Key enablers for 5G adoption among Asia-Pacific countries

Report (revised draft)

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2023-09-11

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1 Introduction

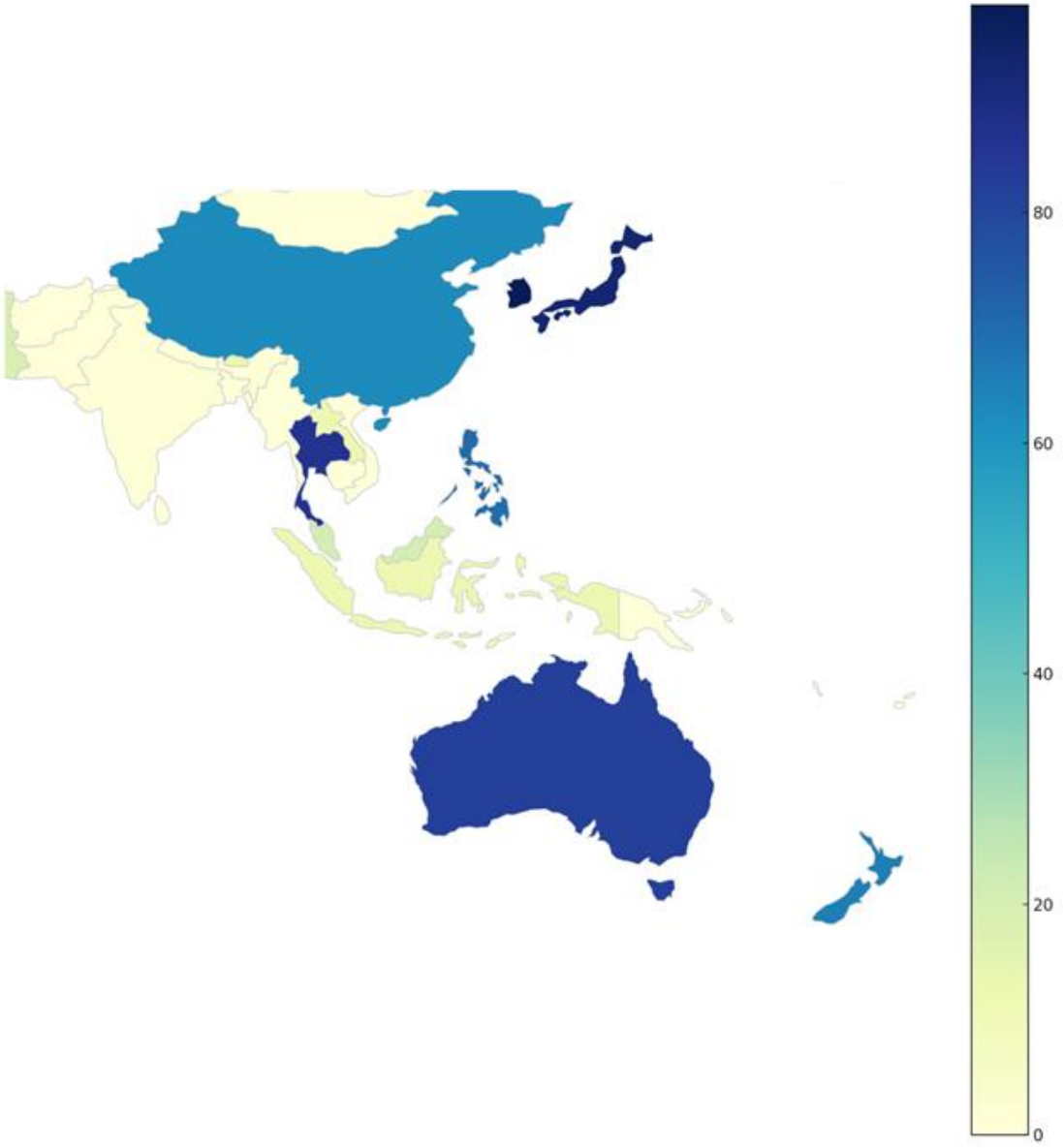
5G is the new generation of mobile technology, capable of ultra-fast speeds, low latency, and excellent reliability. Estimations vary, but 5G is expected to enable 13.2 trillion of global economic output by 2035 and support over 22 million jobs.[1] The rapid advancement of telecommunications technology has brought about transformative changes in various sectors, and the advent of 5G is poised to revolutionize connectivity on an unprecedented scale globally and in the APAC region (see Communication and Authority (2016); Liu et al. (2017); International Telecommunication Union (ITU) (2018a); Andonian, Karlsson, and Nonaka (2018); International Telecommunication Union (ITU) (2018b); Hasan (2019); Sawad, Nilavalan, and Al-Raweshidy (2020); Clari, Fadil, and Pourcher (2020); Iqbal et al. (2021); Shayea et al. (2021); Houngbonon, Rossotto, and Strusani (2021); Hong, Ryu, and Lee (2021); Koratagere Anantha Kumar et al. (2021); Association of Southeast Asian Nations (ASEAN) (2022); Olofsgård and Göransson (2022); ABI Research (2023); International Telecommunication Union Development Sector (2023)). With key industries such as manufacturing, healthcare, transportation, utilities, retail, financial services and public sector benefiting the most from the new technology for digital transformation, Industry 4.0 and enterprise 4.0 with 5G networks will emerge not only as the foundation for advanced communication services, but also as a support to a range of socio-economic transformation and development as a whole.

Commonly mentioned characteristics associated with 5G include, (a) Increased Bandwidth and Data Rates: 5G offers significantly higher bandwidth and data rates compared to previous generations of mobile networks. This enables faster and ultra-reliable connections, allowing for a wide range of new applications and services that support bandwidth-intensive applications like 4K/8K video streaming, virtual reality, and immersive gaming; (b) Low Latency: 5G networks aim to provide ultra-low latency, which is essential for applications that require real-time responsiveness, such as autonomous vehicles, remote surgery, and augmented reality. The reduced latency enhances user experience and enables new possibilities in various industries; (c) Massive Device Connectivity: 5G is designed to support a massive number of connected devices simultaneously. This capability is crucial for the Internet of Things (IoT), where a vast array of sensors, smart devices, and machines can communicate seamlessly and efficiently; (d) Network Slicing: Network slicing is a key feature of 5G that allows the network to be divided into multiple virtual networks, each tailored to specific requirements. It enables customized services for different industries and applications while optimizing resource allocation and network management; (e) Edge Computing: 5G networks integrate with edge computing infrastructure, bringing computational power closer to the end-user devices. This proximity reduces latency and enables time-sensitive applications by processing data locally, rather than relying on distant cloud servers; (f) Network Resilience

[1] https://www-file.huawei.com/-/media/corporate/pdf/public-policy/public_policy_position_5g_spectrum_2020_v2.pdf?la=en & https://www.gsma.com/asia-pacific/communities/ap5gic/

and Reliability: 5G networks are designed to be highly resilient and reliable, offering uninterrupted connectivity even in densely populated areas or during high-demand situations. This resilience ensures consistent service delivery, critical for applications requiring constant connectivity; and (g) Spectrum Availability: The availability of suitable frequency bands and spectrum allocation is essential for deploying 5G networks. Governments and regulatory bodies play a crucial role in allocating and managing spectrum resources to enable 5G deployment.

5G Population Coverage APAC 2022 (Source: GSMA)



As countries around the world prepare for the deployment of 5G networks, it is crucial to assess the enablers and factors influencing its implementation at the country level. International Telecommunication Union (ITU) (2018b) is an early comprehensive report by the International Telecommunication Union (ITU) on the opportunities and challenges of 5G, the fifth generation of mobile technologies that recommends policy-makers and regulators to adopt a measured, practical and collaborative approach to address the issues related to 5G and to create an enabling environment for its development and adoption. The report identifies a number of specific key issues and responses for regulators and policy-makers to consider as they formulate strategies to stimulate investment in 5G networks, which include investment case, spectrum management issues,[2] infrastructure sharing, access costs, investment incentives and others. It is also recommended that regulators should consider when planning for 5G, ranging from streamlining small cell deployments, facilitating fibre backhaul, harmonizing and licensing spectrum, promoting infrastructure sharing, supporting 5G pilots and trials, and ensuring digital inclusion and consumer protection. Furthermore, the report recommends that policy-makers and operators should consider deploying 5G networks where there is demand or a robust commercial case in favor of doing so, and also recommends that policy-makers improve the availability and quality of 4G networks until the case for 5G networks becomes clearer and more compelling.

This report aims to propose a framework for a comprehensive study of the 5G enablers for Asia-Pacific (APAC) ITU member states to better understand individual country's readiness and preparedness for the next generation of wireless communication technology, as well as provide valuable insights and suggestions for improvements needed for 5G mobile development and adoption, by delving into the key aspects that facilitate the deployment of 5G, such as infrastructure readiness, spectrum allocation, policy and regulatory frameworks, industry collaboration, and research initiatives. Additionally, the study aims to also identify challenges and barriers that need to be addressed to ensure a smooth transition to 5G, including financial considerations, skill gaps, regulatory hurdles, and public concerns. By understanding these challenges, stakeholders can develop strategies and recommendations to overcome obstacles and capitalize on the opportunities presented by 5G.

The findings and recommendations as a result of this study aim to guide policymakers, regulators, industry players, and other relevant stakeholders in their efforts to foster an enabling environment for the successful deployment and utilization of 5G technology in their respective countries. Ultimately, the goal is to unlock the immense benefits of 5G, ranging from enhanced mobile broadband to transformative applications in sectors like healthcare, transportation, and industry, thereby contributing to national socioeconomic development and competitiveness in the digital age.

[2] A key aspect of 5G SA or full 5G is its relevance for economic verticals and hence the aspect of spectrum for public networks, spectrum for private networks, etc.

Background information on 5G technology

In today's interconnected world, where the demand for high-speed and reliable connectivity continues to grow, the emergence of 5G technology represents a significant leap forward in wireless communication. 5G, short for fifth-generation, is the latest generation of mobile network technology, succeeding its predecessor, 4G/LTE. It offers exponentially faster data transmission speeds, lower latency, increased network capacity, energy efficiency, and the ability to connect a massive number of devices simultaneously.

Unlike previous generations of wireless networks, 5G is not just an incremental improvement; it introduces a paradigm shift in network architecture and capabilities. At its core, 5G utilizes advanced technologies such as large-bandwidth spectrum resources, massive MIMO (Multiple-Input Multiple-Output), and network slicing to deliver exceptional performance.[3] One of the key features of 5G is its remarkable speed. With peak download speeds projected to reach up to 20 gigabits per second (Gbps), speeds that are up to 100x faster than 4G LTE networks. 5G surpasses its predecessors by a significant margin. This ultra-fast connectivity enables seamless streaming of high-definition content, real-time cloud gaming, and swift downloads of large files.[4]

Moreover, 5G technology significantly reduces latency, the time it takes for data to travel between a source and a destination. With latency expected to be as low as 1 millisecond, 5G enables near-instantaneous communication, opening doors to applications that demand real-time responsiveness. Reduced latency will support new applications that leverage the power of 5G, the Internet of Things (IoT), and artificial intelligence, as well as industries such as autonomous vehicles, remote robotic surgery, and industrial automation stand to benefit immensely from this ultra-low latency.[5]

Another fundamental aspect of 5G is its ability to support a massive number of connected devices concurrently. This feature is critical for the Internet of Things (IoT) ecosystem, where billions of interconnected devices, sensors, and machines require constant and reliable connectivity. With 5G, the infrastructure can handle the substantial increase in device density, paving the way for smart cities, smart homes, and various IoT-driven innovations.[6] According to Omdia, 5G standard for Massive IoT will support up to 1 million

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[3] https://www.techtarget.com/searchnetworking/Enterprise-5G-Guide-to-planning-architecture-and-benefits

[4] https://www.intel.com/content/www/us/en/wireless-network/5g-benefits-features.html

[5] https://www.intel.com/content/www/us/en/wireless-network/5g-benefits-features.html

[6] https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-5g

connected devices for every 0.38 square miles (roughly 1 square kilometer).[7] When fully operational, 5G networks will have the capacity to connect 500 times more devices than 4G and this is the foundation for the future of Massive IoT—a world with a million or more connected devices per square kilometre.[8]

Compared to previous generations, 5G is designed to minimize energy consumption while delivering superior performance and allowing energy-saving mechanisms that make 5G a sustainable and environmentally friendly technology, striking a balance between connectivity needs and energy efficiency.[9]

Furthermore, it is worth noting that 5G is not solely limited to mobile broadband enhancements. The technology offers diverse use cases, including enhanced mobile services, mission-critical communications, massive IoT deployments, and network infrastructure support for emerging technologies like virtual reality (VR), augmented reality (AR), and artificial intelligence (AI). And as countries worldwide embrace the potential of 5G, it is expected to revolutionize industries, drive innovation, and create new economic opportunities. From autonomous transportation systems to smart manufacturing, 5G technology will act as a catalyst for digital transformation, enabling faster data-driven decision-making, unlocking new business models, and reshaping the way societies function.

Notwithstanding the enormous benefits of 5G, there are some downsides and current issues of 5G, as highlighted by Cherukuri (2022) such as the need for significant infrastructure investment. The transition from 4G to 5G is not a simple upgrade; it requires a complete overhaul of existing infrastructure, which includes the deployment of new antennas and base stations, as well as the installation of high-speed fiber connections to these sites. Thus, the cost of this infrastructure development is substantial and could be a barrier to 5G rollout, particularly in rural and remote areas where the return on investment may be lower. Overall, the larger costs associated with 5G could potentially be passed on to end-users, which would act as a barrier to switch from 4G to 5G.[10]

While 5G infrastructure requires a significant upfront investment, it does promise a host of long-term benefits that can offset these initial costs such as enhanced operational

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[7] https://omdia.tech.informa.com/OM004695/5G-and-Massive-IoT-legacy-technologies-will-bridge-the-gap-for-now

[8] https://www.rogers.com/business/blog/en/understanding-massive-iot-and-why-it-matters-for-your-business

[9] According to McKinsey, 5G-new-radio standard is more energy efficient per gigabyte than are the 4G standards. See https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-case-for-committing-to-greener-telecom-networks

[10] https://www.deloitte.com/global/en/our-thinking/insights/industry/technology/5g-adoption.html

efficiency, the potential for new revenue streams from innovative services and technologies, and the likely reduction in technology costs as the industry matures, all of which contribute to the future value of 5G. Further, advanced features of 5G, such as automation and AI integration, can decrease maintenance costs, while improved network speed and communication could boost productivity across sectors.

