

Apple Response to ICASA “Long-Term Spectrum Outlook for South Africa”

Contact Details

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Introductory Remarks

Apple Inc. (Apple) appreciates the opportunity to provide some input on the topics and questions being raised by ICASA in “Long-Term Spectrum Outlook for South Africa”.

Apple believes 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 licence-exempt mid-band spectrum to deliver innovative applications and services, utilising the latest generation of technologies.

In this response Apple’s focus has been in a few key areas where we believe it is important to assist in developing an appropriate regulatory framework to the benefit of citizens, businesses, and the economy in general.

There is nothing confidential in this response, and if anything is unclear, or if further details are required, we’d be pleased to provide additional input.

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2.5 ATU

1. Please comment on whether the above captures the relevant regulatory and policy aspects of long-term spectrum planning.

Apple Response to Q1

Apple supports ICASA’s timely implementation of the recommendations identified in the first set of ATU Spectrum Recommendations since we believe they capture the relevant regulatory and policy aspects required for long-term spectrum planning. We concur it is important to ensure timely progression of the following elements contained in the recommendations as following –

- Development of **national broadband plan** and **spectrum roadmap** including spectrum plans in support of the roll-out of technology neutral mobile broadband. We see a licence-exempt element being equally important when considering new technologies, e.g., Wi-Fi 6E and progression to Wi-Fi 7, while simultaneously protecting the incumbent services.
- Defining **future spectrum requirements** for both licenced and licence-exempt technologies required to deliver new and innovative broadband services and applications in a spectrally efficient manner. An important element is having a technology neutral 5-to-10-year spectrum outlook vision. Where protection of the incumbents is important and the avoidance of reallocating/repurposing existing services and/or users should be minimised.
- Ensuring that **policy development and implementation** in spectrum allocation and utilization is transparent.
- Implement a clear timeline for releasing appropriate **mobile broadband spectrum** in the low, mid, and high bands for the rollout of broadband under licenced and licence-exempt regulatory frameworks plus ensure access to additional backhaul spectrum is enabled.
- Monitor implementation of broadband spectrum plans and enable flexibility in spectrum regulation in order to **ensure efficiency in spectrum** use including development of a spectrum sharing framework for mobile broadband; developing models for spectrum trading; encouraging network deployments particularly in rural, unserved and underserved areas; implement “use-it-or-lose-it” /

“use-it-or-share-it” obligations on spectrum licenses; and allow staggered/instalment payments for settling spectrum fees.

- Identify **future technological trends** (spectrum sharing mechanisms and emerging standards) and their impact on spectrum policy and planning.
- Accommodate **emerging technologies and standards** extending mobile broadband networks into unserved and underserved areas.
- Ideally **standardise frequency allocations** for wireless broadband regionally, allowing for the possible reduction of cross-border interference and supporting common technical standards while taking into account the elements previously listed.

Apple recognises the importance of identifying future technological trends, including spectrum sharing mechanisms and emerging standards. We support ICASA undertaking an assessment on the impact on spectrum policy and planning, and we believe this is particularly important with respect to the 6 GHz band prior to any decision being taken on WRC-23 Agenda Item 1.2.

3.1 IMPACT OF BROADBAND

2. Are there services, in addition to broadband, that ought to be considered as important for economic growth? If so, please explain what these services might be and what the trade-offs are between using spectrum for broadband and alternative services. Please provide any evidence from other countries that may be relevant.

Apple Response to Q2

Apple considers licence-exempt technologies, e.g., Wi-Fi 6E and Wi-Fi 7, as falling within the “broadband” terminology and we see them as a critical element important for economic growth.

We are supportive of enabling access to additional low, mid, and high frequency bands for broadband to assist in increasing economic growth both “direct” (infrastructure investment and rollout) and “indirect” (services and capabilities enabled by broadband).

We agree that the impact of broadband access on economic growth depends, in part, on the level of actual broadband penetration and increasing the rates of penetration should be a priority, particularly in rural and under-developed areas.

We agree that expanding access to broadband services in South Africa will lead to greater economic growth, productivity, and employment. That said, we do not see the 6 GHz band (whether identified by the WRC-23 for IMT or not) as being suitable for higher power / standard power infrastructure or wide-area geographical coverage.

3.2 BROADBAND PENETRATION IN SOUTH AFRICA

3. Please comment on the above assessment of the status quo on broadband penetration in South Africa, and what role spectrum may play in addressing the gaps identified.

Apple Response to Q3

Apple supports efforts to improve broadband penetration, coverage, and take-up in South Africa. We note there have been low rates of uptake of mobile broadband in South Africa even with almost full 3G coverage. We do not believe this is due to lack of spectrum assigned to the mobile operators, but this seems to be used by the same operators as a reason to secure access to additional spectrum.

