هيئة الاتصالات وتقنية المعلومات
Communications and Information Technology Commission

Spectrum for IMT-2020 and beyond

Fostering Commercial and Innovative Use of Radio Spectrum in the Kingdom of Saudi Arabia

July 2020

Public Consultation Document on

CITC Five-year Outlook on Spectrum for Commercial and Innovative Use 2020-2024

Forward

CITC issued its National Spectrum Strategy 2020-2025 (NSS) earlier this year. The NSS is aspired to "Unlock the potential of radiocommunication in Saudi Arabia for a smarter and safer future". This is a holistic vision that outlines the potential of radio spectrum, to transform Saudi Arabia into a digital society by enabling a range of industries and sectors. The NSS vision aligns with the Saudi Vision 2030, by striving to ensure availability of radio spectrum to fulfill the needs of spectrum license holders and end-users alike, thus serving the interests of the whole nation.

Three guiding principles will anchor CITC's efforts towards fulfilling the National Strategy's Vision:

1) Promote certainty and encourage investment through spectrum policies which anticipate and meet the needs of Spectrum users.

2) Efficiently and proactively seek out opportunities to optimize the benefits of spectrum for its users, maximizing its value to society.

3) Build strong relationships with all national stakeholders and regularly engage with them to ensure that spectrum management decisions reflect market dynamics.

The NSS aims to promote innovation and commercial uses of spectrum to "Foster Commercial and Innovative Uses", by increasing access to spectrum, ensuring management practices account for competitive dimensions, and tackling problem issues unique to the local ICT market context. It will push 5G+ deployment to position Saudi Arabia among leading nations in unlocking innovative high-performance use cases and applications and enable their deployment for vertical industries in both the public and in private sectors.

The NSS also aims to enable applications and use cases that rely heavily on free/eased access to spectrum and unlocking spectrum related innovation to "Accelerate Innovation and Emerging Radio Technologies". CITC aims to increase the total portion of unlicensed spectrum to enable the wireless Internet of Things and to promote emerging radio technologies.

In conjunction with these objectives, other priorities of the NSS aim to "Facilitate Wireless Access and Investments", "Empower a smart spectrum", ensure "Future-Proof Planning and Allocation", and "Embrace Market-oriented Approaches" to increase CITC's agility, by adopting market-based models for spectrum management and using mechanisms and tools that are inherently driven by market dynamics.

Through the NSS, CITC is determined to "Unlock the future". CITC has an ambitious target to keep Saudi Arabia IMT-2020 networks and other emerging radio technologies at the forefront, by making more than 10 GHz of spectrum available for innovative uses by 2024.

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List of Abbreviations

NSS	National Spectrum Strategy 2020-2025 of Saudi Arabia
IMT	International Mobile Telecommunications
ICT	Information and Communication Technology
WRC	World Radiocommunications Conference
WLAN	Wireless Local Area Networks
SRD	Short Range Device
LPWAN	Low-Power Wide-Area Networks
QoS	Quality of Service
LSA	Licensed Shared Access
PAL	Priority Access License
US	United State of America
sub-1 GHz	Below 1 GHz
USF	Universal Service Fund
IoT	Internet of Thing
NB-IoT	Narrow Band Internet of Things
LAN	Local Area Networks
UHF	Ultra-High Frequency
SHF	Super High Frequency
EHF	Extremely High Frequency
HAPS	High Altitude Platform Station
Li-Fi	Light Fidelity
MEC	Mobile Edge Computing
LEO	Low Earth Orbit
mmWave	Millimeter-wave
V2V	Vehicle-to- Vehicle
V2X	Vehicle-to- Everything
3GPP	Third Generation Partnership Project
NFV	Network Function Virtualization
SDN	Software Defined Networking
C-RAN	Cloud Radio Access Network
RANs	Radio Access Networks
SDR	Software Defined Radio
CR	Cognitive Radios
SON	Self-Organizing Network
D2D	Device-to- Device Communication
MIMO	Multi input Multi Output
WAN	Wide Area Networks
NR-U	New Radio in Unlicensed Bands

WiFi6	Sixth Generation of Wi-Fi
eMBB	Enhanced Mobile Broadband
NFAT	National Frequency Allocation Table
UE	User Equipment
PPDR	Public Protection and Disaster Relief
GSM-R	Global System for Mobile Communication in Railway
PMR	Private Mobile Radio
MNOs	Mobile Network Operators
M2M	Machine-to-Machine

Introduction

The global need for radio spectrum access is increasing rapidly, driven by growing demand for existing digital wireless services, the emergence of new technologies and use cases, and international harmonization decisions relevant to spectrum. Radio spectrum use continues to evolve rapidly in the Kingdom of Saudi Arabia. The use of radio spectrum, through its role in enabling new technologies and innovation, also contributes to improvements in economic efficiency, productivity and return on investment. We forecast that spectrum-related activities will potentially add over SAR 500 million to the annual gross domestic product (GDP) of Saudi Arabia, representing a growth of more than ~3% of GDP by 2025. We also anticipate that the release of these key commercial bands will stimulate growth of 18 – 36 billion SAR of non-oil revenue within the Kingdom's economy by 2025.

More than 10 GHz of frequency bands have been identified and allocated for commercial use by technologies like IMT-2020 and beyond in the World Radiocommunications Conference (WRC-19). Here in CITC, we believe the release of this spectrum should set a paradigm-shift in spectrum allocation for innovative use. Releasing and licensing the use of this spectrum should be an enabler for the digital transformation of Saudi Arabia. We believe this digital transformation, underpinned by emerging wireless technologies, will require a corresponding evolution in our own spectrum policy and the way we authorize its use, with the ultimate aim of transforming telecom service providers to digital service providers.

'Fostering Commercial and Innovative Use' is one of the strategic priorities of the National Spectrum Strategy's strategic pillar of 'Unlocking the Future'. One of this program's initiatives is to drive 5G+ and promote innovation and commercial uses of spectrum. This public consultation is the first step in a program to shape CITC's outlook on the commercial use of spectrum. We are now seeking opinions from all interested parties, both nationally and internationally, on how CITC should proceed with the release of this unprecedented amount of commercial spectrum, to achieve the goals of the National Spectrum Strategy, and on how to transform Saudi Arabia into a digital society. The timeline in Figure 1 below shows the next steps to be taken in executing this program.

- **26 July 2020**
  - Releasing Public Consultation
- **3 September 2020**
  - Workshop for Sectors and Verticals on emerging uses cases and wireless tech.
- **27 September 2020**
  - Deadline to receive responses
- **26 November 2020**
  - Publishing CITC Five-year Spectrum Outlook for Commercial and Innovative use
- **7-9 December 2020**
  - Regional/Global Workshop on 'Fostering Commercial and Innovative Use of Spectrum'

Figure 1: Timeline of steps to activate the strategic priority of 'fostering commercial and innovative use'

CITC's Five-year Spectrum Outlook for Commercial and Innovative use, will set a roadmap for what, when and how different frequency bands will be available for release and use. It will ensure an open and transparent environment that provides stakeholders with further visibility on CITC's spectrum management processes and how it formulates plans for the future.

How to Read this Consultation

This document is structured into ten main sections. We remind respondents that they are not obliged to submit an opinion on every question in the entire document if they do not wish to. They are welcome to limit their answers to only the questions of interest to them, or their industry sector. The document starts by asking questions about licensing regimes and mechanisms. Then, it consults on policies to ensure utilization of spectrum and meeting demands of users for different technologies and applications while allowing fair access to other radio services. It concludes with deep diving on potential bands to explore options on making them available for use.

Section 2: Licensing Regimes. In this section, CITC is seeking opinions on licensing, light licensing and general authorized access for all users. This section could be of interest the most to technology standardization bodies and wireless industry organizations.

Section 3: Access Right. In this section, CITC is exploring the possibility of expanding the rights of spectrum user to include trading it to other users.

Section 4: Award Mechanism. This section about the different mechanisms of licensing the use of spectrum.

Section 5: Spectrum Utilization. This section tries to explore factors affecting spectrum utilization and investment in infrastructure and setting obligations on spectrum licenses.

Section 6: Demand of Verticals. The section is about different methodologies to meet vertical industries' demand.

Section 7: Spectrum Licensees. The section is about to whom should spectrum be licensed. This section is of great interest to existing and potential players.

Section 8: Emerging Radio Technologies. The section list main trends in radio technologies and seeks input on how to adopt technologies in the Kingdom. This section is of great interest to technology developers and manufacturers.

Section 9: Competition and Complementarity of Technologies. The section continues the discussion on competition and co-existence between technologies.

Section 10: Fair Access to Adjacent Sectors. It is a section about ensuring other radio services to having access to spectrum.

Section 11: Frequency Bands. This the largest and most important section of this consultation. It asks many questions about each band we might make available over the next few years.

How to Respond to this Consultation

Participants who wish to submit their views/comments on this Public Consultation Document must submit them to CITC no later than Sunday, September 27, 2020.

Views/comments can be submitted to one or more of the following addresses:

- By email to:

  Spectrum.Strategy@citc.gov.sa

- Hand-delivered (paper and electronic) at the CITC premises or By mail to:

  Communications and Information Technology Commission

  Al-Nakheel District

  Prince Turki Bin Abdul Aziz I Street intersection with Imam Saud Bin Abdul Aziz Road

  PO Box 75606, Riyadh 11588

  Saudi Arabia

CITC invites all members of the public, including individuals, public organizations and commercial entities to engage in this process by submitting comments. Participants are invited to provide their views in detail. CITC also encourages Participants to support their comments with relevant data, analysis, benchmarking studies and other information. CITC will take all comments into consideration during its deliberation process, but CITC is under no obligation to adopt the comments or proposals of any participant. The consultation document and any responses to it are not binding on CITC. The Commission may publish the comments on its website if it deems appropriate and in conformance to its Statutes.

To participate in this consultation process, stakeholders are advised to provide their comments through the format shown below.

Section #	Question #	Response & Comments

1. The Status Quo

CITC today is making a fair amount of spectrum available for commercial and innovative use (both licensed and unlicensed), as shown in Figure 2 below.

[1] Regulatory Policy for Commercial Spectrum Bands Identified for IMT, Wireless Local Area Networks Usage Regulations, CITC Technical Specification RI114: Specification for License – Exempt LPWAN Devices

Figure 2: Spectrum authorized for commercial and innovative use in Saudi Arabia

Saudi Arabia has 1110 MHz of IMT spectrum licensed to five different operators as per Figure 3 below. This makes Saudi Arabia one of the lead countries among the G20 countries in terms of the amount of radio spectrum awarded to operators in IMT frequency bands[2]. Figure 4 represents these assignments in term of bandwidth per band to each operator. Initial benchmark analysis conducted by CITC shows that mobile operators in Saudi Arabia have access to larger contiguous bandwidth in most bands compared with operators in most of the advanced countries.

[1] Regulatory Policy for Commercial Spectrum Bands Identified for IMT, Wireless Local Area Networks Usage Regulations, CITC Technical Specification RI114: Specification for License – Exempt LPWAN Devices

[2] How Saudi Arabia is deploying ICTs against COVID-19 – and beyond, ITU News, July 24, 2020

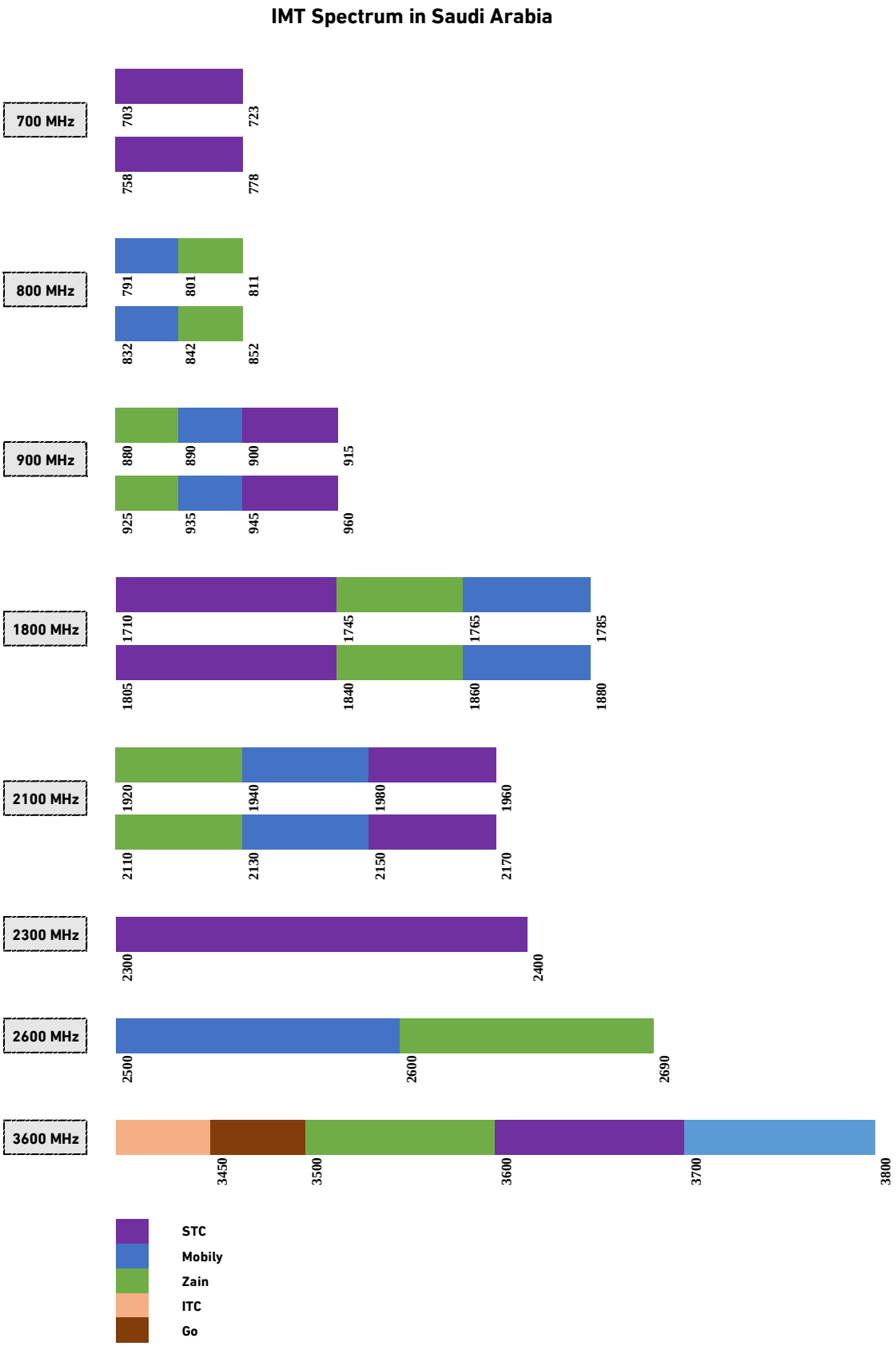

Figure 3: IMT Spectrum specific assignments to operators in Saudi Arabia

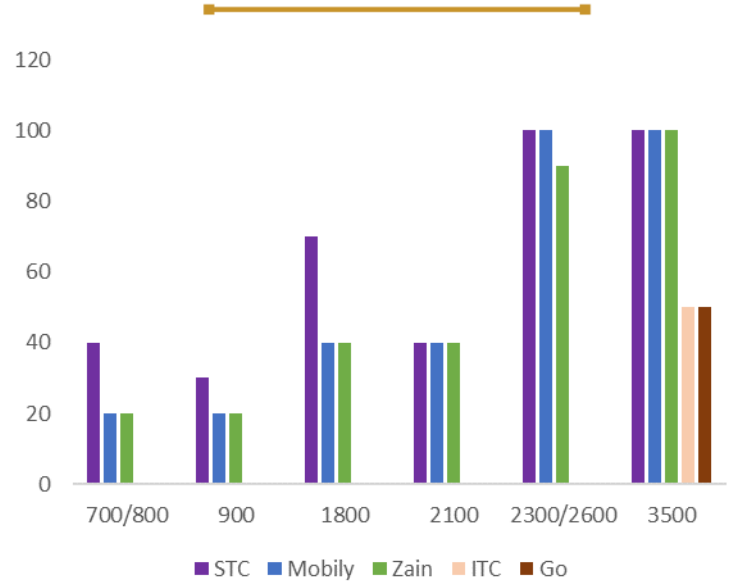

Figure 4: Bandwidth of IMT spectrum blocks assigned to operators in Saudi Arabia

Nevertheless, CITC hasn't yet declared mission accomplished, as more effort needs to be done to manage commercial use of spectrum. We can't settle only to sustaining success to foster commercial and innovative use of spectrum, but rather we need a realignment and sometimes a turnaround to be able to achieve the ambitious goals of NSS and contribute toward making Saudi Arabia one of the world's advanced digital societies.

