Your response

Question	Your response
Do you have any comments on our proposals?	Please see Annex "Apple Response to "Ofcom's proposed Plan of Work 2022/23"" below.

Annex: Apple Response to "Ofcom's proposed Plan of Work 2022/23"

Introductory Remarks

Apple Inc. (Apple) appreciates the opportunity to provide input on some of the focus areas raised in "Ofcom's proposed Plan of Work 2022/23".

We believe a balanced approach to enabling access to licenced spectrum and licence-exempt spectrum is needed to fully realise the potential of wireless technologies in manufacturing, health care, social care, transportation, entertainment, and many other sectors. We would like to specifically highlight the importance of access to appropriate license-exempt mid-band spectrum for delivering innovative applications and services using the latest generation of technologies. This approach has generally been overlooked by policymakers and not explored in depth during the previous International Telecommunication Union's World Radio Conferences

In this response Apple's focuses on a few key areas where we believe it is important to develop an appropriate regulatory framework to the benefit of citizens, businesses, and the economy in general.

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Mobile Strategy

Mobile strategy. We will develop a strategy for our approach to the sector that will underpin our future regulation and support the delivery of high-quality connectivity and innovation to deliver good outcomes for consumers and citizens. We will take a broad look at changes taking place across the sector, including the growing role of the tech giants and the potential for greater fixed-mobile convergence, to consider how competition currently operates and how it is likely to evolve over the next 5 to 10 years. This will be undertaken alongside our mobile spectrum demand project. The review will have two main phases. Phase one will focused on evidence gathering and included a consultation to invite stakeholders' views. The second phase will build on stakeholder responses to draw initial conclusions and set out any next steps.	Publication Q3 2022/23

Apple Response

Apple believes it is important for Ofcom to take into consideration the spectrum needs for licence-exempt technologies to ensure an appropriate balance is achieved with licensed spectrum requirements. We support innovative, fair, and transparent technology neutral approaches to define a mobile strategy, but this needs to be more than just IMT (5G/6G) focussed and should take into consideration other technologies and the need for a licence-exempt and/or light-licensed regulatory framework. We support the initial phase of evidence gathering and we would be pleased to contribute to the second phase.

Award Spectrum Bands as they are Cleared and Released

Award spectrum bands as they are cleared and released. Enable millimetre wave bands to be used for new and innovative services, including 5G.	Consultation Q1 2022/23 Statement Q3 2022/23

Apple Response

Apple generally agrees that spectrum should be made available as soon as practically feasible. We don't necessarily agree that bands should be specifically cleared prior to release if coexistence and sharing is feasible unless some form of incentive pricing had been applied or a full cost benefit analysis undertaken. We are interested in which frequency bands Ofcom is considering for mmWave above and beyond the 26 GHz and 66 GHz bands.

Database Approach to Spectrum Management

Database approach to spectrum management. We will set out our thinking on the potential role automated assignment databases could play in meeting future spectrum management challenges. We will seek input on the range of solutions, challenges and benefits our approach might encounter alongside traditional spectrum management authorisation options.	Consultation Q3 2022/23

Apple Response

Apple suggests that any introduction of innovative approaches to spectrum management, including light-licensing possibly using databases needs to be carefully considered; harmonized globally to the greatest extent possible; and balanced noting the complexity in the design and implementation of databases. We would be pleased to provide additional detail when the consultation is available.

In the meantime, Apple supports making 5925-7125 MHz available for Low Power Indoor (LPI) Wireless Access Systems / Radio Local Area Networks (WAS/RLAN) and Very Low Power portable indoor/outdoor WAS/RLAN including narrow-band Frequency-Hopping Spread Spectrum (FHSS) on a licence-exempt basis. If AFC/CBRS/light-licensing is being considered for 6425-7125 MHz we recommend that it should only apply to higher power WAS/RLAN while still enabling, without addition restrictions, Low Power Indoor (LPI) and Very Low Power portable indoor/outdoor WAS/RLAN on a licence-exempt basis.

For all or part of the 5925-7125 MHz range, Apple believes that user equipment or client devices should not be subject to light-licensing or registration.

Licence-exempt systems and protocols are inherently built using polite spectrum sharing techniques, examples are Clear Channel Assessment and Energy Detection techniques. Utilising these techniques for the future increased utilising of the spectrum is desired.