Also worth mentioning is that 5G networks are not immune to security threats. In fact, the risks are amplified due to the sheer volume of devices that will be connected and the sensitive nature of the data they will handle. Cybersecurity concerns range from data privacy and protection to potential threats to critical infrastructure.

Furthermore, the risk of exacerbating the digital divide arising from real skills and education gaps, and concerns about the health effects of radiofrequency radiation, potential interference with flight operations, device compatibility and battery drain on cellular devices, and others, are some important issues that remain.[11] Be as it may, while there are challenges to the deployment of 5G technology, the benefits are significant and will likely outweigh the challenges in the long run.

In sum, 5G technology represents a transformative shift in wireless communication, delivering unprecedented speed, ultra-low latency, massive connectivity and energy efficiency. As countries adopt and deploy 5G networks, they open doors to a wide array of applications, revolutionizing industries and paving the way for a more connected and advanced digital future, which will potentially affect nearly all aspects of socio-economic livelihood. Not all impacts are positive however and it is therefore important to carefully consider how to align the introduction of new 5G networks by mitigating negative side-effects, while maximizing benefits.

Scope

This evaluation will align to the ITU-T or the Telecommunication Standardization Sector of the International Telecommunication Union (ITU), which coordinates with all entities involved with creating standards in the telecommunications industry. The ITU-T including develops international standards known as ITU-T Recommendations which act as defining elements in the global infrastructure of information and communication technologies (ICTs). The report also aligns to the ITU Radiocommunication Sector (ITU-R) which is responsible for radio communications, specifically the management of the international radio-frequency spectrum and satellite orbit resources and the development of standards for radiocommunication systems with the objective of ensuring the effective use of the spectrum. Furthermore, most of the data is due to the ITU Telecommunication Development Sector (ITU-D), the third of the three sectors (divisions or units) of the International Telecommunication Union (ITU) that is responsible for creating policies, regulation and providing training programs and financial strategies in developing countries.

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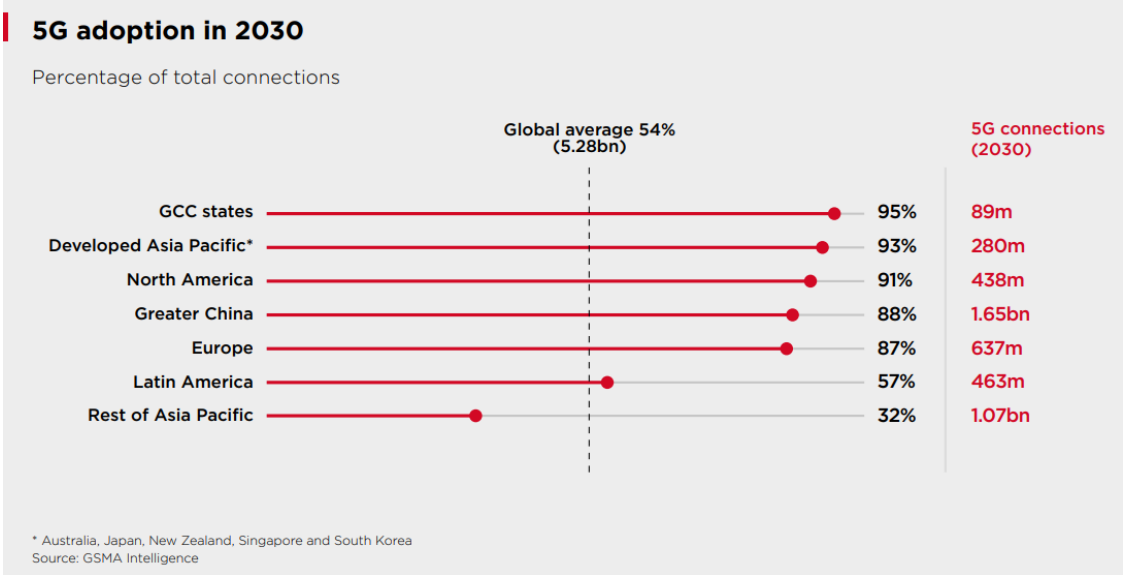
[11] https://www.enterprisenetworkingplanet.com/management/top-issues-facing-5g-networks/

In the APAC region, there remains a wide variety of network deployments and technologies (see GSMA (2021)). While the majority of countries are beginning to invest in 5G networks, there is still a lot of LTE investment, particularly in countries where regulators have not been clear with their spectrum release programme. In some countries where LTE roll-out has been slower, while operators and policymakers continue to carefully consider how to balance the need for increased LTE availability against the introduction of new 5G networks.



The figure above from GSMA (2023) illustrates the diversity of APAC region in terms of its status on 5G adoption. By the end of 2023, it is expected that 5G adoption will hit the mass market in Australia (42%), China (45%), Japan (47%) and South Korea (53%), putting them on par with global peers such Germany (35%) and the US (59%). Despite delays caused by the COVID-19 pandemic, 5G networks are progressing in many APAC countries. According to a report by GSMA,[12] 4G will remain the dominant technology in Asia-Pacific for the foreseeable future, but it said "a second wave of 5G network rollouts has begun in Asia-Pacific".[13] GSMA also reports also that 5G coverage is set to accelerate across the Asia Pacific region as the technology's footprint expands. Currently, it is commercially available in 14 markets, with others, including India and Vietnam, going live in the coming months.[14]

The scope of this study will cover mainly Asia-Pacific ITU member states for the deployment of 5G technology. The countries under consideration include Afghanistan,

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[12] https://www.gsma.com/newsroom/press-release/gsma-report-shows-5g-coverage-is-set-to-accelerate-across-asia-pacific-but-the-usage-gap-remains-significant/

[13] https://www.gsma.com/newsroom/press-release/gsma-report-shows-5g-coverage-is-set-to-accelerate-across-asia-pacific-but-the-usage-gap-remains-significant/

[14] https://www.gsma.com/asia-pacific/resources/5g-in-action/

Australia, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, People's Republic of China, Democratic People's Republic of Korea, Fiji, India, Indonesia, Iran, Japan, Kiribati, Republic of Korea, Lao P.D.R., Malaysia, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nauru, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Thailand, Timor-Leste, Tonga, Tuvalu, Vanuatu, and Viet Nam.[15] The study aims to identify the key 5G enablers for each country mainly using ITU's DataHub (as well as indicators from other sources) to gain insights into their individual readiness for 5G wireless communication technology.

2 Conceptual Framework

In the literature, several key enablers for 5G adoption are often discussed. These enablers vary depending on the context and specific focus of the research. For example, Akyildiz et al. (2016) identifies 10 major technological breakthroughs that will bring renaissance to wireless communication networks: (1) a wireless software-defined network, (2) network function virtualization, (3) millimeter wave spectrum,[16] (4) massive MIMO, (5) network ultra-densification, (6) big data and mobile cloud computing, (7) scalable Internet of Things, (8) device-to-device connectivity with high mobility, (9) green communications, and (10) new radio access techniques.

At the country-level, however, several key enablers are crucial for the successful implementation and adoption of 5G technology. The specific importance of each enabler may vary depending on the country's existing infrastructure, regulatory framework, and technological readiness.

Significant enablers suggested in the literature are:

1. Infrastructure & Network: 5G is a next-generation wireless technology that is expected to revolutionize the way we communicate and interact with the world around us.Building the necessary infrastructure is a fundamental enabler for 5G adoption. This includes deploying a network of base stations, upgrading existing telecommunications infrastructure, and establishing fiber-optic networks to support high-speed connectivity. Small cell deployment is also key for 5G proliferation. Especially access to street furniture and energy efficient backhaul links is crucial. Policy facilitation on Right of Way and access to other street infrastructure such as electric poles, billboards, traffic signals etc., is important (See ITU (2019) & Grijpink et al. (2023)). According to McKinsey & Company, the infrastructure investments required to enable 5G are significant. Mobile operators must

[15] Democratic People's Republic of Korea, Kiribati, Marshall Islands, Micronesia, Nauru and Tuvalu are omitted from the empirical part due to lack of data.

[16] Although millimeter band was initially thought to be one of the prime drivers earlier, in practicality it failed in the 5G public networks rollout. Several countries reported millimeter band's inefficiency for coverage leading to very high costs of network investment. These network deployments were rolled back as in the USA.

invest in all network domains, including spectrum, radio access network (RAN) infrastructure, transmission, and core networks.[17] The presence of a strong network indicates a region's readiness to deploy and scale 5G services. Moreover, the seamless integration of previous network generations (like 2G, 3G, 4G) with 5G is also crucial for a smooth transition and widespread adoption.[18]

2. Affordability & Costs: Affordability of mobile data, handsets, and other devices is also an important factor that can influence the adoption and usage of 5G services and applications.[19] The World Bank suggests that the affordability of broadband services should not exceed 5% of the average monthly income to be considered affordable.[20] However, in many countries, especially in low- and middle-income regions, the cost of mobile data and devices is still high, which can limit the access and usage of these services among low-income households and individuals. Therefore, it is important to develop policies and strategies that can promote affordable and accessible mobile data and devices for all. This includes measures such as reducing taxes and fees on mobile services, promoting competition among service providers, investing in mobile infrastructure in underserved areas, and providing subsidies or vouchers for low-income households.

3. Consumer & Ownership: A key factor determining the success of new technology is the consumer demand and adoption. Consumers need to be ready and eager to use 5G services and applications, which require higher data speeds, lower latency, and greater reliability. However, consumer readiness is not only influenced by their interest and awareness, but also by their ability and access to 5G-enabled devices and networks. Factors like mobile ownership, literacy, and basic skills reflect the population's capability and willingness to embrace 5G services. For example, mobile ownership indicates the availability and affordability of 5G-compatible devices, literacy indicates the level of education and digital skills among consumers, and basic skills indicate the ability to use mobile services effectively and safely. These factors can vary significantly across different regions, countries, and income groups, affecting the potential adoption and diffusion of 5G.[21] Therefore, it is important to measure and monitor these factors to understand the consumer readiness for 5G.

4. Content & Services: 5G is a next-generation wireless technology that is designed to deliver higher data speeds, lower latency, and greater reliability than its predecessors. However, 5G is not just about speed; it's about the revolutionary services and content it can

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[17] Wilson (2023)

[18] HKT (2023)

[19] https://www.broadbandcommission.org/advocacy-targets/2-affordability/

[20] According to GSMA, the cost of mobile data and devices should be less than 2% of the average monthly income to be considered affordable

[21] Wilson (2023)

support, from augmented reality to IoT applications.[22] The potential of 5G goes beyond faster downloads and smoother streaming. It enables new use cases and applications that were not possible before, such as remote surgery, autonomous vehicles, smart cities, and immersive entertainment. To realize this potential, a rich ecosystem of digital content and services is required that can drive 5G adoption by showcasing its potential benefits and applications. This includes content providers, app developers, device manufacturers, network operators, and other stakeholders who can collaborate to create innovative solutions that leverage the unique capabilities of 5G. By doing so, they can unlock new revenue streams, enhance user experiences, and create new business models that can transform industries and societies.[23]

5. Spectrum and Bandwidth: Effective spectrum management and allocation by regulatory authorities are vital for 5G deployment. Governments need to allocate suitable frequency bands for 5G networks and ensure that spectrum policies are favorable, enabling operators to acquire and deploy spectrum efficiently.[24] However, a routine way of spectrum management may not lead to any significant economic benefits from 5G. According to the GSMA 5G Spectrum Public Policy Position whitepaper GSMA (2023), 5G needs spectrum across low, mid and high spectrum ranges to deliver widespread coverage and support all use cases. The whitepaper also suggests that governments and regulators should avoid inflating 5G spectrum prices as this risks limiting network investment and driving up the cost of services. Furthermore, regulators must consult 5G stakeholders to ensure spectrum awards and licensing approaches consider technical and commercial deployment plans.[25] Consideration of case studies of 5G spectrum through local licensing, as well as different spectrum pricing systems (e.g. with commitment to investment in infrastructure (France), with commitment to cover several municipal areas, along amazon coast, highways etc. (Brazil) or CBRS Spectrum for 5G (USA) and so on) will be addressed. Furthermore, administrative assignment or auction is a contentious issue in some countries. Best practices may be shared.

6: Security & Legislation: Robust cybersecurity measures are critical for protecting 5G networks and the data transmitted over them. Countries should develop and enforce cybersecurity regulations, establish standards, and promote best practices to safeguard

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[22] https://www.qualcomm.com/5g/what-is-5g

[23] https://www.3gpp.org/technologies/5g-system-overview.

[24] ITU-R (2014) is a comprehensive report intended to assist administrations in developing strategies on economic approaches to national spectrum management and their financing. Also International Telecommunication Union (2015) is a handbook on national spectrum management that provides guidance and information on the principles, processes, functions and activities of spectrum management at the national level.

[25] See also GSMA (2022)

against potential threats and vulnerabilities.[26] Collaboration between regulatory bodies and industry stakeholders to address cybersecurity risks, and the level of preparedness and response mechanisms to handle cybersecurity incidents is vital for the success of 5G deployment. ITU as early as 1996 has addressed the importance of security frameworks for open systems, which are systems that can communicate and exchange data with other systems, emphasizing confidentiality frameworks as a way of protecting information from unauthorized disclosure. ITU-T (1995) explains the basic concepts, types and facilities of confidentiality mechanisms, as well as the management and interactions of confidentiality with other security services, while ITU-T (2023b) and ITU-T (2023a) addresses security guidelines and requirements for IMT-2020 edge computing services, and network slice, respectively. More recently, the GSMA and 3GPP have developed two unified cybersecurity standards for mobile network equipment: NESAS and SCAS.[27]

7: Economic & Development Indicators: Other socio-economic factors such as per capita income and value-added in high-tech manufacturing may influence 5G deployment, investing in R&D activities related to 5G technology and its usage, and so on.[28] For example, higher per capita income may indicate a greater ability and willingness to invest in 5G infrastructure and services, while higher value-added in high-tech manufacturing may indicate a more favorable environment for innovation and technology development. These factors can also affect the demand for 5G services and applications, as they can influence the affordability, accessibility, and quality of digital content and services.[29] Therefore, it is important to consider these factors when assessing the potential of 5G in different regions and countries. By doing so, policymakers, regulators, and industry players can identify the key drivers and barriers of 5G adoption and develop effective strategies to promote its growth and development.