We do not fully support the views that “having access to spectrum lowers the cost to operators of rolling out both improved coverage and capacity, since it requires them to build fewer base stations”. It is our view that having access to additional spectrum would only improve coverage if the spectrum in question was in the lower frequency bands but at the same time this would not improve capacity since to improve capacity access to higher frequencies would be required and therefore smaller cell sizes and thus more basestations would be needed.

We agree that larger allocations of spectrum are necessary to provide higher speed mobile broadband especially as the demand for data increases rapidly, but one would think that before assigning additional spectrum the mobile operators should be encouraged to migrate their networks from 3G to 4G or even 5G to improve spectrum efficiency. We suggest that consideration be given to provide mobile operators with incentives (e.g., reduced annual license fees, access to low cost backhaul spectrum) to improve their network technologies, coverage, and billing plans being offered.

While there may be several reasons why spectrum assignment could be seen as critical to achieving cheap broadband this does not necessarily equate to that broadband being of a high quality. We believe it is important to focus on spectrum efficiency and technological advancements to improve network deployment, coverage, and take-up. Access to some additional spectrum may indeed be needed to expand access to broadband, to improve the quality of service to those customers that already have access, and to reduce the cost of access for all, but this needs to be considered carefully to ensure that this spectrum is used efficiently and not to the detriment of other usages.

3.3 KEY TRENDS

4. What future changes, if any, should ICASA examine with regard to the existing licensing regime to better plan for innovative new technologies and applications and allow for benefits that new technology can offer, such as improved spectrum efficiency?

Apple Response to Q4

Apple suggests that ICASA should generally take a more proactive and positive position on making additional licence-exempt spectrum available and open full 6 GHz band (5925-7125 MHz) for licence-exempt use for state-of-the-art Wireless Systems and their evolution.

Apple believes that in addition to enabling access to appropriate spectrum for IMT it is vital to ensure that access to spectrum for complementing licence-exempt Wireless applications e.g., peer-to-peer connectivity solutions such as Bluetooth™, 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.

5. What future emerging technologies are to be taken into consideration and which technologies will have a significant impact? When are these technologies expected to become available?

Apple Response to Q5

Apple believes that there needs to be a balance between licensed technologies, e.g., 3G, 4G, 5G, and in the future certain elements of 6G, and license-exempt technologies such as Wi-Fi 6E and its evolution to Wi-Fi 7, and other licence-exempt technologies. A balance is needed between licensed 5G/6G and licence-exempt in the mid-band frequency ranges since we believe that these technologies are complimentary.

With respect to IMT spectrum requirements we would like to point out that there are already frequency bands identified for IMT that can, and should, be utilised now as well as in the coming 5-10 years.

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, since this 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. Therefore, we believe it is important to reiterate the justification on why WAS/RLAN needs access to the whole 1200 MHz within 5925-7125 MHz.

New WAS/RLAN standards, 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 frequency range to support current and emerging innovative use cases. Opening only 500 MHz of the lower 6 GHz band would mean WAS/RLAN networks 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.