Mobile Spectrum Demand

Mobile spectrum demand. Considered alongside our mobile strategy, our initial conclusions paper will set out our assessment of how demand for mobile services and the UK's mobile networks may evolve in the period to 2035, and whether additional spectrum may be needed.	Publication Q3 2022/23

Apple Response

Apple believes that while it is important to quantify the needs for licensed spectrum it is equally important to also quantify the needs for appropriate licence-exempt spectrum. As previously stated, we support making 5925-7125 MHz available for Low Power Indoor (LPI) Wireless Access Systems / Radio Local Area Networks (WAS/RLAN) and Very Low Power portable indoor/outdoor WAS/RLAN including narrow-band Frequency-Hopping Spread Spectrum (FHSS) on a licence-exempt basis.

Engaging with Industry on Wireless and Spectrum

Engaging with industry on wireless and spectrum. We will continue our work to raise awareness of wireless and spectrum in the delivery of digital transformation across different industry sectors. We will continue our engagement to understand and monitor spectrum use and identify unmet demand.	Ongoing

Apple Response

Apple welcomes further opportunities to engage with Ofcom and would be happy to provide additional information on what we believe is the current unmet demand for access to spectrum for licence-exempt technologies, and what might be the future requirements.

International Engagement

International engagement. We will continue to engage across Europe and globally, alongside UK stakeholders, to ensure that UK interests are appropriately reflected in international spectrum decisions and debates. We will lead UK preparations for the World Radiocommunications Conference (WRC) which will take place in 2023 and will issue a consultation on UK preparations in summer 2022.	Consultation Q1 2022/23 Statement Q3 2022/23

Apple Response

Apple supports Ofcom taking a leadership position; we request Ofcom advocate that no IMT identification is needed in the 6 GHz band under WRC-23 Agenda Item 1.2. In the subsequent text we provide additional justification to substantiate this position.

Upper 6 GHz Band

Upper 6GHz band. Following consultation, we will look to license low-power indoor systems in the 6425 to 7070 MHz band that will enable the opportunity to deploy Wi-Fi-like equipment for industry, business and research users. We are aware that there is also industry interest in an authorisation regime that is more suitable for consumer use – for example, for mobile networks or licence-exempt Wi-Fi. This is out of scope for this consultation – but we will ensure that our proposals do not prevent these potential future uses.	Statement Q1 2022/23

Apple Response

Apple believes that in addition to enabling access to appropriate spectrum for IMT it is vital to ensure that access to spectrum for licence-exempt Wireless applications e.g., peer-to-peer connectivity such as Bluetooth™ protocols, Wi-Fi, and other Short-Range Device (SRD) applications is also made available. Licence-exempt access will be very important for applications that will be backhauled over the fibre network. We would like to specifically highlight the importance of licence-

exempt access to the full 6 GHz band (5925-7125 MHz) for state-of-the-art wireless systems and their evolution.

Apple believes that the best use for the whole 6 GHz band (5925-7125 MHz) is for licence-exempt Wireless Access Systems / Radio Local Area Networks (WAS/RLAN), including narrow-band Frequency-Hopping Spread Spectrum (FHSS) applications, which also enables their evolution.

In the context of the World Radiocommunication Conference 2023 (WRC-23) Agenda Item 1.2 Apple does not believe an IMT identification is needed in any part of the 5925-7125 MHz frequency range as this would likely deny businesses and citizens the benefits of next generation of WAS/RLAN/Wi-Fi technologies.

New WAS/RLAN wireless systems, in particular the evolution of Wi-Fi 6E to next generation Wi-Fi known as Wi-Fi 7, will need access to the full 1200 MHz bandwidth within the 5925-7125 MHz range to support current and emerging innovative use cases. Opening only 500 MHz of the lower 6 GHz band would mean WAS/RLANs in dense deployments would have to continue to utilise smaller channel bandwidths, but with access to the full 1200 MHz, larger channel bandwidths of 160 MHz and eventually 320 MHz, as supported by Wi-Fi 7, could be more easily accommodated.

