Ericsson's Response to Ofcom's Fixed Wireless Spectrum Call for Input

Ericsson welcomes the opportunity to respond to Ofcom's Call for Input on its fixed wireless spectrum strategy. Our response is from the perspective of a technology provider. We do not operate our own fixed wireless links, but we do provide relevant equipment and service to network operators in the UK.

We would like to highlight these key messages:

- Fixed wireless technologies continue to evolve at a rapid pace, enabling new use cases, which can be challenging to predict accurately in a 5 – 10 year time horizon
- Fixed wireless links will remain an important complement to fibre networks, particularly in the many cases where fibre links are not economical to deploy or not flexible enough
- For any new or amended band plans, we would like to re-iterate the importance of international harmonisation, to enable timely and economic availability of equipment
- We would suggest putting a further emphasis on the future spectrum requirements of fixed wireless access – we anticipate fixed wireless access to play an increasingly important role in delivering future ultra-fast broadband speeds, bridging the "last metres" between fibre and premise, using exiting 4G and emerging 5G radio technologies

About Ericsson globally

Ericsson is the driving force behind the Networked Society – a world leader in communications technology and services. Our long-term relationships with every major telecom operator in the world allow people, business and society to fulfil their potential and create a more sustainable future.

Our services, software and infrastructure – especially in mobility, broadband and the cloud – are enabling the telecom industry and other sectors to do better business, increase efficiency, improve the user experience and capture new opportunities.

With customers in 180 countries and approximately 115,000 employees, we combine global scale with technology and services leadership. We support networks that connect more than 2.5 billion subscribers. Forty percent of the world's mobile traffic is carried over Ericsson networks. And our investments in research and development ensure that our solutions – and our customers – stay in front.

Founded in 1876, Ericsson is headquartered in Stockholm, Sweden, and generated revenue of SEK 246.9 billion (around £22 billion) in 2015. Ericsson is listed on the NASDAQ OMX stock exchange in Stockholm and the NASDAQ in New York.

About Ericsson in the UK

Ericsson engages geographically through 10 regional units, one of which is Region Western & Central Europe (RWCE), which includes Germany and the UK and is headquartered in London.

Ericsson is active in the UK since 1898, when we opened our first sales office here. In the early 1900s Britain accounted for ~30% of Ericsson's overall sales. More recently, Sony Ericsson, our mobile handset joint venture with Sony was headquartered in London prior to its sale to Sony in 2012.

Ericsson has made a number of significant investments in the UK, including the acquisitions of Marconi, Technicolor Broadcast Services, Tandberg TV and Red Bee Media (formerly part of the BBC). The UK is the global hub of Ericsson's media business and the majority of media-related R&D, especially video compression development, is done at our site in Southampton.

In February 2016, we launched a research partnership on 5G with King's College in London, in which we address the various technologies required to deliver next-generation communication networks and their implications on consumers and society.

Our main customers in the UK include the mobile operators EE, O2, Vodafone and Three, for which we manage a total of 44,000 radio sites and a number of other network-related services. We are a key supplier to the TV and internet service providers BT, Sky, Virgin Media and TalkTalk, and to the main UK broadcasters BBC, ITV, Channel 4 and Channel 5. We turn over around £500 million p.a. and employ around 4,000 employees in 13 offices across the UK.

Ofcom’s questions

Question 1:

a) Please indicate which user type given in Table 1 best describes your use of fixed wireless links?

Ericsson does not operate own fixed wireless links, since we are a provider of products and services into network operators.

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.

Not applicable (see response to question 1a)

Question 2:

a) Please indicate the applications provided by your use of fixed wireless links and the benefits these provide to citizens and consumers.

N/a

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.

N/a

c) For each link, please provide details of the application supported.

N/a

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?

See answer to b) below.

b) What market trends and drivers will affect the use of fixed wireless links to deliver the relevant applications in the future?