8: Regulatory & Policy: Establishing a supportive regulatory framework is crucial for 5G adoption. Clear regulations and policies should address issues such as spectrum allocation, infrastructure deployment, licensing, privacy, and competition. A favorable regulatory environment surrounding 5G deployment, including licensing, permitting, and compliance requirements, as well as their impact on investment and innovation by encourages investment and promoting healthy competition among operators.[30]

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[26] https://digital-strategy.ec.europa.eu/en/library/cybersecurity-5g-networks-eu-toolbox-risk-mitigating-measures & https://www.cisa.gov/topics/risk-management/5g-security-and-resilience & https://www.cyber.gc.ca/en/guidance/cyber-security-considerations-5g-networks-itsap80116

[27] See https://www.gsma.com/security/network-equipment-security-assurance-scheme/

[28] PwC (2023)

[29] Qualcomm (2023)

[30] National Telecommunications and Information Administration, United States Department of Commerce, https://www.ntia.gov/files/ntia/publications/2021-1-

9. Geographical & Environmental Factors: Geographical factors can influence 5G deployment strategies. For instance, densely populated urban areas might benefit from 5G's high capacity, while challenging terrains might require specific infrastructure solutions. Access to electricity, land area, and population density can affect availability and accessibility of 5G infrastructure and services in different regions. For example, higher access to electricity may indicate a more favorable environment for 5G deployment, while higher population density may indicate a greater demand for 5G services and applications. Therefore, it is important to consider these factors when developing 5G deployment strategies and policies that can promote equitable and sustainable growth of 5G.[31]

10. Governance & Stability: A comprehensive national broadband strategy is important to ensure equitable access to 5G services across the country. Considering the need to assess the demand and sustainability of the 5G projects, the service providers may naturally begin with potential areas in the order of revenue returns. Although it is desirable that government's focus on bridging the digital divide, especially in rural and underserved areas, by promoting affordable and accessible connectivity options,[32] it should be noted that deployment of 5G networks is not practicable unless there are demanding 5G use cases which provide sustainability of the 5G projects as per the 5G network toolkit. National broadband strategy should also focus on ideation, piloting, adoption of 5G use cases to trigger the demand in economic verticals for 5G rollout.

Overall, by focusing on the above enablers, countries can create an ecosystem conducive to 5G adoption, which facilitates economic growth, innovation, and improved quality of life for their citizens.

12_115445_national_strategy_to_secure_5g_implementation_plan_and_annexes_a_f_final.pdf and https://digital-strategy.ec.europa.eu/en/policies/eu-radio-spectrum-policy

[31] https://jsis.washington.edu/news/what-will-5g-mean-for-the-environment/

[32] https://www.csis.org/analysis/accelerating-5g-united-states

3. Research Question and Objectives

The report seeks to investigate the current status of key 5G enablers, including infrastructure readiness, national broadband strategies, regulatory frameworks, spectrum availability and allocation, and policy enablers, in APAC countries, and how these enablers related to the implementation and adoption of 5G technology.

More specifically, based on the evaluation of 5G enablers, the specific research objective are:

1. To provide a detailed description of the status of key 5G enablers in APAC countries, including infrastructure readiness, spectrum availability regulatory frameworks, and policy enablers, in order to provide information on best practices for appropriate consideration by APAC countries for 5G implementation and adoption.

2. Provide insights into the readiness and progress of 5G enablers allowing for a clear identification of areas where improvement or strategic interventions may be required.

4. Data Source

The main data sources for analysis are:

1. The ITU DataHub (WTID indicators) which contains information and statistics that were compiled and/or collected by the ICT Data and Analytics Division and the Regulatory and Market Environment Division of the International Telecommunication Union (ITU). The database contains ICT indicators for various the years for around 180 statistics and for over 200 economies worldwide including cover fixed-telephone, mobile-cellular, fixed-broadband and mobile-broadband services, as well as statistics concerning international connectivity, quality of service, traffic, persons employed, ICT prices, revenue, investment and data on ICT access and use by households and individuals. Selected demographic and macro-economic statistics are also included in the database. The data are collected from the annual statistical questionnaires sent out by the Telecommunication Development Bureau (BDT) of ITU to telecommunication ministries, regulators and national statistical offices.

2. Other relevant country-level data especially from GSMA[33], WDI (World Development Indicators) and WGI (Worldwide Governance Indicators), EGDI (E-Government Development Index) and other data from respective national statistical offices as and when required.

[33] https://www.gsma.com/r/somic/

Specific Variables Used in the Study

1. Infrastructure & Network: 5G relies on a robust and advanced infrastructure, including cell towers, base stations, and data centers. The presence of a strong network indicates a region's readiness to deploy and scale 5G services. The seamless integration of previous network generations (like 2G, 3G, 4G) with 5G is also crucial for a smooth transition and widespread adoption.

Variable	Source
Infrastructure	GSMA
Network coverage	GSMA
Network performance	GSMA
2G Population Coverage	ITU World Indicators/ICT Indicators database
3G Population Coverage	GSMA Intelligence
4G Population Coverage	GSMA Intelligence
5G Population Coverage	GSMA Intelligence
Mobile download speeds	Ookla's Speedtest Intelligence
Mobile upload speeds	Ookla's Speedtest Intelligence
Mobile latencies	Ookla's Speedtest Intelligence
Electric power consumption (kWh per capita)*	IEA
Fixed broadband subscriptions (per 100 people)	ITU-WTID
Secure Internet servers	Netcraft
Secure Internet servers (per 1 million people)	Netcraft
4G services commercially available*	ITU
Population coverage by mobile network technology (At least 2G)	ITU-WTID
Population coverage by mobile network technology (At least 3G)	ITU-WTID
Population coverage by mobile network technology (At least 5G)	ITU-WTID
Population coverage by mobile network technology (At least LTE/WiMAX)	ITU-WTID

(note: * denotes variables latter dropped in the analysis due to insufficient observations.)

2. Affordability & Costs: For widespread 5G adoption, services and devices must be affordable for the masses. This category gauges the economic feasibility of 5G for consumers, considering factors like handset costs, data pricing, and other related expenses. A region where ICT services are affordable is more likely to see quicker 5G uptake.

Variable	Source

Variable	Source
Affordability	GSMA
Mobile data affordability	GSMA
Handset affordability	GSMA
Taxation	GSMA
Affordability of entry basket (1GB)	Tarifica
Affordability of higher basket (5GB)	Tarifica
Affordability of entry basket (1GB) for poorest 40%	Tarifica
Affordability of higher basket (5GB) for poorest 40%	Tarifica
Device affordability	Tarifica
Device affordability for poorest 40%	Tarifica
Cost of taxes on mobile data	GSMA Intelligence
Cost of taxes on handsets	GSMA Intelligence
Cost of sector specific taxes on mobile data	GSMA Intelligence
Mobile data and voice high-consumption basket	ITU
Mobile data and voice low-consumption basket	ITU
Device Pricing*	A4AI

3. Consumer & Ownership: The readiness and eagerness of consumers to adopt new technologies play a vital role in the success of 5G. Factors like mobile ownership, literacy, and basic skills reflect the population's capability and willingness to embrace 5G services.

Metric	Source
Consumer Readiness	GSMA
Mobile Ownership	GSMA
Basic Skills	GSMA
Literacy	UN and UNESCO
School Life Expectancy	UN
Gender gap in mobile ownership	GSMA Intelligence, Gallup World Poll
Gender gap in mobile internet	GSMA Intelligence, Gallup World Poll, DataReportal
Mobile cellular subscriptions (per 100 people)	ITU-WTID
Households with Internet access at home*	ITU-WTID
Individuals using the Internet (% of population)	ITU-WTID
Mobile cellular subscriptions	ITU-WTID

4. Content & Services: 5G is not just about speed; it's about the revolutionary services and content it can support, from augmented reality to IoT applications. A rich ecosystem of digital content and services can drive 5G adoption by showcasing its potential benefits and applications.

Metric	Source
Content and Services	GSMA
Top-Level Domains (TLDs) per person	ZookNIC
Mobile Social Media Penetration	DataReportal
Locally developed apps per person	Appfigures
Digital Language Support	Derivation
Language accessibility of top ranked apps	Appfigures, Ethnologue, GSMA Intelligence

5. Spectrum & Bandwidth: Spectrum is the lifeblood of wireless communication. Efficient spectrum allocation, management, and usage are crucial for the successful deployment of 5G. The availability of various bands, especially those suitable for 5G, is an indicator of a region's readiness.

Metric	Source
Spectrum	GSMA
Spectrum assigned in bands below 1GHz	GSMA Intelligence
Spectrum assigned in bands between 1-3GHz	GSMA Intelligence
Spectrum assigned in bands between 3-6GHz	GSMA Intelligence
Spectrum assigned in mmWave bands	GSMA Intelligence
Amount of spectrum licensed for IMT systems in MHz	ITU
Amount of spectrum offered for IMT systems in MHz	ITU
Digital Dividend spectrum reallocated	ITU
IMT (3G/4G) spectrum assigned**	ITU
Information on spectrum publicly available	ITU
International bandwidth usage	ITU-WTID
Lit/equipped international bandwidth capacity	ITU-WTID
National Table of Frequency Allocations	ITU
Spectrum licences technology-neutral	ITU
Spectrum or license fees subject to value-added taxes (VAT)	ITU

(** Overlaps with the first three spectrum measures (below 1GHz, 1-3GHz, 3-8GHz))

6. Security & Legislation: As 5G networks will support critical applications, ensuring their security is paramount. Robust cybersecurity legislation and measures are essential to protect these networks from threats. Additionally, clear legislation can provide a framework for 5G deployment and operations.

Metric	Source
Cybersecurity Index	ITU
Cybersecurity legislation/regulation exist	ITU
ICT consumer protection legislation	ITU

7. Economic & Development Indicators: The overall economic health and developmental stage of a region can influence 5G deployment. Developed regions with strong economic indicators might have the resources and incentives to invest in and adopt 5G faster.

Metric	Source
GNI per capita USD	WDI
GDP per capita (constant 2015 USD)	WDI
GDP per capita PPP (constant 2017 international USD)	WDI
GNI per capita (constant 2015 USD)	WDI
GNI per capita PPP (constant 2017 international USD)	WDI
Gini index	WDI
High-technology exports (% of manufactured exports)	UN
Human capital index (HCI) (scale 0-1)	WDI
ICT goods exports (% of total goods exports)	UNCTAD
ICT goods imports (% total goods imports)	UNCTAD
ICT service exports (% of service exports BoP)	IMF
ICT service exports (BoP current USD)	IMF
Inflation consumer prices (annual %)	IMF
Investment in ICT with private participation (current USD)	WDI
Public private partnerships investment in ICT (current USD)	WDI
Real effective exchange rate index (2010 = 100)	WDI
Real interest rate (%)	IMF
Tax revenue (% of GDP)	IMF
Time required to start a business (days)	WDI
Trade (% of GDP)	WDI
Trade in services (% of GDP)	IMF
Logistics performance index: Overall (1=low to 5=high)	WDI
Medium and high-tech manufacturing value added (% manufacturing value added)	UNIDO

8. Regulatory & Policy: Regulatory support is crucial for 5G's success. Policies that encourage investment in 5G infrastructure, ensure fair competition, and set clear guidelines can accelerate 5G deployment and adoption.

Metric	Source
E-Government Score	UN
Regulatory Quality: Estimate	WGI
Broadband services are part of universal service/access scheme	ITU
Cloud computing policies	ITU
Counterfeit policies for the ICT sector	ITU
Foreign ICT service providers treated differently in terms of taxation	ITU
National broadband plan exists	ITU
National development strategy digital agenda or digital stimulus strategy incl. broadband	ITU
National strategy policy or initiative focusing on emerging technologies	ITU
Restriction to foreign participation or ownership in the ICT sector	ITU
Quality of Service (QoS) regulatory framework - Services subject to QoS monitoring	ITU

9. Geographical & Environmental Factors: Geographical factors can influence 5G deployment strategies. For instance, densely populated urban areas might benefit from 5G's high capacity, while challenging terrains might require specific infrastructure solutions.

Metric	Source
Access to electricity (% of population)	IEA, IRENA, UNSD, World Bank, WHO
Land area (sq. km)	FAO
Population total	UN
Surface area (sq. km)	FAO
Population density (people per sq. km of land area)	FAO, WDI

10. Governance & Stability: The overall governance quality, political stability, and transparency in a region can influence the trust of investors and stakeholders in 5G projects. Stable regions with good governance are more likely to attract investments necessary for 5G deployment.