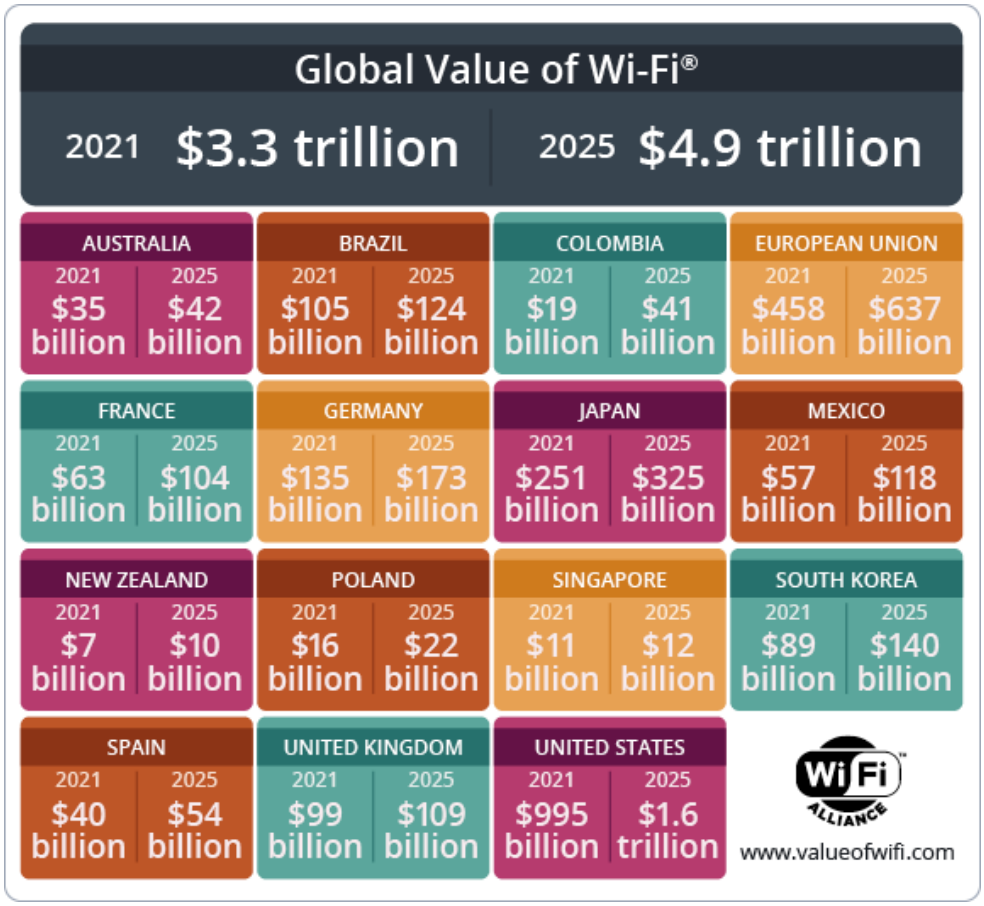
Wider channel bandwidths increase spectrum efficiency and deliver high-bandwidth application and services, while maintaining the ability to share spectrum with incumbents and other licence-exempt deployments. A lack of wider channels would have a detrimental impact on real-time video services and high-bandwidth immersive services.

Wi-Fi 7 will rely on up to 320 MHz channels to further improve latency, throughput, reliability, and quality of service relative to Wi-Fi 6. The FCC in the U.S. has said: “Making the entire band available for these unlicensed operations enables use of wide swaths of spectrum, including several 160-megahertz channels, as well as 320-megahertz channels, which promotes more efficient and productive use of the spectrum, and would also help create a larger ecosystem in the 5 GHz and 6 GHz bands for U-NII devices.[1]”

Apple notes the Wi-Fi Alliance (WFA) economic assessment study[2] on the value of Wi-Fi to economies indicated that the value to the global economy is anticipated to be $4.9 trillion by 2025. The value for the United Kingdom is approximately $99 billion in economic value and is anticipated to be $109 billion by 2025.

