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Charting a 5G Future: Why 6GHz Spectrum Holds the Key to Malaysia's Connectivity Goals

The roll out of the 5G network in Malaysia in 2021 sparked Malaysia's visionary leap into becoming a high-income country through digital transformation. Through the government-owned entity, Digital Nasional Berhad (DNB), the government aims to accelerate network deployment, bridge digital disparities, and enable mobile network operators (MNOs) to focus on innovative service deployment[1]. As of May 31, Malaysia managed to achieve 62.1% coverage of populated areas involving 5,058 5G sites, an increase of 2.6% since the end of April. Under DNB's lead, the country is on track to achieve its 80% 5G network coverage target in populated areas by the end of the year[2]. 5G was expected to elevate GDP growth by over 20 per cent and generate around 230, 000 new jobs by 2030[3].

The escalating demand for 5G is not confined solely to Malaysia; countries across the globe are witnessing a surge in this demand too.

[1] Kirennesh Nair, "Fahmi: Malaysia's 5G Coverage Now at 62.1%," The Star, June 7, 2023.
[2] Kirennesh N, "Malaysia's 5G Coverage.
[3] Olofsgård, Markus, and Philip Göransson. "Key Success Factors for End-User Adoption of 5G Technology Within a Low-Middle Income Country: A case study in Malaysia." (2022).

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Therefore, the need for an equitable and efficient allocation of radiofrequency spectrum has become increasingly paramount. The upcoming World Radiocommunication Conference 2023 (WRC-23) stands as a pivotal event on the horizon, where international stakeholders will gather to deliberate on crucial matters regarding spectrum allocation and management. Given the exponential growth and acceleration of 5G networks, discussions at WRC-23 will center on the imperative to secure additional spectrum resources to accommodate the burgeoning demands of this technology. The success of Malaysia's 5G deployment serves as a compelling testament to the tangible benefits that a well-established network can bring, propelling nations toward economic growth, job creation, and enhanced digital capabilities.

A Comprehensive Look at Spectrum Allocation

What is Spectrum?

- In our ever more interconnected world, the dependence on wireless communication has become a fundamental pillar of modern living. Whether it's the usage of mobile devices and GPS tracking in vehicles, the effortless transmission of television and radio content, the availability of complimentary WiFi in cafes, our everyday life is enmeshed with wireless connectivity. This marvel of connectivity is made possible through the radio frequency spectrum.

  Imagine the radio spectrum as an expansive network of roads, each lane is designated for a particular type of communication. Each lane has its own unique frequency to ensure the seamless transmission of wireless signals. For example, a particular lane might be dedicated to satellite communications while another could serve as the domain for mobile phones. Nonetheless, a spectrum could become overcrowded, similar to how a highway can become congested which would hinder the swift transmission of information. This happens when more people and industry rely on wireless connectivity to function.

Spectrum Management: The International Telecommunication Union (ITU)

- However, since spectrum is not an infinite resource that can be easily generated, ensuring its optimal utilization is crucial. While individual nations possess the sovereign authority to manage their radio spectrum usage, they do so within the framework of internationally agreed-upon guidelines established by the International Telecommunication Union (ITU), a constituent of the United Nations responsible for overseeing information and communications technology. Acting as a unifying force for telecommunications regulatory bodies worldwide, the ITU convenes at the World Radiocommunication Conference (WRC) to deliberate on revisions and amendments to radio regulations, particularly with regard to the allocation of specific frequency

- bands for various services[4]. This dynamic process enables governments to judiciously release additional harmonized spectrum, strategically meeting the escalating demands of burgeoning services.

Spectrum Terminology

- In understanding spectrum management, different terminologies are used to explain the availability of a frequency band for specific service types, technological ranges, or entities.

  Allocation: A specific band is 'allocated' by a particular service category (such as mobile, satellite, or broadcasting) either by a national regulatory authority, documented within the National Frequency Allocation Table (NFAT), or at the global scale through the ITU, as outlined in the comprehensive 'Radio Regulations'[5].

  Identification: A band could then be 'identified' for a restricted array of technologies. For instance, a band 'allocated' for mobile services may be 'identified' for International Mobile Telecommunications (IMT), implying its applicability to a specific group of compatible mobile technologies.

  Allotment: 'Allotment' pertains to a decision reached at either a regional or national level, aimed at designating a frequency channel for utilization by a specific service type across one or more countries, subject to specific conditions.