A large share of fixed wireless links is driven by mobile backhaul use, for which the capacity demand continues to grow strongly. However, there is also a substantial use beyond mobile

operators, for example for home broadband, which experiences even stronger capacity demand. Fixed wireless link technology continues to evolve rapidly to meet the evolving broadband network needs, capable of providing fiber like transport.

c) What bands will be relevant to support the future changes?

Spectrum in different frequency ranges is used by fixed wireless links to support communication in many types of locations, from sparsely populated rural areas to ultra-dense urban environments. Lower frequency bands are needed for longer distances, while higher frequencies are suitable for shorter distances. Since all parts of the networks are experiencing strong demand for more capacity, its remains important to have access to sufficient spectrum in all frequency ranges from low to high. In addition, new innovative multiband solutions are expected to unleash the use of higher frequencies over much wider geographical areas (see link below). The 70/80GHz band is rapidly gaining popularity, as it offers wide spectrum and channels alike, enabling capacities in the 10Gbps range over a few kilometres.

https://www.ericsson.com/res/thecompany/docs/publications/ericsson_review/2016/etr-multiband-booster-bachhaul.pdf

d) Could your use of fixed wireless links be provided by alternative solutions? If so please give details of alternatives.

N/a

Question 4:

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

Fixed wireless performance has been enhanced tremendously over the past few decades. Many new innovations have and will become available, to support the evolution of broadband networks. For example: extreme order modulation, wider frequency channels, new frequency bands and new concepts such as multiband. Ericsson regularly publishes outlooks on fixed wireless, such as:

https://www.ericsson.com/res/thecompany/docs/publications/ericsson_review/2016/etr-multiband-booster-bachhaul.pdf

https://www.ericsson.com/res/docs/2015/microwave-2020-report.pdf

b) What is the timescale for implementation in equipment?

We continuously research and develop fixed wireless innovations, which we then implement in equipment depending on market demand.

Question 5:

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

N/a

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

N/a

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 do not see any significant barriers currently. We suggest planning ahead for evolved band plans, e.g. 6L/6U, and facilitating the introduction of innovations such as Line-of-Sight MIMO and multiband solutions.

Question 6:

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

5G will be flexible and scalable to provide wireless connectivity for a wide range of applications, use cases and deployment types, such as enhanced (mobile and fixed) broadband, massive IoT and critical MTC. The presence fibre infrastructure is in general increasing, but fixed wireless links will remain an important complement, particularly in the many cases where fibre links are not economical to deploy or not flexible enough.

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.

See also answer to question 3.
Since all parts of the networks, from rural to urban, are experiencing strong demand for more capacity, it remains important to have access to sufficient backhaul spectrum in all frequency ranges from low to high. Many of the bands being studied for 5G use are today allocated to fixed microwave services as well. A shift is expected from the use of the fixed microwave bands in the 24.25-43.5 GHz range to use of the 70/80 GHz band. The 60 GHz band can play a role for small cell backhaul, but so far suffers from poor international harmonization. Some use-cases, such as small cell backhauling in ultra-dense scenarios, might be addressed in future 5G spectrum. In the longer term, the W and D bands are expected to provide solutions for any application benefiting from very large bandwidth and for which a distance up to about 1 kilometre is sufficient.

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

Although the dominant use of fixed microwave is for mobile backhaul, it is extensively used by many other industries and sectors. Individual spectrum licenses per installation, hop-by-hop, is most common. This provides the ultimate sharing of spectrum for all users of fixed microwave. Geographical area licenses, frequency block, are beneficial when sufficient spectrum is available to dedicate for particular uses. This is also necessary for some wireless technologies, such as point-to-multipoint, and of advantage for fast deployments in difficult interference planning environments, such as for dense small cell backhaul. Simplified license schemes and license administration are generally beneficial for uptake of new technologies and efficient use of spectrum.

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.

