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3 March 2022

Long-Term Spectrum Outlook for Independent Communications Authority of South Africa

GSOA would like to thank ICASA for the opportunity to provide comments to the consultation regarding the Long-Term Spectrum Outlook.

GSOA[1] is the global platform for collaboration between satellite operators. As the world's only CEO-driven satellite association, GSOA leads the sector's response to global challenges and opportunities. It offers a unified voice for the world's largest operators, important regional operators and other companies that engage in satellite-related activities. GSOA is recognised as the representative body for satellite operators by international, regional, and national bodies including regulators, policymakers, standards-setting organisations such as 3GPP, and international organisations such as the International Telecommunications Union (ITU) and the World Economic Forum (WEF).

Questions:

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

The licensing of mobile (terrestrial) services is raising the issue of coexistence with other services deployed in the same frequency band or adjacent bands. It is extremely important that regulators approach this licensing in a way that enables the continued and safe operations of existing and future services, in particular, Fixed Satellite Services (FSS). This is because satellite operators need certainty about the conditions that will guarantee a stable regulatory environment to support investment in broadband and other connectivity services to end users in South Africa. It is essential that frequency bands allocated to both terrestrial and satellite services contain the necessary regulatory provisions to ensure the delivery of interference-free services.

The licensing of mobile services for 5G also raises the question of the amount of spectrum needed for each mobile operator. Several studies and reports demonstrate that it is possible to commence deploying 5G networks with (far) less spectrum than 100 MHz per operator[2].

GSOA notes that technical analysis has demonstrated that co-existence between ubiquitously deployed satellite services and terrestrial mobile services are not feasible, as widely documented by ITU studies[3].

Co-frequency sharing between FSS and MS remains complex even in the case of FSS Earth stations at known location as large separation distances must be observed in order to avoid harmful interference into the earth station receivers.

GSOA supports ICASA's proposals to identify future technological trends. GSOA urges ICASA to ensure these proposals provide a balanced approach and includes an ecosystem of different technologies to provide connectivity for urban, suburban and rural areas without further creating a digital divide among communities.

[1] The members, activities, and other details about GSOA can be found at www.gsoasatellite.com

[2] Example of such study: Ofcom, Figure A7.26, *Award of the 700 MHz and 3.6-3.8 GHz spectrum bands: Annexes*, 13 March 2020

[3] E.g. Reports ITU-R S.2368, S.2367, M.2109

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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?

Broadband is not just a consequence of economic growth; it is also a cause[4]. The matter of the connection between broadband service and economic growth, and the direction of causation has been subject of studies for over 15 years. It is known as an endogenous problem and one that is subject to network effects, that is, where the benefits are appreciable after a certain threshold of connections have been put in place. (World Bank, 2016) Indicates, on the topic of causation, that it likely flows both ways. Authors such as Hardy in (1980) and Roeller & Waverman in (2001), among others, have postulated that the nature of the influence of telecommunications upon economic development and growth lies in the presence of positive externalities, complementarities, and a "network effect", which other types of infrastructure either lack or have in a lesser amount. In particular, the presence of positive externalities in the relationship between the telecommunications sector with other sectors of the economy is what is said to increase the efficiency of the economy as a whole.[5]

Sub-Saharan Africa has succeeded in the last decade in bringing voice services within reach of some three quarters of the population. Still, there remains key challenges to tackle to further develop broadband connectivity in Africa. Rural connectivity in Africa remains a challenge with many areas not having even basic connectivity. Telecommunications is an essential service, and broadband access is vital to all members of society. A significant challenge in terms of connectivity in rural Africa is low population densities coupled with the low income of the population. Rural Africa lacks much-needed supporting infrastructure such as roads and electric power. The low population density, low income, and lack of supporting infrastructure make the establishment and continued operation of conventional terrestrial ICT networks in these areas economically unsustainable. In addition to broadband services such areas could benefit from a variety of services that can also be provided through satellite telecommunications which are all important avenues to economic growth: broadcasting, connectivity for humanitarian and inter-governmental programs, emergency response, supporting healthcare services (telemedicine), connectivity for critical operations (oil and gas, mining…), government defense, maritime, air traffic management and navigation, mobile backhauling.

Satellite provides the bandwidth for Internet service to end users. Satellite has and continues to provide expanded Internet bandwidth for sub-Saharan Africa and South Africa. Access to satellite broadband will only continue to increase with the construction of new High Throughput GSO and NGSO satellites.

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[4] https://www.infodev.org/articles/broadband-africa-policy-promoting-development-backbone-networks
[5] See: https://documents1.worldbank.org/curated/en/178701467988875888/pdf/102955-WP-Box394845B-PUBLIC-WDR16-BP-Exploring-the-Relationship-between-Broadband-and-Economic-Growth-Minges.pdf
See: Hardy, A. (1980). The role of telephone in economic development. Telecommunications Policy, 4(4). 278-286
See: Roeller, L. and Waverman, L. (2001) Telecommunications Infrastructure and Economic Development: A Simultaneous Approach. American Economic Review, 91(4)
see also:
https://www.researchgate.net/publication/282154817_UNIVERSAL_TELECOMMUNICATIONS_SERVICE_AND_ITS_IMPACT_ON_ECONOMIC_GROWTH

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Satellite communication the most viable way of ensuring Universal Access to broadband in South Africa, and the latest generation of satellites (both GSO and NGSO) will even more options for consumers in South Africa.