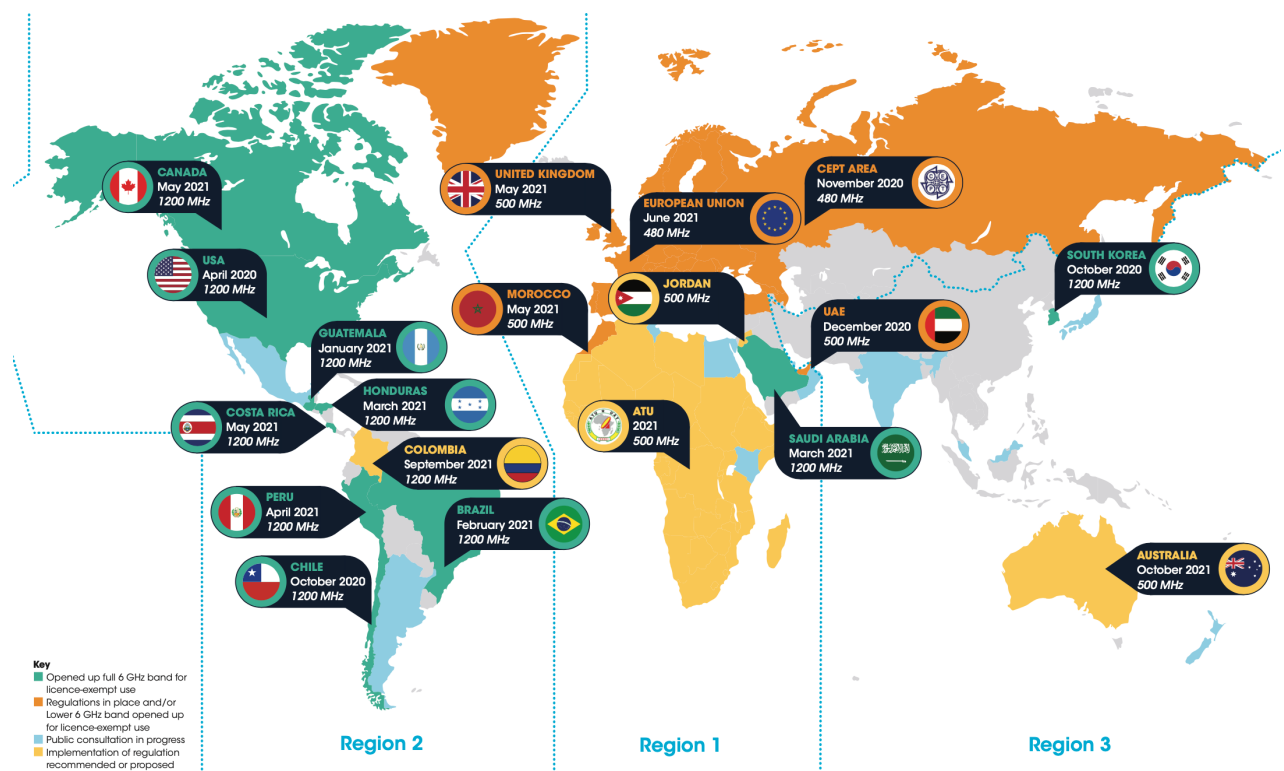
Wider channel bandwidths increase spectrum efficiency and deliver high-bandwidth application and services, while maintaining the ability to share spectrum with incumbents and other licence-exempt deployments.

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 MHz channels, as well as 320 MHz 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."

Apple notes the Wi-Fi Alliance (WFA) economic assessment study¹ 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.

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 Gbit per second 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 Gbits per second are expected². 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 map³.



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.

One immediate step that Apple suggests ICASA could undertake is to implement ATU-R Recommendation 005-0 for the lower 6 GHz band (5925-6425 MHz) to allow license-exempt WAS/RLAN operation.

6. What and how will technology developments and/or usage trends aid in relieving traffic pressures? When are these technologies expected to become available?

Apple Response to Q6

Apple has not responded to this question.

¹ <https://www.wi-fi.org/news-events/newsroom/wi-fi-global-economic-value-to-reach-5-trillion-in-2025>

² 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)

³ Policy Impact Partners, Published December 2021

7. Are there any IoT applications that will have a large impact on the existing licence-exempt bands? If so, what bands will see the most impact from these applications?

Apple Response to Q7

Apple has not responded to this question.

4.1 STANDARDISATION OF LISTS OF APPLICATIONS FOR DIFFERENT ITU RADIO SERVICES

8. Please provide your views regarding the standardization of the naming of applications in the NRFP in accordance with CEPT ECC decision 1(03) approved 15 November 2001 and its subsequent revisions.

Apple Response to Q8

Apple supports adopting a similar structure to that in the European Union where all EU members maintain their databases and provide input on the application(s) being used. As noted, the European Conference of Postal and Telecommunications Administrations (CEPT) maintains the European Communications Office (ECO) Frequency Information System (EFIS). We suggest ICASA consider adopting a similar structure.

9. What are your forecasts for data traffic and radio frequency spectrum needed over the next 5, 10 and 20 years for each of the EFIS application layers?

Apple Response to Q9

Apple has not responded to this question.

10. How much spectrum is allocated to each of the EFIS application layers, and what is the economic value of spectrum used in each of the above EFIS application layers? What are the opportunity costs for current spectrum allocations for EFIS these application layers (what is the value to alternative users of these allocations)?

Apple Response to Q10

Apple has not responded to this question.

4.2.1 MOBILE

11. How should demand for commercial mobile services and IMT in the next few years be determined? What traffic model should be used in South Africa for traffic demand expectations? What are your comments on the spectrum requirements set out on Table 2? What are your views on using the Recommendation ITU-R M.1768-1 methodology to forecast IMT spectrum demand in South Africa? Please complete the input parameters in the attached spreadsheet for the market study information needed to apply the Recommendation ITU-R M.1768-1.

Apple Response to Q11

Apple has not responded to this question.

12. Provide your support or reasons for objections on the bands being considered internationally for 5G commercial mobile allocations.