Metric	Source
Gender Equality	GSMA
Local Relevance	GSMA
CPIA building human resources rating (1=low to 6=high)	WDI
CPIA business regulatory environment rating (1=low to 6=high)	WDI

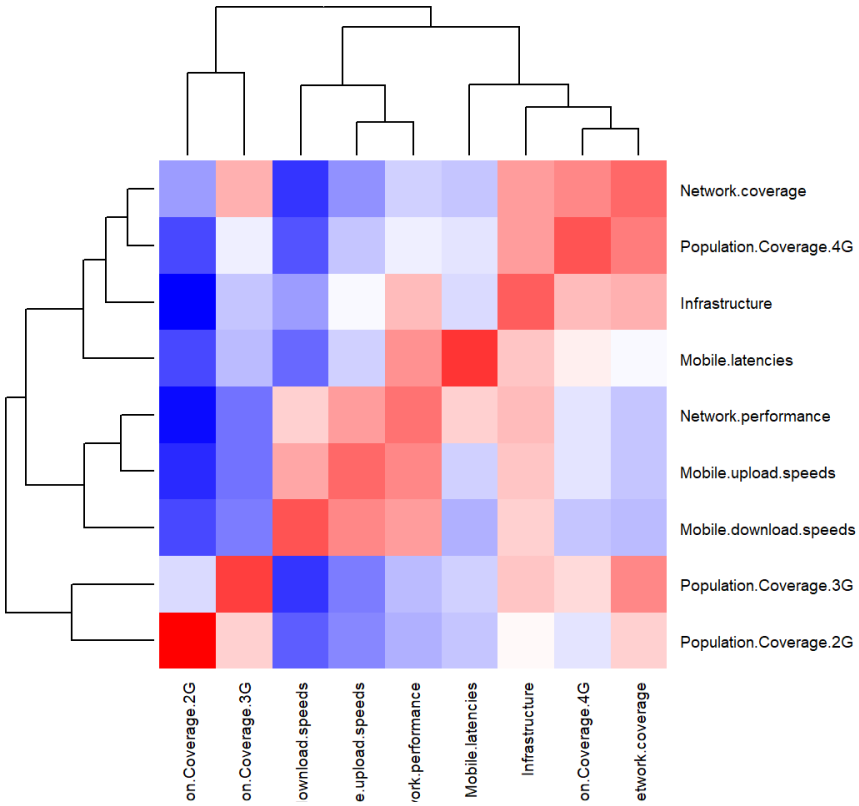
Metric	Source
CPIA property rights and rule-based governance rating (1=low to 6=high)	WDI
CPIA trade rating (1=low to 6=high)	WDI
CPIA transparency accountability and corruption in the public sector rating (1=low to 6=high)	WDI
Consumer price index (2010 = 100)	WDI
Government Effectiveness: Estimate	WDI
Political Stability and Absence of Violence/Terrorism: Estimate	WGI
Rule of Law: Estimate	WGI
Strength of legal rights index (0=weak to 12=strong)	WDI

5. Statistical and Econometric Analysis

Below are correlations of variables in each enabler to 5G population coverage in 2022. ALL refers to all 170 countries, ITU32 refers to 32 APAC countries. Note that correlation is for years 2022, 2017 and 2014. Correlations are not performed for categorical (non-numeric) variables.

1. Infrastructure & Network	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
	ALL Cs	ITU32	ALL Cs	ITU32	ALL Cs	ITU32
Cluster Index	0.73	0.76	0.70	0.77	0.73	0.79
Infrastructure	0.82	0.87	0.68	0.77	0.81	0.88
Network coverage	0.64	0.69	0.61	0.63	0.79	0.85
Network performance	0.80	0.75	0.63	0.67	0.70	0.73
2G Population Coverage	0.29	0.41	0.36	0.52	0.40	0.49
3G Population Coverage	0.38	0.46	0.45	0.43	0.59	0.64
4G Population Coverage	0.43	0.39	0.64	0.63	0.84	0.90
5G Population Coverage	1.00	1.00				
Mobile download speeds	0.88	0.86	0.69	0.73	0.71	0.68
Mobile upload speeds	0.73	0.62	0.65	0.70	0.67	0.69
Mobile latencies	0.32	0.26	0.42	0.36	0.64	0.67
Fixed broadband subscriptions (per 100 people)					0.75	0.83
Secure Internet servers			0.29	0.58	0.25	0.57
Secure Internet servers (per 1 million people)			0.59	0.45	0.61	0.58
Population coverage by mobile network technology (At least 2G)			0.26	0.32	0.31	0.45
Population coverage by mobile network technology (At least 3G)			0.33	0.33	0.44	0.44
Population coverage by mobile network technology (At least 5G)			0.89	0.49		
Population coverage by mobile network technology (At least LTE/WiMAX)			0.41	0.33	0.63	0.66

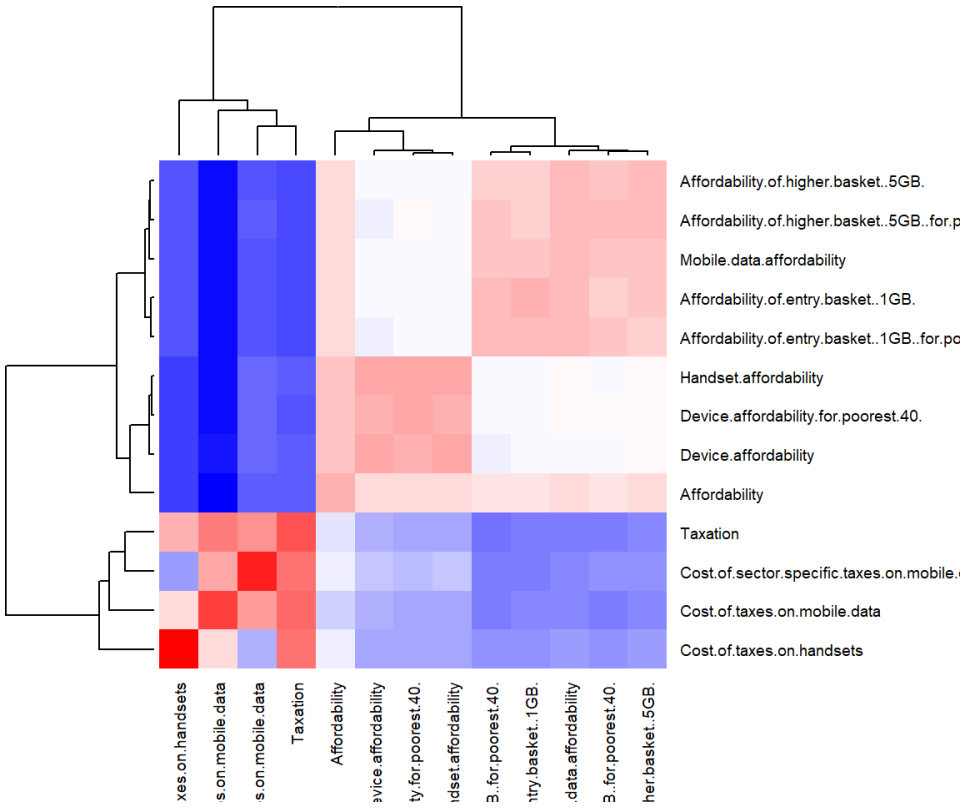
The cross correlation dendrogram below shows 3 distinct clusters which inform further analysis in the panel data regression.



2. Affordability & Costs	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Affordability	0.69	0.61	0.66	0.66	0.68	0.63
Mobile data affordability	0.62	0.47	0.60	0.49	0.65	0.44
Handset affordability	0.68	0.48	0.63	0.61	0.63	0.64
Taxation	0.28	0.40	0.28	0.37	0.25	0.40
Affordability of entry basket (1GB)	0.56	0.36	0.55	0.41	0.60	0.38
Affordability of higher basket (5GB)	0.62	0.55	0.61	0.55	0.65	0.48
Affordability of entry basket (1GB) for poorest 40%	0.59	0.37	0.57	0.42	0.63	0.39
Affordability of higher basket (5GB) for poorest 40%	0.65	0.56	0.63	0.55	0.67	0.47
Device affordability	0.65	0.47	0.61	0.62	0.61	0.64
Device affordability for poorest 40%	0.70	0.49	0.65	0.61	0.65	0.63

2. Affordability & Costs	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Cost of taxes on mobile data	0.09	0.35	0.04	0.28	0.03	0.30
Cost of taxes on handsets	0.23	0.30	0.28	0.37	0.23	0.23
Cost of sector specific taxes on mobile data	0.31	0.33	0.29	0.26	0.27	0.32
Mobile data and voice high-consumption basket	-0.37	-0.37				
Mobile data and voice low-consumption basket	-0.39	-0.39				

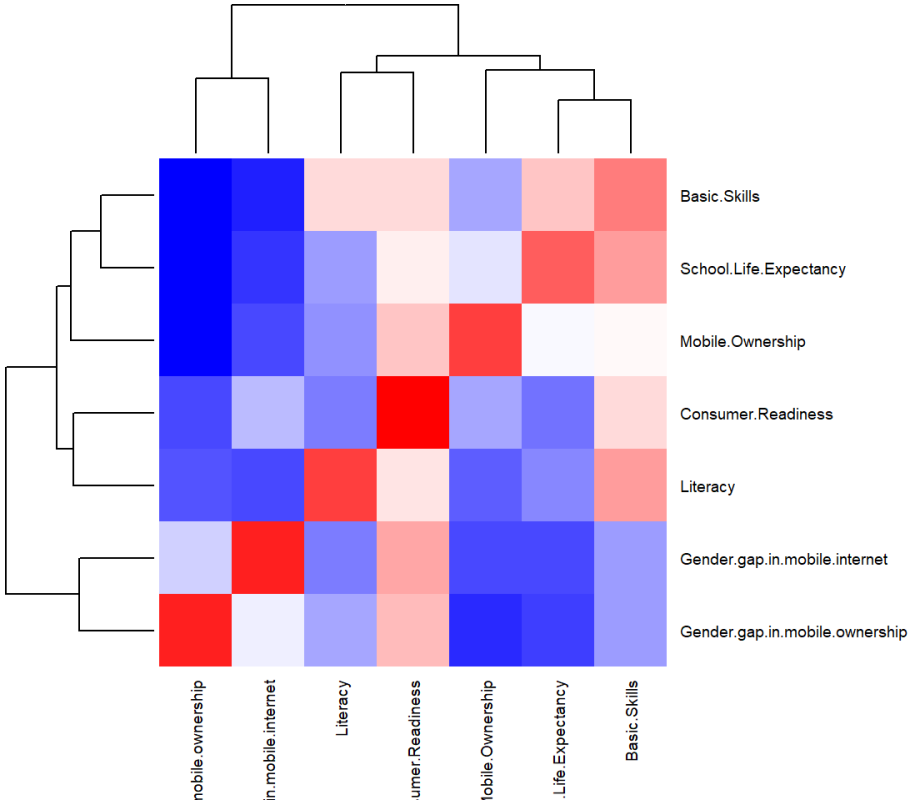
The cross correlation dendrogram below shows 2-3 distinct clusters which inform further analysis in the panel data regression.



3. Consumer & Ownership	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Consumer Readiness	0.56	0.58	0.58	0.66	0.54	0.59
Mobile Ownership	0.69	0.70	0.68	0.71	0.66	0.70

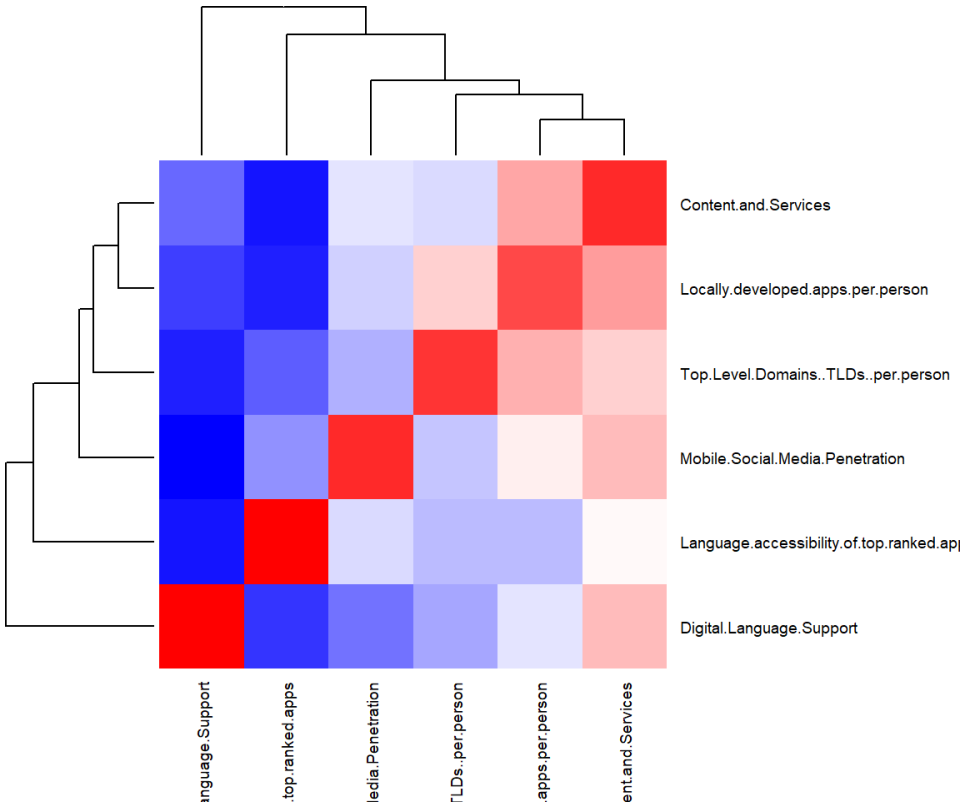
3. Consumer & Ownership	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Basic Skills	0.58	0.61	0.57	0.61	0.56	0.58
Literacy	0.44	0.42	0.45	0.45	0.45	0.47
School Life Expectancy	0.63	0.65	0.62	0.64	0.60	0.58
Gender gap in mobile ownership	0.35	0.35	0.38	0.49	0.30	0.36
Gender gap in mobile internet	0.35	0.34	0.43	0.55	0.37	0.36
Households with Internet access at home			0.49	0.69	0.71	0.79
Individuals using the Internet (% of population)			0.68	0.67	0.73	0.77
Mobile cellular subscriptions			0.07	0.12	0.08	0.13

The cross correlation dendrogram below will inform further analysis in the panel data regression.