In addition, the benefits that other technologies can provide to the overall economy and society should not be disregarded, such as narrowband and earth observation - which require spectrum - supporting agriculture, disaster management and other important critical fields.

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?**

GSOA supports South Africa's target of achieving a broadband penetration of approximately 80 per cent by 2020[6].

The critical issue for South Africa today expanding coverage and bridging the digital divide. Satellites, and especially the new generation of high throughput satellites, have a vital role to play in ensuring that no one should ever be excluded from the knowledge society, and this will help South African users keep pace with market growth. However, regulatory uncertainty around certain frequency bands (e.g. C band) can seriously undermine the investment needed to ensure growth for the satellite industry.

The satellite industry is constantly evolving and is at the forefront of innovation. The recent introduction of HTS and VHT GSO and NGSO satellites aims to bring much more satellite capacity to the region. The lower unit costs will enable significantly lower retail pricing for satellite broadband services within Africa and South Africa.

Terrestrial networks are vulnerable to major man-made and natural events that can result in significant service outages. Satellite services are not vulnerable to these types of outages and can provide robust capabilities through these types of disasters.

Lastly, satellite broadband is the key to achieving rural access. Therefore, it is a key ingredient for equitable socio-economic development. Satellite bandwidth can be delivered to any location in South Africa. The socio-economic benefits of providing broadband through satellites in rural areas include helping to redress the urban/rural divide in broadband access, and the implications for economic growth associated with broadband.

Focus on C-band spectrum:

For example, it is essential to note that the satellite C-band use is of particular interest for bridging the digital divide thanks to its key characteristics. The C-band frequencies provide satellite coverage of the Earth and robustness of satellite transmissions to atmospheric conditions which remain unmatched. This specific combination makes this band even today a prime asset for satellite services as well as a critical target for continued investment to enable fundamental missions (aeronautical communications, weather services, emergency response, disaster recovery, connectivity anywhere, broadcasting…). We acknowledge that 5G would provide good broadband speeds, and therefore MNOs argue that they must have access to C-band to deliver this much needed connectivity. However, C-band 5G spectrum is aimed solely for urbanized deployments. Over recent years, many countries have licensed UHF frequency bands such as the 800 MHz band to their mobile operators. These lower frequencies are ideal for providing wide-area coverage due to their improved propagation characteristics compared to higher frequencies.

[6] http://www.ictindaba.com/2012/images/ICT_Indaba_2012_African_ICT_Ministerial%20Declaration_07June2012.pdf

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Most European and Asian countries, which have already invested heavily in 4G, are only using 5G C-band for capacity infill in cities, leveraging 5G NR Phase 1 capability. Phase 1 (non-standalone mode) uses existing LTE coverage to carry out control functions, with data capacity provided by a 5G only if additional, overlapping coverage is available. As such, in the first phase of 5G roll-out, a 4G network is required to handle the command-and-control functions, meaning that 5G coverage cannot extend beyond any existing 4G coverage. In the second phase of stand-alone 5G, it is expected that lower frequency (i.e. 700 MHz) coverage will be needed as a command-and-control, and coverage layer to support capacity hotspots in higher frequency bands (i.e. C-band or mmWave). In fact, mobile operators have now recognized that C-band is not intended for rural coverage. The GSMA Intelligence report entitled "Economic benefits of using the 3.5 GHz range (3.3-4.2 GHz) for 5G" states, concerning C-band that:
".. the model only considers benefits to the urban population. Due to its technical characteristics, it is expected that this is going to be the primary use of the band"
It is critical to ensure that the C-band frequencies remains available for satellite operations on an interference free basis. There have been long-lasting debates on the use of C-band spectrum for mobile services in the band to develop 5G for urbanised areas. Therefore, a balanced approach needs to be struck to allow C-band satellite services to continue to operate and provide rural connectivity solutions.

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?**

From the satellite perspective, the following principles should form the basis of any framework for satellite licensing in South Africa:

- Licensing of satellite networks or services should comply with rules that govern radio spectrum and associated orbital resources;
- An "Open Skies" policy, where landing rights are not imposed as an additional requirement in addition to a separate domestic authorization process;
- Transparent regulatory framework with clear rules to establish regulatory certainty to support a long-term investment environment;
- Domestic user terminals should be licence-exempt or licenced without the need for individual terminal-by-terminal authorisation (*e.g.*, on a blanket licensing basis);
- Free circulation of foreign visiting earth station in motion (ESIM), based on mutual recognition of authorisations issued by other countries;
- Publish timely procedures for authorising user terminals operations;
- Ensuring adequate spectrum for existing and future satellite services allowing for innovation; and
- Reasonable spectrum fees based on administrative costs.

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?**

Today, satellite broadband services provide connectivity to fixed locations and mobile users wherever they may be around the globe.

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Earth stations in motion (ESIM) are satellite user terminals operating with Fixed Satellite Service (FSS) networks using frequency bands allocated to FSS. These services may use small fixed antennas or small form factor antennas mounted on aircraft, ships or land vehicles in motion.

ESIM provide broadband connectivity ubiquitously on Land (Land ESIM), pier-to-pier for maritime (Maritime ESIM) and gate-to-gate for aviation (Aeronautical ESIM) while communicating with space stations based on national administration authorisations/local licensing conditions.
GSOA urges ICASA to promote, within SADC and the ATU, regional harmonisation and streamlining of regulatory arrangements for fixed and mobile satellite user terminals with similar technical and operational characteristics (*e.g.*, ESIM/ VSATs). An excellent way to encourage expansion of existing satellite technologies and the deployment of new ones is to encourage 'blanket or class licensing', along with free circulation of visiting ESIM. This type of action would be in line with the SADC framework for ESIMs as supported by ICASA in that organization[7]. This will permit faster availability of high-bandwidth/broadband applications for South African users, including for satellite-powered high-capacity services.