Apple Response to Q12

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 solutions such as Bluetooth™, Wi-Fi, and other Short Range Device (SRD) applications is also made available.

In the context of the World Radiocommunication Conference 2023 (WRC-23) Agenda Item 1.2, we do 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. Therefore, we believe it is important to reiterate the justification on why WAS/RLAN needs access to the whole 1200 MHz within 5925-7125 MHz.

Given the right regulatory conditions the 5925-7125 MHz band will see the greatest evolution within the next 5 years. 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. In those countries where the full 1200 MHz bandwidth is made available within 5925-7125 MHz will greatly benefit from global economies of scale and timely equipment availability.

13. Are the spectrum allocations comprehensive enough for spectrum demand projections for commercial mobile services in South Africa for the next 10 to 20 years?

Apple Response to Q13

Apple has not responded to this question.

14. Is there a demand for more flexible frequency licensing and frequency assignment/allotments processes on a regional basis required to complement the national frequency licensing and frequency assignments/allotments in the next 10 to 20 years?

Apple Response to Q14

Apple has not responded to this question.

15. Are there any other frequency bands that should be considered for release in the next 10 to 20 years for commercial mobile that are not discussed? Provide motivations for your proposal.

Apple Response to Q15

Apple suggests that there will be requirements to access additional spectrum for 6G. While it is too early to speculate on which bands should be considered under 6G we believe that there are some aspects that need to be considered.

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.

16. Which vertical markets will require the most secured licensed spectrum to overcome their current interference and congestion issues?

Apple Response to Q16

Apple has not responded to this question.

17. Assuming that South Africa follows the ITU's recommendations to assign up to 1,940MHz of spectrum for IMT-2000 and IMT-advanced services, and that South Africa follows trends in Europe

for potentially another 2,000 MHz of spectrum for IMT-2020, what bands would need to be freed up?

Apple Response to Q17

Apple notes that a large amount of mid-band spectrum has already been identified for IMT with successive WRCs identifying specific frequency bands for the deployment of IMT systems (see table below). This spectrum constitutes a good mix of “coverage” bands (below 5 GHz) and “capacity” bands (mmWave spectrum above 24 GHz). In all three ITU Regions, IMT has access to at least 1348 MHz of prime mid-band spectrum below 5 GHz significantly more than is available for WAS/RLAN. We suggest these bands should be harnessed to improve coverage before specifically identifying more mid-band spectrum for IMT.

Frequency Bands Identified for IMT

Frequency Bands identified for IMT (MHz)	Footnotes identifying the band for IMT in the Radio Regulations			Bandwidth (MHz)
	Region 1	Region 2	Region 3	
450-470	5.286AA			20
470-698	-	5.295, 5.308A	5.296A	228
694/698-960	5.317A	5.317A	5.313A, 5.317A	262
1 427-1 518	5.341A, 5.346	5.341B	5.341C, 5.346A	91
1 710-2 025	5.384A, 5.388			315
2 110-2 200	5.388			90
2 300-2 400	5.384A			100
2 500-2 690	5.384A			190
3 300-3 400	5.429B	5.429D	5.429F	100
3 400-3 600	5.430A	5.431B	5.432A, 5.432B, 5.433A	200
3 600-3 700	-	5.434	-	100
4 800-4 990	-	5.441A	5.441B	190
24 250-27 500*	5.532AB			3250
37 000-43 500*	5.550B			6500
45 500-47 000*	5.553A			1500
47 200-48 200*	5.553B			1000
66 000-71 000*	5.559AA			5000

18. What are your views on reallocating the following bands for IMT over the next years? Table 3: List of possible future IMT bands (please supplement or delete as your organisation considers reasonable)

- 450-470 (20MHz)
- 617-698 (70MHz)
- 1 427-1 518 (91MHz)
- 1 710-2 025 (315MHz)
- 3 300-3 400 (100MHz)
- 3 400-3 600 (200MHz)
- 3 600-3 800 (200MHz)
- 4 800-4 990 (190MHz)
- 24 250-27 500 (3250MHz)
- 37 000-43 500 (6500MHz)

- 45 500-47 000 (1500MHz)
- 47 200-48 200 (1000MHz)
- 66 000-71 000 (5000MHz)

Apple Response to Q18

Following on from our response to question 17, Apple generally agrees with the frequency bands listed with respect to possibly making them available for IMT except for 66-71 GHz (please see additional detail below).