In conjunction with drafting its Five-year Spectrum Outlook for Commercial and Innovative use, CITC is reviewing its relevant regulatory documents that govern the use of commercial spectrum[3].

A. Can you comment on the licensed frequency spectrum to operators in Saudi Arabia today in terms of bandwidth and distribution? On spectrum made available to other technologies on open sharing-basis?
B. In conjunction with releasing more spectrum in the coming few years, do you recommend CITC to look into further refarming of these assignments to make available spectrum more contiguous, in consultation with concerned stakeholders (for example refarming sub-GHz bands to provide service providers with large contiguous carriers)?
C. What updates do you recommend CITC takes into consideration when it reviews its spectrum regulatory documents mentioned above?

[3] Regulatory Policy for Commercial Spectrum Bands Identified for IMT, Wireless Local Area Networks Usage Regulations, CITC Technical Specification RI114: Specification for License – Exempt LPWAN Devices

2. Spectrum Licensing Regimes

In the past, CITC followed two main regimes in making spectrum available for commercial and innovative use: licensed spectrum and unlicensed spectrum.

The former regime makes the spectrum right of use exclusive to a single operator for independent usage[4], while the latter makes spectrum more widely available for common (non-exclusive) usage, subject to some regulatory constraints to ensure equitable access to all parties.

Exclusivity allows a spectrum operator to exercise more flexibility in deploying the wireless network, optimizing network costs, and making services affordable. Nevertheless, it limits the utilization of this spectrum to one user, and his investment plan, if flawed, could compromise the efficient use of the spectrum resource, due to the financial constraints that operator faces[5].

On the other hand, unlicensed usage of spectrum applies Spectrum commons theory, where the spectrum bands should be directly managed by its users, rather than by a regulated[6]. However, this can lead to a "tragedy of the commons"[7] outcome if the use is not well coordinated. Appropriate regulatory constraints, such as limiting the transmitted power, can help to minimize the interference between different users, but it can also reduce the efficient utilization of the frequency and limit the user's capability to guarantee a defined quality of service and availability. It should be noted that unlicensed frequency bands are usually made available for common use, free of charge, in contrast to exclusively licensed IMT bands where fees are paid to reflect the opportunity cost to other users who do not have the right to use it.

To date, multiple frequency bands have been made available for common use (unlicensed) in Saudi Arabia. While the 2.4 GHz and 5 GHz bands are the most popular unlicensed frequency bands, particularly for WLAN, other bands have also been made available for unlicensed use by Short Range Devices (SRD) and Low Power Wide Area Network (LPWAN) devices. Some potential LPWAN users have claimed that they are unable to utilize the band 866-869 MHz on a secondary basis because its secondary use is subject to band sharing with the primary user[8]. This means some technologies might be unable to benefit from secondary access to spectrum, and instead, they may require protection from the other users. In other words, this LPWAN technology might request protected access to this band on a primary basis and free of charge.

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[4] Parag Kar, Licensed vs Unlicensed Spectrum, Published on January 24, 2018 at LinkedIn.

[5] See Section 4 (Spectrum Utilization) for more details

[6] Martin Cave, Chris Doyle, William Webb, Modern Spectrum Management, Cambridge University Press, 2007

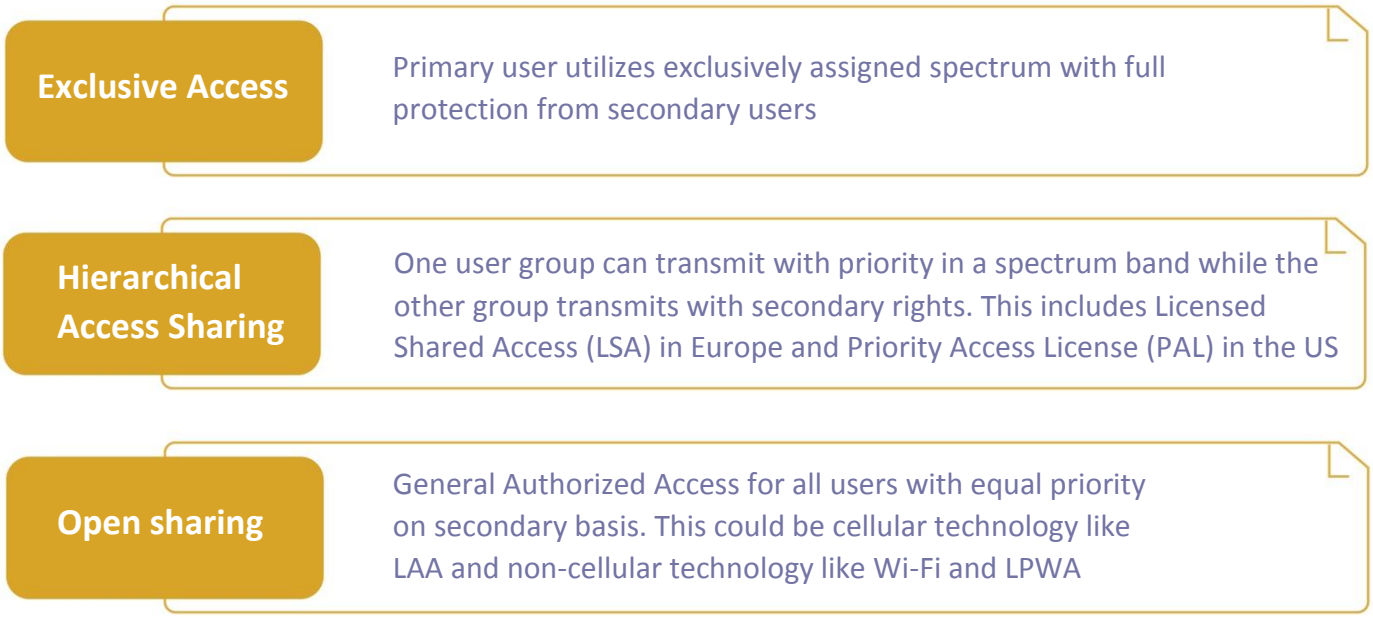
[7] a shared resource is inevitably ruined by uncontrolled use.

[8] See CITC Technical Specification RI114: Specification for License – Exempt LPWAN Devices

Market-based commons[9] is a regime whereby non-exclusive licenses will be granted to multiple users. It relies on the market and the licensees to carry out the necessary coordination, thus providing all users of a channel with some degree of protection.

Light licensing[10] provides inclusive access to many users, the total number of which can be either capped or left unlimited. It is a less costly option for users, and a less burdensome process for the regulator to administrate. However, setting the appropriate license limitations is critical to avoid compromising the quality of service. In this Shared Licensed Spectrum, "access and sharing conditions impact investment, commercial viability and QoS"[11].

The FCC's Part 96 Rules establishes a three-tiered access and authorization framework[12]. The three levels can be summarized in Figure 5 below.



[13] Arturo Basaure, Regulation for dynamic spectrum management, 2016

Figure 5: Three-tiered access and authorization framework

CITC is seeking input from interested parties on regimes for making spectrum available in the future.

A. What licensing regime should CITC adopt when releasing commercial frequency bands listed in Section 11 of this document? What factors should be taken into consideration? e.g., Radio Technology (IMT vs. non-IMT),

[9] William, Baumol (2005). Toward an Evolutionary Regime for Spectrum Governance. Washington, DC: Brookings Institution Press

[10] Eur Ing Laurent Bodusseau, Spectrum Sharing, GSMA. 2017

[11] Eur Ing Laurent Bodusseau, Spectrum Sharing, GSMA. 2017

[12] 3.5 GHz Band Overview at: https://www.fcc.gov/wireless/bureau-divisions/mobility-division/35-ghz-band/35-ghz-band-overview

[13] Arturo Basaure, Regulation for dynamic spectrum management, 2016

Frequency band (low vs. high-frequency spectrum, and scarcity vs. relative abundance). Please support your arguments with evidence.

B. What would be the impact of the above-listed licensing regimes on spectrum utilization, investment in wireless infrastructure, improving competition and QoS for end-users? Please comment on the slow deployment and investments in the recently licensed mobile spectrum bands in Saudi Arabia. Please support your arguments with evidence.

C. Can you quantify the impact of the different regimes of licensing on spectrum value and utilization? Please cite references to support your answers.

D. As radio technology advances and interference mitigation mechanisms become smarter, will technology be more resilient to interference and be capable of allowing a wider range of shared spectrum access scenarios while ensuring the co-existence of other users and wireless systems? If you agree, please provide examples of current and future systems that illustrate this sharing capability.

E. Will the development of future cellular technology standards that are better tailored to non-exclusive access, such as NR-U, make future IMT standards better able to share spectrum?

F. If CITC determines that spectrum that is licensed to a primary user (e.g., government or broadcaster) is underutilized, would you suggest that CITC allow commercial operator(s) to have opportunistic access to this spectrum (e.g., a hierarchical access sharing model)? Alternatively, do you consider it more appropriate for CITC to work with stakeholders, in order to clear as much of the underutilized spectrum, so that it could be exclusively assigned to other user(s) such as mobile operators? If you agree with the latter approach, please comment on the need for mobile operators to contribute to funding the refarming process?

G. Do you think CITC can adopt both licensed and unlicensed regimes for different technologies in the same band? Are there benefits of splitting the band into both licensed and unlicensed allocations?

H. As we move from one licensing regime to another, how should this affect the fees paid by licensees?

3. Spectrum Access Rights

CITC mainly followed the spectrum 'usage rights' model[14], under which the licensee is permitted to transmit up to a defined power level at a specified location for a specified period. The licensee must also meet certain obligations in terms of coverage and QoS to the end-users. An alternative authorization regime is the 'property right[15]' model. This

[14] Johannes M. Bauer, A Comparative Analysis of Spectrum Management Regimes, Published November 2006

[15] G. R. Faulhaber and D. Farber, "Spectrum management: Property rights, markets, and the commons," in Telecommunications Policy Research Conference Proceedings, 2003

model encourages spectrum to be treated as private property, in a similar manner to land. This model assumes spectrum is acquired through means of market forces, at a meaningful price, and the spectrum owner should then be able to trade this spectrum in 'secondary markets' if so desired. The property right model grants the spectrum owner the right to use the resource, the right to earn income from it and the right to transfer it to others[16]. The property right eliminates many of the terms and conditions usually attached to a license, such as specifying the technology and service. Advocates of this model espouse that it promotes innovation and leads to more efficient use of spectrum resources, as the spectrum owners would maximize their utility through commercializing the resource[17]. On the other hand, this model risks leading to artificial scarcity of spectrum, as privatization of the spectrum resource can lead to perverse incentives not to use it at all[18].

CITC issued a document on 'Regulatory Policy for IMT Frequency Bands'[19] in 2017, which stated 'Licensees who decide to merge or acquire another licensee or wish to trade, share or lease frequency blocks awarded via their respective Radio licenses need to apply to CITC for approval. On a case by case basis, CITC will decide whether to approve the spectrum arrangements or revoke it and reacquire the spectrum, completely or partially' (See the relevant section of the document, titled: Spectrum Screening).

A. What are the costs and benefits of allowing the spectrum bands listed in Section 11 to be traded in a secondary market? Do you believe that CITC should allow secondary trading of spectrum? Please provide supporting arguments with your answer.
B. Should CITC adopt a property rights model when releasing any of the spectrum bands listed in Section 11? Please note that any spectrum acquired through a spectrum trade would remain subject to its original conditions and obligations. Please provide supporting arguments with your answer.
C. What are your views on CITC adopting a hybrid model, where it licenses spectrum based on usage with rights and obligations, with the flexibility to trade that spectrum with obligations attached?

4. Spectrum Award Mechanisms

There are various types of award mechanisms that may be used to license spectrum for commercial use, with the most common being an auction process. This is because it is the process deemed most likely to allocate spectrum to the

[16] Martin Cave and William Webb, The Unfinished History of Usage Rights for Spectrum, Telecommunications Policy, Volume 36, Issue 4, May 2012, Pages 293–300

[17] J. Peha, "Spectrum management policy options", 1998

[18] G. R. Faulhaber, "The question of spectrum: Technology, management and regime change," in The Conference on the Economics, Technology and Policy of Unlicensed Spectrum, 2005.

[19] See Regulatory Policy for Commercial Spectrum Bands Identified for IMT

users who have the highest valuation and therefore, can be expected to make the best use of it[20]. Other mechanisms include direct assignment where blocks of the frequency band are assigned directly to the user, on a 'first come first served bases' without a competitive process. This method is used when an auction may not be applicable or desirable, such as when there are no competing commercial demands for the band[21]. Another mechanism is the comparative evaluation or 'beauty contest' which is a competitive process where prices only play a partial role[22]. While auction are more efficient and transparent market-based process, it constrains the regulator's control over the outcome[23] and its ability to use the spectrum assignment process to achieving specific regulatory objectives, such as promoting the entry of new competition into the market. On the other hand, 'beauty contests' are inherently less transparent could the perception of bias can result in challenges to a regulator's selection decision.

Prior to 2016, CITC favored direct assignments to license spectrum. Licenses were generally assigned on a first-come first-served basis, with some administrative approval or rejection decisions made on the basis of technical matters, such as the availability of a desired frequency, etc. CITC's historical first come first served approach to spectrum licensing led to anti-competitive behavior by some users, i.e., blocking of frequency bands by hoarding underutilized spectrum. Between 2017 and 2019, CITC conducted four auctions which collectively released more than 750 MHz of IMT spectrum to the market. CITC opted to expedite these auctions in a relatively short period, in order to address the acute spectrum scarcity and asymmetry that had developed in the market. Various auction types were selected for these awards, including Clock Auctions and Simultaneous Multi-Round Auctions. The main regulatory objectives for CITC when faced with a once-off opportunity to license such a large amount of mobile spectrum, was improving the QoS for users in Saudi Arabia[24], while also allowing the different players in the market to decide which spectrum bands would best serve their needs and how much bandwidth they would need to operate their wireless networks efficiently. A secondary objective was to identify a fair price for exclusive access to IMT spectrum. Although the reserve price in these auctions was set substantially below the international benchmark derived from the analysis conducted by CITC and its consultants, the auctions' outcomes revealed that some competitors in the market are subject to strict financial constraints that limit their ability to acquire a reasonable portion of spectrum and sustainably invest in it.