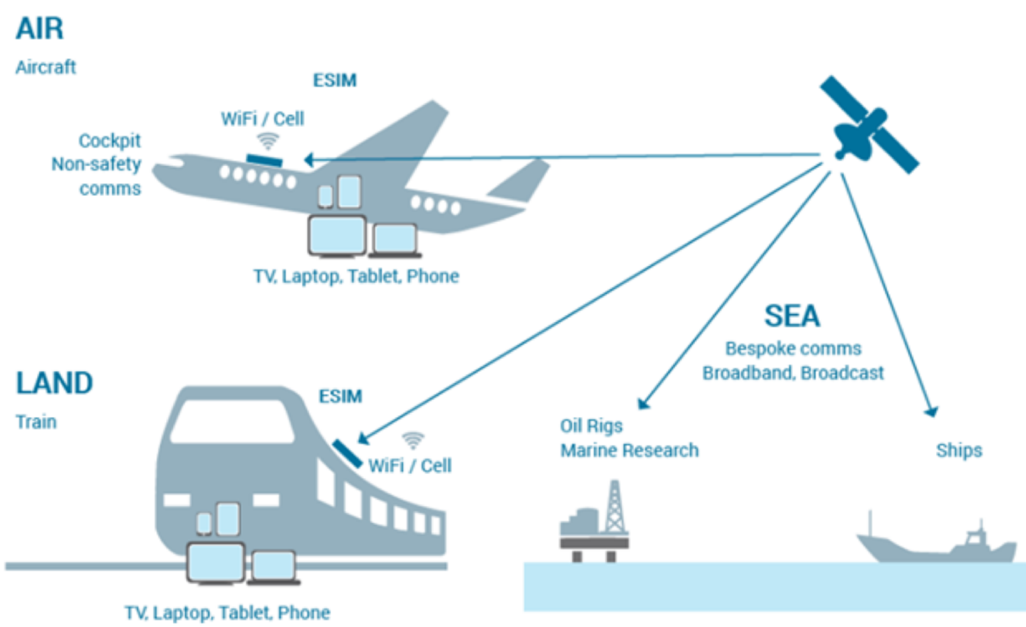

Figure 1: ESIMs Applications and User Cases

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

Increasingly, ESIM on aircraft are being used to connect airline digitization functions, (*e.g.*, electronic flight bags, aircraft fleet sensors and others), in addition to passengers and crew. This trend is also taking place with maritime and land mobile applications, especially in the transportation sectors.
Advances in satellite antenna technology, including the development of stabilised antennas capable of maintaining a high degree of pointing accuracy when in motion, have allowed the development of user

[7] SADC Recommendation on a Harmonised Approach to Domestic Licensing and Mutual Licence Recognition of Earth Stations In-Motion (ESIMs)

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terminals on various mobile vessels and vehicles. In addition, highly directional antennas allow ESIMs moving at high speeds to accurately and safely send information to GSO and NGSO satellites.
ESIM is designed to operate in the same interference environment and comply with technical operating requirements and regulatory constraints similar to those for typical uncoordinated FSS earth stations.
The increase in demand for ESIM application has led to an increase in spectrum needs to follow consumer requirements. This can be seen through the current work in progress under the following WRC-23 agenda items:

- WRC-23 AI 1.15 to provide the regulatory and technical conditions under which GSO ESIM can be used in the 12.75-13.25 GHz (Earth-to-space) band under ITU Resolution 172 (WRC-19).
- WRC-23 Agenda Item 1.16 is seeking to study and develop technical, operational, and regulatory measures to facilitate the use of the frequency bands 17.7-18.6 GHz, 18.8-19.3 GHz, 19.7-20.2 GHz, 27.5-29.1 GHz, and 29.5-30 GHz by non-GSO FSS ESIM. On-going work at the ITU has identified similar sharing situations as previously decided for GSO ESIM and technical provisions to enable non-GSO ESIM are in the process of being developed for decision by WRC-23.
GSOA would like to highlight the following technology developments that are geared towards ensuring that satellite broadband services are part of the overall 5G ecosystem:
- Massive Multiple-Input-Multiple-Output (MIMO) – This technology entails the use of a multiple antennas at the transmit and receive communication endpoints. MIMO technologies will improve network coverage and deliver enhanced network capacity, without imposing additional spectrum bandwidth requirements. MIMO is a key feature of the 5G NR standard[8].
- Spectrum Refarming – Mobile network operators (MNOs) across the globe have commenced decommissioning of legacy 2G/3G networks. Some of these network shutdowns have been initiated by regulators in consultation with the industry, but most have been operator-led, A non-exhaustive account of decommission programs is shown in the table below[9]. The spectrum released through these decommissioning initiatives can be refarmed for the 5G networks thus providing ample additional spectrum bandwidth to cater for the forecasted mobile data traffic growth. Based on GSOA's assessment, the decommissioning of current 2G/3G networks in South Africa has the potential to unlock a minimum of 186 MHz of spectrum bandwidth[10].

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?

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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?