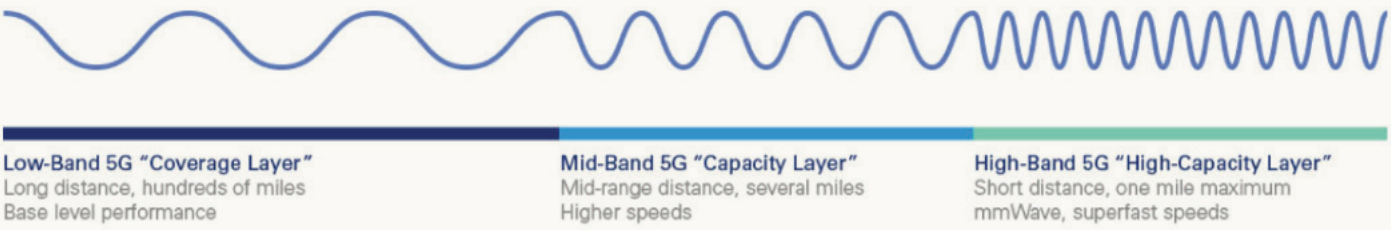
  Assignment: A distinct frequency channel is 'assigned' to an individual user by a national governmental body or regulatory agency.

Spectrum band: low-band, mid-band, high-band

- Spectrum bands are distinct portions of the frequency spectrum, each with its unique range of frequencies. These bands serve as the fundamental building blocks for wireless communication, delineating the boundaries within which various services, technologies, and applications operate.

  Currently, the International Mobile Telecommunications (IMT) - which is a global standard for mobile communication systems that enable wireless voice, data, and multimedia services across various mobile devices, such as smartphones and tablets - uses spectrum in the range of 450 MHz to 50 GHz[6]. Depending on the frequency range and the amount of spectrum in the range, various bands serve distinct purposes and can't replace one another. These bands are divided into low-bands, lower mid-bands, upper mid-bands, and high bands[7].

[4] GSMA, "Introducing Spectrum Management," 2017, https://www.gsma.com/spectrum/wp-content/uploads/2017/04/Introducing-Spectrum-Management.pdf.
[5] GSMA. "Spectrum Management".
[6] GSMA Intelligence, "The Socio-Economic Benefits of Mid-Band 5G Services" (GSMA, 2022).
[7] GSMA Intelligence. "Benefits of Mid-Band 5G"



Source: Westbase.io. "What Is Low, Mid, and High-Band? The 5G Spectrum Layers Explained." Westbase. May 27, 2022. https://www.westbase.io/what-is-low-mid-and-high-band-the-5g-spectrum-layers-explained.

Low-bands (e.g. 600, 700, 800, and 900 MHz): Low-bands excel in extensive coverage and indoor reach due to strong signal propagation. Using this low-band spectrum will make sure that the wireless network reaches everywhere, even inside buildings. However, it can't carry as much information at once and thus has a slower speed.

Lower mid-bands (e.g. 1500, 1800, 1900, 2100, 2300, 2600 MHz): Lower mid-bands are currently being used for IMT for 2G, 3G, 4G, and 5G.

Upper mid-bands (e.g 3.3-4.2, 4.5-5, 5.925-7.125 GHz): In most countries, the upper mid-band spectrum used for 5G is around 3300 to 3800 MHz. These upper mid-bands are great for covering cities, as they balance signal strength and capacity well. The rules for 5G allow a channel that's 100 MHz wide, and they can even combine multiple channels to reach a maximum of 400 MHz bandwidth.

High bands (e.g., 26, 28, 40, 50, 66 GHz, also referred to as mmWaves): High-bands work well for busy areas with many people using data and when fast data speeds are required.

Exploring the Demands and Significance of Spectrum in the 6GHz range (5925-7125 MHz)

Increasing Demand for 5G

- The APAC region's journey toward unlocking the full potential of 5G depends not only on technological progress but also on the strategic allocation and management of spectrum resources. A report by Global System for Mobile Communications Association (GSMA) underscores the crucial role of mid-band spectrum to achieve the speed and efficiency required for 5G's functionality. Central to the 5G vision is establishing high-speed wireless mobile connectivity akin to fixed networks, catering to a variety of use cases. The demands on 5G are substantial, with the need to deliver a mobile data rate experience of 100 Mbit/s in the downlink and 50 Mbit/s in the uplink, while also accommodating an impressive one million connections per square kilometer. This presents a formidable challenge, particularly in densely populated urban centers.

- The demand for more spectrum to be allocated to International Mobile Telecommunications (IMT) services are driven by several global changes. They include the rollout of 5G New Radio (NR) technology allowing faster and more efficient wireless communication, the shutting down of older 2G and 3G networks, the increase in remote work and learning because of COVID-19 lockdowns, and people preferring faster and more secure wireless data instead of public Wi-Fi[8].