A. What are the main lessons learned from participants' experiences during CITC's auctioning of spectrum since 2017?

[20] RSPG Report on Efficient Awards and Efficient Use of Spectrum, October 2015

[21] Spectrum Access: Allocation Policies and the Assignment Process, National Academies of Sciences, Engineering, and Medicine, 2015

[22] Auctions and Beauty Contest: A Policy Prospective, M.C.W. Janssen, 2002

[23] Spectrum license assignment in the Asia-Pacific region, Hans-Martin Ihle, 2016

[24] Saudi Arabia had an average download speed of 9 Mbps in 2017. It has an average download speed of 66 Mbps for mobile internet by June 2020.

B. Do you agree that CITC should auction the frequency bands listed in Section 11? For which bands do you think an alternative award mechanism, such as beauty contest or a direct assignment, might be a more efficient licensing of spectrum?

C. Do you agree that backhaul spectrum utilized for high-density fixed wireless (such as the E-band) can be auctioned on a block-assignment basis, instead of licensing single-channel assignments on a per-link basis? Please provide supporting arguments in your answers.

D. What methodology should CITC follow when valuing spectrum bands and setting auction reserve prices?

5. Spectrum Utilization

Expanding cellular network coverage and QoS depends heavily on spectrum, but also on the availability of sites and the capabilities of the wireless technology[25]. While always adding more spectrum bandwidth would lead to better connection speeds enjoyed by end-users, it might artificially limit the number of operators and discourage them from properly investing in sites to reuse frequencies and utilize spectrum efficiently. Making enough spectrum available to network operators to provide good services is a priority, but CITC wants to ensure not many frequency bands available and underutilized due to the slow investment in the infrastructure in specific areas. CITC assigned IMT spectrum in the sub-1 GHz and above 2 GHz bands over the period 2017-2019. Information about the level of deployment in these bands across operators' sites[26] revealed substantial underutilization of spectrum, as shown in Figure 6 below.

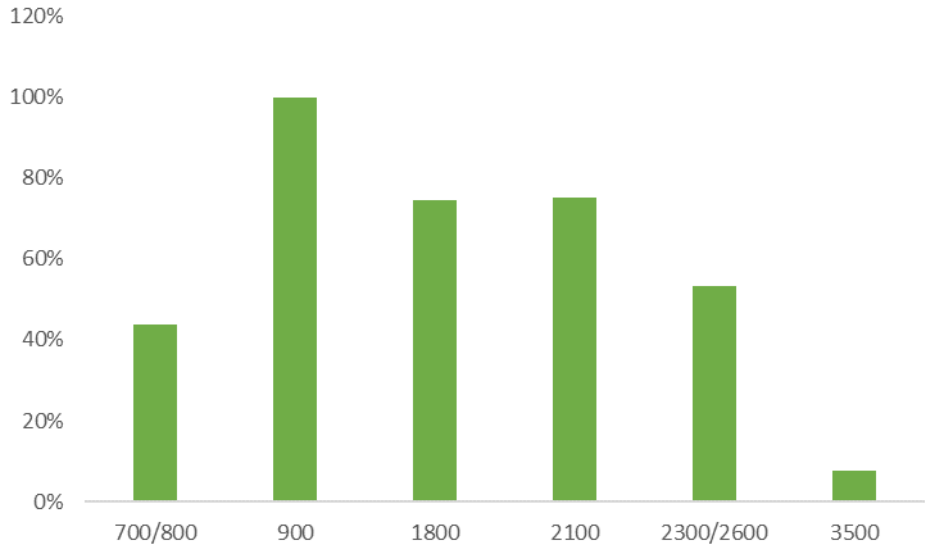


Figure 6: Estimated utilization of licensed IMT bands by Saudi operators

[25] Expanding mobile wireless capacity: The challenges presented by technology and economics, Richard N. Clarke, 2014

[26] Based on collected information from operators, we estimated the utilization by dividing the accumulative number of sites deploying specific band over the accumulative total number of all sites nationwide.

Because all spectrum licenses were awarded on a nation-wide basis, spectrum in some less populated regions of Saudi Arabia has unfortunately remained underutilized. With network rollout in some rural areas being subsidized by the USF program, other players find it more unviable to invest in the areas subject to USF subsidization of a single operator. Moreover, because CITC, in general, followed the technology neutrality principle in setting license obligations, some rural areas still lack basic 4G and NB-IoT service availability.

To encourage investment and improve QoS across the kingdom, CITC adopted a cascading approach to QoS obligations, including rural obligations, over the period 2020 to 2027, as shown in the timeline chart below. When doing so, CITC designed less competitive auctions to end up with moderate prices as a function of the corresponding obligations[27].

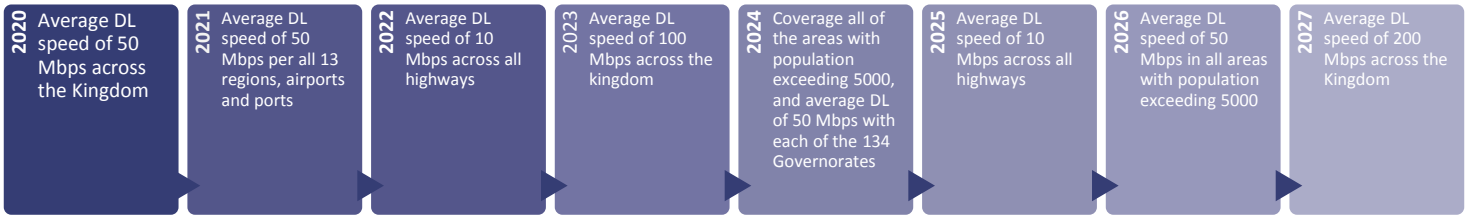


Figure 7: IMT License Coverage and QoS Obligations

Some mobile operators deemed the cascading QoS obligations of 50 Mbps by 2021 to be excessively high, although each operator has access to at least 310 MHz of bandwidth. The QoS divide between the densely populated urban areas and less-dense areas is likely to remain high, as operators have less incentive to invest in the less-dense areas despite having exclusive access to a large amount of spectrum.

A. What are your views on the current status of slow investment in the spectrum acquired in the recent CITC auctions? How can CITC encourage more utilization of the spectrum exclusively assigned to operators?
B. What metrics do you believe CITC should use to assess spectrum utilization by mobile operators?
C. Do you agree that the obligations mentioned above are achievable? Please explain, and cite references and relevant benchmarks to support your answers
D. How can CITC improve spectrum utilization in less populated areas? Do you believe it would be a reasonable regulatory measure for CITC to mandate USF operators also to use the spectrum assignments of other competing operators, if those assignments are unused/underutilized in USF areas, to improve rural service provision?

[27] The Impact of Obligations in Spectrum Value, Luis Guillermo Alarcon Lopez, 2017

E. Do you think CITC should introduce geographic regional spectrum licenses rather than nation-wide spectrum licenses? Would that improve spectrum utilization and improve QoS in less-populated regions? Please justify.

F. What metrics, other than coverage and QoS, should CITC consider when setting obligations on spectrum licenses? Please cite references and benchmarks in support of your answer.

G. Should CITC amend its technology neutrality principle when setting obligations (for example, by introducing 5G deployment obligations to ensure that 5G is widely available across the Kingdom)?

6. Demand of Verticals

5G technology is intended to be the unified platform that will enable the digital society of the future. It is a cellular broadband "network of networks" the will unleash a massive IoT ecosystem, where networks can serve the communication needs for billions of connected devices[28]. Smart sophisticated use cases across all sectors (verticals), provided by both private and public organizations will be enabled through 5G, striking the right balance between speed, latency, and cost.

Military experts anticipate that the 5G system will play an essential role in defense systems[29]. The US Department of Defense classified 5G as a critical strategic technology, and work is ongoing to accelerate the development and deployment of 5G-enabled capabilities[30]. 5G-enabled precision agriculture will also assist farmers in tackling many of the challenges posed by climate change[31]. Other use cases in the energy and industry sectors include gas detection and prevention, industrial robots and control systems[32]. The growing demand and dependency on 5G capabilities put pressure on 5G service providers to cater to these evolving use cases.

If traditional mobile operators, who have been granted exclusive access to 5G spectrum, do not anticipate these requirements and provide such capabilities into their networks, then *ex-ante* regulation might be necessary to ensure such industry-transforming use-cases are realized. Some European countries have set aside mobile spectrum for private licensing as an alternative to imposing obligations on mobile operators."5G private networks are dedicated networks, acting as a local area network (LAN) to provide secured connectivity and meeting specific requirements (throughputs, latency, security, reliability) within limited geographic areas"[33]. Nevertheless, this approach could lead to the non-efficient utilization of a valuable 5G spectrum in areas where it is in great demand for mobile

[28] Introducing 5G technology and networks (definition, use cases and rollout), Thales, 2018

[29] The Hidden Military Use of 5G Technology, Manlio Dinucci, 2019

[30] Department of Defense (DoD) 5G Strategy (U), 2 May 2020

[31] 5G: the gamechanger for precision agriculture, UNDP, 2019

[32] 5G in Oil & Gas: Advantages and Use Cases, teletimes, 2020

[33] European countries look likely to set aside mobile spectrum for private licensing, European 5G Observatory, 2020

services[34]. There may also be interference concerns if independent 5G networks are located in close proximity to areas where public mobile networks use the same spectrum. Moreover, dividing the available 5G spectrum between many players could lead to scarcity and potentially degrade the quality of 5G services available to the kingdom's consumers. As an example of ex-ante regulation, the Finnish regulator foresaw the need for spectrum license obligations to serve vertical industries. If the market fails to meet the demand for verticals, and commercial agreements could not be reached, then the regulator may mandate operators to lease some of their frequencies to the vertical industries[35]. CITC is eager to ensure the 5G needs of verticals are met without negatively impacting commercial 5G services.

There is a dual option approach to promote industry verticals, as depicted in the chart below. Generally, it is more straight-forward when verticals would be served through service providers who have access to an adequate 5G spectrum. However, if method A does not satisfy industries needs for verticals, then CITC's fallback option would be to meet this demand through Methods B or C, where 5G spectrum is refarmed for use by independent 5G networks that cater specifically to industry requirements or unlicensed spectrum is leverage through NR-U deployments. CITC's intention would be to ensure that independent 5G networks are built and utilized in a manner complementary to the commercial 5G networks and not a substitute for them, i.e., to provide solutions to demand that can't otherwise be met by commercial service providers.

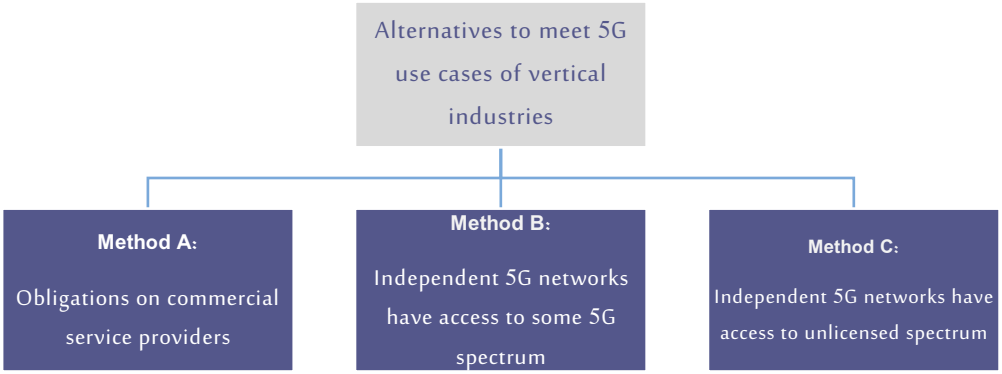


Figure 8: Alternatives to meet 5G use cases demanded by vertical industries

A. What are the most important 5G use cases of different industries that have to be satisfied? Are any of them being provided today by service providers?
B. Why do you think some European countries decided to set-aside 5G spectrum for independent use? Is it challenging for commercial operators to meet vertical demands? Please Explain and support your views with evidence.

[34] The 5G challenge for regulators – examining the cost of reserving spectrum for private networks, Brett Tarnutzer, GSMA, May 2020

[35] 5G: Finland is doing the right things, ficom.fi, 2019

C. How can CITC ensure the vertical industries demand and use cases are met through commercial service providers who have access to 5G spectrum? What obligations should be attached to 5G spectrum licenses to ensure these verticals are catered for?

D. At what point do you think CITC should adopt Method B? Please propose specific criteria that should trigger Methods B or C and what its terms and conditions should be?

7. Spectrum Licensees

The potential release of more than 10 GHz of spectrum allocated to commercial and innovative use over the next few years in UHF, SHF, and EHF bands, in combination with advances in technologies and applications, will require significant innovation in spectrum management. Traditionally, the regulator grants a spectrum license to an existing player, who builds and operates a network utilizing this spectrum to provide services to end-users. This traditional spectrum management practice is fundamentally outdated[36], and achieving digital transformation would require more innovative spectrum management practices. CITC is keen to explore all alternatives and options before licensing this unprecedented vast amount of commercial spectrum.

7.1. Market Players

Technologies continue to evolve and new use cases for them continue to develop. However, as discussed in Section 5, there are growing concerns and much speculation within industry, that the traditional players in the mobile arena may not meet the new waves of demand from users across all industry sectors and all geographical regions. For traditional mobile operators to enable the digital transformation of the country, they need to move from being communication service providers to digital service providers[37]. Internationally, regulators are revamping their spectrum regulatory policies to cope with these technology changes, to ensure that the transformation to the digital society of the future is enabled by granting access to spectrum (both 5G and beyond) to those who can successfully execute this transformation.

There are currently five mobile and fixed service providers in the Saudi telecoms market[38]. New players could potentially also enter this market, by, for example, providing emerging services and applications, such as IoT, HAPS, and Broadband Satellite. CITC is eager to ensure that spectrum reserved for innovative and commercial use is also accessible to new digital operators, who could also spearhead the country's digital transformation. These digital operators may be either the existing players or potential new digital entrants to the market. The new digital

[36] Innovations in Spectrum Management, Internet Society, 2019

[37] Global digital telecoms playbook, EY, 2015

[38] stc, Mobily, Zain, ITC, Go

environment could open the door to innovative concepts such as community networks[39] and small operators[40], who can fill access gaps that large traditional operators are less likely to address. Moreover, global digital services providers[41] such as Facebook, Google, Microsoft, and SpaceX, are now offering users global connectivity. These companies are building global internet infrastructure by investing in innovative radio platforms and technologies which could change the landscape of future digital services and accelerate disruptive competition.

A. Do you think CITC should limit access to spectrum to existing players in the local market? How will this help in the digital transformation that Saudi Arabia is aspiring to achieve? Please support your answer with detailed justification.
B. How can CITC ensure that the release of this spectrum, to existing or new players, will enable the digital society of the future and "5G everywhere"?

7.2. Spectrum Operator and Service Provider

Mobile Network Operators have access to spectrum, which they use to provide service to their end-users. In a vibrant and competitive market, this leads to both infrastructure-based and service-based competition[42]. While the benefit of competition is obvious in terms of end-user welfare, the competition amongst operators at the infrastructure level can lead some inefficiency[43], such as unnecessary duplication of certain infrastructure assets, etc. Having one or more nation-wide physical networks, on the other hand, might lead to a more efficient allocation of resources[44]. Separation of the entities operating spectrum (i.e., building and operating physical networks), from the entities offering services to end-users, would mean that service providers compete on retail services to the end-users. Still, they would widely be supported by the same spectrum and physical infrastructure[45].

Meanwhile, the physical network operator(s), would provide the wholesale network access that underpins the retail providers, without competing in the retail market themselves. The physical network operators, if more than one, would also compete with each other in terms of technology innovation, QoS and wholesale pricing. Three scenarios broadly summarizing this discussion are shown in the Figure 9 below.