It is important for ICASA to regularly assess spectrum demand against categories of services, much like in the European Union, whereby a list of service applications provides a basis for analysis. All EU members maintain their databases and provide input on the standard application used in the region.

[8] https://www.rcrwireless.com/20210921/carriers/massive-mimo-boosts-capacity-and-availability-for-5g-operators-in-speed-tests-analyst-angle
[9] Analysis Mason - Operators' decisions to shut down legacy 2G/3G networks need to be commercially driven
[10] Assuming migration from the currently assigned 900 MHz and 2100 MHz spectrum bands

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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?

-

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)?

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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 Reference source not found.? 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.

GSOA recommends that ICASA conduct an audit analysis and examine what progress has been made with regards to IMT deployment, and how much spectrum has yet to be allocated and licensed or used from already existing and harmonized mobile spectrum. New spectrum identifications for IMT in South Africa should take into account all other uses of the bands of interest.

Whilst the ITU identifies particular pieces of spectrum for IMT services, not all of that spectrum may necessarily be able to be used for those services. In some cases, the spectrum needs to be divided into specific frequency bands.

Therefore, determining how much spectrum could be used for mobile services in each region requires an assessment of which bands and which arrangements can be used.

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

As mentioned in the previous question, in assessing the amount of spectrum which it would be possible for ICASA to license, we need to consider which bands could be used in each region. For example:

- Band 33 (1900 – 1920 MHz) overlaps with Band 2 (1850 – 1910 paired with 1930 – 1990 MHz). In Regions 1 and 3, there is a choice between the two and in either case 20 MHz of spectrum is made available thus the 20 MHz shown alongside Band 2 could be replaced with 20 MHz in Band 33, but the overall totals would be identical (albeit with a marginally different share between FDD and TDD bands).
- Band 7 (2500 – 2570 paired with 2620 – 2690 MHz) can be combined with Band 38 (2570 – 2620 MHz) and used in a wholly TDD arrangement when it is then known as Band 41. In either case, the total amount of spectrum available is unchanged, but the distribution of spectrum between TDD and FDD would be different.
- These values represent a core set of frequencies that should be licensed in each region. Some countries may have access to more than this through, for example, additional footnotes (e.g., the 4800 MHz range, which is identified in just five countries), but ATU is one supportive of this band under WRC agenda item 1.1

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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?

-

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?

-

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.

See question 12. But it is worthwhile also considering the amount of spectrum that it has been forecast would be needed by 2020 for IMT services. This was published in ITU-R Report M.2290.[11]

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

-

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?

ITU Region 1 covers Europe (including the CIS), the Middle East and Africa. As these regions have significantly different uses of spectrum driven by different regulatory regimes (for example, the European Union which makes directives for all countries in its purview). In Africa, the amount of spectrum identified for IMT by the ITU amounts to a total of between 1272 and 1372 MHz depending on the specific country, from which 1080 MHz forms harmonised mobile bands.

To date the average amount of spectrum licensed in this region today is 477 MHz, which is well under 50% of that which is harmonised. There remains vast amounts of harmonized spectrum identified for IMT that can be allocated and licensed before additional spectrum is identified. GSOA encourages ICASA to release identified IMT spectrum before considering additional spectrum for IMT. Any future spectrum should only be identified and released once a market-based need has been identified.

18. What are your views on reallocating the following bands for IMT over the next years?

- 450-470 (20MHz)
- 617-698 (70MHz)
- 1 427-1 518 (91MHz)

In selecting frequencies for potential IMT deployment, the band 1.427-1. 518 MHz band should not be allocated to 5G deployment given the danger of disrupting mobile-satellite service ("MSS") operations in the band above 1518 MHz for critical safety operations. As the Authority knows, the adjacent frequency

[11] "Future spectrum requirements estimate for terrestrial IMT"

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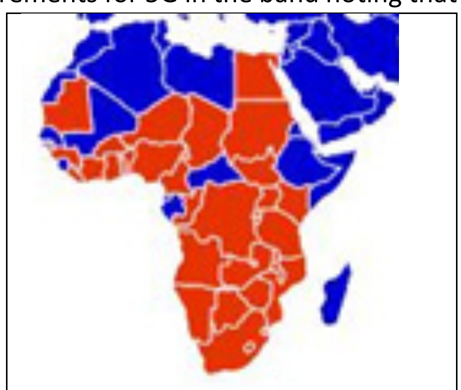
band 1518-1559 MHz is utilized for the delivery of essential and critical mobile satellite services in South Africa. These are land-based, maritime, and aeronautical services, including industrial uses, important government uses, and safety of life communications. Studies conducted in CEPT and ITU have shown that there is a significant potential for harmful interference to L-Band MSS operations posed by the introduction of new IMT operations in the band 1492-1518 MHz. This interference is caused both by out-of-band emissions from new IMT base stations, and by receiver overload in the MSS terminal's receiver. If South Africa decides to identify the frequency band 1 427 – 1 518 MHz for IMT, MSS operations must be protected. Mechanisms to address this interference are well understood and include increased frequency separation below 1518 MHz, out-of-band emissions limits on IMT emissions falling into the MSS band, reducing the EIRP limits on IMT operations in the frequencies adjacent to the MSS band, and applying PFD limits in specific areas where the most sensitive and critical MSS terminals operate.