In areas with low or no network coverage, the priority should be to roll out networks and leverage the existing bands identified for IMT identified. Many countries are considering making the 3300-4200 MHz and possibly 4800-4990 MHz bands available for licensed spectrum use. Whilst not all countries can make all of these bands available due to existing usage, this is a significant potential resource for licensed mid-band spectrum in the medium term. Those countries employing the 3700-4200 MHz band for fixed satellite services can still make use of the 3300-3700 MHz band for IMT which will be sufficient to ensure that each mobile operator can get access to 100 MHz contiguous spectrum and therefore offer a high quality of service in the areas where their networks are deployed.

As already mentioned, Apple notes that parts of **3.3-4.2 GHz** are already used for IMT and will continue to serve as the basis of 5G rollouts over the coming decade. Increasing the amount of globally harmonised spectrum in the range comes with major benefits as the GSMA have stated⁴ spectrum in the 3.3-4.2 GHz frequency range “would help speed up the introduction of 5G; improve network performance; help drive innovation; and bring down costs. It would also help boost economic benefits of up to \$80 billion over a 15-year period”. We believe it is vital to have balance between access to licensed mid-band spectrum within the 3.3-4.2 GHz frequency range and access to licence-exempt mid-band spectrum in 5925-7125 MHz.

Apple believes **26 GHz** is a prime IMT/5G mmWave band as it suits dense small cell networks in urban hotspots where additional capacity is vital. Noting 26 GHz was identified for IMT at WRC-19 and that decision means governments can assign it for IMT/5G helping deliver long-lasting socio-economic benefits. According to the GSMA⁵ “5G needs a significant amount of new harmonised mobile spectrum so defragmenting and clearing prime bands should be prioritised. Regulators should aim to make available 80-100 MHz of contiguous spectrum per operator in prime 5G mid-bands (e.g., 3.5 GHz) and around 1 GHz per operator in high-bands (e.g., mmWave spectrum)”.

Apple does not believe that **66-71 GHz** should be made available for licensed IMT. Many parts of the world have already made 57-71 GHz available for multiple applications and specifically under licence-exempt access rules. This spectrum has a host of opportunities for licence-exempt use cases in the consumer space and making it available will enable innovation and access to systems using these technologies for the residents of South Africa.

19. Provide your support or reasons for objections on the bands being considered internationally for 5G commercial mobile, fixed, satellite, or licence-exempt allocations.

Apple Response to Q19

Please see Apple’s response to Q17 and Q18, where we do not believe that 66-71 GHz should be made available for licensed IMT since many parts of the world have already made 57-71 GHz available for multiple applications and specifically under licence-exempt access rules.

4.2.2 FIXED

20. Provide your support or reasons for objections on the bands being considered internationally for fixed applications. Please provide a list of such bands for potential fixed use.

Apple Response to Q20

Apple has not responded to this question.

21. Are the spectrum allocations comprehensive enough for spectrum demand projections for fixed services in South Africa for the next 10 to 20 years?

Apple Response to Q21

⁴ [The 3.5 GHz range in the 5G era](#). Published November 2019

⁵ [GSMA Mobile Policy Handbook](#). Published February 2018

Apple has not responded to this question.

23. Are there any other frequency bands that should be considered for release in the next 10 to 20 years for fixed services that are not discussed? Provide motivations for your proposal.

Apple Response to Q22

Apple has not responded to this question.

22. Is there a demand for more flexible frequency licensing and frequency assignment/allotments processes for fixed services on a regional basis required to complement the national frequency licensing and frequency assignments/allotments in the next 10 to 20 years?

Apple Response to Q23

Apple has not responded to this question.

24. Will the demand for commercial mobile, licence-exempt, satellite, or fixed wireless services/applications impact the demand for backhaul spectrum? If so, how and which of these

Apple Response to Q24

Apple has not responded to this question.

25. Are there adequate spectrum allocations for video backhaul for broadcast and security services in South Africa? What is the realistic demand for these services in the next 10 to 20 years?

Apple Response to Q25

Apple has not responded to this question.

26. How much will transmission technology improve the volume of traffic in the next 10 to 20 years?

Apple Response to Q26

Apple has not responded to this question.

27. What and how will technology developments and/or usage trends aid in relieving traffic pressures and addressing spectrum demand for backhaul services? When are these technologies expected to become available?

Apple Response to Q27

Apple has not responded to this question.

28. How much bandwidth for backhaul will be saved due to the deployment of fibre networks in South Africa for the next 5, 10 to 20 years?

Apple Response to Q28

Apple has not responded to this question.

4.3.1 AERONAUTICAL (INCLUDING RADIOLOCATION)

29. What will impact on the demand for these services/applications in the coming 10-20 years? What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Aeronautical services in South Africa?

Apple Response to Q29

Apple has not responded to this question.

4.3.2 BROADCASTING

30. What will impact on the demand for these services/applications in the coming 10-20 years?
What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Broadcasting services in South Africa?