1 A Rule by the Federal Communications Commission, May 2020

2 https://www.wi-fi.org/news-events/newsroom/wi-fi-global-economic-value-to-reach-5-trillion-in-2025

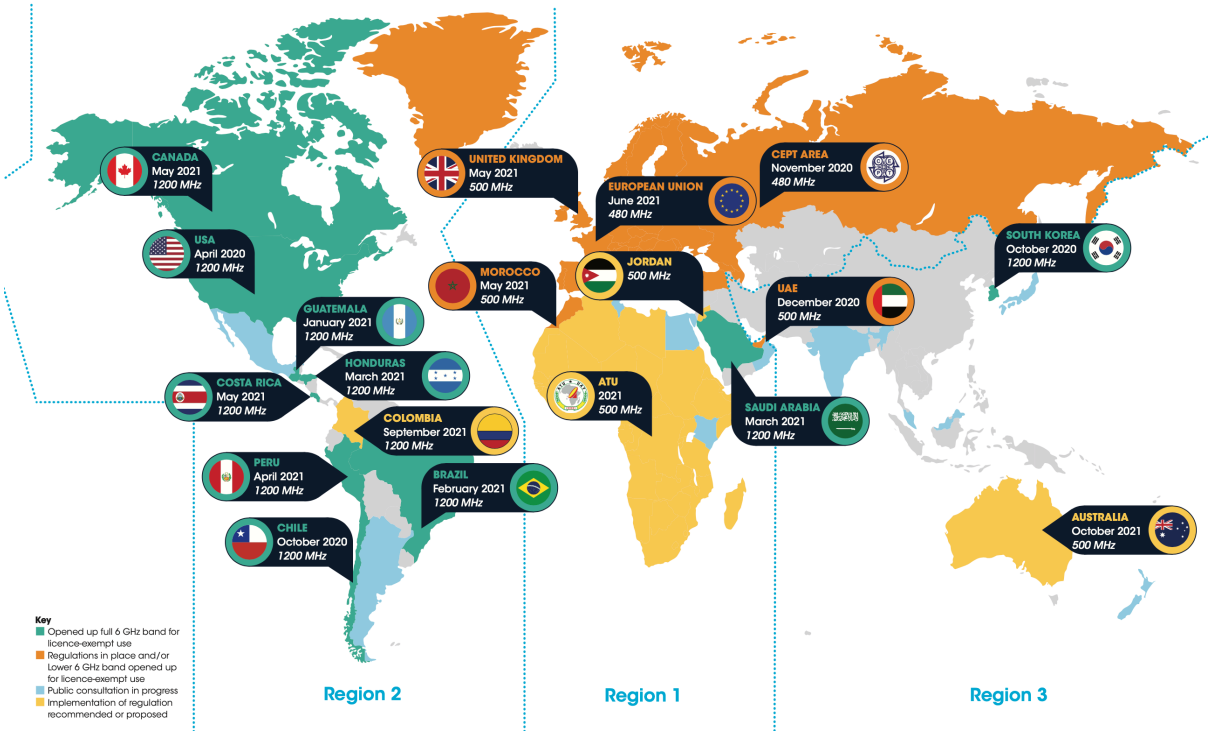


Also, we note there is a growing demand for licence-exempt spectrum to provide additional capacity and higher data rates. Technological advances and accelerating deployments of ultra-fast access networks (fibre, cable, and Fixed Wireless Access) will provide speeds in excess of 1 Gigabit per second (Gbps) to households, enterprises, and public institutions. Already today, some broadband providers are offering residential customers Fibre to the Home (FTTH) connectivity with data rates of 10 Gbits per second. By 2030, peak data rates between 50 and 100 Gbps are expected[3]. These data rates will have to be made available to the users most of whom will be using their connected devices indoors, with most mobile devices being connected through WAS/RLAN/Wi-Fi. To respond to these demands, additional licence-exempt mid-band spectrum needs to be made available.

From technical and economic standpoints, the 5925-7125 MHz band is the most attractive option, particularly as many countries around the world (for example USA, Canada, Brazil, Honduras, Chile, Korea, and Saudi Arabia) plan or already authorize licence-exempt operation in the 5925-7125 MHz band. It is also important to note that other Administrations have already taken the decision to release, or are in the processes of releasing, the entire 6 GHz band (5925-7125 MHz) as depicted in the map[4].

[3] Analysys Mason: Full-fibre access as strategic infrastructure: strengthening public policy for Europe, June 2020. BREKO: Breitband Kompass 2016-2017, IEEE ComSoc: “More Bandwidth, Please” (presentation)

[4] Policy Impact Partners, Published December 2021



Apple acknowledges that it is important to protect incumbent users in the Fixed Satellite Service and the Fixed Service. Duly noting the World Radiocommunication Conference 2019 decision to study coexistence between IMT with other incumbent services, as mentioned previously, we do not believe an IMT identification is needed in any part of 5925-7125 MHz as this would deny businesses and citizens the benefits of next generation of WAS/RLAN/Wi-Fi technologies.