Additional Mid-Band Spectrum to Achieve 5G Goals

- Particularly, internet usage in APAC countries vary significantly; however the demand for 5G is surging given that the region is home to highly populous nations like China and India while also hosting seven out of the ten largest cities in the world[9]. According to a study by GSMA, in highly populated cities, an average of 2 GHz of middle-range wireless spectrum is typically required. If there's not enough spectrum available, meeting IMT-2020 requirements becomes risky, and without proper assignments, a lot more base stations would be necessary. In places where it's possible to make the network denser, the total cost of setting up and maintaining networks could be 3 to 5 times higher over a ten-year span when there's a shortage of 800-1000 MHz of spectrum. This would mean investing an extra $782 million to $5.8 billion in each city, which is a costly solution.

The Case of Kuala Lumpur

In the context of Malaysian cities like Kuala Lumpur, a study by Opensignal, revealed that Kuala Lumpur placed second among 11 APAC countries studied in terms of download speeds at 376.6 Mbps download speed[10]. Kuala Lumpur also distinguishes itself by topping the chart for fastest 5G Upload Speed at 52.8 Mbps, surging ahead of Seoul and Taipei by 12.2-13.7 Mbps. Comparing 5G with 4G, is crucial to showcase the former's superior performance. In Malaysia, Kuala Lumpur's inhabitants experience a substantial difference in average download speeds between 5G and 4G connections. The city's 5G Download Speed score is a remarkable 19 times higher than its 4G Download Speed score, underlining the impact of recent 5G launch but also DNB's limited usage. If demand for 5G increases, several potential outcomes could arise such as network congestion, date speed reduction, latency increase and there degradation of overall quality service in urban Kuala Lumpur.

- Other than that, if there is not enough spectrum, introducing additional base stations, instead of allocating more spectrum, would lead to a much larger carbon footprint. This added network densification would also increase the energy consumption of mobile networks in cities by 1.8-2.9 times, both in operation and during manufacturing. However, achieving such a high level of densification might not even be possible due to other issues like excessive interference, limited availability of suitable sites, and strict rules regarding electromagnetic fields[11].

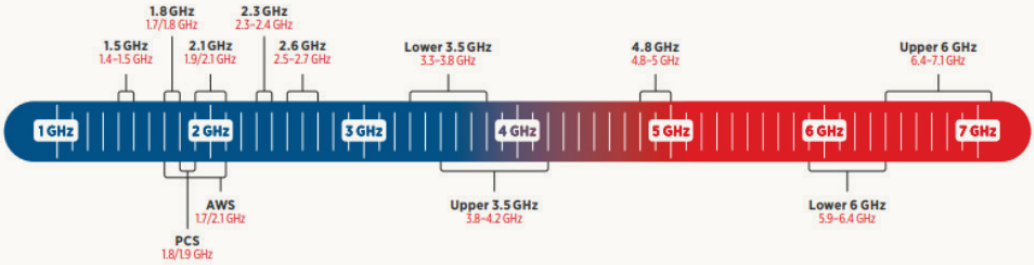
[8] Windsor Place Consulting Pty Ltd, "Optimising IMT and Wi-Fi Mid-Band Spectrum Allocations: The Compelling Case for 6 GHz Band Partitioning in Asia-Pacific," 2021.
[9] Windsor Place Consulting. "Optimising IMT and Wi-Fi Mid Band".
[10] Opensignal, "The 5G Experience in APAC's Biggest Cities | Opensignal," www.opensignal.com, August 16, 2022 https://www.opensignal.com/2022/08/16/the-5g-experience-in-apacs-biggest-cities#:~:text=Seoul%20had%20the%20highest%20score.
[11] GSMA, "Vision 2030 Insights for Mid-Band Spectrum Needs," 2021.

- Therefore, the availability of additional spectrum in mid-bands is particularly important for making fixed wireless access more affordable. With this extra spectrum, each cell site would be able to provide 3.5-6 times more homes with 5G fixed wireless access. This could lead to significant cost savings in building and expanding networks and would enable affordable internet connections in areas where other broadband options are not financially feasible, especially in places where fiber-optic connections are scarce or mainly limited to large cities.