Apple Response to Q30

Apple has not responded to this question.

31. How much spectrum should be maintained for terrestrial broadcasting in the band 470MHz to 694MHz in the next 10 to 20 years?

Apple Response to Q31

Apple has not responded to this question.

4.3.3 DEFENCE SYSTEMS

32. What will impact on the demand for these services/applications in the coming 10-20 years?
What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Defence services in South Africa?

Apple Response to Q32

Apple has not responded to this question.

4.3.4 MARITIME (INCLUDING RADIOLOCATION)

33. What will impact on the demand for these services/applications in the coming 10-20 years?
What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Maritime services in South Africa?

Apple Response to Q33

Apple has not responded to this question.

4.3.5 METEOROLOGICAL (INCLUDING RADIOLOCATION)

34. What will impact on the demand for these services/applications in the coming 10-20 years?
What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Meteorological services in South Africa?

Apple Response to Q34

Apple has not responded to this question.

4.3.6 PROGRAMME MAKING & SPECIAL EVENTS (PMSE)

35. What will impact on the demand for these services/applications in the coming 10-20 years?
What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for PMSE services in South Africa?

Apple Response to Q35

Apple has not responded to this question.

4.3.7 EMERGENCY SERVICES (INCLUDING PPDR)

36. What will impact on the demand for these services/applications in the coming 10-20 years?
What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for PPDR services in South Africa?

Apple Response to Q36

Apple has not responded to this question.

37. Can mobile broadband currently be used for PPDR purposes? If not, will this be possible in the future with better quality of service and lower prices?

Apple Response to Q37

Apple has not responded to this question.

38. Are there any reasons to consider further spectrum from broadcasting in the band 470MHz to 694MHz to public protection and disaster relief (PPDR) services in the next 10 to 20 years?

Apple Response to Q38

Apple has not responded to this question.

4.3.8 SATELLITE SYSTEMS

39. What will impact on the demand for these services/applications in the coming 10-20 years? What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Satellite services in South Africa?

Apple Response to Q39

Apple has not responded to this question.

40. Which applications and allocations will require the most frequency spectrum demand in the following frequency bands?

- C-band
- Ku-band
- Ka-band

Apple Response to Q40

Apple has not responded to this question.

41. What and how will technology developments and/or usage trends aid in relieving traffic pressures and addressing spectrum demand for satellite services? When are these technologies expected to become available?

Apple Response to Q41

Apple has not responded to this question.

4.3.9 RADIO ASTRONOMY (INCLUDING SPACE SCIENCE)

42. What will impact on the demand for these services/applications in the coming 10-20 years? What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Astronomy services in South Africa?

Apple Response to Q42

Apple has not responded to this question.

4.3.10 SHORT-RANGE DEVICES

43. What will impact on the demand for these services/applications in the coming 10-20 years? What is the realistic demand for these services in the next 10 to 20 years? Are there adequate spectrum allocations for Short-range services in South Africa?

Apple Response to Q43

Apple has not responded to this question.

4.3.11 OTHER

44. Which vertical markets will require most secured licensed spectrum to overcome their current interference and congestion issues?

Apple Response to Q44

Apple has not responded to this question.

45. How much will spectrum management and orderly frequency planning improve the interference situations in certain frequency bands?

Apple Response to Q45

Apple suggest that a more dynamic approach to spectrum sharing might be required in the future. This may include the need for databases in some instances, but this needs to be carefully considered noting the desire to ensure some level of harmonisation and the complexity in the design and implementation of databases.

4.5 BANDWIDTH AVAILABILITY IN DRAFT NRFP-21

46. Please provide input on future spectrum requirements for the different service allocations as well as the urgency for such additional frequency allocations for such a service.

Apple Response to Q46

As previously mentioned, Apple believes that given the right regulatory conditions the 5925-7125 MHz band will see the greatest evolution within the next 5 years. 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. In those countries where the full 1200 MHz bandwidth is made available within 5925-7125 MHz will greatly benefit from global economies of scale and timely equipment availability.

47. Which Service allocations require RFSAP's and for which frequency bands. Also specify the urgency for the creation of such RFSAP's.

Apple Response to Q47

Apple has not responded to this question.

4.6 TASKS FLOWING FROM THE COMMENTS ON THE DRAFT NRFP-21 RELATING TO SPECTRUM OUTLOOK.

48. Please provide your organisations strategy and suggestions on how the Authority can ensure that spectrum outlook and demand studies can contribute to stimulation of the South African economy.