For much of the past decade, the 5G community has called for 100 MHz per operator in the mid-bands to support 5G needs but has only recently begun advocating that the upper 6 GHz band is additionally needed, while the rationale and benefits have not been clearly articulated. Much of this discussion is happening in the context of the preparations for the ITU World Radiocommunication Conference 2023.

It is also important to note that there are no standards related to licenced IMT in the 6 GHz band thus no equipment exists. In addition, with major markets having already made the full 6 GHz band licence-exempt, these frequencies won't be harmonised for licensed 5G. WAS/RLAN/Wi-Fi in the 6 GHz will generate immediate benefits to citizens and businesses, as the ecosystem exists already.

Developing Ofcom's understanding of emerging and disruptive technologies ……

Developing Ofcom's understanding of emerging and disruptive technologies and the roles they play in delivering services to consumers and businesses. We are seeking to understand, by engaging with technologists in academia and industry internationally, the potential impact of technological innovation on the sectors we regulate, including evolutions of known technologies and radical new technologies. These include technologies such as artificial intelligence (AI), quantum communications, new computing architectures and new materials.	Ongoing

Apple Response

6G Standardisation

Apple observes that the journey to a new generation of wireless is broadly following the same path and cadence as 5G and the generations before it. Europe is pursuing leadership through programs like Horizon 2020 where there have already been at least 20 early project investments in 6G focus areas. In 2022, we only expect to see this ramp up through the new Horizon Europe/Smart Networks

and Services Public Private Partnership (SNS-PPP) where the green agenda and industrial enablement are emerging as the highest priorities.

In the US, Apple is pleased to see greater early national engagement in 6G consensus building through the new Alliance for Telecommunications Industry Solutions Next Generation Networks (ATIS NGN) and ATIS Next Generation Alliance (NGA) initiatives. Through this, we do expect to see some unique positions and priorities to emerge, reflective of the diversity of players and interests in the US. This is of course healthy and is in fact a strong indicator of the success of 5G in expanding the wireless ecosystem to its current level.

In the Asia region there is a substantial amount of research and activity on-going. Amongst these, China is driving its own position through the IMT-2030 partnership, with research projects planned, similar to the other regions of the world.

Apple expects all these positions to be brought into alignment in the ITU, ultimately, leading to the beginning of the standardization process in 3GPP in less than 5 years. We expect 3GPP to continue in its essential leadership role in the formal definition of the 6G standard. While there is perhaps an increased risk of regional fragmentation such an outcome must be avoided. Apple recognizes the immense contribution that international standards have made in enabling our wireless world today. Through 6G, we expect to see the enablement of many more possibilities and value. Apple believes that consensus driven international standardization is the best path to bring this value to our products and the world.

6G Spectrum

New use cases, device complexity, as well as the goal of service coverage may require more innovative spectrum policies e.g., shared licensing. System architectures need to take the dynamic and flexible nature of future deployments and business models into consideration as well as the impact of new technologies and applications.

For the spectrum frameworks we need to distinguish new spectrum and its implication on radio technologies from usage/licensing rules for both new and existing spectrum. Investigations should include licensed vs. flexible and increased shared use of spectrum.

Architecture design and spectrum rules should enable local and private network extensions and service extensions. Consideration should be given to:

- Flexibility to enable new business and use cases
- Adaptivity to local (and temporal) needs: local needs for wireless services may not always coincide with centralized network planning assumptions or commercial considerations. 6G architectures should allow for flexible and efficient adaptation of deployments based on local needs, e.g., as local business models.
- Enabling ubiquitous and equitable access: for people to participate in future work and social life, access to wireless network services will be crucial. Ubiquitous access requires adequate spectrum and the ability to efficiently deploy services to promote coverage. Therefore, 6G technologies and networks need to enable extreme coverage, flexible outdoor to indoor deployments, and flexible (on-demand) spectrum usage.
- Avoiding fragmentation (of standards and spectrum): spectrum fragmentation is a strong driver of device cost and complexity. Adoption of a new standard that tries to address that problem should generally be faster because of availability of affordable devices.

_____ End _____