[39] Community Networks: Switch it on, Community Networks ITU-D SG-1 Workshop, 2018

[40] Innovations in Spectrum Management, Internet Society, 2019

[41] Tech giants are battling it out to supply the global internet, The Conversation, April 2018

[42] Infrastructure-Based Versus Service-Based : Competition In Telecommunications, 2006

[43] Competition in services or infrastructure-based competition? Mats A. Bergman, 2004

[44] "Secure 5G: The Eisenhower National Highway System for the Information Age." docs.house.gov, 2018

[45] Mexico granted the whole 700 MHz to a single wholesale operator. See: Nokia to deploy 700MHz wholesale network in Mexico, mobileworldlive, 2017

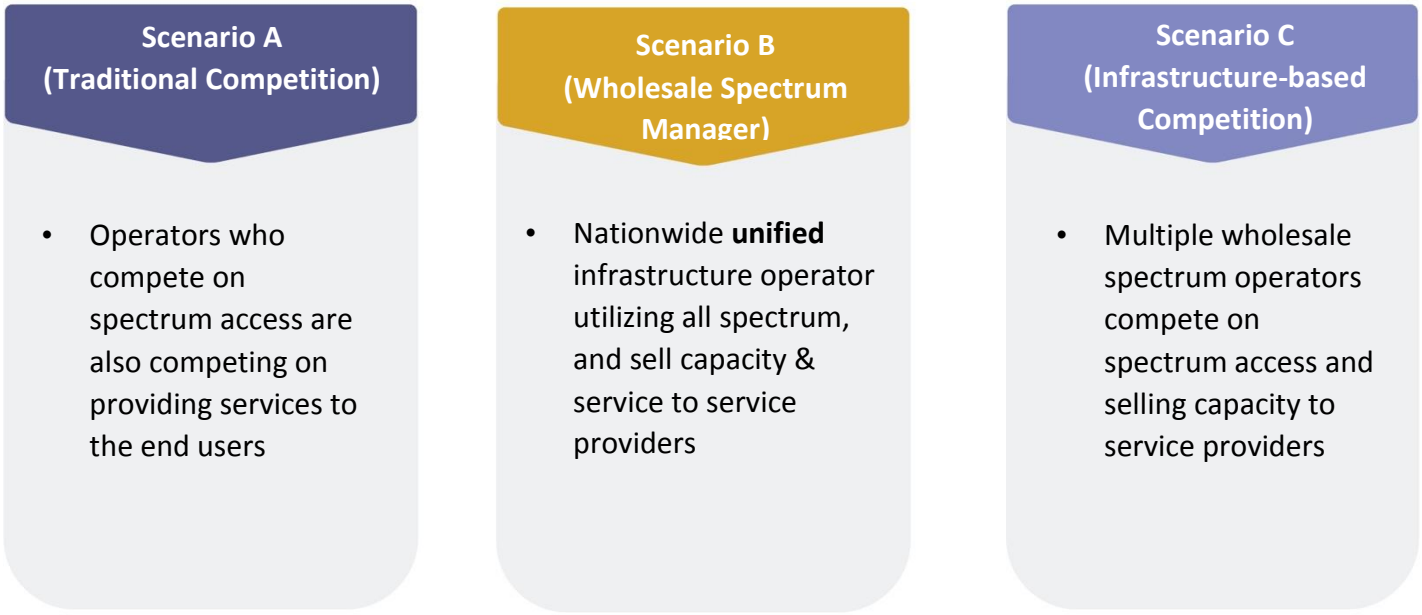


Figure 9: Scenarios of operating spectrum

When CITC adopted its unified licensing regime, radio licenses became independent from service provider licenses. Nevertheless, mobile spectrum has to date only been licensed to those who have service provider licenses.

A. Knowing that Scenario A is the status quo in Saudi Arabia, do you recommend CITC to explore or adopt Scenarios B and C? Please elaborate.
B. Would the separation of spectrum operators and service providers lead to better utilization of the spectrum? Would it improve the status of the underutilized spectrum in some geographical regions?

8. Emerging Radio Technologies

The focus of this section is on emerging technologies in wireless networks, specifically, but not limited to, 5G, WLAN and LPWA. There are many overlaps and correlations between these emerging technologies and use cases, and some of them are or will be enabled by 5G cellular systems while others are proprietary or open standard technologies. According to market research firm Gartner, figure 10 below shows top wireless technology trends expected to play a significant role over the next five years[46]. Here we list some of the technologies that CITC consider them to be enablers of its effort toward fostering commercial and innovative use of spectrum

[46] Gartner Identifies the Top 10 Wireless Technology Trends for 2019 and Beyond, July 23, 2019

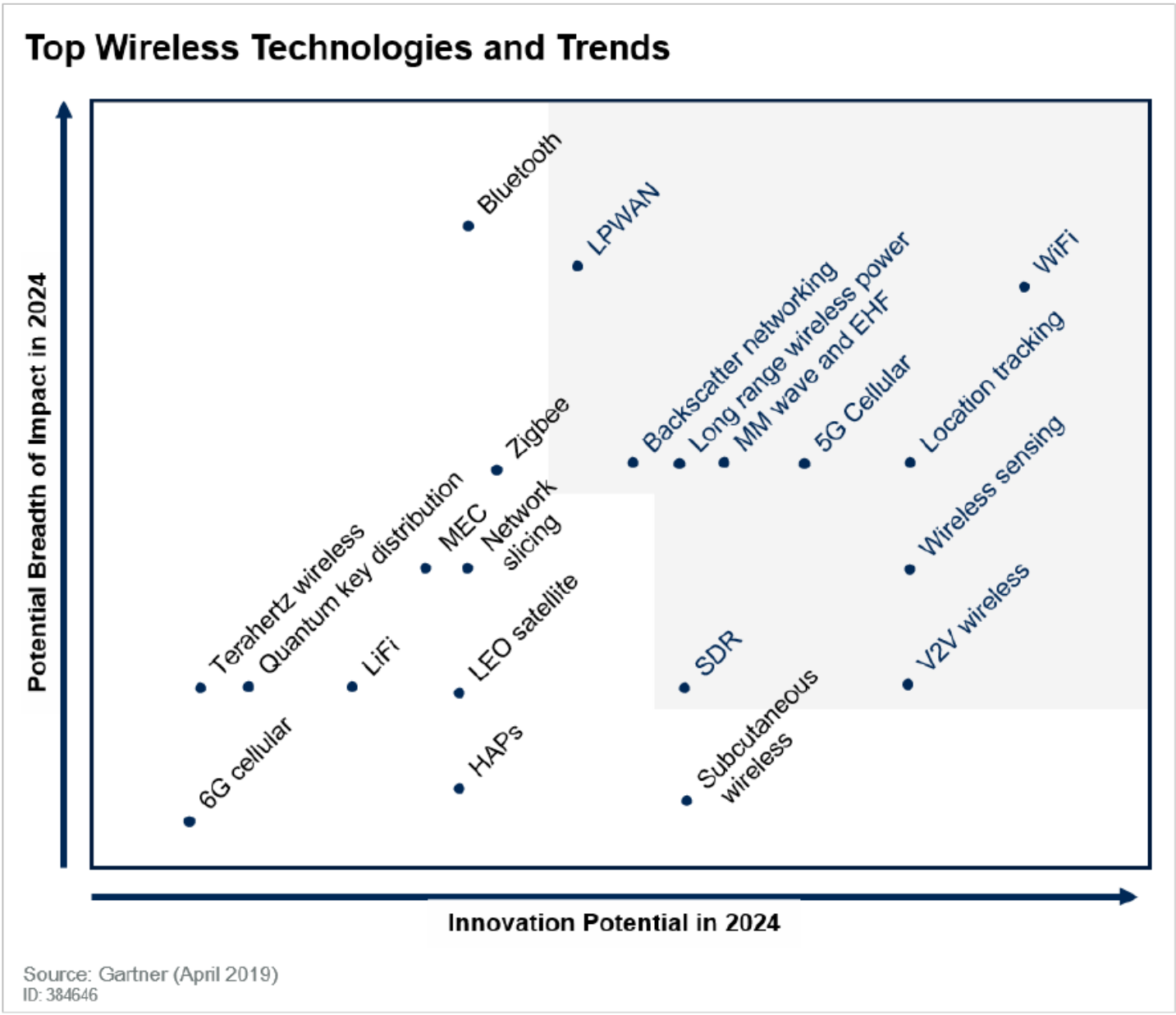


Figure 10: Top wireless technologies with a prediction of their potential innovation and impact by 2024

8.1. IMT 2020

The ITU-R is developing the International Mobile Telecommunication-2020 (IMT-2020) standard for 5G. The ITU goal is to have an approved IMT-2020 standard this year. This will be an incremental step in the evolution of mobile wireless communications, capable of delivering improved connectivity, higher network speeds, and very low latency[47]. Figure 11 summarizes the projected improvement of IMT-2020 over IMT-Advanced.

[47] "Framework and overall objectives of the future development of IMT for 2020 and beyond, ITU-R M.2083.0," ITU-R, 2015.

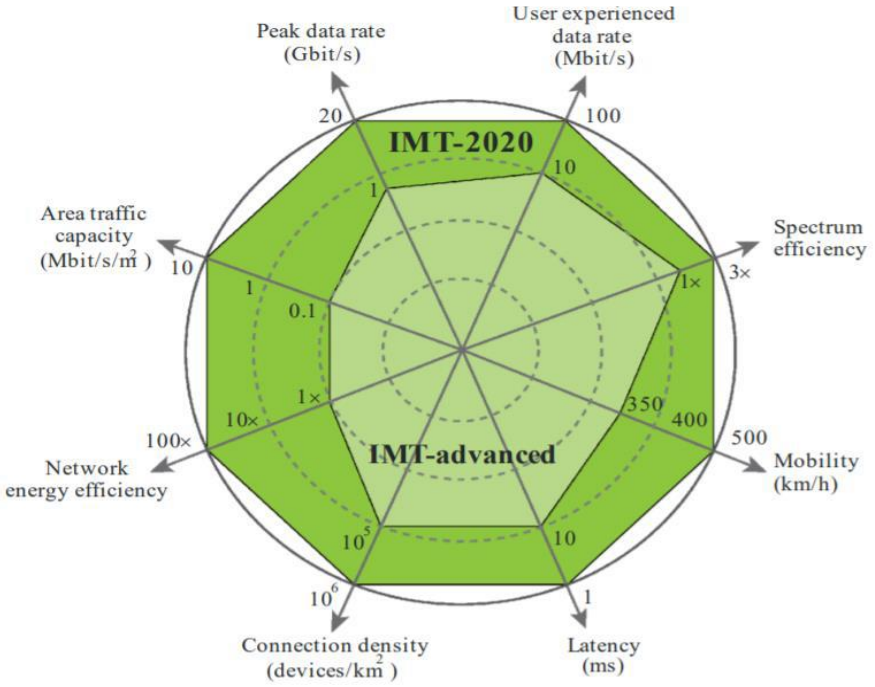
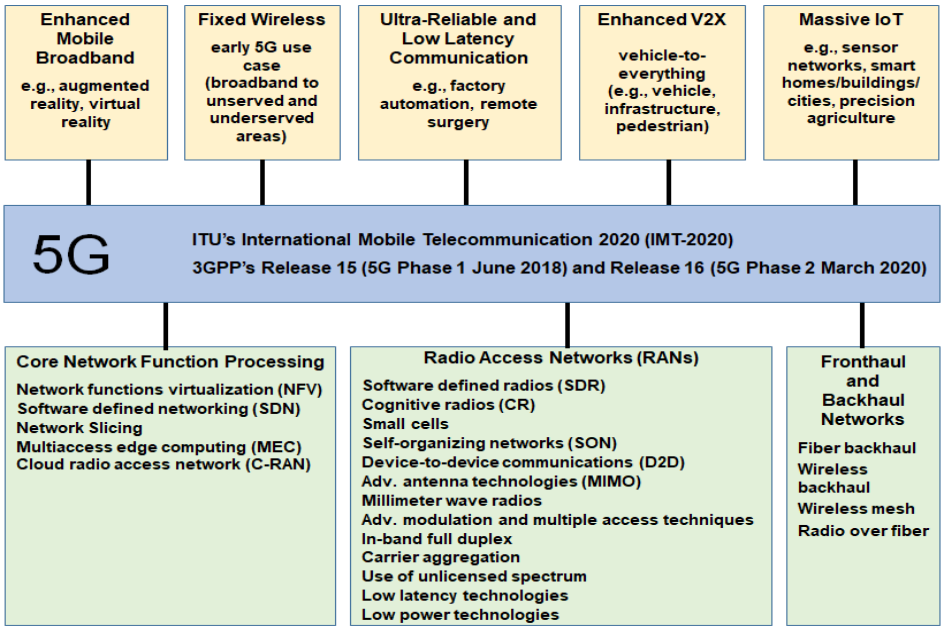


Figure 11: Improvement of 5G over 4G

5G will enable new classes of applications, and use cases[48], examples of these 'enabling technologies' are shown in figure 12 below. The main characteristics of 5G-enabling technologies to meet these diverse applications are flexibility and adaptability[49].



[48] Emerging technologies and their expected impact on non-federal spectrum demand, White House OSTP (May 2019)

[49] Emerging technologies and their expected impact on non-federal spectrum demand, White House OSTP (May 2019)

Figure 12: 5G-Enabled Technologies (top), and 5G-Enabling Technologies (bottom).

Source: Emerging technologies and their expected impact on non-federal spectrum demand, White House OSTP (May 2019)

8.2. Unlicensed NR

NR-U is a radio access technology that has been recently standardized to enable the utilization of the 5G NR radio interface in an unlicensed spectrum for both standalone deployments and by operators that have access to a licensed spectrum. While such technology will contribute to the evolution of flexible spectrum usage, concerns over competition with other unlicensed technologies have been raised[50].

8.3. Fixed Wireless Access

Fixed Wireless Access (FWA) provides connectivity to stationary or nomadic points. It has been used as a substitute to wireline connections in the last mile. It uses standardized 3GPP architectures and standard mobile components to deliver high-speed broadband to residential and enterprise applications in suburban and rural areas. Most of the existing FWA deployments use medium- and high-frequency bands, but where demand for mobile broadband is low, it is possible to deploy FWA also in the low- and medium-frequency ranges without negatively impacting the mobile users' experience. 5G FWA can provide a competitive alternative to fiber across all markets. This ensures suburban and rural consumers can receive the bandwidth required to support high definition streaming services and high-speed Internet access[51].

8.4. Low-power wide-area networks (LPWAN)

LPWAN serves as a generic term for any network designed to communicate wirelessly with low power comparing to other networks such as the cellular network. It is being considered for machine-to-machine (M2M) communication, providing low cost, broad area coverage for many IoT applications. For penetration capability, many LPWAN technologies tend to use spectrum in the lower frequency bands (e.g., under 1 GHz). LPWAN networks generally fit in between the short-range wireless technologies such as Bluetooth, or WiFi and cellular technologies and typically support extensive areas such as cities.

LPWAN technologies can be divided into proprietary (like LoRa, Sigfox, Ingenu, Symphony), standard cellular (like NB-IoT and LTE-M), and standard/open protocols operate in the unlicensed ISM spectrum (like WiFi 802.11ah). The 3GPP currently supports LPWAN use cases through LTE-M and NB-IoT technologies and their evolutions, with NR variants under development for Rel-17 and beyond.

8.5. WiFi 6e

[50] U. L. Workgroup, "Unlicensed Spectrum LTE," Wireless Broadband Alliance, 2016.

[51] FWA: Market, Applications And Technology, OPNET Solutions, March 3, 2020

WiFi use is growing over recent years; this growth is driven by the rising of connected devices and the arrival of innovative applications such as Augmented Reality (AR), Virtual Reality (VR), and Ultra High Definition video. However, WiFi technologies evolved to be more spectrum efficient, wider channels, and more channels are required to meet the growing demand for this technology.