Apple Response to Q48

Apple suggests that ICASA undertake a coexistence study between WAS/RAN and incumbents (not IMT) in the 6425-7125 MHz frequency range outside WRC-23 Agenda Item 1.2 as this will supplement any studies being progressed within Agenda Item 1.2. We see this as an important element in the overall coexistence scenarios that so far has not been considered.

5 FREQUENCY MIGRATION AND COSTING

49. The spectrum outlook described above in Section 4, and in particular the substantial additional requirements for IMT and fixed-wireless spectrum, suggest that a number of additional bands will need to be assigned for the purposes of internet access, and incumbent users will need to be migrated out of the bands mentioned in the list on Table 3 and on any bands your organisation suggests on Table 4. What are the costs of migrating these users so that radio frequency spectrum is allocated to its highest value use?

Apple Response to Q49

Apple has not responded to this question.

50. What would the costs of freeing up spectrum for commercial fixed and mobile use be (considering the bands mentioned above on Table 3 and Table 4)? What would the economic benefits of doing so be, in respect of increase consumer surplus, and increased producer surplus?

Apple Response to Q50

Apple has not responded to this question.

51. Assuming that South Africa follows the ITU's recommendations to assign up to 1,940MHz of spectrum for IMT-2000 and IMT-advanced services, and that South Africa follows trends in Europe for potentially another 2,000 MHz of spectrum for IMT-2020, what would the costs of freeing up the

various spectrum bands be? In this regard, please refer to Table 3 and Table 4, as explained above.

Apple Response to Q51

Apple has not responded to this question.

6 SPECTRUM SHARING

52. Due to the scarcity of high demand spectrum and the consequential fact that Spectrum Sharing in certain bands are non-negotiable, how shall you describe the best sharing conditions for the South African scenario?

Apple Response to Q52

Apple supports making the whole 6 GHz band available for LPI and VLP should be licence-exempt but if AFC/CBRS/light-licensing is being considered for 5925-7125 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. We believe that user equipment or client devices should not be subject to light-licensing or registration.

6.3 ALTERNATIVE SPECTRUM SHARING SCENARIOS

53. Due to the convergence of technologies and the changes in regulatory licensing environment do you believe that certain service allocations categories will or need to change?

Apple Response to Q53

Apple suggests that the introduction of innovative approaches to spectrum management, including light-licensing 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. 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.

54. What existing licence-exempt frequency bands will see the most evolution in the next five years?

Apple Response to Q54

Apple believes that given the appropriate regulatory conditions the whole 6 GHz band (5925-7125 MHz) will see the greatest evolution within the next 5 years.

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.

In those countries where the full 1200 MHz bandwidth is made available within 5925-7125 MHz will greatly benefit from global economies of scale and timely equipment availability.

Apple suggests that ICASA should strive for a harmonised approach maximising economies of scale through making the whole 6 GHz band (5925-7125 MHz) available for licence-exempt Wireless Access Systems / Radio Local Area Networks (WAS/RLAN) including Frequency-Hopping Spread Spectrum (FHSS). We strongly encourage ICASA as a leader to engage with its neighbours to try and secure similar regulatory frameworks enabling access to licence-exempt 6 GHz mid-band spectrum.

At a global level, Apple recognises that it is important to protect incumbent users, including the Fixed Satellite Service and the Fixed Service, in the 6 GHz band, but in the context of the World Radiocommunication Conference 2023 (WRC-23) Agenda Item 1.2 we do 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.

55. How much spectrum, and in which bands, should be made available for licence-exempt purposes (such as Wi-Fi) over the 5, 10 and 20 years? What would the costs of freeing up these bands for IMT be? What would the economic benefits of doing so be, in respect of increase consumer surplus, and increased producer surplus? Which vertical markets will require most secured licensed spectrum to overcome their current interference and congestion issues?

Apple Response to Q55

Apple notes that since the WRC-03 (2003) decision to enable access to new spectrum in the 5 GHz range, there have been revolutionary changes in Wi-Fi technology, use cases, and demand. Wi-Fi has evolved from an amenity that helps make broadband connectivity easier to use to an essential part of broadband delivery and an essential element in enabling businesses and people to get online in urban, suburban and rural areas. At the same time, the devices running on Wi-Fi networks have become increasingly powerful with each generation making greater demands on Wi-Fi networks.

With a technical architecture that is device-centric and not centrally managed, Wi-Fi has become increasingly ubiquitous, enabling it to benefit from enormous global economies of scale. More than 18 billion Wi-Fi devices will be in use in 2022, with 4.4 billion new devices shipped every year, according to research firm IDC⁶.

Given the important role that Wi-Fi plays in the broadband ecosystem, and its ongoing growth, there is a need to consider making the full 1200 MHz in the 5925-7125 MHz (6 GHz) band available on a licence-exempt basis to support the ever-increasing demand.