Ericsson welcomes the effort of CEPT and administrations to deliver detailed information on current incumbents, the extent of their current spectrum usage and plans for the future. Together with sharing analysis and mitigation techniques this is a key element in determining the possibilities for successful IMT-2020 usage of different frequency bands. In particular, it is noted that the bands in the list for AI 1.13 are allocated to the fixed service as well, and that they are among other things used for backhaul for mobile services. The FS use of the 38 GHz band is extensive in especially the European region, which to some extent is the case also for the 26, 28 and 32 GHz bands (see the comprehensive global view on FS microwave radio spectrum use in Ericsson Mobility Report June 2016, https://www.ericsson.com/mobility-report/the-need-for-spectrum-harmonization). However, as communication networks are upgraded for even higher capacities, a shift is expected from the use of the FS bands in the 24.25-43.5 GHz range to use of the 70/80 GHz band (71-76 GHz paired with 81-86 GHz), which offers very high bandwidth. Regulations that secure the use of the 70/80 GHz band for FS point-to-point microwave radio use, would thus facilitate the future availability of suitable IMT-2020 spectrum in the 24.25-43.5 GHz range.

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?*

N/a

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.

N/a

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?

Emergency services networks require a materially higher availability level than commercial mobile networks. Redundant physical backhaul routes are necessary and typically a mix of fibre, fixed wireless and satellite links are deployed. The envisaged high data rate use case for emergency services, such as live video streaming, will continue to drive the demand for high capacity and low latency.

Question 10:

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

As per question 9, very high availability and very low latency will continue to be the key requirements and should be reflected in the spectrum strategy.

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?

N/a

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.

N/a

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?*

N/a

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.

N/a

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?*

N/a

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.

N/a

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.*

N/a

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?

N/a

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?*

We do not provide equipment for narrow band communication in our Fixed Services/Microwave portfolio. In general, however, we recommend to be cautious in allowing communication in the guard bands since it restricts the possibilities to change any frequency arrangements.

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

N/a

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

N/a

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?*

There is continued demand for capacity in the transmission networks. The use of wider channels will increase the overall capacity and lower the cost per Mbit/s. The demand could come from upgrading existing trunk systems and new installations as a fibre alternative in rural areas.

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?*

The network and site effects during a migration into the new frequency arrangement is well described in the ECC report 235. The implications for migration of existing equipment, to the new band plan, depends on the flexibility of the existing equipment. New/upgraded channel filters will at least be needed.

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?*

It is only the market demand that sets the time line for equipment availability. There are no technical limitations that would delay the introduction.

It is important to have harmonized regulation to drive volume of scale, for example within Europe. It would also be important for Ofcom and other regulators to indicate very early any upcoming changes in regulation to the existing users. Changes can also be facilitated by having time limits on the current licenses.

Question 17:

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

Many different applications could be envisaged in the W and D band. Generally, any application benefiting from very large bandwidth and for which a distance up to about 1 kilometre is sufficient.

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

Applied research is ongoing and we expect technology availability in ~5 years. The availability of mature equipment at scale is dependent on market demand and harmonized regulations.

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

These high frequencies are characterized by fairly high atmospheric attenuation, few dB/km, and the possibility of high-directivity antennas of very small size. This should effectively limit interference and make it feasible to use simplified authorisation regimes.

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?*

The atmospheric attenuation increases with frequency and there are also several absorption peaks, as can be seen in the figure below. It should be noted that the frequency range from 252-275 GHz is co-primary allocated to Fixed Services. The frequency range 252-312 GHz has a moderate atmospheric absorption of ~5-10 dB/km and could thus be useful for fixed service applications, with reach up to a few hundred meters. The frequency ranges with very high absorption peaks – 320-330 GHz; 370-390 GHz and 437-455 GHz - may be more suitable for unlicensed short range use. In between these peaks the attenuation exceeds 10 dB/km but may still be useful for short reach fixed service applications.