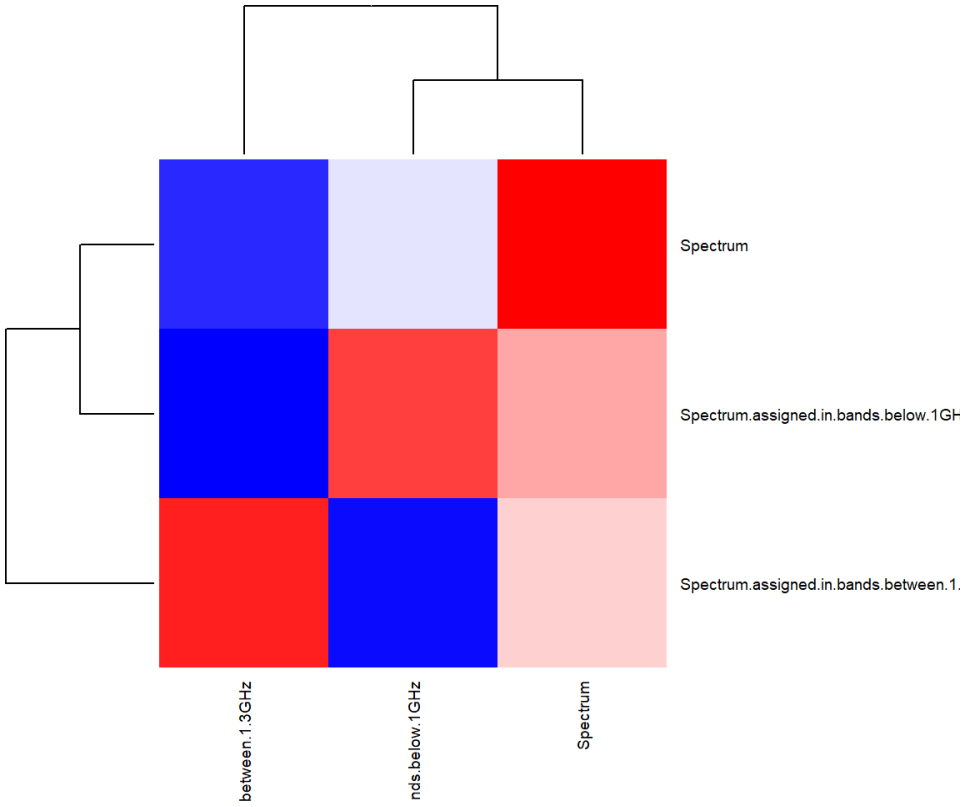
4. Content & Services	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Content and Services	0.70	0.70	0.69	0.75	0.68	0.72
Top-Level Domains (TLDs) per person	0.61	0.45	0.61	0.46	0.61	0.48
Mobile Social Media Penetration	0.64	0.64	0.55	0.64	0.59	0.55
Locally developed apps per person	0.63	0.47	0.67	0.61	0.68	0.61
Digital Language Support	0.39	0.49	0.40	0.53	0.40	0.53
Language accessibility of top ranked apps	0.42	0.50	0.44	0.53	0.45	0.58

The cross correlation dendrogram is shown below.



5. Spectrum & Bandwidth	2022 ALL Cs	2022 ITU32	2017 ALL Cs	2017 ITU32	2014 ALL Cs	2014 ITU32
Spectrum	0.71	0.74	0.56	0.65	0.56	0.71
Spectrum assigned in bands below 1GHz	0.57	0.48	0.43	0.48	0.45	0.53
Spectrum assigned in bands between 1-3GHz	0.61	0.67	0.58	0.68	0.55	0.67
Spectrum assigned in bands between 3-6GHz	0.75	0.72				
Spectrum assigned in mmWave bands	0.40	0.60				
Amount of spectrum licensed for IMT systems in MHz			0.37	-0.48		
Amount of spectrum offered for IMT systems in MHz			0.03	-0.32		
Digital Dividend spectrum reallocated						
IMT (3G/4G) spectrum assigned						
Information on spectrum publicly available						
International bandwidth usage	0.24	0.25	0.26	0.38	0.27	0.66
Lit/equipped international bandwidth capacity	0.31	0.42	0.36	0.47	0.45	0.58
National Table of Frequency Allocations						
Spectrum licences technology-neutral						
Spectrum or license fees subject to value-added taxes (VAT)						

Below is a partial cross correlation dendrogram.



6. Security & Legislation	2022 ALL Cs	2022 ITU32	2017 ALL Cs	2017 ITU32	2014 ALL Cs	2014 ITU32
Cybersecurity Index	0.62	0.57	0.62	0.69	0.55	0.62
Cybersecurity legislation/regulation exist						
ICT consumer protection legislation						

7. Economic & Development Indicators	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
GNI per capita USD	0.71	0.71	0.71	0.71	0.65	0.65
GDP per capita (constant 2015 USD)	0.72	0.69	0.71	0.69	0.70	0.68
GDP per capita PPP (constant 2017 international USD)	0.76	0.61	0.76	0.61	0.74	0.60
GNI per capita (constant 2015 US$)	0.78	0.77	0.75	0.73	0.73	0.70

7. Economic & Development Indicators	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
GNI per capita PPP (constant 2017 international USD)	0.83	0.82	0.79	0.61	0.79	0.58
Gini index	-0.40	0.27	-0.38	0.07		
High-technology exports (% of manufactured exports)	0.39	0.45	0.37	0.52		
Human capital index (HCI) (scale 0-1)	0.75	0.81				
ICT goods exports (% of total goods exports)	0.37	0.47	0.36	0.53		
ICT goods imports (% total goods imports)	0.40	0.53	0.37	0.52		
ICT service exports (% of service exports BoP)	0.15	-0.30	0.13	-0.14	0.02	-0.26
ICT service exports (BoP current USD)	0.26	-0.01	0.35	0.06	0.34	0.00
Inflation consumer prices (annual %)	-0.18	-0.31	-0.17	-0.42	-0.29	-0.30
Investment in ICT with private participation (current USD)	0.10	-0.13				
Public private partnerships investment in ICT (current USD)	-0.79	-1.00				
Real effective exchange rate index (2010 = 100)	-0.13	-0.26	-0.04	-0.16	-0.05	-0.06
Real interest rate (%)	-0.12	0.26	-0.14	-0.48	-0.20	-0.41
Tax revenue (% of GDP)			0.23	0.10	0.21	-0.06
Time required to start a business (days)			-0.21	-0.21	-0.26	-0.35
Trade (% of GDP)	0.46	0.28	0.39	0.16	0.37	0.17
Trade in services (% of GDP)	0.27	0.19	0.28	0.15	0.26	0.14
Logistics performance index: Overall (1=low to 5=high)	0.82	0.78			0.78	0.80
Medium and high-tech manufacturing value added (% manufacturing value added)	0.65	0.66	0.64	0.66		

8.Regulatory & Policy	2022 ALL Cs	2022 ITU32	2017 ALL Cs	2017 ITU32	2014 ALL Cs	2014 ITU32
E-Government Score	0.65	0.75	0.66	0.69	0.65	0.74
Regulatory Quality: Estimate			0.72	0.70	0.71	0.69

9. Geographical & Environmental	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Access to electricity (% of population)			0.42	0.36	0.44	0.46
Land area (sq. km)			0.07	0.30	0.07	0.30
Population total	0.03	0.07	0.04	0.08	0.04	0.08
Surface area (sq. km)			0.07	0.30	0.07	0.30
Population density (people per sq. km of land area)			0.24	0.31	0.24	0.31

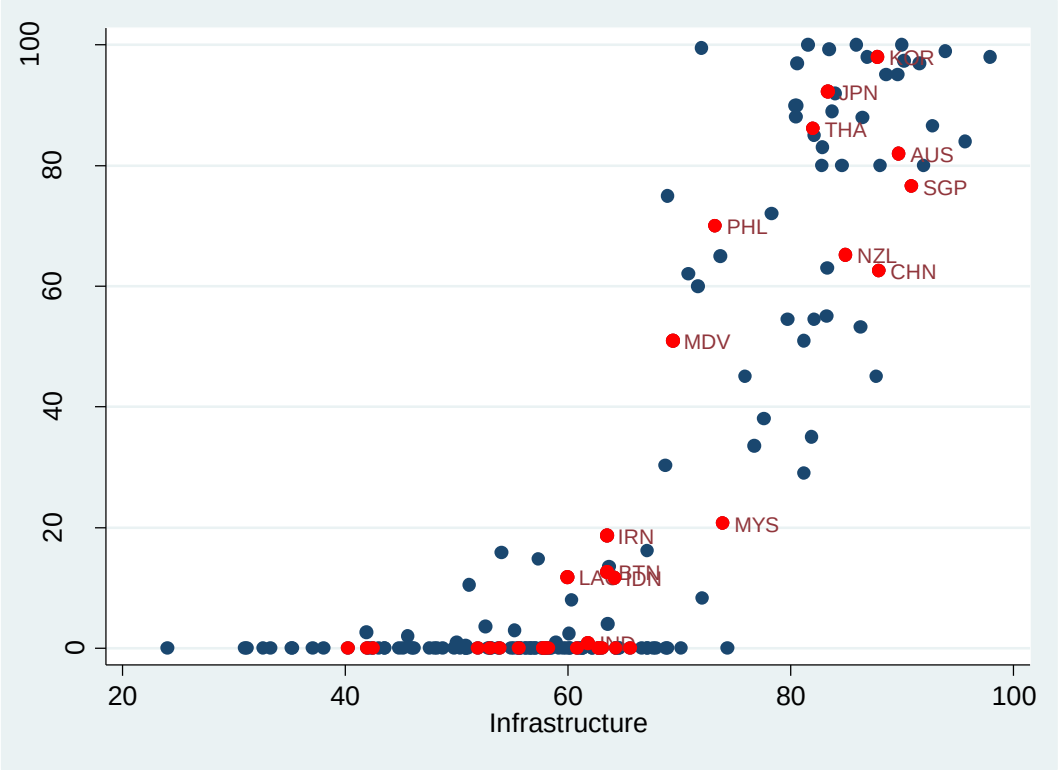
10. Governance & Stability	2022 ALL	2022 ITU32	2017 ALL	2017 ITU32	2014 ALL	2014 ITU32
Gender Equality	0.36	0.35	0.42	0.53	0.37	0.40
Local Relevance	0.65	0.69	0.65	0.72	0.66	0.71
CPIA building human resources rating (1=low to 6=high)			0.22	0.35	0.24	0.45
CPIA business regulatory environment rating (1=low to 6=high)			0.15	0.30	0.14	0.32
CPIA property rights and rule-based governance rating (1=low to 6=high)			0.11	0.15	0.05	0.12
CPIA trade rating (1=low to 6=high)			0.03	0.11	-0.03	0.08
CPIA transparency accountability and corruption in the public sector rating (1=low to 6=high)			0.08	0.13	-0.04	-0.06
Consumer price index (2010 = 100)	-0.11	-0.55	-0.11	-0.30	-0.30	-0.27
Government Effectiveness: Estimate			0.72	0.67	0.73	0.71
Political Stability and Absence of Violence/Terrorism: Estimate		0.45	0.25	0.48	0.23	
Rule of Law: Estimate			0.70	0.57	0.71	0.63
Strength of legal rights index (0=weak to 12=strong)		-0.01	-0.11	0.08	0.03	

For each of the 10 enablers identified above, correlation analysis as well as panel data regression was use to select the most appropriate variable for further analysis. The following variables were identified as most suitable for further analysis.

Panel-data Fixed Effects Regression Model

The following are results from panel data fixed effect regression (unless specified when OLS is used due to data limitation)):

1. Infrastructure & Network: Infrastructure Index, Network coverage, Network Performance



- All 170 Cs

Variable	Coef.	P-value
infrastructure	2.226232	0.000

- 32 APAC

Variable	Coef.	P-value
infrastructure	1.112861	0.010

Panel fixed-effects regression (controlling for individual country characteristics) on our data confirms that infrastructure is a significantly important enabler of 5G both globally and in the APAC region.

- All 170 Cs

Variable	Coef.	P-value
networkcoverage	1.615828	0.008
networkperformance	.6252701	0.000

- 32 APAC

Variable	Coef.	P-value
networkcoverage	.8340523	0.070
networkperformance	.3736552	0.043

When breaking down overall infrastructure into network coverage (which is highly correlated to 4G population coverage and latency) and network performance (which is highly correlated to upload and download average speeds), both are important enablers for 5G globally, but network coverage is not statistically significant for APAC region. Further regressions below show the importance of mobile download speeds, while latency does not seem important as yet.

- All 170 Cs

Variable	Coef.	P-value
popcoverage4G	.0734549	0.050
mobilelatencies	.0351087	0.210

- 32 APAC

Variable	Coef.	P-value
popcoverage4G	.0864748	0.329
mobilelatencies	.0144485	0.317

- All 170 Cs

Variable	Coef.	P-value
mobileuploadspeeds	.1857664	0.255
mobiledownloadspeeds	.4825686	0.006

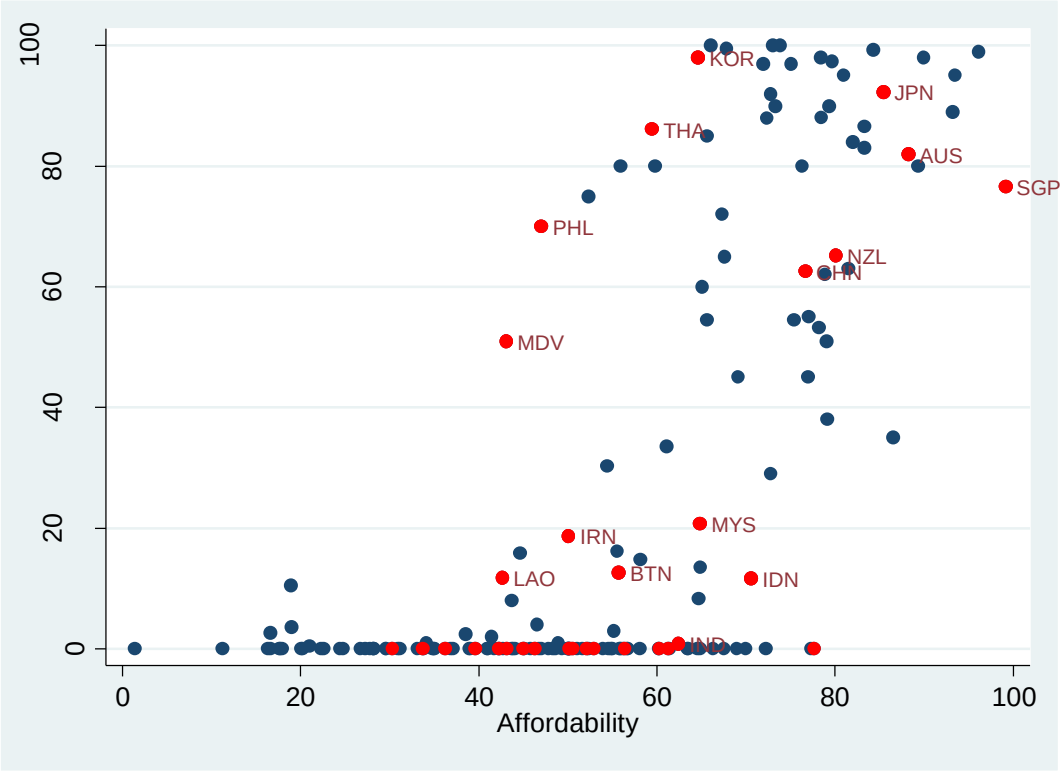
- 32 APAC

Variable	Coef.	P-value
mobileuploadspeeds	.0843981	0.577
mobiledownloadspeeds	.4403185	0.058

Building the right infrastructure plays a pivotal role in unleashing the transformative potential of 5G technology. It serves as the foundation upon which the promises of faster speeds, minimal latency, and extensive connectivity can be realized. By strategically establishing this infrastructure, we pave the way for innovations that can enhance various aspects of our lives, from enabling remote healthcare services and advancing smart cities to facilitating seamless communication between devices. Ultimately, this well-structured infrastructure is the key that opens doors to a more connected and efficient future, where

the possibilities of 5G are harnessed to create positive impacts across diverse industries and communities.