Therefore, any implementation of this entire bandwidth without a mandate to ensure the continued operation of MSS will not provide sufficient protection to current and future MSS operations. Accordingly, GSOA respectfully recommends that if South Africa makes the 1427-1518 MHz band available for IMT use, it do so in a manner that protects MSS operations. This could include not introducing new mobile operations in the upper portion of this frequency (e.g., 1492-1518 MHz), or adopting other technical and operational measures to ensure compatibility between new terrestrial mobile services and MSS systems.

• 1 710-2 025 (315MHz)

• 3 300-3 400 (100MHz) & 3 400-3 600 (200MHz)

It is worth noting that in many African nations, the 3300 – 3400 MHz frequency range is already being considered for IMT services. This is the case in South Africa which has identified this band for the mobile service in its national frequency allocation table. This provides 100 MHz of additional spectrum for 5G and together with other spectrum available in lower bands it should satiate demand for mid-band spectrum for many years. South Africa is planning to implement mobile services in the 3400-3600 MHz, therefore amounting to 300 MHz of contiguous spectrum when considering the 3300-3400 MHz band. This, in addition to spectrum in lower bands should be more than enough to cover the needs of national operators to meet the demand of their users in urban areas. It is also worthwhile to point out that current reports[12] indicate that by 2025 only 2% of sub-Saharan population will use 5G versus 58% for 3G and 27% for 4G. This should be taken into account when evaluating spectrum requirements for 5G in the band noting that frequencies below 3GHz remain prime mobile bands.



Countries (in red) in Africa which have identified the frequency range 3300 – 3400 MHz for IMT services

Figure 2: African Countries that have identities IMT in 3.3-3.4 GHz

[12] Source: GSMA, "The Mobile Economy 2020" Report, 2020

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MNOs, however, are pushing for access to the whole of C-Band, despite that the already allocated to mobile services 3300-3400 MHz band not being utilized in most countries and to the fact that the C-band is already in use for satellite services, fixed links and, in some countries, for fixed wireless access.
The need for additional C-band spectrum therefore needs to be balanced against the impact it would have on incumbent services, especially considering the argument put across by MNOs that they will not use the C band for rural areas but rather for urbanized areas only[13] which are the only places where infrastructure is available to support such use. The risk of allocating the whole C-band spectrum is that other services helping to bridge the digital divide, FS and FSS, would be driven out of the band. This would lead to accentuating the differences and gaps between rural and urban environments in their access to connectivity.

An auction for 300 MHz of C-Band spectrum for terrestrial use is sufficient to promote the initial deployment of 5G in South Africa. With 300 MHz (between 3.3-3.6 GHz), there is enough spectrum for every MNO to offer high quality 5G services.
• 3 600-3 800 (200MHz)
Above 3600 MHz and up to 4200 MHz, satellite (FSS) services are essential for video distribution, with the result that C-band spectrum is intensely used by satellite, both on a frequency and geographic basis. This part of C-band frequencies is heavily used and is a cornerstone of satellite services, providing connectivity within and to areas where other available satellite frequency bands are inappropriate or where other technologies cannot provide reliable coverage and services. Many operators utilize C-band frequencies for critical satellite services, such as the distribution of television channels, broadcasting and the coverage of special events (such as major sports events), network connectivity and network extension services, VSAT networks, government services, disaster relief, and other applications. In South Africa, as is the case across the Africa, C-band is the backbone of video distribution as was noted by the responded to the ICASA inquiry for the implementation of the Radio Frequency Migration Plan and IMT Roadmap[14]. In addition, FSS serves as the backhaul for cellular networks in much of Africa including South Africa.
Taking into account the arguments exposed on the bands 3300-3400 MHz and 3400-3600MHz above and the heavy use of satellite services above 3600 MHz, GSOA recommends against the reallocation of the entire 3600-3800 MHz for IMT.
As ICASA has acknowledged in their 2021 report on The State of 5G in South Africa:

"There is considerable concern that the rollout of 5G could simply serve to aggravate the digital divide. For example, in sub-Saharan Africa less than half the population has access to mobile services, and the dominant technology remains 2G. Even in South Africa, around a third of subscribers do not have access to a smartphone."

According to GSMA itself, mobile penetration in Sub-Saharan Africa in 2020 was at 45%, while mobile internet user penetration was at 26%. In the foreseeable future, 4G will be the dominant technology which

[13] Horwitz, Jeremy. The definitive guide to 5G low, mid and high band speeds. [Online] VentureBeat.com, December 2019. https://venturebeat.com/2019/12/10/the-definitive-guide-to-5g-low-mid-and-highband-speeds/.
[14] Government Gazette Number 45247 (Notice 580 of 2021)

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currently only amounts to 11% of all connections, while 2G still amounts to almost 45% of all connections. Furthermore, according to the GSMA:[15]

"5G trials have been conducted elsewhere in Sub-Saharan Africa, including in Gabon, Kenya, Nigeria and Uganda. However, mass adoption of mobile 5G is not imminent in the region. With significant unused 4G capacity and 4G adoption still relatively low, the focus in the near term for operators and other stakeholders is to increase 4G uptake".