Global Recommendations for the 6GHz Band

- Upcoming discussions at WRC-23 will include proposals for the 6GHz band. This mid-band spectrum, ranging around 6 GHz, boasts excellent coverage and capacity, making it an attractive option for both licensed and unlicensed use. This versatility positions it favorably for a wide range of applications, catering to both IMT (International Mobile Telecommunications) and Wi-Fi services. Specifically, the ITU delineates additional frequencies frequencies in upper 6GHz (6425-7125 MHz) for IMT in Agenda Item 1.2

  As discussions at the conference unfold, it becomes clear that the allocation of the 6 GHz spectrum will not only impact global wireless communication strategies but will also play a pivotal role in enabling innovative and transformative technologies across a diverse range of sectors.



Source: GSMA Intelligence, "The Socio-Economic Benefits of Mid-Band 5G Services" (GSMA, 2022).

The Socio-economic Benefits of Mid Band Spectrum

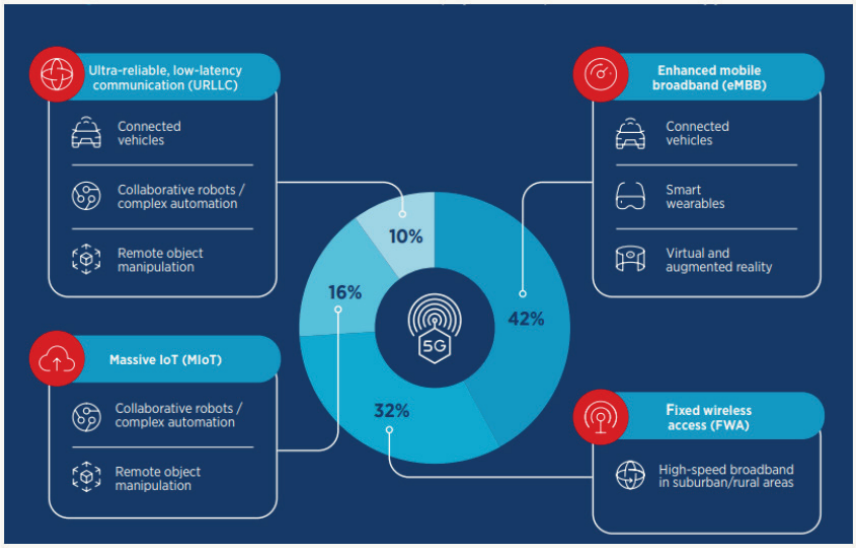
- In addition to the possible adverse effects of not implementing mid-band spectrum, it's equally essential to emphasize the socio-economic advantages that can be gained through the utilization of mid-band 5G services. A recent study conducted by the GSMA unveiled a compelling correlation between mobile technology and economic growth[13]. This study revealed that, between the years 2000 and 2019, each $100 increase in income per capita was accompanied by an approximate $10 contribution from mobile technology. This showcases the substantial economic impact of mobile technology to an individual's economic prosperity.

  The potential of 5G technology to revolutionize the global economic landscape is particularly noteworthy. Projections indicate that by the year 2030, 5G could generate a staggering $960 billion of additional GDP value-add to the global

[12] Windsor Place Consulting. "Optimising IMT and Wi-Fi Mid Band".
[13] GSMA Intelligence. "Benefits of Mid-Band 5G".

- economy[14]. This equates to roughly 0.70% of the projected global GDP, underlining the transformative potential of this technology. Within this paradigm, mid-band 5G stands out as a pivotal driver of economic growth, accounting for a substantial uplift of more than $610 billion to the global GDP in 2030, constituting about 65% of the overall 5G benefit.

  The 5G ecosystem is rich with diverse use cases, each poised to usher in unprecedented progress across industries. One such use case is the Massive Internet of Things (MIoT), set to catalyze the digitalization of the manufacturing sector. With the potential to amplify productivity and curtail costs, MIoT applications are projected to be particularly transformative for manufacturing. Moreover, the manufacturing sector's agile adoption of new technologies positions it as an optimal candidate for reaping the benefits of MIoT applications, surpassing even the agricultural sector in terms of productivity.



Source: Distribution of mid-band benefits by use cases, GSMA Intelligence, cite socioeconomic benefits of mid band report.

Specifically, manufacturing is poised to reap the greatest rewards from mid-band 5G spectrum, followed by services such as healthcare and education, as well as public administration. However, the potential gains could be compromised if additional mid-band spectrum is not allocated to mobile services. An ominous projection warns that without this allocation, the anticipated 5G benefits could

- plummet by up to 40%. Such a scenario would see the 2030 5G benefits decrease from 0.68% of GDP (approximately $960 billion) to a mere 0.42% of GDP (less than $600 billion). This serves as a powerful reminder of the critical need for proactive spectrum allocation to ensure the realization of the full socio-economic potential of the mid-band 5G spectrum.