WiFi use currently relies on 2.4 GHz and 5 GHz band; however, there is a need for more spectrum to fulfill the current and the future demand of this technology. Wi-Fi6 is the next generation of wireless router protocol, which also known as 802.11ax. The new standard offers improvements over the current standard with more spectrum in 6 GHz band in the WiFi 6e variant. The new standard will overcome congestion issues caused by multiple devices in the home, including enabling different IoT applications. From spectrum availability perspective, there are differences between countries and regions in the targeted band for WiFi6e; some countries such as the US support the extension in the band 5925-7125 MHz, while many other countries consider the expansion up to 6425MHz[52].

8.6. Broadband Private Mobile Radio (PMR)

PMR was mainly developed for business users who need to have contacted over short distances with a central base station. Such a system serves a closed user group operated by the same organization as its users. Some users across the world require not only mission-critical voice, but also real-time imagery, video, geo-localization, and high-speed access to private cloud-based information and applications, which can be served by broadband PMR standards-based on Long Term Evolution (LTE).

8.7. Broadband LEO NGSO

NGSO global broadband communications serve users worldwide. NGSO systems could efficiently use the existing FSS spectrum to make new services globally available, including bringing broadband to be unserved and underserved locations and consumer groups. LEO and MEO satellites operate closer to the earth, which gives lower signal delay compared to other GEO satellites. Recently, some companies are actively developing new LEO satellite constellations to provide high capacity broadband internet services globally.

8.8. V2X

The connected vehicle applications continue to grow rapidly; these applications will enable drivers and passengers to benefit from infotainment, navigation, safety and telematics services, which will generate benefits for individuals and society as a whole. Vehicle to everything (V2X) is one of the important intelligence transportation systems that enable vehicles to communicate laterally with everything, including vehicles, infrastructure, and pedestrians. The system has two modes of operations; Short-range direct communications and Long-range network communications.

[52] Wi-Fi 6E: What Is It, and How Is It Different From Wi-Fi 6?, Chris Hoffman, 2020

Short-range direct communications between vehicles (V2V), between vehicles and infrastructure (V2I), and vehicles to pedestrians (V2P). In this mode, C-V2X target to operates in multiple bands, including the 5.9 GHz frequency band – the ITS (intelligent transport system) spectrum that has been identified and harmonized internationally for safety purposes. Where, in the Long-range network communications, in which C-V2X employs the conventional mobile network to enable the vehicle to receive information about road conditions and traffic in the area. In this mode, C-V2X operates in licensed spectrum to mobile operators to provide connectivity to its customers[53].

8.9. WiGig

WiGig is a wireless standard to provide high speeds that could reach up to 8 GBps. This technology designed to use the band (57.24 – 70.20) GHz to transmit information, with variants that expand the expansion of the band to 76 GHz being under consideration. While the traditional WiFi connection uses 2.4GHz and 5GHz bands. WiGig uses beamforming technology to send signals between devices at proximity, which focused on mitigating any interference from near devices and on maintaining high performance even in areas where the 60 GHz spectrum used heavily.

The connection in 60 GHz signals is typically sight-to-sight since the signal can't go through walls or cover large areas. WiGig technology is very promising in serving ultra-high bandwidth and very latency applications, there are trends to rely in this technology to be used in application such as virtual reality (VR) and Augmented Reality (AR)[54].

8.10. HAPs

The Radio Regulation (RR) defines a High-altitude platform station (HAPS) as radio stations located on an object at an altitude of 20-50 kilometers and a specified, nominal, fixed point relative to the Earth. HAPS can be used to provide fixed broadband connectivity to users and be used in transmission links for backhauling traffic. Both applications of HAPS would enable broadband deployment in remote and rural areas. HAPS trials have been taking place in some countries to demonstrate the ability to provide broadband connectivity, backhaul links, and for disaster recovery communications. The main challenge for this technology is to be used heavily worldwide is to reduce the current high deployment cost of this technology. WRC-19 has identified additional radio-frequency bands for (HAPS) systems, to support the trends toward this technology, which could be the main solution to provide connectivity in many cases.

8.11. HIBs

[53] Connecting vehicles today and in the 5G era with C-V2X(Cellular Vehicle-To Everything), "GSMA, 2019

[54] S. Shunnaq, "WRC-19: 14.75 GHz in spectrum bands above 24 GHz can be used for 5G on a global basis," Cullen-International, 2019

High altitude platform stations as IMT base stations (HIBS) is expected to be as a part of IMT networks using the same frequency bands identified for IMT. Currently, many IMT networks are using different frequency bands; so many user terminals support multiple bands. Therefore, to allow flexible use of frequencies for HIBS, additional identification for HIBS may be required within existing IMT bands in the frequency ranges below 2.7 GHz. Based on that, WRC-19 has resolved to study (HIPS) identification in specific frequency bands below 2.7 GHz already identified for IMT, on a global or regional level.

HIBs solutions provide a very large footprint that can complement the coverage provided by mobile network operators (MNOs) in rural areas, with low latency comparing to the satellite applications, including non-geostationary satellites (NGSO). These features could make this technology to be the main platform to provide mobile broadband connectivity to remote and rural areas[55].

8.12. Radar for gesture-recognition technology

There is growing interest in using human gestures as a means of interaction with computing devices. Radars have been recently used for gesture recognition, which is important in many types of applications that involve smart homes and human-machine interfaces. Hand gesture recognition is a type of human-computer interaction that gets the hand gestures of humans sorted and steered the device for each gesture. Some of the studies focus on radar-based hand gesture recognition on E band or WLAN[56]. Google's Project Soli[57] is an example of this application.

8.13. Next Generation Positioning (NGP)

Wireless Local Area Networks (WLAN) is extending its fields of application, including applications such as indoor wireless positioning. The challenges for such application is dealing with indoor environments, that surrounded by walls, floors and other obstacles. Which will affect the signal propagation and, therefore, the accuracy of the positioning systems. The proposed technique consists of a passive positioning approach based on two methods for positioning: distance-based and angle-based algorithms. Moreover, the work for standardizing this technique is undergoing on the amendment of IEEE 802.11az, and it will be standardized under "Next Generation Position Systems (NGP)".

Next Generation Positioning (NGP) study group was formed in January 2015, to address the needs of a "Station to identify its absolute and relative position to another station or stations it's either associated or unassociated with".

[55] S. Shunnaq, "WRC-19: 14.75 GHz in spectrum bands above 24 GHz can be used for 5G on a global basis," Cullen-International, 2019

[56] Jiajun Zhang, "Doppler-Radar Based Hand Gesture Recognition System Using Convolutional Neural Networks", 2017

[57] https://atap.google.com/soli/

The goal is to define a specification to the MAC and PHY for this technique and to finalize this standard in March 2021[58].

A. What technologies do you think CITC should foster to use spectrum the most? Please elaborate.
B. How can CITC enable the use of spectrum for innovative technologies? Should CITC make the decision on which technology use which frequency band? Please elaborate.
C. What should frequency band be made available for which technology? On an exclusive or shared basis?
D. How can CITC enable the use cases for IoT applications? Please evaporate

9. Competition and Complementarity of Technologies

Several new radio technologies are evolving to occupy IMT and non-IMT spectrum listed in Section 11 of this document. While many of these technologies may compete for access to spectrum, they can also have mutual dependencies and synergies with each other. A current example of this in the interplay between the cellular and Wi-Fi networks that are often interwoven, to offload mobile data traffic from the cellular network to the non-cellular WiFi LAN[59]. Two-tier networks involving a conventional cellular network, overlaid with shorter range hotspots like femtocells and distributed antennas[60] is another example of the collaboration between macrocells and femtocells, which can improve cellular system capacity. 5G is largely dependent on an exclusively licensed spectrum to deliver services, but unlicensed spectrum plays a complementary role by allowing operators to supplement their 5G services by aggregating both licensed and unlicensed spectrum bands[61].

Direct competition between technologies is clear when the technologies play similar roles and are a direct substitute for one another. NR-U and Wi-Fi is an example of competition for the access rights to spectrum between similar technologies[62]. 5G and WiFi6e are other examples of complementary technologies in 6 GHz spectrum. There are some convergence and overlap of the two technology features, but they play different roles[63].

Wherever possible, CITC follows the technology neutrality principle in regulating the use of spectrum by wireless systems. CITC also believes that enhancing complementarity and co-existence of future radio technologies is the way

[58] Elena Santiago, "passive positioning approaches in the future positioning systems", 2017

[59] Cellular Traffic Offloading through WiFi Networks, Savio Dimatteo, 2011

[60] Spectrum Allocation in Two-Tier Networks, Vikram Chandrasekhar and Jeffrey G. Andrews, 2018

[61] 5G Spectrum, GSMA Public Policy Position, March 2020

[62] Qualcomm takes on Wi-Fi with LTE-U, RCR Wireless News, 2015

[63] Competition vs. Complementarity, White Paper by Georg Serentschy, 13 January 2020

forward to make the best use of technology in general. Nevertheless, the inability of some technologies to co-exist with each other risks turning complementarity into competition. High altitude platform stations as IMT base stations (HIBS) is an excellent example of how technology like HAPS can merge to complement and be part of the future evolution of IMT-2020.

A. How can CITC help to support the co-existence and complementarity of different technologies through spectrum policy? Please support your answer with specific suggestions of how CITC can promote growth and adoption of new emerging technologies in the Kingdom.
B. Should CITC deviate from the technology neutrality principle when regulating and licensing the use of frequency bands? Is it justifiable for the CITC to mandate a specific technology for a licensee should use in order to avoid co-existence problems?

10. Fair Access to Adjacent Sectors

The persistent growth of wireless systems means that many of the radio services relying on spectrum are now competing for access to it, to support new innovative applications and their growing user bases. Identifying an additional spectrum to meet demand for IMT leads to competition over spectrum with other sectors including Defense, broadcasting, satellite, and it also poses co-existence challenges for other users of spectrum such as meteorology and navigation, etc. It is important for CITC to enable commercial and innovative use of spectrum for 5G and other emerging wireless technologies, to lead the country on the road toward the digital society of the future. It is also important for CITC, as the national spectrum manager, to ensure that all other radio services in adjacent sectors also enjoy fair access to spectrum. CITC must balance the growing importance of IMT in the kingdom's digital society, with the interests of other spectrum users, so as not to place undue restrictions on their future growth. As discussed in the previous section on technologies and competition, radio services such as satellite services can work in alignment with this technological progress. Satellite components of IMT systems should contribute to 5G evolution and complement it through Low Earth Orbit (LEO) satellite constellations, more than compete against terrestrial 5G in some currently underserved markets.

A. How can CITC ensure the demand coming from other sectors for other radio services have interference-free access to spectrum, while fostering the innovative commercial use of spectrum?
B. What methodology can CITC use to decide between competing or conflicting demand from different radio services?

11. Frequency Bands

Additional frequency bands have recently been identified for IMT to be utilized by 5G technology[64]. Moreover, other bands are under review in the current study period for the upcoming WRC-23 to decide whether it can be identified for IMT as well. On the other hand, multiple frequency bands are being designated for other non-cellular technologies; some are license-exempt, across the globe. In light of all factors discussed in previous sections and the frequency bands mentioned in this section, CITC is drafting its outlook on spectrum allocated for commercial and innovative use, including a roadmap of what spectrum is going to be released, when, and how. The Figure below shows a list of the main bands under focus.

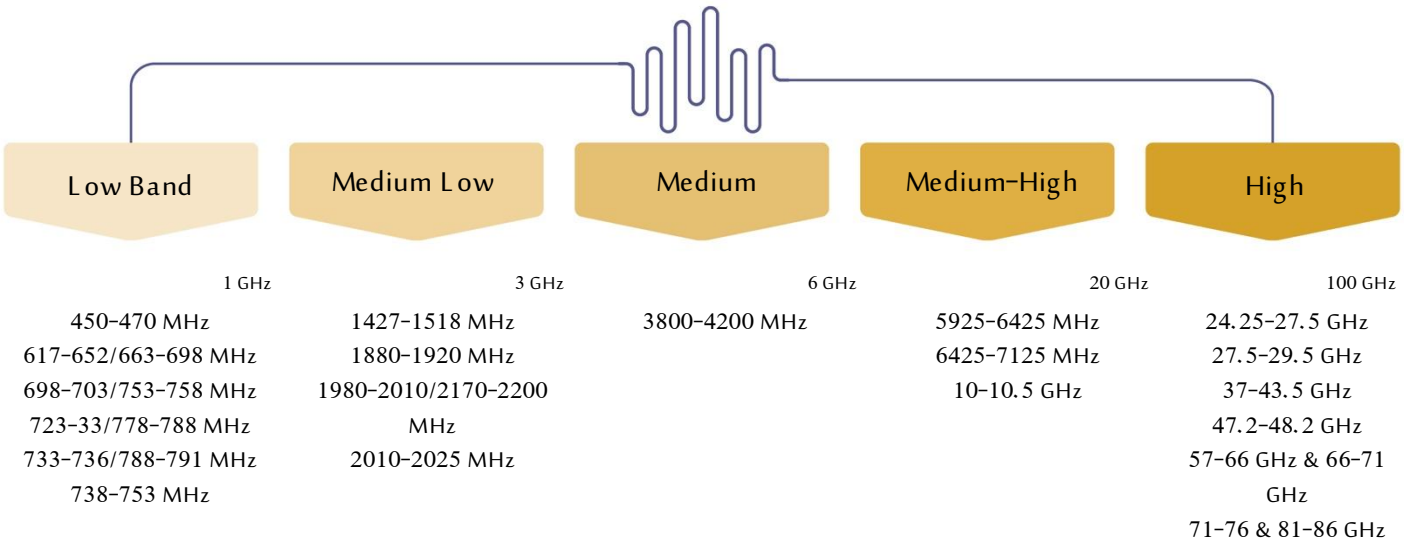


Figure 13: Targeted bands for release for commercial and innovative use

Initial studies by CITC looked into multiple factors to develop an understanding of the criteria that should influence its roadmap for IMT spectrum release over the coming years. CITC searched and sought preliminary inputs on international harmonization, global trend, end-users devices ecosystem, support of equipment by manufacturers, and demand by existing operators in the local market, to develop a prioritization matrix on which bands need to be released first. Initial results showed that the remaining parts of the 700 MHz band (723-733/778-788 MHz), the 1500 MHz and the 26 GHz bands have potential priority to be released by late 2020, early 2021.

A. Should CITC release spectrum as it becomes available? Or should it be done in a phased manner, i.e., defer the release of some spectrum bands until they can be awarded collectively in bundles? What factors should CITC consider when determining the release timeframe for spectrum, e.g., availability of complementary high and low-frequency bands, etc.? Please elaborate.

[64] See: https://news.itu.int/wrc-19-agrees-to-identify-new-frequency-bands-for-5g/

B. How can CITC develop a timing roadmap for commercial spectrum award(s)? What factors should be included in the prioritization matrix, and what should be the appropriate weighting of each element?

C. To the best of your knowledge, can you suggest a commercial spectrum award roadmap? Please explain.

11.1. 450-470 MHz

Frequency band 450-470 MHz being used worldwide mainly for PMR / PAMR services. Some countries already have networks providing connectivity for millions of devices using CDMA450 or LTE450 technology. These networks have been assigned nationwide licenses, and existing CDMA networks are likely to migrate toward Long Term Evolution (LTE) technology. In Saudi Arabia, this band is used mainly for Public Safety Services (UHF radio communication and TETRA Networks). In other countries, 450-470-MHz band is already adopted by the railway industry. This band is attractive to users due to its favorable propagation characteristics. These characteristics result in a spectrum which delivers good coverage along with good in-building penetration and lower infrastructure costs. The band 450-470 MHz is also identified by ITU Radio Regulations (RR) footnote 5.286AA for use by administrations wishing to implement International Mobile Telecommunications (IMT).