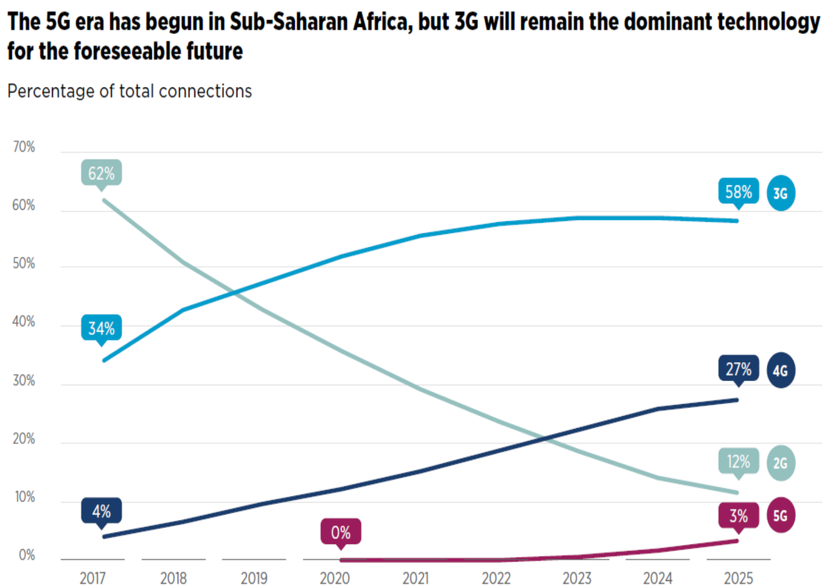

Figure 3: GSMA research does not support the need for more spectrum, since 3G/4G will be the dominate technology

As can be seen from the above figure, simply adding more mid-band spectrum is not the answer to the challenges faced by the mobile industry in South Africa and broadly speaking in Sub Sahara Africa.

Therefore, GSOA advocates - as agreed by ICASA - that efficient and effective management of spectrum is key to maximise the opportunities that mobile connectivity can bring to society, by making sure the required spectrum resources are available under the right conditions and thus lowering broadband costs, increasing coverage and boosting connectivity. Hence it is most efficient to first ensure that existing spectrum in both sub 1GHz and 3.5 GHz band ranges, as well as in other IMT bands, is fully utilized before seeking additional spectrum for future 5G technology. This considering that 5G technology will only account for 2% of all connections in Africa by 2025 (according to GSMA[16]) while migrating satellite services operating in C-band today will be welfare destruction.

More specifically, migrating the satellite services from the C-band has financial investment detriments and practical consequences. Satellite operators will incur costs in upgrading their equipment to meet the band clearance requirement and may also be impeded to providing services, resulting in loss of existing

[15] https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/09/GSMA_MobileEconomy2020_SSA_Eng.pdf
[16] Source: GSMA, "The Mobile Economy 2020" Report, 2020

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or prospective customer base. Lastly, operators may require additional satellite capacity to ensure sufficient supply available in the reduced FSS frequency range as to absorb the incumbent services that must be moved and to meet contractual obligations for contingency capacity in the event a transponder or a satellite suffers a failure.

• 4 800-4 990 (190MHz)

This spectrum is currently being studied under WRC-23 agenda item 1.1 as potential additional frequencies for mobile services. This could represent yet another alternative for meeting the mobile service demands while avoiding some more contentious bands such as the C-band as presented above.

• 24 250-27 500 (3250MHz)

GSOA supports the identification of the globally harmonized 24,250-27,500 GHz (26 GHz) band for IMT. Satellite operators provide broadband services in the adjacent 28 GHz frequency band. As such, GSOA is concerned about potential out-of-band emissions from the 26 GHz band by terrestrial IMT/5G systems into the 28 GHz band. Increases in power by terrestrial IMT/5G systems in the 26 GHz band could increase IMT out-of-band emissions into the 28 GHz band. Increased out-of-band emissions in the 26 GHz band could adversely affect the interference environment in the 28 GHz band by interfering with the ability of satellite receivers in space to receive signals from earth stations. Therefore, GSOA respectfully requests that ICASA limit out-of-band emissions from IMT operations into the 26 GHz band to protect satellite broadband service in the adjacent 28 GHz band. GSOA also requests that ICASA ensure that the *aggregate level* of IMT out-of-band emissions from the 26 GHz band into the adjacent 28 GHz band does not cause harmful interference to satellite receivers in the 28 GHz band.

GSOA members have supported the study and development of reasonable operating parameters for IMT in the 26 GHz band throughout the ITU WRC-19 process. To this end, GSOA urges ICASA to conform domestic implementation of terrestrial IMT/5G to the operating parameters decided in Resolution 242 (WRC-19)[17]. Among several items, GSOA emphasizes the importance of the portion of Resolution 242 (WRC-19) that requires that IMT base stations within the 26 GHz frequency band with high power operations (e.i.r.p. per beam exceeding 30 dB (W/200 MHz)) not point their antenna beams upward and maintain a minimum separation angle of ≥ 7.5 degrees from the geostationary orbit. GSOA urges ICASA to include these technical limitations on IMT base stations, as outlined in Resolution 242 (WRC-19). These power and separation angle limitations provide specific limits on the IMT services operating in the 26 GHz band to protect existing satellite services in the adjacent 28 GHz band. Therefore, GSOA respectfully requests that ICASA adopt these IMT limitations to protect critical satellite broadband services operating above 27.5 GHz.

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

See response to questions 18 and 40.

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.

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[17] ITU Radio Regulation, Resolution 242 (Rev. WRC-19), “Terrestrial component of International Mobile Telecommunications in the frequency band 24.25-27.5 GHz”.

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

-

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?

-

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.

-

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

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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?

-

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

-

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?

-

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?

-

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?

-

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?

-

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

-

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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?

-

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?

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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 PMSE services in South Africa?