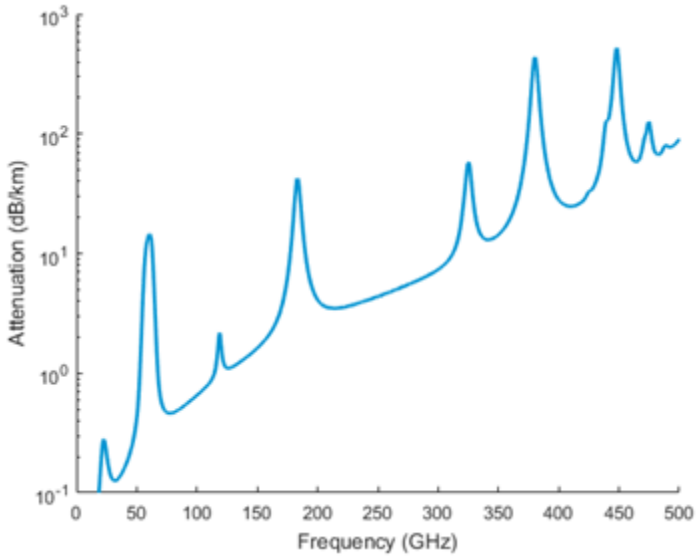

Figure: Atmospheric attenuation in dB/km up to 500 GHz (plot based on recommendation ITU-R P.676). Assumption is room temperature and normal humidity.

b) What are the anticipated timescales for the development of equipment and applications for these bands?

There are today at least three different processes allowing for semiconductor devices above 275 GHz (Fraunhofer IAF, Germany; Teledyne Inc., USA; and Northrop-Grumman, USA); all three are based on InP technology and driven by advanced space and defence applications. Exploratory research work has been published on key circuits for telecommunication (see references below). It should also be mentioned that these high carrier frequencies impose severe challenges on building practice, packaging, and interconnects. We believe it is not likely we will see mature commercial equipment for these bands within the next ~10 years.

W.R Deal, et. al.,Low Noise Amplification at 0.67 THz Using 30 nm InP HEMTs, IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS, VOL. 21, NO. 7, JULY 2011

Y. Yan, et. al.,340 GHz Integrated Receiver in 250nm InP DHBT Technology, IEEE TRANSACTIONS ON TERAHERTZ SCIENCE AND TECHNOLOGY, VOL. 2, NO. 3, MAY 2012

M. Abbasi, et. al., Single-Chip 220-GHz Active Heterodyne Receiver and Transmitter MMICs With On-Chip Integrated Antenna, IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES, VOL. 59, NO. 2, FEBRUARY 2011

Question 19:

a) *What is the future demand for bands listed in Table 4 for Fixed Service applications?*

N/a

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

The 31, 52 and 55 GHz band has historically gained very little interest.
There has been considerable interest in the 60 GHz band the last couple of years with equipment available from many vendors, including Ericsson. However, the deployments are still fairly limited. The 60 GHz band is unfortunately poorly harmonized and fragmented. Ericsson does currently not provide equipment for the 65 GHz part. Harmonized regulations to facilitate production at scale would be essential.

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.

Since this Call for Input covers fixed wireless spectrum, we would suggest that Ofcom might consider putting more emphasis on the future spectrum requirements of fixed wireless access (FWA). We anticipate fixed wireless access to play an increasingly important role in delivering future ultra-fast broadband speeds to the home and offices. FWA can bridge the “last metres” between fibre and premise in a more economic and cost effective way than fibre all the way to the premise. This can already be achieved by using exiting 4G technologies (see e.g. UK Broadband’s Relish offering) and is expected to make a significant leap forward with emerging gigabit LTE and 5G radio technologies (see e.g. https://www.ericsson.com/networks/offerings/5g-radio).
Availability of sufficient spectrum and an appropriate allocation regime will be crucial to enable FWA as a dynamic and efficient complement to fibre deployments.

For further conversations or questions, please contact:

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