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
450 - 455 MHz	FIXED MOBILE 5.209 5.286 5.286A 5.286B 5.286C	COM	7, 10
455-456 MHz	FIXED MOBILE 5.209 5.286A 5.286B 5.286C	COM	7, 10
456 - 457 MHz	FIXED MOBILE	COM	7, 10
460-467 MHz	FIXED MOBILE 5.289	COM	7,10

A. What is your opinion on the utilization of the band for IMT/TETRA/RSTT services?
B. Is there a need for more sub 1 GHz spectrum for IMT/TETRA/RSTT services?
C. Do you expect that the spectrum demand for PMR TETRA radio would decline within the next five years?
D. What is your interest in the 450MHz band? Please provide information regarding the band ecosystem, implementation of 10 MHz duplex frequency split in
E. 450¬–470 MHz along with your requirements for bandwidth and indicative plan for rolling out services using this spectrum.
F. What impact will adding this spectrum have on your network performance?
G. When is the demand likely to require reallocation of the 450MHz band to IMT, if at all? Please evidence your demand assessment and provide information on UE availability.
H. What are your views on sharing and compatibility studies between the present services and IMT services? How can primary users be best protected if CITC allows the use of the 450 MHz band for providing IMT services?
I. Which allocation methodology should be used for allocating spectrum bands identified for use with 5G? Why?

11.2. 617–652/663–698 MHz

The frequency band 617–652/663–698 MHz is used in many regions of the world for digital TV. However, many countries may not utilize the band efficiently for broadcasting services. In Saudi Arabia, there is limited deployment of broadcasting services in the 600 MHz band. At the last WRC, an agenda item proposed a review of the spectrum use and studying the spectrum needs of existing services within the frequency band 470–960 MHz in Region 1. Concerning other regions, the US and Canada made the 600 MHz spectrum band available for mobile broadband. It uses 3GPP band 71/n71.

CITC is seeking to maximize and ensure the efficient allocation and use of this band. 5G applications and systems need to access different frequency bands to address requirements from the diverse range of 5G usage scenarios. The sub 1 GHz spectrum could provide in-depth and extensive coverage for eMBB, IoT, including fulfilling the demands of low latency applications and services.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
470 – 694 MHz BROADCASTING 5.149 5.291A 5.294 5.296 5.300 5.304 5.306 5.311A 5.312	470 – 614 MHz BROADCASTING Fixed 5.294 5.300 Land mobile 5.296 5.149 5.306 5.311A KSA 01 KSA 09	Broadcasting	Geneva Agreement 2006
	614 – 694 MHz BROADCASTING Fixed 5.294 5.300 Land mobile 5.296 5.149 5.306 5.311A KSA 01 KSA 09		Candidate for IMT
694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING 5.300 5.311A 5.312	694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING Fixed 5.300 5.311A KSA02	Identified for IMT	

A. What is your opinion on the current utilization of the band for broadcasting services?
B. What do you anticipate the future of Digital Broadcasting in the Kingdom to be? Do you expect that the spectrum demand for broadcasting will decline within the next five years?
C. In your opinion, how much spectrum is needed for terrestrial broadcast TV? Will the band 470–617 MHz satisfy broadcasting needs (if any)?
D. How will the growing popularity of streaming services change the need for digital terrestrial TV broadcasting?
E. Is there a need for more sub 1 GHz spectrum for IMT/5G?

F. What could be an operator's interest in the 600MHz band? Please provide information regarding the band ecosystem along with your requirements for bandwidth and indicative plan for rolling out services using this spectrum.

G. What impact will adding this spectrum have on your network performance? What impact will it have on your 5G plans?

H. When is the demand likely to require reallocation of the 600 MHz band to IMT, if at all? Please include evidence in your demand assessment and provide information on UE availability

I. What are your views on sharing and compatibility studies between broadcasting and mobile services? How can primary users be best protected if CITC allows the use of the 600 MHz band for providing IMT services?

J. How do you see the importance of international coordination for utilizing the band? Under what circumstances would you like to see the availability of the band for IMT services? Could Country A use the band for IMT, while the neighboring Country B uses the band for broadcasting? How can cross border interference between them be minimized in this scenario?

K. Which allocation methodology should be used for allocating spectrum bands identified for use with 5G? Please explain your answer and provide justification

11.3. 698-703/753-758 MHz

Some countries started using the frequency band 698-703/753-758 (B68) for IMT applications from 2015. Whilst some used and planned this band for PPDR applications, others are considering future spectrum options in the band for GSM-R applications. CITC previously consulted with mobile service providers on their desire to assign this band. However, no demand was expressed at that time. CITC intends to award this band before the end of 2020 and welcomes any proposal or suggestions for new players who could provide public services using this band.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING 5.300 5.311A 5.312	694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING Fixed 5.300 5.311A KSA02	Identified for IMT	

A. Do you agree with CITC's assessment to award 698–703/753–758 (B68) this year? Please explain your answer
B. What is an operator's interest in the use of the band? Please provide information regarding the band ecosystem.
C. What should be the appropriate assignment mechanism?
D. What should be the procedure and fees for awarding these licenses, in terms of roll-out plan and obligations associated with these licenses
E. What conditions should be applied to protect other users of the 700 MHz band and usage in adjacent frequency bands? Please justify your answer
F. What services/applications should be accommodated in the band? Are there any other international developments in the band that the CITC is not aware of? Please provide details
G. If technologies like TETRA and GSM-R services are used in this band, what are the additional measures that should be imposed to ensure co-existence with the adjacent LTE networks? How can interference be best prevented if CITC allows the use of the band?
H. Are there requirements for PPDR applications in this band in the Kingdom? Please provide justification in your answer.
I. Do you have any requirements for GSM-R in this band? If yes, when would you wish to have the availability?
J. Are MNOs currently providing all applications required by the civil users? If not, please submit a list of the applications that are underserved, along with a detailed description of each.
K. Are there spectrum needs for private civil networks using this band that would serve sectors and verticals such as the industrial and energy sectors? If yes, do you support enabling geographically limited private deployments using this band?
L. When is the demand likely to happen for this band? Provide information on network User Equipment (UEs) availability.
M. Are there any other international developments in the band that the CITC is not aware of? (Please provide details)

11.4. 723–733/778–788 MHz

The frequency band 700 MHz is a harmonized band for terrestrial systems capable of providing wireless broadband services. The band has excellent propagation characteristics and could improve coverage for mobile telephony and mobile broadband in the Kingdom. As a result of the recent spectrum auctions, CITC has awarded 2x20 MHz in B28 and 2x10 MHz still remains unassigned. CITC intends to award the unsold block either by the end of 2020 or in early 2021.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
694 – 790 MHz	694 – 790 MHz	Identified for IMT	
MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING 5.300 5.311A 5.312	MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING Fixed 5.300 5.311A KSA02		

A. Do you agree with CITC's initial assessment that the main benefit of the sub-GHz bands is to provide substantially higher coverage and significantly higher average spectral efficiency? Please justify your answer
B. Do you agree with CITC's assessment to award the remaining 2x10 MHz in 700 MHz this year? Please explain your answer
C. What is an operator's interest in the use of the 700 MHz band? In responding , please indicate your views on what assignment method should be applied? What is the procedure and fees for acquiring these licenses in terms of roll-out plans and obligations associated with these licenses?
D. What conditions shall be applied to protect other users of the 700 MHz band and usage in adjacent frequency bands? Please justify your answer

Are there any other international developments in the band that the CITC is not aware of? Please provide details

11.5. 733-736/788-791 MHz

It has come to CITC's attention that some countries have identified the band 733-736/788-791 MHz for PPDR applications. Others plan to use this band for M2M applications. CITC welcomes any ideas and suggestions for providing public services using this band or services that can contribute to satisfying the needs.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING	694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING Fixed 5.300	Identified for IMT	

5.300 5.311A 5.312	5.311A KSA02		
790 – 862 MHz FIXED MOBILE except aeronautical mobile 5.316B 5.317A BROADCASTING 5.312 5.319	790 – 862 MHz FIXED MOBILE except aeronautical mobile 5.316B 5.317A BROADCASTING KSA 02	Identified for IMT	

A. To what extent are you interested in the band? Please provide information regarding the band ecosystem along with your indicative plan for rolling out services using this spectrum.
B. Are there requirements for PPDR applications for this band in the Kingdom? Provide justifications.
C. What services/applications should be accommodated in the band? Are there any other international developments in the band that the CITC is not aware of?
D. If applications like PPDR and M2M are used in this band, are there additional measures that should be imposed to ensure co-existence with adjacent networks? How can interference be best prevented if CITC allows the use of the band?
E. Are MNOs providing all applications required by civil users? If not, please submit a list of them.
F. Are there spectrum needs for private civil networks using this band that serves sectors and verticals such as the industrial and energy sectors? If yes, do you support enabling geographically limited private deployments?
G. Which allocation methodology should be used for allocating the band?
H. Are there any other international developments in the band that the CITC is not aware of? (Please provide details)

11.6. 738-758 MHz

It has come to CITC's attention that some countries are awarding the band 738-753 MHz for use by terrestrial systems capable of providing wireless broadband services, as a supplementary downlink band (i.e. limited to base station transmission). CITC is in favor of awarding this band for mobile operators to provide broadband services.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING 5.300 5.311A 5.312	694 – 790 MHz MOBILE except aeronautical mobile 5.312A 5.317A BROADCASTING Fixed 5.300 5.311A KSA02	Identified for IMT	

A. Do you agree with CITC's initial assessment to assign the band for mobile operators to provide broadband services? Please justify your answer
B. To what extent are you interested in the band? Please provide information regarding the band ecosystem along with your indicative plan for rolling out services using this spectrum.
C. Would you be interested in seeing the 738 – 758 MHz band used to enable an SDL for 4G, 5G, or another technology, and within what timeframe?
D. What services/applications should be accommodated in the band? Are there any other international developments in the band that the CITC is not aware of?
E. Which allocation methodology should be used for allocating the band?
F. What are the technical measures that should be imposed to avoid causing out of band emission to the adjacent bands?
G. Are there spectrum needs for private civil networks using this band to provide services for various sectors and verticals such as the industrial and energy sectors? If yes, do you support enabling geographically limited private deployments
H. What minimum coverage requirements would you see associated with spectrum usage rights?

11.7. 1427-1518 MHz

The frequency band 1427-1518 is allocated for mobile services globally; the band is identified for IMT but with some differences in the IMT ranges between regions and administrations. The IMT identification for the band has been in force since WRC-15, but the use of the band for IMT is still very limited worldwide, with very slow growth in the ecosystem of the band. A lot of discussions are going on concerning the best way to use the band. However, there is

no consensus on the matter between different countries and industrial stakeholders. Currently, 3GPP has identified many different arrangements for the band for (4G and 5G) services, with different duplexing schemes including (FDD, TDD, and SDL). This fragmentation confuses regulators worldwide on how and when to release this valuable frequency band. Also, attention must be paid to ensure protection for the adjacent band, and terrestrial utilization of this band shouldn't overpower "soft" signals from Global Positioning System (GPS) satellites[65].

CITC is seeking a clearer vision on the international development of the band, and the ecosystem and potential growth of the band. CITC might consider awarding this band over the next 12 months.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
1 427 – 1 429 MHz SPACE OPERATION (Earth-to-space) FIXED MOBILE except aeronautical mobile 5.341A 5.341B 5.341C 5.338A 5.341	1 427 – 1 429 MHz SPACE OPERATION (Earth-to-space) FIXED MOBILE except aeronautical mobile 5.341A 5.338A 5.341 KSA 02	Identified for IMT	
1 429 – 1 452 MHz FIXED MOBILE except aeronautical mobile 5.341A 5.338A 5.341 5.342	1 429–1 452 MHz FIXED MOBILE except aeronautical mobile 5.341A 5.338A 5.341 KSA 02	Identified for IMT	
1 452 – 1 492 MHz FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B 5.341 5.342 5.345	1 452 – 1 492 MHz FIXED MOBILE except aeronautical mobile 5.346 BROADCASTING BROADCASTING-SATELLITE 5.208B 5.341 5.345 KSA 02	Identified for IMT	

[65] Spectrum Interference Issues: Ligado, the L-Band, and GPS, Congressional Research Service, May 28, 2020

1 492 – 1 518 MHz FIXED MOBILE except aeronautical mobile 5.341A 5.341 5.342	1 492 – 1 518 MHz FIXED MOBILE except aeronautical mobile 5.341A 5.341 KSA 02	Identified for IMT	

A. What is an operator's interest in the 1500 MHz band? Please provide information regarding the band ecosystem along with your requirements for bandwidth and indicative plan for using this spectrum
B. What impact will adding this spectrum have on your network performance? What impact will it have on your 5G plans?
C. The band has been identified for IMT in region one since WRC-15, but the development of the band for IMT is still minimal. What in your view, the reasons behind the limited worldwide IMT use of the band until now?
D. The frequency band (1452-1492) is identified partially in region 1 for IMT. Do you see this as an obstacle toward using the band for IMT in Saudi Arabia or toward harmonized use of the band? If so, please explain?
E. There are services, other than IMT, currently allocated in the band, including Broadcasting and Satellite Broadcasting services. What is your opinion on the current and future utilization of the band for those services?
F. There are critical services and applications in the adjacent band such as radio navigation services, which used for the Global Navigation Satellite System (GNSS) and mobile satellite services (MSS). What are your views on sharing and compatibility studies between the adjacent services and mobile services? How can they be protected if CITC allows the use of the 1500 MHz band for providing IMT services, and what conditions should be applied to protect them? Please justify your answer
G. There are many channel arrangements standardized by 3GPP for this band, with different duplexing schemes (TDD, FDD, and SDL)? Which 3GPP band and channelization arrangement should be used for assigning the band? Why? Does this have any link with protecting the current services?
H. Do you agree with CITC's assessment to assign the band for mobile operators to provide 5G broadband services? Please justify your answer

11.8. 1880–1920 MHz

The frequency band 1880–1920 MHz was identified for IMT in the 1990s. Many countries released part of this band a long time ago to be used for 3G systems. Currently, there is minimal use for this band for TDD 4G applications under band (B39), with a small ecosystem compared to other bands below 3 GHz. It is also important to note that the sub-band 1880–1900 MHz is covered by CITC RI040 for DECT phones.