2. Affordability & Costs: Affordability Index, Taxation, Handset and device affordability



- All 170 Cs

Variable	Coef.	P-value
affordability	.7166672	0.005

- 32 APAC

Variable	Coef.	P-value
affordability	.2118241	0.293

While affordability typically stands out as a crucial factor in enabling the adoption of 5G technology, it is interesting to note that this might not hold true for the APAC region. When separating affordability into data affordability and mobile/handset affordability shows that affordability of higher 5Gb in general is an important enabler for 5G globally, it is not statistically significant for APAC even when considering affordability for the poorest 40 percent.

- All 170 Cs

Variable	Coef.	P-value
affordability5gb	.2891865	0.033

Variable	Coef.	P-value
affordability1gb	.0606692	0.695

Variable	Coef.	P-value
affordability5gbfor~40p	.3130694	0.038
affordability1gbfor~40p	.0599002	0.704

- 32 APAC

Variable	Coef.	P-value
affordability5gb	.4847981	0.098
affordability1gb	-.2260143	0.399

Variable	Coef.	P-value
affordability5gbfor~40p	.4853637	0.097
affordability1gbfor~40p	-.2253165	0.399

The same is true when considering device affordability as shown below. Although handset affordability is important generally globally as 5G enablers, this is not statistically significant for APAC region, even for the poorest 40 percent

- All 170 Cs

Variable	Coef.	P-value
handsetaffordability	2.975661	0.001
deviceaffordability	-2.611501	0.001

- 32 APAC

Variable	Coef.	P-value
handsetaffordability	2.330358	0.081
deviceaffordability	-2.234763	0.069

Variable	Coef.	P-value
deviceaffordabilityforpoorest40	.0475808	0.728

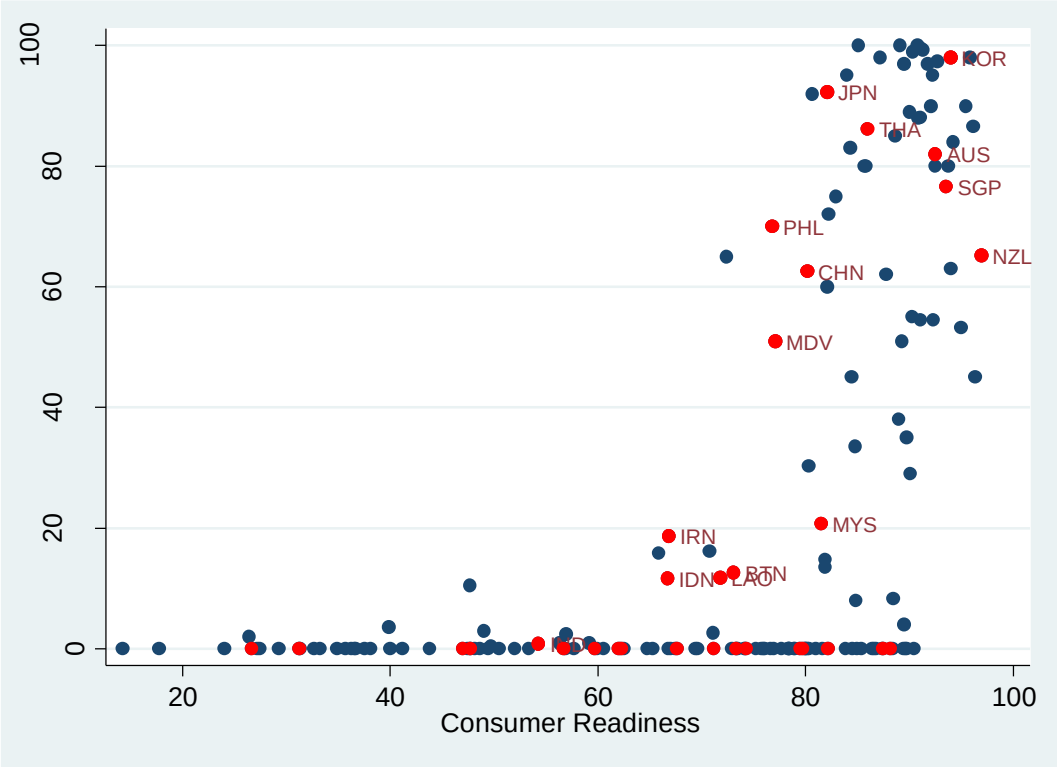
While affordability typically stands out as a crucial factor in enabling the adoption of 5G technology, and there are occasion reports that the price of 5G terminals in the Asia-Pacific region are high thereby hindering the increase of 5G user penetration,[34] it is interesting to note that this might not hold true given the regression results. However, although not shown here, panel data regression with 4G population coverage suggests that there may be

[34] See APAC 5G Industry Community, GSMA Asia Pacific

some empirical evidence that high taxation may work against possibly 5G adoption in APAC.

Be as it may, while affordability has historically played a pivotal role in technology adoption, the unique dynamics and market conditions in the APAC region seems to have allowed the region to embrace and invest in cutting-edge technologies despite potential affordability concerns. Factors such as rapid economic growth, high levels of digitalization, and cultural nuances might be contributing to this phenomenon.

3. Consumer & Ownership: Consumer Readiness Index, Mobile Ownership, Mobile cellular subscriptions (per 100 people)



- All 170 Cs

Variable	Coef.	P-value
consumerreadiness	.3125009	0.162

Variable	Coef.	P-value
mobileownership	2.790186	0.000

- 32 APAC

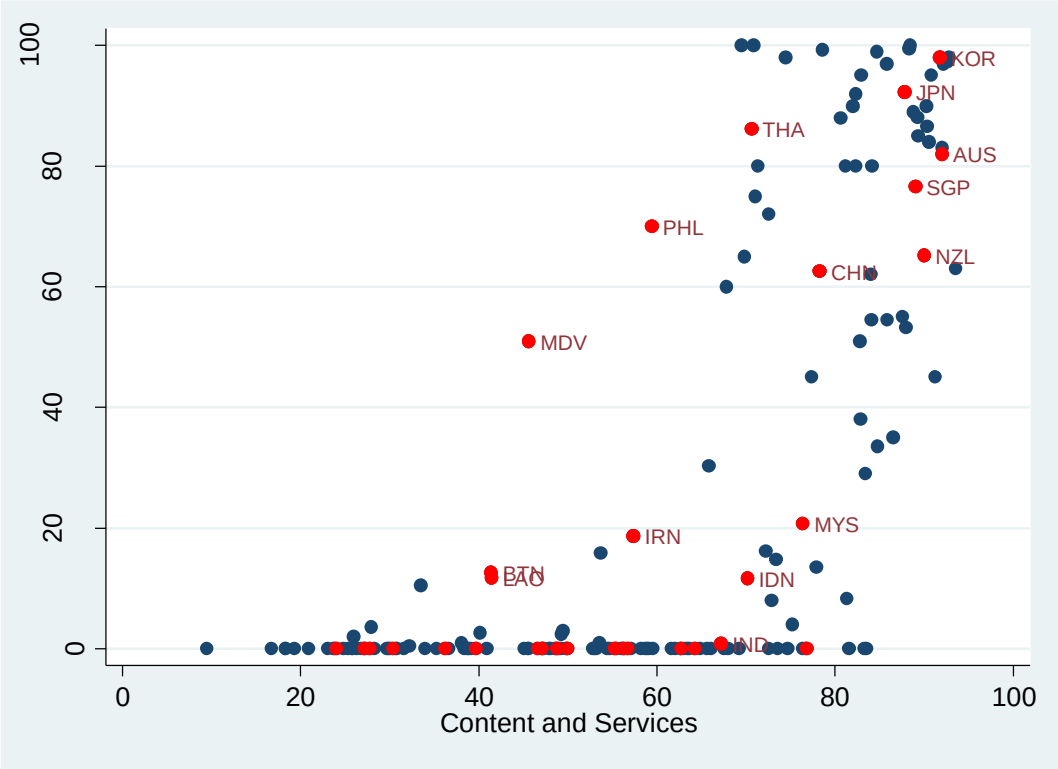
Variable	Coef.	P-value
consumerreadiness	-.0147836	0.949

Variable	Coef.	P-value
mobileownership	2.132845	0.001

Consumer and ownership dynamics should play a pivotal role as enablers for the widespread adoption and success of 5G technology. General engagement and ownership of consumers drive the demand for advanced services and experiences that 5G offers. In the above regressions, although GSMA consumer readiness index is not statistically significant in explaining 5G usage globally and in the APAC region, mobile ownership is highly significant as a 5G enabler. Other consumer characteristics such as basic skill, literacy, and school life expectancy, mobile cellular subscriptions per 100 populations, percentage of individuals using the Internet and mobile-cecllular subscriptions were correlated with 5G and 4G population coverage.

It may be too early to say, but as individuals embrace the potential of 5G-enabled applications, from augmented reality to IoT solutions, they will not only enrich their lives but also contribute to the growth and evolution of industries. Consumer-centric ownership will create a symbiotic relationship where the demand for 5G services fosters innovation, prompting businesses to develop and deliver cutting-edge offerings. This positive feedback loop should lead to a virtuous cycle of continuous advancements, shaping a future where individuals and industries thrive together in the realm of 5G possibilities.

4. Content & Services: Content and Services Index and Top-Level Domains (TLDs) per person



- ALL 170 Cs

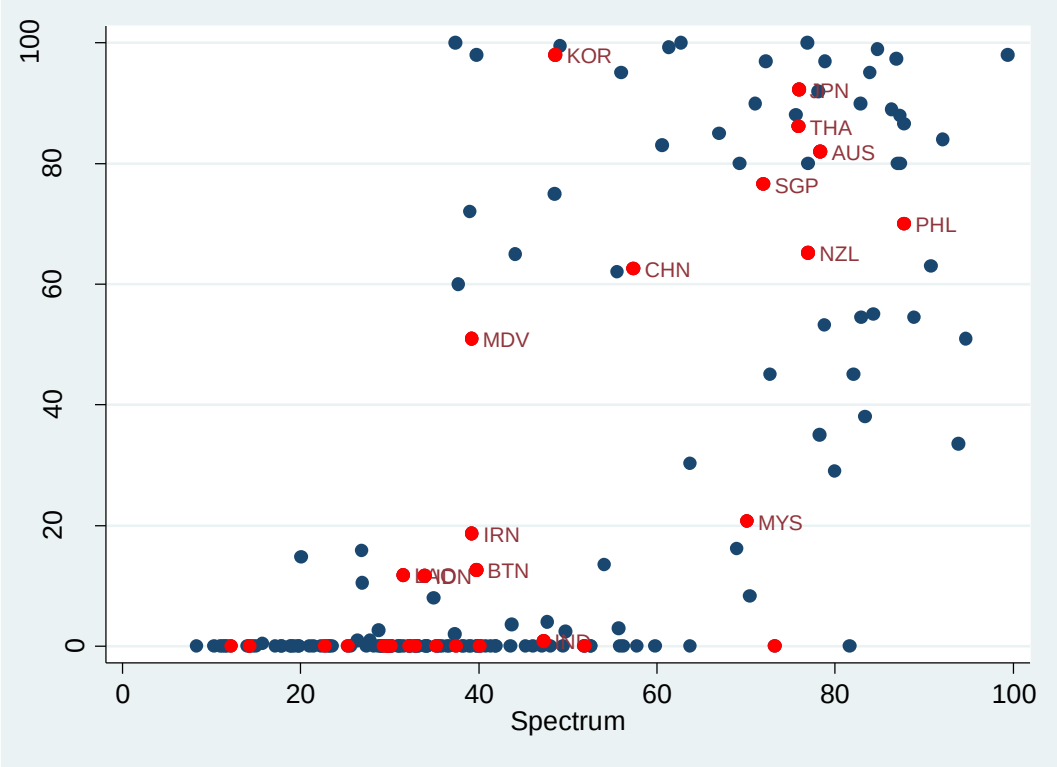
Variable	Coef.	P-value
contentandservices	-1.72656	0.023
topleveldomainstldsperperson	1.571271	0.082

- 32 APAC

Variable	Coef.	P-value
contentandservices	-2.221123	0.004
topleveldomainstldsperperson	.6669618	0.264

Contrary to expectations, content and services, which encompasses the availability of secure online content and services tailored to the local population, such as mobile social media penetration, intensity of locally developed apps, digital language support and language accessibility of top ranked apps appear to have a negative impact on the 5G adoption. Only access to Top-Level Domains (TLDs) per person is positively but not statistically related to 5G population coverage. Despite the intuitive notion that accessible and relevant digital content would fuel 5G adoption, it seems that other underlying factors might be influencing this relationship. This unexpected outcome may be a reflection of the intricate interplay between technology adoption and local dynamics. While the creation of content within a country might have been anticipated to facilitate adoption, it is clear that the context is more complex. This insight invites us to delve deeper into understanding the specific nuances that contribute to this unexpected correlation and to explore how it interacts with various aspects of the 5G ecosystem.

