.

b) What is the timescale of equipment availability for these bands?

Prototypes have been integrated to research main enabling technologies and testing the propagation in a field trial to start in the second half of September. Commercial deployment is not expected in the next two years both due to maturity of technology and availability of standards.

As a consequence, careful consideration to channel coverage to be achievable in short time is fundamental. In particular, new possibility of equipment, allowing the functionality to be covered without traditional diplexer, leading to much more compact use of spectrum compared with traditional equipment, should be considered, also from point of view of authorization and frequency use.

c) What would you consider to be the appropriate authorisation regime to facilitate access to spectrum in the W and D bands?

Considering the nature of applications, related to a possible use with high density, licensing assignments based on block of light licensing are felt as the most appropriate.

Unlicensed use could be considered effective only in conjunction with proper equipment requirement aimed at counteracting interference.

From market vision, the possibility to have a common view of Administrations is felt as very beneficial.

In addition, normative activities have to be finalized (just started) and bands need to be open.

Question 18:

a) Do you have a view on potential frequency bands between 275–450 GHz that could be suited for Fixed Service and for what applications?

Discussion on possible use of these systems are just at beginning (ETSI ISG mWT, ITU-R WP5C). Possible very high capacity transmission at quite short distance could be possible; use in outdoor is still to be evaluated

b) What are the anticipated timescales for the development of equipment and applications for these bands? 29 Fixed Wireless Spectrum Strategy - Call for Input

Not deeply considered up to now: components availability and request for real market are the driving points to be considered.

Question 19:

a) What is the future demand for bands listed in Table 4 for Fixed Service applications? b) What is the status of fixed wireless links equipment availability in these bands?

We think that there is the need by industry to focus effort and resources.

In particular, the bands around 50 GHz are not considered important due to lack of components, antennas and especially because similar applications could be covered by other bands at the moment still under exploited.

Products covering the 32 GHz and 65 GHz are available.

Question 20:

Question 20: Are there other aspects of the review on which you have evidence that would help inform our consideration of future developments in the Fixed Service sector? If so, please provide as much evidence possible.

We are of the opinion that the introduction of active antennas could have an increasing importance in network performances, as far as technical capabilities of these devices will improve. In addition to the capability of steering antenna beam, possibility to modify the shape of beams, so to counteract possible interferers, is expected to become available, allowing higher density and possibility to use conditions of NLoS. Proper rules to take account of these features will need due attention at due time.

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