It has come to CITC's attention that there are studies currently suggesting the use of part of the band (specifically 1900–1920 MHz) for future Railway's LTE applications. As these applications are very important for safety-of-life and to monitor and control the railway traffic, it is very important to hear from all stakeholders on the requirements of different applications in the near future. With regard to IMT needs in the band, CITC has noticed that there is no national demand for IMT applications in the band when conducted internal consultations with the local operators. This could be due to the limited growth of the band's ecosystem and difficulties in protecting adjacent bands since this band lies between two of the most valuable IMT bands (1800 and 2100 MHz). CITC is willing to hear from all stakeholders to ensure the efficient allocation and use of this band, and to consider any demand from different industries and stakeholders.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
1 710 – 1 930 MHz FIXED MOBILE 5.384A 5.388A 5.388B	1 710 – 1 880 MHz FIXED MOBILE 5.384A 5.388A 5.388B 5.149 5.341 5.385 5.388 KSA 02	Identified for IMT	
	1 880 – 1 920 MHz Fixed MOBILE 5.384A 5.388A 5.388B 5.149 5.341 5.385 5.388 KSA 02	Identified for IMT	

5.149 5.341 5.385 5.386 5.387 5.388	1 920 – 1 930 MHz FIXED MOBILE 5.384A 5.388A 5.388B 5.149 5.341 5.385 5.388 KSA 02	Identified for IMT	

A. There is a range of different applications and services allocated in the band, as illustrated above. What do you suggest CITC should adopt from these applications and services? Please provide information regarding the ecosystem along with your requirements for bandwidth and the plan for rolling out services using this spectrum.
B. Do you think that part of the band should be licensed for IMT, i.e., 1880–1920 or just 1900–1920 MHz in order to protect DECT?
C. What is an operator's interest in the 1900 MHz band? Please provide information regarding the band ecosystem along with your requirements for bandwidth and indicative plan for rolling out services using this spectrum.
D. What impact will adding this spectrum have on your network performance? What impact will it have on your 5G plans?
E. The band was identified for IMT over 20 years ago. Some countries assigned the band, or part of the band, to operators a long time ago. However, the development of the band for IMT remains limited compared to other bands below 3 GHz. What are the reasons behind the limited use of the band until now?
F. What could be an operator's interest in the use of the 1900 MHz band? Please indicate your views on Which assignment mechanism shall be applied, Roll out plan, and Obligations associated with these licenses,
G. Some reports are suggesting the use of the band for applications other than IMT, such as LTE for Railway and Unmanned Aircraft System[66]. Do you have requirements for any application other than IMT in this band? If yes, please provide details about the application and the needed timeline to use the band.

11.9. 1980–2010 / 2170–2200 MHz

The frequency band 1980–2010/2170–2200 MHz has been allocated for both mobile and mobile satellite services and identified for IMT for a very long time. The band is adjacent to the band 2100 MHz band (1920–1980/2110–2170

[66] ECC Report 314, Co-existence between Future Railway Mobile Communication System (FRMCS) in the frequency range 1900–1920 MHz and other applications in adjacent bands, May 2020

MHz), which is used extensively worldwide for providing 3G and 4G services, and has recently been standardized for 4G and 5G use (3GPP band 65/n65). CITC assumes that the use of the 1980–2010/2170–2200 MHz band will serve as an extension to the current use in 2100 MHz, providing mobile operators with larger bandwidth assignments in this important frequency range.

CITC has noted some recent interest in using the band for LTE Air to ground technology, to provide low latency high-speed internet connectivity to the aircraft passengers and also notes that other bands can be used to provide those services. CITC is also aware of the demand from some satellite providers, to provide IMT satellite services in the band. In this respect, WRC-19 recommended some measures to ensure coexistence between the satellite and terrestrial components of IMT. CITC is seeking to hear from all stakeholders to ensure the efficient allocation and use of this band, and to consider any demand for the band from industries and stakeholders.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

1980–2010 MHz			
ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
1 980 – 2 010 MHz FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.351A 5.388 5.389A 5.389B 5.389F	1 980–2 010 MHz FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) 5.351A 5.388 5.389A 5.389B KSA 02	Identified for IMT	
2170–2200 MHz			
ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
2 170 – 2 200 MHz FIXED MOBILE MOBILE-SATELLITE (space-to-Earth) 5.351A 5.388 5.389A 5.389F	2 170 – 2 200 MHz FIXED MOBILE MOBILE-SATELLITE (space-to-Earth) 5.351A 5.388 5.389A KSA 02	Identified for IMT	

A. There are competing demands in the band from different applications and services as illustrated above. What do you recommend CITC should adopt from these applications and services? Please provide information regarding the ecosystem along with your requirements for bandwidth and plan for rolling out services using this spectrum.

B. What impact will adding this spectrum have on your network performance? What impact would it have on your 5G plans?

C. The band was allocated for mobile and mobile satellite services a long time ago, with IMT identifications for both components: however, CITC has seen limited growth either satellite or terrestrial service in the band. What in your view, the reasons behind the limited use of the band so far?

D. Do you agree with CITC's assessment to assign the band to mobile operators to provide broadband services as an extension to the current ecosystem in the 2100 MHz band? Please justify your answer

E. Do you agree with CITC assessment to award the 2100 MHz band this year for IMT? Please justify your answer

F. What is an operator's interest in the use of the 2100 MHz band? Please indicate your views on which assignment mechanism should be applied, Roll out plan and Obligations associated with these licenses

11.10. 2010–2025 MHz

The frequency band 2010–2025 MHz has been allocated for mobile services, and identified for IMT for a very long time. The band is identified by 3GPP for LTE as B35 for TDD. However, CITC has seen very limited growth in the ecosystem for terrestrial IMT in the band. Along with the IMT identification, the band is identified for High Altitude Platforms (HAPS) also, but there has been limited use for this application as well. Also, the band is allocated for Mobile Satellite services in Region 2, and it has come to CITC's attention that there are some intentions to use this band for Narrowband IoT applications in Region 2.

Given the lack of use for IMT services for more than 15 years, The European Union adopted a decision in 2016 to make this band available for mobile wireless video links and cordless cameras. CITC is seeking to hear from all stakeholders to ensure the efficient allocation and use of this band, and to consider any demand from either industry or any other stakeholders.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
2 010 – 2 025 MHz FIXED MOBILE 5.388A 5.388B 5.388	2 010 – 2 025 MHz FIXED MOBILE 5.388A 5.388B 5.388 KSA 02	Identified for IMT	

A. There are various applications and services allocated and identified in the band as illustrated above. What do you recommend CITC to adopt out of the listed application and services? Please provide information regarding the ecosystem along with the bandwidth requirements for rolling out services using this spectrum.

B. What impact would adding this spectrum to your 5G network have on its performance? What impact will it have on your 5G deployment plans?

C. Based on your interest of the band, please indicate your views on which assignment mechanism should be applied, what obligations should be associated with the licenses

D. The band has been identified for IMT for a long time; however, the development of the band for IMT is still limited compared to other bands below 3 GHz. What in your view, the reasons behind IMT's limited use of the band until now?

E. The band is adjacent to some IMT applications and to other services as well, what are your views on sharing and compatibility studies for this band with these services, considering your recommended application in the above questions? How can primary users be best protected if CITC allows the use of the band for providing IMT services?

11.11. 3800-4200 MHz

The usage of Fixed Satellite Service (FSS) in the band 3800-4200 MHz varies across the world. Historically, the 3800-4200 MHz band has been used by apparatus licensed FSS earth stations (space-to-Earth) (i.e., earth receive) and the Fixed Service (i.e., point-to-point links). However, there are no assignments in the Kingdom for the Fixed Service in this band and limited usage of FSS. Meanwhile, some countries have released or plan to release 3800-4200 MHz for 5G. Others have launched public consultations concerning the release of portions of these bands for 5G.

In the recent auction held in the Kingdom, 300 MHz of spectrum was awarded to the three mobile operators in the 3.5 GHz band to provide 5G services. There could be extra demand for 5G services in the Kingdom in the future, which could lead to the need for additional spectrum, e.g., making 200 MHz contiguous channels available, noting the increased support for band n77 by network and device vendors globally. Other countries are exploring the concept of spectrum sharing between existing services and 5G services, highlighting the potential of the 3.8 GHz to 4.2 GHz sub-band as an excellent opportunity given its characteristics.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
3 800 – 4200 MHz FIXED FIXED-SATELLITE (space-to-Earth) Mobile	3 800 – 4 200 MHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE KSA 01	 FSS earth stations UWB Applications	 Potential Future IMT Band

A. Do you agree with CITC that there is limited existing usage for FSS in the 3.8-4.2 GHz within the Kingdom? CITC would like to seek views and comments on suitable technical parameters, including the reasonable amount of guard band needed to reduce potential interference between IMT and FSS use in the band.

B. Are you in favor of providing 5G fixed/mobile access services in this band? Do you think that other technical solutions should be considered to provide this type of service?

C. What are the future requirements of FSS earth stations in the 3800-4200 MHz band? Does this differ by geographical area and/or segment of the band?

D. If licensed FSS earth stations are affected by re-planning activities in the 3800-4200 MHz band, what alternative deployment options could be considered?

E. What are the future requirements for 5G services in the 3800-4200 MHz band, and what arrangements should be considered? Does this differ by geographical area and/or segment of the band? Please provide information regarding the band ecosystem along with your indicative plan for rolling out services using this spectrum.

F. Do you support enabling geographically limited private deployments in the 3.3-4.2 GHz band, either using a set-aside portion of the band or as secondary users under the condition of not affecting the operation of licensed/primary users? What would be the appropriate geographic boundaries for such licenses? What would be an appropriate duration for such licenses? Please justify your answers.

G. Please provide information on network and UEs availability

H. What new types of applications do you foresee could access this spectrum on a shared basis? Please provide details on the potential applications and their characteristics of use.

I. Provide your view on the possibility of spectrum sharing, and how to enable enhanced sharing, in this band.

J. What licensing mechanisms are appropriate (spectrum, apparatus or class licensing)?

K. Do you think it is important to implement the flexible use of the 3.4-4.2 GHz band for both access and backhauling/transport applications?

L. How can cross-border interference be best prevented in the 3.8-4.2 GHz band? Please justify your answers?

M. Are there spectrum needs for private networks using 3.8-4.2 GHz for various sectors and verticals such as the industrial and energy sectors?

N. Are there any other international developments in the 3800-4200 MHz band that the CITC should be aware of?

11.12. 5925-7125 MHz

The frequency band 6425-7125 MHz is used by medium/high capacity, long-distance fixed terrestrial links (point-to-point) of mobile broadband networks. Mid-band spectrum offers higher capacity than low-band (sub-1GHz) and greater coverage than high-bands (millimeter waves). WRC-19 agreed to study the band 6425-7125 MHz for a possible identification for IMT in the run-up to WRC-23. While decisions on the future identification of the 6425-7125 MHz band will be taken at WRC-23, there is an ongoing debate across the globe on the usage of the broader 5925-7125 MHz range. There is a suggestion that this band might be used to offload traffic from mobile networks to WiFi, especially with 5G rollout, and some countries have decided to use this band for WiFi technology.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
5 925 – 6 700 MHz FIXED 5.457 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C 5.149 5.440 5.458	5 925 - 6 700 MHz FIXED FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.149 5.440 5.458 KSA 01 KSA 09	FSS earth stations Fixed links UWB Applications	 ITU-R F.383-9 Recommends 1
6 700 – 7 075 MHz FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 MOBILE 5.458 5.458A 5.458B	6 700 - 7 075 MHz FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 MOBILE 5.458 5.458A 5.458B KSA 01	FSS earth stations Fixed links UWB Applications	

7 075 – 7 145 MHz FIXED MOBILE 5.458 5.459	7 075 – 7 145 MHz FIXED MOBILE 5.458 KSA 10	Fixed links UWB Applications	 ITU-R F.385-10 Annex 1

A. Are you in favor of identifying the 6425-7125 MHz band for IMT applications? Please justify your answer.
B. Are you in favor of identifying the 5925-7125 MHz band for Wi-Fi applications on a license-exempt basis? Please justify your answer
C. When are the demand and technology likely to develop, if at all? Please elaborate
D. What is your view on the co-existence between WiFi and the incumbent services, such as the Fixed Service (FS), Fixed-Satellite Service (FSS), Radio astronomy (RAS), Intelligent Transport Systems (ITS) applications? How can the existing services be best protected?
E. What is your view on the co-existence between WiFi and IMT services?

11.13. 10-10.5 GHz

Frequency band 10-10.5 GHz is allocated for many services in the radio regulation, which include Fixed, Mobile, Radiolocation and Earth exploration satellite services. The band is used heavily by medium/high capacity, long-distance fixed terrestrial links (point-to-point).

WRC-19 agreed to study the band for a possible identification for IMT in the run-up to WRC-23, as it can offer higher capacity than low-band and better coverage than high-bands (millimeter waves). As per the discussions in WRC-19, the initial thought for using this band for IMT is to be used in high dense areas, since the use for fixed links could be limited for long distance in suburban and rural areas. ITU-R study groups will make detailed coexistence and sharing studies with different operation scenarios with all current and adjacent services to have a clearer vision by WRC-23.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
10 – 10.4 GHz EARTH EXPLORATION-SATELLITE (active) 5.474A 5.474B 5.474C FIXED MOBILE RADIOLOCATION Amateur 5.474D 5.479	10 – 10.4 GHz EARTH EXPLORATION-SATELLITE (active) 5.474A 5.474B 5.474C FIXED MOBILE RADIOLOCATION Amateur 5.474D 5.479	Fixed: 10-10.680 GHz	ITU-R F.747-1 Recommends 4
10.4 – 10.450 GHz FIXED MOBILE RADIOLOCATION Amateur	10.4 – 10.450 GHz FIXED MOBILE RADIOLOCATION Amateur	Fixed: 10-10.680 GHz	ITU-R F.747-1 Recommends 4
10.45 – 10.5 GHz RADIOLOCATION Amateur Amateur-satellite 5.481	10.45 – 10.5 GHz RADIOLOCATION Amateur Amateur-satellite	Fixed: 10-10.680 GHz	ITU-R F.747-1 Recommends 4

A. Do support identifying the 10-10.5 GHz band for IMT applications? Please justify your answer.
B. What is your view on the co-existence between IMT and the incumbent services, which include Fixed, Mobile, Radiolocation and Earth exploration satellite services? How can the existing services be best protected?
C. The band is allocated for fixed services for a long time, with heavy use for point to point application and less use for PMP applications including FWA. What are your views on using the band for FWA applications as the band already allocated for fixed service? Please justify your answers.

11.14. 24.25-27.5 GHz

At WRC-19, after intensive discussions, the conference identified the band 24.25-27.5 GHz along with other mm-waves for IMT. The expected social-economic impact of allocating the mm-waves for 5G networks is significant: the

implementation of 5G applications for Industry 4.0 and connected transport promises many benefits. The band 24.25–27.5 GHz has the largest worldwide interest of mm-waves. Some countries have already auctioned the band and many other countries have announced their plans to release it as the first 5G mm-wave band. The mm-wave era of providing mobile services will provide ultra-high capacity with the very high bandwidth of these bands. However, the use of these bands is linked with many technical and financial challenges due to the weak propagation characteristics of these bands, which require massive numbers of stations in the band.

On the other hand, WRC-19's decision to identify the band came with many conditions to protect the current working services and applications either in the band or in the adjacent bands, especially earth exploration services, which are currently used for weather forecasts applications. After extensive discussions, the conference adopted conditions on unwanted emissions to protect these services.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
24.25 – 24.45 GHz FIXED	24.25 – 24.45 GHz FIXED KSA 03		Potential Future IMT Band
24.45– 24.65 GHz FIXED INTER-SATELLITE	24.45 – 24.65 GHz FIXED INTER-SATELLITE KSA 03		Potential Future IMT Band
24.65 – 24.75 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE	24.65 – 24.75 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE KSA 03		Potential Future IMT Band
24.75 – 25.25 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.532B	24.75 – 25.25 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.532B KSA 03		Potential Future IMT Band

25.25 – 25.5 GHz FIXED INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	25.25 – 25.5 GHz FIXED INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space) KSA 03		Potential Future IMT Band
25.5 – 27 GHz EARTH EXPLORATION-SATELLITE (space-to-Earth) 5.536B FIXED INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A	25.5 – 27 GHz EARTH EXPLORATION-SATELLITE (space-to-Earth) 5.536B FIXED INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A KSA 03		Potential Future IMT Band
27-27.5 GHz FIXED INTER-SATELLITE 5.536 MOBILE	27-27.5 GHz FIXED INTER-SATELLITE 5.536 MOBILE KSA 03		Potential Future IMT Band

A. As this band is the first 5G mm-wave band, many countries around the world have adopted the band for 5G applications. What are the anticipated 5G use cases in the band for various categories of users, including verticals, and what are the expected timelines for these use cases to become available? Please justify your answer

B. Do you agree with CITC's assessment to award the 24.25-27.5 GHz for 5G this year? Please justify your answer

C. What are the future requirements for 5G services in the 24.25-27.5 GHz band, and what arrangements should be considered? Does this differ by geographical area and/or segment of the band? Please provide information regarding the band ecosystem along with your indicative plan for rolling out services using this spectrum.