5. Spectrum & Bandwidth: Spectrum Index



- ALL 170 Cs

Variable	Coef.	P-value
spectrum	.9864496	0.001

- 32 APAC

Variable	Coef.	P-value
spectrum	.6239846	0.024

Spectrum and Bandwidth exhibit a significant relationship with 5G adoption.

- ALL 170 Cs

Variable	Coef.	P-value
spectrumassignedinbandsbelow1ghz	.5895437	0.020
spectrumassignedinbandsbetween13	-.1001304	0.621
spectrumassignedinbandsbetween36	.2927941	0.029
spectrumassignedinmmwavebands	-.0861197	0.524

- 32 APAC

Variable	Coef.	P-value
spectrumassignedinbandsbelow1ghz	.6099447	0.016
spectrumassignedinbandsbetween13	.0318005	0.401

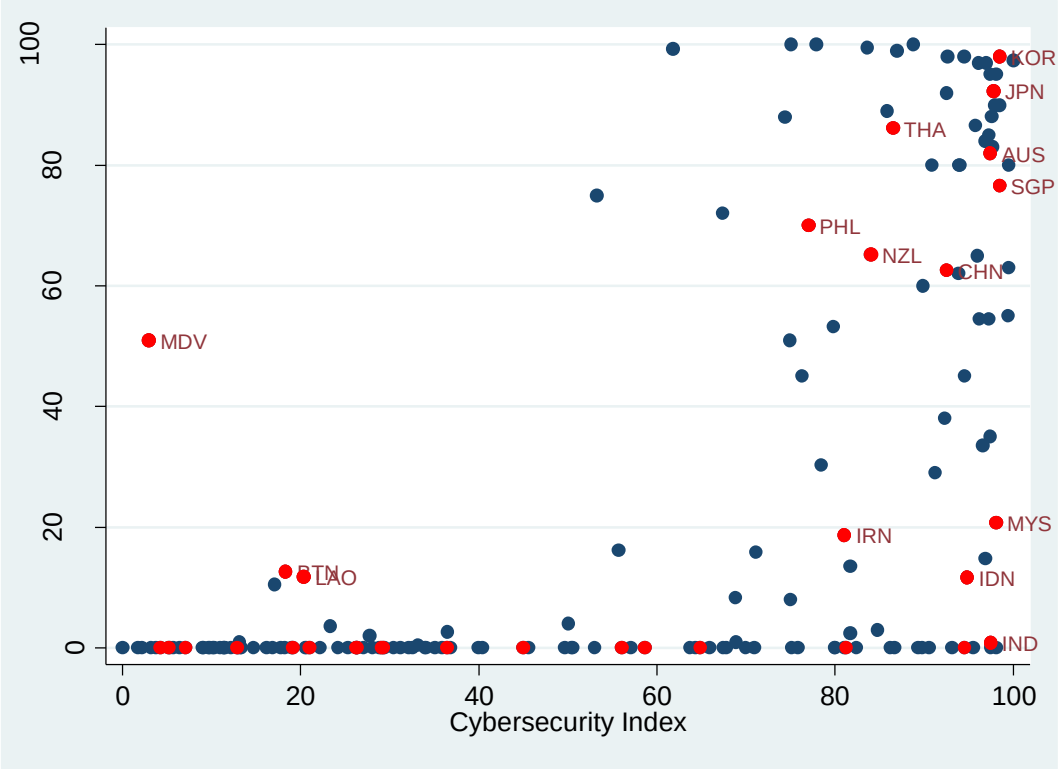
Variable	Coef.	P-value
spectrumassignedinbandsbetween36	.1793522	0.303
spectrumassignedinmmwavebands	-.1029227	0.382

(Note: Actually most countries have chosen C-band and FDD bands for the mainstream 5G spectrum. Mmwave is usually reserved in hotspot areas.)

Taking a close look, the amount of spectrum in bands below 1 GHz assigned to mobile network operators is positively related to 5G population coverage, while the empirical evidence on higher frequencies bands assigned is mixed at best. In fact, 5G spectrum auctions have attracted great attention from operators, which will greatly affect the success of 5G. Sufficient spectrum resources are the basis for successful 5G network construction and commercial use. Sufficient spectrum are provided to improve operators' investment efficiency and ensure user experience. The prerequisite for operators to put 5G into commercial use is to allocate sufficient low-frequency, intermediate-frequency, and high-frequency spectrum.[35]

6. Security & Legislation: Cybersecurity Index

(Note: Regression analysis used because only 2022 data is unavailable)



[35] See for example Miller et al. (2022) & https://www.gsma.com/spectrum/5g-spectrum-guide/

- ALL 170 Cs

Variable	Coef.	P-value
cybersecurityindex	.5201573	0.000

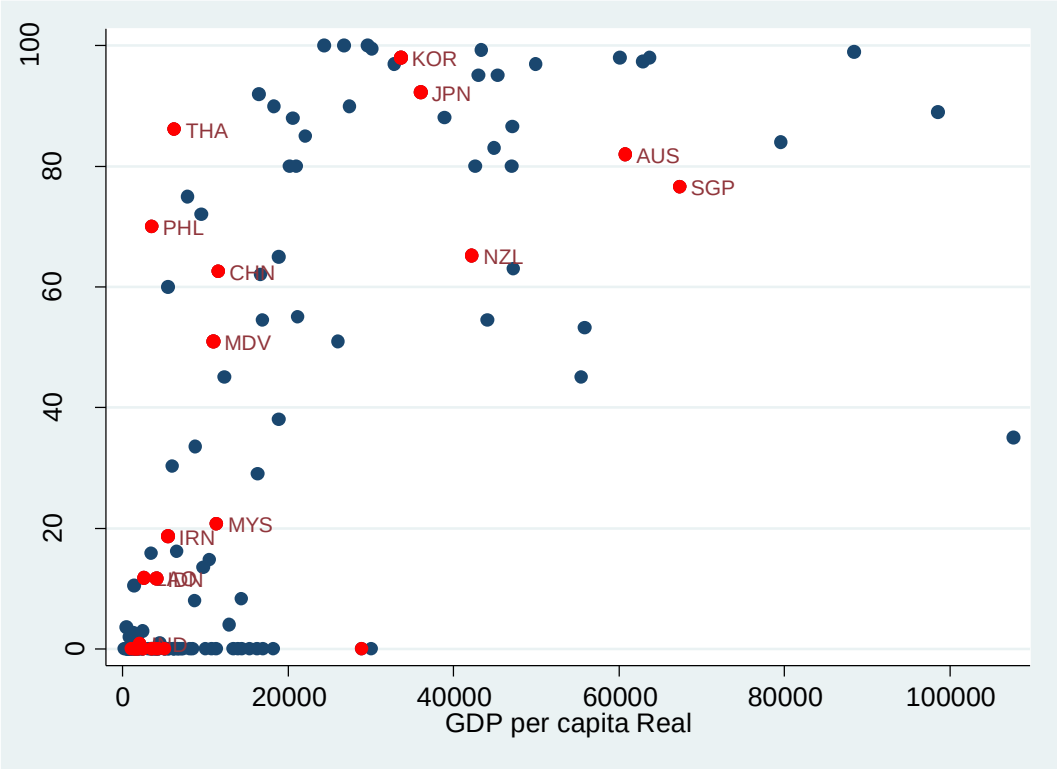
- 32 APAC

Variable	Coef.	P-value
**cybersecurityindex*	.4982565	0.003

Cybersecurity stands as a pivotal cornerstone in the realm of 5G technology. As we embrace the transformative potential of 5G, it becomes imperative to ensure the utmost security and resilience in our digital landscape. With the exponential increase in connected devices and data exchange, the significance of safeguarding sensitive information and critical infrastructure cannot be overstated. Cybersecurity not only safeguards personal privacy but also protects businesses, governments, and critical services from potential threats and breaches. By prioritizing robust cybersecurity measures, we create a secure foundation upon which 5G can flourish, fostering trust and confidence among users, enabling innovation, and paving the way for a safer and more connected future.

7. Economic & Development Indicators: GDP per capita (constant 2015 USD), High-technology exports (% of manufactured exports), ICT goods/services exports/imports

(Note: Regression analysis used because only 2022 data is unavailable)



- 94 Cs

Variable	Coef.	P-value
gdppercapitareal	.000988	0.000
hightechnologyexportsofmanufactu	.6855046	0.010

- 15 APAC

Variable	Coef.	P-value
gdppercapitareal	.0012817	0.001
hightechnologyexportsofmanufactu	.5413152	0.212

Income per capita and international trade (not shown here) emerge as a crucial factor that influences the 5G landscape. High-technology exports holds significance as a potential enabler, yet interestingly, this is not the case for the APAC region. While this might initially seem counter intuitive, it again underscores the need to integrate plans and strategies for industry digital development and the use 5G to help industry digitalization.

- 115 Cs

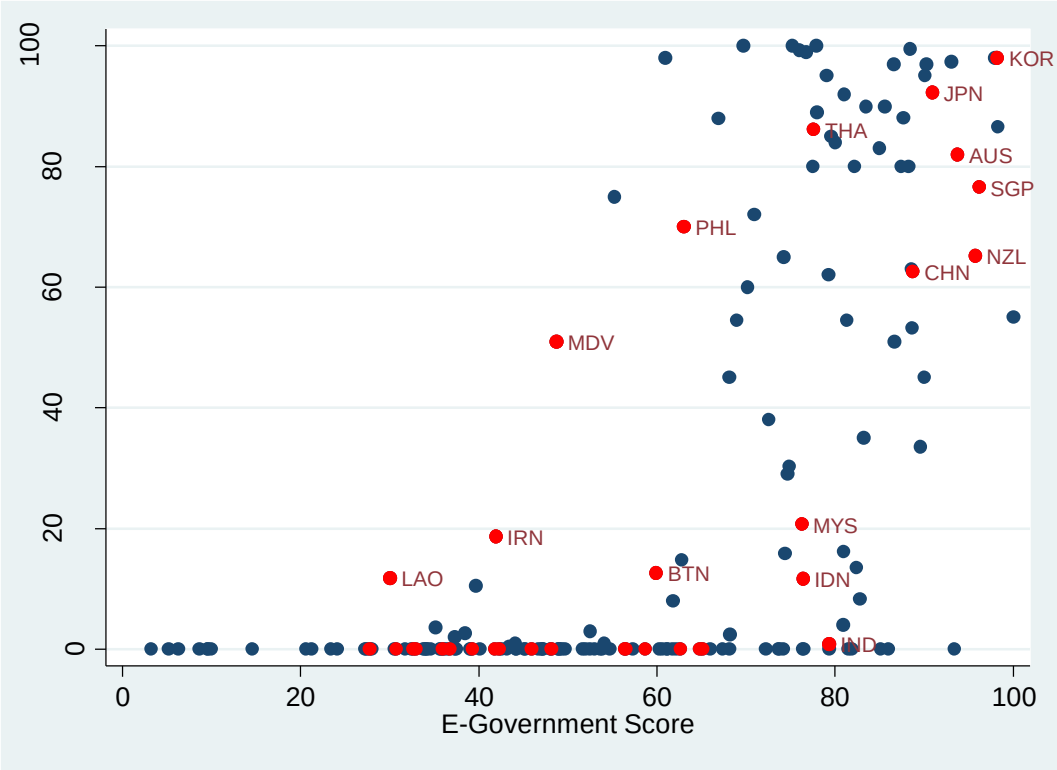
Variable	Coef.	P-value
gdppercapitareal	.0009843	0.000
ictgoodsexportsoftotalgoodsexpor	1.385964	0.003
ictgoodsimportstotalgoodsimports	-.3997404	0.582
ictserviceexportsofserviceexport	-.1097719	0.510

- 20 APAC

Variable	Coef.	P-value
gdppercapitareal	.0009706	0.039
ictgoodsexportsoftotalgoodsexpor	1.351248	0.108
ictgoodsimportstotalgoodsimports	-.7012658	0.725
ictserviceexportsofserviceexport	-.4238203	0.290

Regression results seem to indicate that ICT goods exports is an important enabler for 5G, but APAC countries seem not yet to have exploited this. Interestingly, neither imports of ICT goods nor export of ICT services are related to 5G usage. Although other macroeconomics variables such as the real effective exchange rate, interest rates, inflation, and gini seem to have little impact on 5G usage, there is some suggestion (although not shown here) that trade in services might positively help 5G adoption in APAC.

8. Regulatory & Policy: E-Government Score, Regulatory Quality (Estimate)



(Note: Regression analysis used)

- ALL 170 Cs

Variable	Coef.	P-value
egovernmentscore	.248959	0.049
regulatoryqualityestimate	17.41774	0.000

- 32 APAC

Variable	Coef.	P-value
egovernmentscore	.7205469	0.013
regulatoryqualityestimate	8.844773	0.139

The role of e-government and regulatory quality of governance cannot be overstated in the context of 5G technology adoption. Although panel data fixed effect regression does not show any significant relationship between e-governance and 5G adoption, regression analysis indicates some positive relationship including regulatory quality, but the latter is not as strong statistically for the APAC region.

That notwithstanding, e-government initiatives hold the potential to reshape the way governments interact with citizens, businesses, and various stakeholders. Moreover, by leveraging the capabilities of 5G, e-government services can become more efficient, accessible, and responsive, enabling streamlined processes, faster service delivery, and

enhanced citizen engagement. This synergy between 5G and e-government has the power to drive digital transformation at a societal level, fostering transparency, accountability, and inclusivity. As governments harness the capabilities of 5G to provide seamless online services, they pave the way for an empowered, connected, and digitally literate population that can actively participate in the modern digital landscape.