-

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 PPDR services in South Africa?

-

36. 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?

-

37. 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?

-

38. 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?

-

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

- **L-Band and XL-Band**
  Mobile satellite services deployed in the L-Band and XL-Band are poised for phenomenal growth, fueled by the following, amongst others:

▪ Digital Revolution in South Africa – IoT technologies are a key enabler for the creation of data that can yield analytical insights for businesses, communities, or governments. The proliferation of IoT networks in South Africa will translate into higher demand for space-based communication

▪ Economy rebounding from the pandemic – The anticipated increase in both air and marine traffic as the country eases lockdown restrictions, will spur essential and critical communication service requirements, which are fulfilled by mobile satellite systems

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- Disaster relief – Unlike terrestrial networks, space-based communication networks are impenetrable to damage from disasters. As a result, mobile satellite networks provide the most viable solution for communication requirements during disaster relief efforts

The guaranteed access to the L and XL-band in future will ensure that the essential and critical service requirements of South Africa can be met, whilst promoting the sustainable growth of the mobile satellite services market.

- **C-band**

The C-band (from 3400 to 4200 MHz) is a mainstay of satellite communications. From relaying the pictures of the first moon landing in 1969 around the world, to providing broadband interconnectivity in remote areas today, satellite use of the band provides crucial connectivity to various commercial and government entities. In addition to supporting satellites, the band has also historically been used for terrestrial fixed links that can share the band with the satellite downlinks by carefully selecting the location of the links so as not to cause interference.

These fixed services were extended to include fixed wireless access using point-to-multipoint technology. These services typically provide domestic or enterprise broadband internet connectivity, and being fixed services could still be primarily designed so as not to cause harmful interference to satellite reception.

In Africa, unlike other parts of the world such as Europe, the C-Band is heavily used for broadcasting, backhaul, government, and mission-critical communications they need for which results from Africa's unique size, weather, topography, and population distribution.

As a fact, C-band is not unused. It is a busy and vital satellite communications band, evidenced by the more than 50 satellites with C-band payloads over Africa. A recent report by the GSA and Huawei[18] showed that several satellites are over 80% utilised even without considering transponders that have been booked but were not in use at the time. These satellites provide an essential service, delivering connectivity in areas with heavy rainfall and vital communications in users such as governments and airports.

Key applications that use the C band are:

- Direct-to-home ("DTH") services, including both pay and free-to-air distribution. Note that the DTH market in Africa is still relatively nascent, with large multi-national or regional platforms (in particular MultiChoice in South Africa) dominating the TV landscape and with all DTH pay-TV channels today broadcast in Ku-band. There are, however, still some free to air channels in C-band, and national DTT initiatives may look at C-band in several countries
- Cellular backhaul, which underlines a lot of traffic in C-band capacity utilisation, including to the extent possible on a regional (i.e., sub-national) basis. With wireless subscribers dependent on C-band satellite backhaul.

[18] "African C Band Satellite Report: The Systems House" https://gsacom.com/paper/african-c-band-satellite-report-the-systems-house-2021/

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- VSAT networks, providing enterprise or government VSAT sites using C-band, broken down to the extent possible into vertical segments that include (Private enterprise networks, oil&gas, retail, banking, etc.) and Government networks for (Rural connectivity, Civil networks for public offices, e.g., schools, etc.).
- Defence and security.
- Teleports/ground stations using C-band antennas.
- Air navigation, safety and security: Airports and air traffic control centres across Africa are interconnected by C-band networks. The objective of the network is to support the provision of a variety of aeronautical telecommunication services including the mandated Air Traffic Services Direct Speech (ATS/DS) and Aeronautical Fixed Telecommunication Network (AFTN), for which the network was built as well as the migrating of these to the modern equivalent ATN applications of ATS Message Handling System (AMHS), ATS Inter-facility Data Communications (AIDC) and Voice over Internet Protocol (VoIP)[19]

The availability of C-band satellite links is of clear, direct and often considerable importance to various economic sectors in all these sectors above.

Additionally, satellite service sin the C-band have high resistance to rain fade. In C band, service levels and reliability of above 99% are often a prerequisite for professional users, including for the oil and gas and banking industries and GSM backhaul. Service interruptions and poor network quality can cause huge revenue losses for such users.

- **Ku-band**

In the Ku band the global demand, utilisation, and broadband communications application include connectivity requirements for users on aircraft, vessels, and vehicles in motion, is a crucial driver for this spectrum band. The demand is for user terminals that operate at both fixed locations and in motion in urban, suburban and rural areas worldwide.

Therefore, ESIMs refer to the collective designation for three types of earth stations administrations that will need to authorise to transmit while in motion. These earth stations include Land ESIM, Maritime ESIM and Aeronautical ESIM. Land ESIMs refer to an earth station communicating with a satellite while mounted on a land vehicle. In contrast, Maritime ESIM refers to an earth station communicating with a satellite while mounted on vessels or ships. Aeronautical ESIM refers to an earth stations communicating with a satellite while mounted on aircraft.

Generally, ESIMs enable very high data rate broadband communications, navigation, situational awareness, and other services to mobile platforms that often cannot be served using other communications technologies. Licensees use ESIMs to deliver broadband to aircraft, ships, trains, and vehicles in motion using the same frequency bands, satellites, beams, and control stations to provide broadband services via earth stations at fixed locations. This connectivity provides the opportunity for operators, service providers, crew, first passengers and first responders alike to leverage the innovative services offered with broadband internet connectivity.