D. How much spectrum is necessary for a commercially viable 5G service in the band (i.e. 400 or 800 MHz per operator)?

E. Are there any particular parts of the band that would be better suited to specific applications , or within which you would prefer to provide a particular service?

F. What are the network rollout and performance obligations to be imposed on the spectrum usage right holders?

G. With the ultra-high bandwidth of the band , CITC assumes that this band will enable many use cases across different verticals. What action do you recommend CITC should take , in order to enable these verticals in terms of the spectrum perspective? Do you recommend that CITC should continue its current practice of limiting the IMT bands to service providers or to allow users of private 5G networks to apply to the band? Please justify your answer

H. The band is adjacent to many services and applications , including critical applications such as (23.6-24) GHz , which is allocated for Earth Exploration Satellite services , which amongst other things used for weather forecast purposes. What are your views on sharing and compatibility studies for this band with these services? How can primary users be best protected if CITC allows the use of the band for providing IMT services?

I. What is the possibility of allowing geographically limited private deployments in the 24.25-27.5 GHz band?

J. What is your interest in the use of the 24.25-27.5 GHz band? Please indicate your views on what assignment method shall be applied , what is the procedure and fees for acquiring these licenses , roll out plan and indoor usage.

11.15. 27.5-29.5 GHz

The band has been allocated and used for Satellite services for a very long time. However , CITC has noticed a demand for the band as 5G band , and some countries have already assigned the band for those services.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
27.5 - 28.5 GHz FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540	27.5 - 28.5 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540 KSA 03		

28.5 – 29.1 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	28.5 – 29.1 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 KSA 03		
29.1 – 29.5 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A 5.539 5.541A MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	29.1 – 29.5 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A 5.539 5.541A MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540 KSA 03		

A. Do you recommend CITC should consider the use of 5G in this band in the kingdom? Please justify your answer
B. What is the possibility of allowing geographically limited private deployments in the band?
C. What is your opinion on the current utilization of the band for Fixed Satellite services in the Kingdom?
D. How can primary users be best protected if the band is used for providing IMT services? Please provide your views on the compatibility between FSS and mobile services within the band , and how this could be resolved if the band is shared?

11.16. 37-43.5 GHz

At WRC-19 , after intensive discussions , an agreement was made on Agenda Item 1.13 relating to millimeter-wave frequency bands for IMT. Two mmWave 5G bands received the most support from member countries , the 24.25-27.5 GHz , and 37-43.5 GHz ranges. The band 37-43.5 GHz has the contiguous spectrum necessary to provide capacity to support data-intensive 5G applications. In addition , part of this band (38-39.5 GHz) is allocated to HAPS , an emerging technology that CITC would like to explore.

Frequencies in the 37-43.5 GHz band are used by the fixed-satellite service in some countries , although the exact frequencies vary around the world. As a result , countries will only deploy 5G services in the sub-bands they find most convenient. Some countries are auctioning the band 37.6-40 GHz. In Europe , this band is reserved for high-density fixed satellite services , and there is potential for 5G services above 40 GHz. In Saudi Arabia , the band below 40 GHz

is heavily used for fixed (point-to-point applications). CITC is proposing to make the frequency band 37 43.5 GHz available for flexible use for terrestrial services.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

37 – 43.5 GHz			
ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
37 – 37.5 GHz FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) 5.547	37 – 37.5 GHz FIXED MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) 5.547 KSA 03	Fixed links	T/R 12-01 Annex A Potential Future IMT Band
37.5 – 38 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (SPACE-TO-EARTH) 5.547	37.5 – 38 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile SPACE RESEARCH (space-to-Earth) Earth exploration-satellite (SPACE-TO-EARTH) 5.547 KSA 03	Fixed links	T/R 12-01 Annex A Potential Future IMT Band
38 – 39.5 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE Earth exploration-satellite (space-to-Earth) 5.547	38 – 39.5 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE Earth exploration-satellite (space-to-Earth) 5.547 KSA 03	Fixed links	T/R 12-01 Annex A Potential Future IMT Band
39.5 – 40 GHz FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547	39.5 – 40 GHz FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE MOBILE-SATELLITE (space-to-Earth) Earth exploration-satellite (space-to-Earth) 5.547 KSA 03		Potential Future IMT Band

40 – 40.5 GHz EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth)	40 – 40.5 GHz EARTH EXPLORATION-SATELLITE (Earth-to-space) FIXED FIXED-SATELLITE (space-to-Earth) 5.516B MOBILE MOBILE-SATELLITE (space-to-Earth) SPACE RESEARCH (Earth-to-space) Earth exploration-satellite (space-to-Earth) KSA 03		Potential Future IMT Band
40.5 – 41 GHz FIXED FIXED-SATELLITE (space-to-Earth) BROADCASTING BROADCASTING-SATELLITE Mobile 5.547	40.5 – 41 GHz FIXED FIXED-SATELLITE (space-to-Earth) BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 KSA 03	Fixed links	ITU-R F.2005-0 Annex 3 Potential Future IMT Band
41 – 42.5 GHz FIXED FIXED-SATELLITE (space-to-Earth) 5.516B BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551F 5.551H 5.551I	41 – 42.5 GHz FIXED FIXED-SATELLITE (space-to-Earth) BROADCASTING BROADCASTING-SATELLITE Mobile 5.547 5.551H 5.551I KSA 03	Fixed links	ITU-R F.2005-0 Annex 3 Potential Future IMT Band
42.5 – 43.5 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE except aeronautical mobile RADIO ASTRONOMY 5.149 5.547	42.5 – 43.5 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE except aeronautical mobile RADIO ASTRONOMY 5.149 5.547 KSA 03 KSA 09	Fixed links	ITU-R F.2005-0 Annex 3 Potential Future IMT Band

A. What are the spectrum requirements for FSS in the 37–43.5 GHz band in the Kingdom? CITC would like to seek views and comments on the suitable technical parameters, including a reasonable amount of guard band needed to reduce potential interference between IMT and FSS use in the band.
B. Do you think there should be restrictions on the geographic areas in which new FSS earth stations can be deployed in the frequency band 37.5 40 GHz?
C. How can the fixed service applications be best protected if the band 37–43.5 GHz is assigned to provide 5G applications?
D. What are the future requirements for 5G services in the 37–43.5 GHz band, and what arrangements should be considered? Does this differ by geographical area and/or segment of the band? Please provide information regarding the band ecosystem, along with your indicative plan for rolling out services using this spectrum.
E. Do you agree with CITC's intention to make the frequency band 37 43.5 GHz available for flexible use for terrestrial services? Please justify your answer.
F. How can cross-border interference be best prevented in the 37–43.5 GHz band? Please justify your answer
G. What is the possibility of allowing geographically limited private deployments in the 37–43.5 GHz band?
H. Which types of licenses are expected for licensing flexible use in 37–43.5 GHz frequency bands, to support a variety of 5G technologies, applications, and business cases? How long should the license duration be?
I. What network rollout and performance obligations should be imposed on the spectrum usage right holders?
J. Do you recommend that CITC should make some of this band available for use by HAPS technology? Please elaborate.

11.17. 47.2 – 48.2 GHz

The frequency band 47.2–48.2 GHz is identified for IMT in region two and another 69 countries from regions 1 and 3; Saudi Arabia is one of them as stated in 5.553B of the Final Acts (WRC-19) under Resolution 243. It recently came to CITC's attention that the USA has awarded[67] the band mentioned above for mobile operators to provide a better service and to enhance 5G deployment. CITC is taking into consideration the global trends in enabling the mmWave bands to provide IMT/5G services, especially for dense hot-spot/small cell/local networks. Parts of this band are allocated to HAPS as well.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

[67] See: https://www.fcc.gov/auction/103/round-results

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
47.2 – 47.5 GHz FIXED FIXED-SATELLITE (space-to-Earth) 5.552 MOBILE 5.552A	47.2 – 47.5 GHz FIXED FIXED-SATELLITE (space-to-Earth) 5.552 MOBILE 5.552A KSA 03	FSS Earth Station HAPS	Candidate for IMT
47.5 – 47.9 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A MOBILE	47.5 – 47.9 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.552 (space-to-Earth) 5.516B 5.554A MOBILE KSA 03	FSS Earth Station	Candidate for IMT
47.9 – 48.2 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE 5.552A	47.9 – 48.2 GHz FIXED FIXED-SATELLITE (Earth-to-space) 5.552 MOBILE 5.552A KSA 03	FSS Earth Station HAPS	Candidate for IMT

A. What is the suitable time to release the 47.2 – 48.2 GHz band? Please justify your answer
B. Is there any equipment that supports 47.2 – 48.2 GHz? If they are not currently available, when do you expect them to be available? Please justify your answer
C. What is an operator's interest in the use of the 47.2 – 48.2 GHz band? In responding, please indicate your views on what assignment method shall be applied? what is the procedure and fees for acquiring these licenses including roll out plan, obligations associated with these licenses, indoor usage
D. What conditions shall be applied for IMT systems to protect existing users in the 47.2 – 48.2 GHz band, (particularly FSS and FS users) and usage in adjacent frequency bands? Please justify your answer
E. What are the future satellite services trends and potential applications in the band?
F. Do you recommend that CITC should make some of this band available for use by HAPS technology? Please elaborate.

11.18. 66-71 GHz

The band 66-71 GHz was identified for IMT at WRC-19. There is an extensive ecosystem for using the 66-71 GHz band as an extension to the 57-66 GHz license-exempt band. The addition of this unlicensed band, with its lower atmospheric attenuation, enhances the scope of existing applications and offers new possibilities, especially in the transportation sector. This band is under consideration as both a Wi-Gig expansion band and a future home for unlicensed 5G (NR-U) systems. The importance of the 66-71 GHz band for both Wi-Gig and 5G is reflected in the WRC-19 resolution, which invited the ITU-R study groups to develop co-existence measures for these and other wireless access systems. Some countries have decided to use a licence-exempt approach in this band and to implement common technical conditions for short-range wideband data transmission systems and fixed wireless systems. CITC intends to designate the 66-71 GHz band as a license-exempt band.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
66 - 71 GHz INTER-SATELLITE MOBILE 5.553 5.558 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554	66 - 71 GHz INTER-SATELLITE MOBILE 5.553 5.558 MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554 KSA 03		Potential Future IMT Band

A. Please provide your comments on CITC's proposal to designate the band 66-71 GHz for license-exempt operations on a no-protection, no-interference basis. Please justify your answer
B. Are there needs to license the band for IMT services?
C. Are there needs for track-to-train wireless systems in the fixed services to provide broadband connectivity to rail passengers using the 66-71 GHz band? If yes, please justify your answers and provide details.

11.19. 71-76 & 81-86 GHz

The frequency bands 71-76 GHz and 81-86 GHz are allocated on a primary basis to the fixed service globally. In Saudi Arabia, the E-band (71-76 GHz paired with 81-86 GHz) is used for fixed services. These frequency bands have also become strategically important for high-capacity fixed-service links, including backhaul for future mobile networks. There is a vibrant radio equipment ecosystem for transport/backhauling applications in the 71-76 GHz/81-86 GHz,

with the availability of radios supporting the entire band and also the potential for using the band for fixed wireless access applications.

The band allocation in the National Frequency Allocation Table (NFAT) is shown below:

ITU Region 1 Band Allocations and Footnotes	KSA Band Allocations and Footnotes	Usage	Notes
71 – 74 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth)	71 – 74 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth) KSA 03	Fixed: 71-76 GHz	ITU-R F.2006-0 Potential Future IMT Band (66 – 76 GHz)
74 – 76 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING-SATELLITE Space research (space-to-Earth) 5.561	74 – 76 GHz FIXED FIXED-SATELLITE (space-to-Earth) MOBILE BROADCASTING BROADCASTING-SATELLITE Space research (space-to-Earth) 5.561 KSA 03	Fixed: 71-76 GHz	ITU-R F.2006-0 Potential Future IMT Band (66 – 76 GHz)
76 – 77.5 GHz RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	76 – 77.5 GHz RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149 KSA 03 KSA 04 KSA 09	SRD: 76-77 GHz Short Range Radars	
77.5 – 78 GHz AMATEUR AMATEUR-SATELLITE RADIOLOCATION 5.559B Radio astronomy Space research (space-to-Earth) 5.149	77.5 – 78 GHz AMATEUR AMATEUR-SATELLITE RADIOLOCATION 5.559B Radio astronomy Space research (space-to-Earth) 5.149 KSA 03 KSA 06 KSA 09		
78 – 79 GHz RADIOLOCATION Amateur Amateur-satellite	78 – 79 GHz RADIOLOCATION Amateur Amateur-satellite		

Radio astronomy Space research (space-to-Earth) 5.149 5.560	Radio astronomy Space research (space-to-Earth) 5.149 5.560 KSA 03 KSA 09		
79 – 81 GHz RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149	79 – 81 GHz RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite Space research (space-to-Earth) 5.149 KSA 03 KSA 09		
81 – 84 GHz FIXED 5.338A FIXED-SATELLITE (Earth-to-space) MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) 5.149 5.561A	81 – 84 GHz FIXED 5.338A FIXED-SATELLITE (Earth-to-space) MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY Space research (space-to-Earth) 5.149 5.561A KSA 03 KSA 09	Fixed: 81-86 GHz	ITU-R F.2006-0 Potential Future IMT Band (81 – 86 GHz)
84 – 86 GHz FIXED 5.338A FIXED-SATELLITE (Earth-to-space) 5.561B MOBILE RADIO ASTRONOMY 5.149	84 – 86 GHz FIXED 5.338A FIXED-SATELLITE (Earth-to-space) MOBILE RADIO ASTRONOMY 5.149 KSA 03 KSA 09	Fixed: 81-86 GHz	ITU-R F.2006-0 Potential Future IMT Band (81 – 86 GHz)

A. What is your interest in the 71-76 GHz/81-86 GHz band for fixed services? Please provide information regarding the band ecosystem, along with your requirements for bandwidth and indicative plan for rolling out services using this spectrum

B. Do you think the 71-76 GHz/81-86 GHz band can be utilized for IMT/5G services? If yes, is it outdoor or indoor usage? Please justify your answer; technical reasons are welcome.

C. What is the suitable time to release the 71-76 GHz/81-86 GHz band? Please justify your answer

D. Do you agree to implement the flexible use of the band for both access and backhauling/transport applications?

E. What is the possibility of sharing and compatibility of IMT systems with Fixed-Satellite Service in the 71-76 GHz/81-86 GHz band?

F. What is the appropriate licensing mechanism for the band?

G. What is the readiness of IMT/5G infrastructures to use this band?

H. Do you support enabling geographically limited private deployments in the 71-76 GHz/81-86 GHz band?

I. How can the interference be best prevented in the 71-76 GHz/81-86 GHz band? Please Justify.

11.20. Other bands

A. Can you elaborate on making other bands available for IMT applications to serve a specific group of users? For example , the bands 3300-3400 MHz and 4500-5000 MHz for government entities? Please elaborate.

B. Can you comment on the use of the band 57-71 GHz for advanced applications like Multiple Gigabit Wireless Systems (MGWS)?

C. Can you please identify other bands haven't been mentioned that CITC should consider for innovative use? Please elaborate.

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