In particular, Wi-Fi 6E, and its evolution to Wi-Fi 7, needs access to the full 1200 MHz at 6 GHz to support current and emerging innovative use cases, now and in the future. Opening only the lower 500 MHz of the 6 GHz band would mean Wi-Fi networks in dense deployments would have to continue to employ smaller channel bandwidths (as only one 320 MHz channel would be available). But with access to the fully 1200 MHz, larger channel bandwidths of 160 MHz, and especially 320 MHz, 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. In the near future, Wi-Fi 7 will rely on access to 320 MHz channels to further improve latency, throughput, reliability and quality of service relative to Wi-Fi 6E.

Licence-exempt usage throughout the full 6 GHz band will yield many socio-economic benefits, such as helping to address the digital divide, improving rural connectivity, accelerating economic innovation, and delivering greater quality of service. With Wi-Fi embedded in a wide array of client devices, from laptops to tablets and smartphones, consumers can choose the right device capabilities and price for them. Assuming regulators open the full 6 GHz band, the US\$3.3 trillion of value Wi-Fi will add to the world's economy in 2021 will rise to US\$4.9 trillion in 2025, according to research by Telecom Advisory Services for the Wi-Fi Alliance.

Licence-exempt spectrum promotes innovation and competition by lowering barriers to entry. If regulators allow for technical innovation, individuals and companies can choose the technology that best suits them. As users don't need to pay licence fees to use the spectrum, Wi-Fi is one of the most cost-effective ways to provide connectivity.

56. How much spectrum, and in which bands, should be made available for dynamic spectrum access over the next 5, 10 and 20 years? What would the costs of freeing up these bands for IMT be? What would the economic benefits of doing so be, in respect of increase consumer surplus, and increased producer surplus?

Apple Response to Q56

Apple has not responded to this question.

57. What existing licence-exempt frequency bands will see the most evolution in the next five years?

Apple Response to Q57

Apple believes that there will be little evolution in the 2.4 GHz and/or 5 GHz frequency bands since the focus for licence-exempt mid-band spectrum is on the 5925-7125 MHz band going forward. This is because the 2.4 GHz and 5 GHz bands do not have sufficient bandwidth available to allow for evolution.

58. Are there any IoT applications that will have a large impact on the existing licence-exempt bands? If so, what bands will see the most impact from these applications?

Apple Response to Q58

Apple has not responded to this question.

⁶ Source: <https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-2022-wi-fi-trends>

59. Will the trend for offering carrier-grade or managed Wi-Fi services continue to increase over the next five years? If so, will this impact congestion in Wi-Fi bands and which bands would be most affected?

Apple Response to Q59

Apple has not commented on whether carrier-grade or managed Wi-Fi services will continue to increase over the next five years.

We have no visibility into what congestion South Africa might be experiencing in the 2.4 GHz and 5 GHz bands, plus it is difficult to speculate exactly how congestion will manifest itself in the future. That said, Apple supports the Wi-Fi Alliance view that the increasing number of Wi-Fi devices combined with growing demand for Wi-Fi connectivity are projected to exceed the existing available spectrum capacity⁷. The Wi-Fi Spectrum Needs Study indicated that Wi-Fi networks around the world will need access to significantly more mid-band spectrum than is currently available in the 5 GHz range to satisfy expected growth in data traffic, thus the sustained focus on the 6 GHz band (5925-7125 MHz).

The Wi-Fi Spectrum Needs study undertook a comprehensive analysis to determine the number of channels required to support Wi-Fi traffic by taking into consideration existing and future Wi-Fi device capabilities and deployment needs for business, residential and public locations. The study evaluated two demand scenarios: the expected traffic growth and the potential unexpected increase that may come from novel applications. Apple supports the conclusion that between 1.3 GHz and 1.8 GHz more spectrum may be required by 2025 and that the spectrum needs to be sufficiently contiguous to support 160 MHz wide channels, which are required to support a growing number of bandwidth-intensive applications.

If carrier-grade or managed Wi-Fi services were to continue to increase over the next five years it is clear that access to appropriate spectrum will be necessary.

60. Are there specific frequency bands that will be in higher demand over the next 10 to 20 years and do you expect higher demands for spectrum in these frequency bands in South Africa? Are there any other frequency bands that should be considered for release in the next 10 to 20 years for commercial mobile, fixed, satellite, or licence-exempt that are not discussed above? Provide motivations for your proposal.

Apple Response to Q60

Apple has not responded to this question.

_____ End _____

⁷ Additional unlicensed spectrum needed to deliver future Wi-Fi® connectivity. Published 2017