[19] https://www.atns.com/PDF/sadc-meeting/WP-6%20Background%20and%20Rationale%20of%20the%20SADC%20VSAT2%20Network.pdf

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The WRC-23 includes an agenda item (WRC-23 AI 1.15) on the regulatory and technical conditions under which GSO ESIM can be used in Ku-band 12.75-13.25 GHz (Earth-to-space) according to ITU Resolution 172 (WRC-19).

So adequate spectrum is required for ESIMs. The latest commercial satellite broadband networks currently use the existing Ku FSS spectrum ranges to provide broadband internet access service to millions of end-users, and hundreds of millions of personal electronic devices each year, around the world, whether at home, at work, or travelling in vehicles, on ships, or aircraft. As with all other successful services, satellite broadband spectrum requirements expand as user demand grows.

- **Ka-band**

  Ka band will continue to be a critical band for satellite services operating in multiple orbits. These services include broadband services direct to homes, businesses and government users. Today there are hundreds of millions of devices across the globe providing users with broadband connectivity over Ka band satellite networks and more are being launched and put into service. These number are projected to grow in the years ahead, including in South Africa. In addition, innovative satellite designs and smaller, more mobile user terminals are expected to increase the places and users that Ka band satellite networks are able to serve. All of these developments will require adequate spectrum resources for existing and future services in the Ka band.

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?

Advances in satellite antenna technology, particularly the development of stabilized and flat panel array antennas, capable of maintaining a high degree of pointing accuracy even when moving rapidly, have allowed the development of mobile terminals with very stable pointing and efficient form factor characteristics. These mobile terminals are designed to operate in the same interference environment and comply with regulatory constraints for ubiquitous FSS earth stations.

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?

-

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?

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

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

This is a continuing need. It requires preservation and re-examination of the latest developments regarding regulation and technological evolution of the radiocommunication systems. GSOA recommends

that ICASA continue fostering investments in the satellite communications sector in South Africa through consistent and predictable spectrum management policies.

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.

The 1980-2010 MHz and 2170-2200 MHz band is critical to support MSS, including a complementary ground component. As satellite network planning and deployments are ongoing in this band globally, South Africa must act quickly so it can be included in this global ecosystem.
The Ka band continues to be a growth band for satellite services. Today, GSO satellite networks are operating across the full 27.5-30 GHz and 17.7-20.2 GHz bands. In addition, studies are ongoing at the ITU in anticipation of further expansion of satellite services in the same bands for NGSO ESIM under Agenda Item 1.16 and satellite-to-satellite links under Agenda Item 1.17. Therefore, ICASA can expect to see, and should plan for, even more extensive use and intensive reuse of the Ka band for satellite broadband connectivity in the years ahead.
Similarly, the Q/V-bands are critical for broadband satellite services to help solve the digital divide. As systems are being deployed now and additional systems are being planned and licensed globally, it is critical that ICASA act now to allocate and license these bands for satellite broadband.

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

-

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.

-

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?

Incumbent users of the bands mentioned in Table 3 and 4, including satellite operators, will incur costs during migration of services to other bands. The costs will concern more specifically the requirements to upgrade their equipment to meet the band clearance requirement and may also be impeded to providing services, resulting in loss of existing or prospective customer base. Lastly, operators may require additional satellite capacity to ensure sufficient supply available in the reduced FSS frequency range as to

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absorb the incumbent services that must be moved and to meet contractual obligations for contingency capacity in the event a transponder or a satellite suffers a failure.

For instance, a few satellite operators currently distribute their content in South Africa across the entire 3600 MHz – 4200 MHz band. Repacking the distribution of video and network signals into a higher band is a highly complex and costly process that cannot be undertaken without significant operational and financial expenditures by the satellite operator. These operational and financial expenditures would

include significant South African-specific investments in the ground infrastructure necessary to ensure continuity of the incumbent operators services to the South African customer base. More specific clearing costs to be borne by satellite operators and their customers are the following:
- Costs of building additional satellites or modifying existing satellite networks in the 4000-4200 MHz range to ensure continuity of service for media and network distribution.
- Upgrades to High-Efficiency Video Compression (HEVC) equipment.
- Antenna seeding programs to install new earth stations where needed and upgrade existing earth stations.
- Protection costs, as introducing filters to protect services that remain in C Band, adjacent to 5G.

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?
-

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.
-

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?

This is a band- and service-specific basis, but it must be kept in mind that two widely deployed services may not be able to co-exist. Each band must be considered based on the specific circumstances of the band.

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?

GSOA recommends that spectrum allocations always be consistent with the ITU Table of Allocations. Additionally, any potential change to the service allocations must be based solely on the decisions made by a World Radiocommunication Conference. Any other motivation will not guarantee the good coexistence, compatibility, and protection of the existing services with new potential allocations.

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

-

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?

-

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?

-

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

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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?

-

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?

-

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.

GSOA wishes to highlight the anticipated future high demand for the Q/V frequency bands. These frequency bands will play a vital role in delivering feeder links to next generation high throughput satellite systems. The Q/V bands are highly favorable due to their sizeable contiguous bandwidth and the opportunity to augment bandwidth other bands. The utilisation of Q/V bands will also be fueled by the rapidly falling costs of Q/V band components, making satellite systems that operate in these bands more affordable.

Satellite operators, such as Inmarsat, are conducting trials in the Q/V band to better understand performance in real world deployment scenarios.