The Upper 6GHz Spectrum for Large Bandwidth Mid-Band in Malaysia

Why Malaysia needs 6GHz Mid-Band Spectrum

- Malaysia is currently in the process of developing its proposal for the 6GHz band, as the regulatory body, Malaysian Communications and Multimedia Commission (MCMC) is actively working on a public inquiry paper. The undeniable advantage of the 6GHz mid-band frequency becomes evident against the backdrop of escalating 5G demand and the potential gains that 5G technology promises.

[14] GSMA Intelligence. "Benefits of Mid-Band 5G".

- Nations within the Asia Pacific area are anticipated to play a significant role in propelling the economic advantages associated with 5G's mid-band spectrum[15]. Within this landscape, economies in East Asia and the Pacific are forecasted to account for a staggering 80% of the region's GDP contribution, primarily propelled by a heightened level of 5G penetration. As a direct consequence of mid-band 5G technology, the forthcoming impact on GDP is anticipated to stand at $279 billion for the region in 2030. Among these figures, East Asia and the Pacific are expected to shoulder the lion's share, amounting to $218 billion, with the residual $61 billion being attributed to South Asia and Southeast Asia.

  Uniquely positioned within this narrative, Malaysia is set to play a pivotal role in the tapestry of mid-band 5G's economic impact. Specifically, Malaysia is poised to contribute an impressive 12% to the GDP generated by mid-band 5G in the year 2030[16].Very similar to other Asian countries, the current available mid-band spectrum for 5G in Malaysia is not sufficient, as only 200MHz available in C-band is used for IMT. The continuous 700MHz in the upper 6GHz band will be a good candidate band for the future 5G and 6G development in Malaysia.

Technical Considerations: Wi-Fi versus IMT

- Malaysia's strategic adoption of the 6GHz spectrum should follow a balanced and well-considered approach, attuned to the evolving dynamics of wireless communication and the burgeoning demands of technology-driven progress.

  The significance of the upper 6GHz (U6GHz) spectrum as a substantial and contiguous resource cannot be overstated. It stands as Malaysia's primary avenue toward securing a wide mid-bandwidth range, a vital requirement for the impending year 2030. Adopting the upper 6GHz spectrum for Malaysia is pivotal to meet the nation's 2GHz mid-band target for 5G and future technologies. This spectrum stands out as the primary option for providing significant mid-bandwidth in Malaysia, without any comparable alternatives in sight. European countries are considering adopting the upper 6GHz spectrum for International Mobile Telecommunications (IMT) purposes given its benefits. Additionally, key mobile network operators (MNOs) across the Asia-Pacific region, including Singapore's Singtel, China Mobile, and Indonesia, are actively exploring the utilization of the upper 6GHz spectrum for future IMT deployment. Malaysia's alignment with this forward-looking trend is thus both strategic and imperative.

  It's worth noting that, while the upper 6GHz spectrum is pivotal for mobile technology advancement, its impact on future Wi-Fi development is not as critical. The scope of Wi-Fi 6e or Wi-Fi 7 is not confined by the upper 6GHz spectrum, as the largest channel for Wi-Fi 6e is 160MHz. Given that Wi-Fi operates at lower power and exhibits localized spectrum reuse, the combined potential of the lower 6GHz and 5GHz bands should suffice for Wi-Fi6E deployment, featuring up to five times 160MHz channels.

[15] GSMA Intelligence. “Benefits of Mid-Band 5G”.
[16] GSMA Intelligence. “Benefits of Mid-Band 5G”.

Proposal for Malaysia's Position: The Way Forward Ahead of WRC-23

- To stay competitive in the realm of 5G technology, Malaysia should adopt a well-balanced approach to spectrum allocation. It is recommended that Malaysia divides the 6GHz spectrum into two distinct segments, 5925-6425 MHz for Wi-Fi and 6425-7125 MHz for IMT. This allocation caters to both Wi-Fi and IMT demands, fostering harmony between technological advancement and the dynamic needs of diverse stakeholders. As international discussions approach, it is recommended that Malaysia's support for IMT identification in the 6425-7025 MHz frequency range through Region 3 country footnotes at APG 23-6 and WRC-23 be a steadfast priority.

  In summary, Malaysia's embrace of the 6GHz spectrum encapsulates a balanced and forward-looking strategy, aligning with global trends, technological demands, and the potential of next-generation communication. By strategically allocating the upper 6GHz spectrum, Malaysia could position itself at the nexus of innovation and connectivity, poised to thrive in the mobile landscape of the future.