9. Geographical & Environmental Factors: Access to electricity (% of population), Population Total, Population density (people per sq. km of land area)

(note: 4G Population Coverage is used as dependent variable due to missing data for 2022 for regressors)

- ALL 170 Cs

Variable	Coef.	Std. Err.	P-value
accesstoelectricityofpopulation	2.805213	.3042143	0.000
populationtotal	1.10e-06	5.04e-07	0.030
populationdensitypeoplepersqkmof	.1103283	.0347568	0.002

- 32 APAC

Variable	Coef.	Std. Err.	P-value
accesstoelectricityofpopulation	2.70018	.418065	0.000
populationtotal	8.24e-07	3.79e-07	0.037
populationdensitypeoplepersqkmof	.0908778	.0356331	0.016

Access to electricity, total population, and population density are all important in shaping the landscape of 4/5G technology adoption. Access to electricity serves as a foundational enabler, providing the essential infrastructure for widespread technology adoption. A well-connected and electrified population is better positioned to embrace the benefits of 5G connectivity and its transformative applications. Additionally, the size and density of the population play a pivotal role in determining the feasibility and potential reach of 5G networks. As more individuals are integrated into the digital ecosystem, opportunities for innovation and collaboration are heightened, fostering economic growth and societal progress. These factors, collectively, contribute to an environment conducive to unlocking the full potential of 5G and enabling a more connected and inclusive future.

10. Governance & Stability: Gender Equality, Local Relevance, Government Effectiveness: Estimate, Rule of Law: Estimate, Strength of legal rights index (0=weak to 12=strong)

(note: 4G Population Coverage is used as dependent variable due to missing data for 2022 for regressors)

- ALL 170 Cs

Variable	Coef.	Std. Err.	P-value	[95% Conf. Interval]
genderequality	.563774	.0888569	0.000	.3883614 .7391865
governmenteffectivenessestimate	7.066094	10.03243	0.482	-12.73893 26.87111
ruleoflawestimate	-14.98264	13.41121	0.266	-41.45772 11.49244

- 32 APAC

Variable	Coef.	Std. Err.	P-value
genderequality	.5275961	.2481004	0.042
governmenteffectivenessestimate	-2.994571	18.37971	0.872
ruleoflawestimate	67.97246	22.40337	0.005

Interestingly, gender equality plays a critical role in the context of 4/5G technology adoption. Embracing gender equality is not only a matter of social justice but also a strategic imperative for realizing the full potential of 5G's transformative capabilities. By ensuring equal opportunities for women's participation and leadership in the technology sector, we tap into a diverse range of perspectives and skills that can drive innovation and creativity. Gender-inclusive policies and practices foster a balanced and inclusive workforce, leading to more holistic problem-solving and the development of solutions that cater to the needs of all members of society. Additionally, by addressing gender disparities in technology adoption, we bridge the digital divide and create a more equitable future where everyone can benefit from the advancements brought forth by 5G technology.

Summary of Result & Robustness Check

Our analysis confirms that empirically infrastructure (especially network coverage and performance), affordability (i.e. large data transfers), consumer readiness (i.e. mobile ownership), Per Capita income, e-governance, gender equality and sufficient spectrum allocation, amongst other factors, are important enablers of 5G adoption. However, although affordability, cybersecurity and high technology exports of manufactured goods are also generally importantly identified as 5G enablers, there seems to be no statistical evidence that this is the case for the APAC region. Interestingly content and services is not seen as a 5G enabler as is often assumed.[36]

[36] To verify the empirical analysis, robustness checks are performed by investigating the relationship between 5G population coverage by initial conditions and growth of enablers since 2014 to 2022.

6. Policy Recommendations

Based on the empirical findings, several policy recommendations can be formulated to effectively foster 5G adoption and its associated benefits:

1. **Infrastructure Investment**: Given the significance of infrastructure as a 5G enabler, policymakers should prioritize substantial investments in building and upgrading communication infrastructure. This includes deploying high-speed networks and expanding coverage in both urban and rural areas to ensure equitable access to 5G technology. Moreover, there is need to control network evaluation and monitor network coverage and experience indicators. The government may also use USF funds or financial funds to support 4G/5G coverage improvement.

2. **Consumer Readiness Programs**: To harness the potential of consumer readiness as an enabler, policymakers should design and implement programs that enhance digital literacy and awareness. Initiatives focused on educating citizens about the benefits of 5G and its applications can boost adoption rates and bridge the digital divide.

3. **Economic Empowerment**: Recognizing the importance of per capita income, policymakers should emphasize policies that drive economic growth and raise income levels. By fostering favorable business environments, promoting entrepreneurship, and ensuring equitable distribution of wealth, they can create an ecosystem that supports 5G adoption.

4. **E-Governance and Regulatory Reforms**: Policymakers should prioritize the development and implementation of robust e-governance strategies. This includes leveraging 5G technology to enhance government services, improve citizen engagement, and promote transparency. Additionally, regulatory reforms should be a focal point, ensuring that the regulatory environment supports 5G deployment and innovation.

5. **Spectrum**: Effective spectrum management is a critical factor in the success of 5G technology. Governments and regulatory bodies play a pivotal role in establishing clear policies for spectrum allocation, including frequency bands and licensing models. By managing spectrum wisely, nations can not only meet the rising demand for high-speed connectivity but also foster innovation, economic growth, and technological advancement.

6. **Learning from Leading Nations**: Based on the experience of leading 5G countries such as South Korea, Japan, China, Europe, and Thailand, government policies should also include formulating national MBB plans, quantifying MBB development goals, and introducing supporting policies. Moreover, governments should plan for industry digital development and use 5G to help industry digitalization.

7. **Gender Equality Initiatives**: Policymakers should actively promote gender equality in the technology sector. Implementing policies that encourage equal participation and representation of women in the industry can lead to a more

diverse and innovative workforce, ultimately accelerating 5G adoption and fostering balanced technological advancements.

8. **Infrastructure Accessibility**: Addressing access to electricity and population density can have far-reaching impacts on 5G adoption. Policymakers should prioritize infrastructure development to ensure reliable access to electricity, especially in underserved areas. Additionally, urban planning should consider population density to optimize network coverage and connectivity.

9. **Affordability and Cybersecurity Focus**: While affordability and cybersecurity might not be significant enablers for the APAC region, these factors should not be neglected. Policymakers should design initiatives that make 5G services more affordable and ensure robust cybersecurity measures are in place to bolster trust in the technology.

10. **Promote High-Tech Exports**: Policymakers should focus on supporting industries that drive high-technology exports of manufactured goods. While this might not directly impact 5G adoption in certain regions, promoting high-tech exports contributes to economic growth and technological prowess.

11. **Redefine Content and Services Strategies**: Since content and services do not exhibit significant impact as 5G enablers, policymakers should rethink their strategies in this area. Emphasis could shift toward enhancing other enablers, such as infrastructure and consumer readiness, while ensuring that content and services remain relevant and innovative.

12. **Continuous Monitoring and Evaluation**: Given the evolving nature of technology adoption, policymakers should establish mechanisms for continuous monitoring and evaluation of the identified enablers. This will allow for timely adjustments to strategies and policies based on emerging trends and changing dynamics. Regular MBB network quality evaluation helps stimulate market competition and bring better user experience to consumers.

The above policy recommendations aim to help create a comprehensive framework that addresses the multifaceted nature of 5G adoption. By strategically focusing on the identified enablers and tailoring interventions to specific regional contexts, policymakers can drive positive outcomes, fostering widespread 5G adoption and reaping the associated economic, social, and technological benefits.

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Appendix

Variable Description

Variable	Description
Infrastructure	The availability of high-performance mobile internet network coverage. It consists of network coverage, network performance, spectrum, and other enabling infrastructure.
Affordability	The availability of mobile services and devices at price points that reflect the level of income across a national population. It consists of mobile tariffs, Handset price, inequality and taxation.
Consumer Readiness	Citizens with the awareness and skills needed to value and use the internet. It consists of basic skills, gender equality and mobile ownership.
Content and Services	The availability of secure online content and services accessible and relevant to the local population. The Content and Services enabler from GSMA consists of three dimensions: local relevance, availability, and online security. 'Local relevance' measures the amount of content produced in a given country, including e-government services, web domains, social media, and mobile applications. These are included because content that is created or developed within a country is likely to be relevant to many of the people living there.
Network coverage	It consists of 2G population coverage, 3G population coverage, 4G population coverage, and 5G population coverage.
Network performance	It consists of mobile download speeds, mobile upload speeds, and latencies.
Spectrum	It consists of digital dividend spectrum, other spectrum below 1GHz, spectrum in bands 1-3GHz, spectrum in bands above 3GHz, and spectrum in mmWave bands (above 24 GHz).

Mobile data affordability	Mobile data affordability refers to the accessibility and cost-effectiveness of mobile data services for consumers. It is a measure of how easily people can access and use mobile data networks, typically for internet connectivity and various online activities, without experiencing excessive financial burden. Mobile data affordability is a critical factor in determining the digital divide and the level of access to information and online services within a populationor region.
Handset affordability	The MCI is particularly focused on connecting the unconnected, GSMA is interested in measuring the prices of entry-level handsets that allow users access to the internet rather than high-end devices that are sold at premium prices. In order to obtain this data, Tarifica researched the cheapest handset available in each market with internet-browsing capability. This device could therefore be a smartphone10 or a feature phone. Given that the performance of basic internet mobile applications (such as basic video or social networking) is only functional with 3G and 4G, this analysis excluded devices with 2G and WAP connectivity.
Taxation	The taxation indicators from GSMA are developed by estimating the proportion of the monthly cost of mobile data that are (i) accounted for by all taxes and (ii) accounted for by mobile-specific taxes. The third indicator is the proportion of the total cost of a device that is accounted for by all taxes. The reference prices used for mobile data are the 500 MB basket from 2014 to 2018 and the 1 GB basket from 2019 to 2022. The reference price for the device is the same price gathered as part of the indicators on handset affordability.
Mobile Ownership	Refers to the percentage or proportion of a population or market that uses mobile devices, such as smartphones or tablets. This metric is often used to assess the adoption and usage of mobile technology in a specific region, industry, or demographic group.
Basic Skills	It consists of adult literacy rate, school life expectancy, mean year of schooling and tertiary enrolment rate.
Gender Equality	Refers to the state or condition of equal access to and opportunities for both individuals of different genders, specifically, men and women. It involves the removal of discrimination and bias based on gender, ensuring that all individuals have the same rights, responsibilities, and opportunities regardless of their gender identity.

Local Relevance	Local relevance measures the amount of content produced in a given country, including e-government services, web domains, social media, and mobile applications. These are included because content that is created or developed within a country is likely to be relevant to many of the people living there
2G Population Coverage	Population coverage for 2G networks is an important metric for telecommunications providers and regulators, as it indicates how many people within a given area can access basic mobile services using 2G technology. Here are some key points regarding 2G population coverage:
3G Population Coverage	3G (3rd Generation) population coverage refers to the extent to which a 3G mobile network provides service to a specific population or geographic area.
4G Population Coverage	4G (4th Generation) population coverage refers to the extent to which a 4G mobile network provides service to a specific population or geographic area.
5G Population Coverage	5G (5th Generation) population coverage refers to the extent to which a 5G mobile network provides service to a specific population or geographic area.
Mobile download speeds	Mobile download speed refers to the rate at which data can be transmitted from the internet or a remote server to a mobile device, such as a smartphone or tablet, through a mobile data network. It is typically measured in megabits per second (Mbps) or gigabits per second (Gbps) for faster mobile network technologies.
Mobile upload speeds	Mobile upload speed refers to the rate at which data can be transmitted from a mobile device, such as a smartphone or tablet, to a remote server or location on the internet using a mobile data network. Like upload speed on fixed broadband connections, mobile upload speed is measured in megabits per second (Mbps) or gigabits per second (Gbps) for faster mobile network technologies.
Mobile latencies	Mobile latencies refer to the delay or lag that occurs when data is transmitted between a mobile device (such as a smartphone or tablet) and a network or server. It is a critical factor in determining the responsiveness and performance of mobile applications and services.
Spectrum assigned in bands below 1GHz	In GSMA spectrum assignments, several variables play a crucial role in determining how the

Spectrum assigned in bands between 1-3GHz	spectrum is allocated and used. These variables help define the characteristics and regulations for wireless communication services within these frequency ranges. Some key variables include (1)Frequency Range, (2) Bandwidth, (3) Duplexing, (4) Channelization, (5) Guard Bands, (6) Regulatory Restrictions, (7) Service Types, and (8) Technology Compatibility. It is important to note that the actual details of these variables can vary depending on the specific regulatory environment and the band in question. The GSMA (Global System for Mobile Communications Association) and national regulatory authorities work together to define these variables to ensure efficient and interference-free wireless communication services.
Spectrum assigned in bands between 3-6GHz	
Spectrum assigned in mmWave bands	
Affordability of entry basket (1GB)	Mobile data affordability is now measured based on two baskets rather than four baskets. In 2014–2018, the 'entry' basket is based on a consumer using 100 MB of data per month and the 'higher' basket is based on 500 MB of data. In 2019–2022, the entry basket is based on 1 GB of data and the higher basket is based on 5 GB. This approach is more flexible and reflects the increasing use of data by consumers over time, rather than continuing to track baskets that no longer reflect current consumption patterns
Affordability of higher basket (5GB)	
Affordability of entry basket (1GB) for poorest 40%	
Affordability of higher basket (5GB) for poorest 40%	
Device affordability	Device affordability in the context of average monthly GDP per capita refers to the ability of individuals or households within a specific country or region to purchase and use electronic devices based on their average income. It's a measure of how accessible and affordable electronic devices are to the average person in terms of their monthly income.
Device affordability for poorest 40%	Refers to the ability of this lower-income segment to purchase and use electronic devices based on their average monthly income. It focuses on assessing whether these devices are within reach for the economically disadvantaged portion of the population.
Cost of taxes on mobile data	High levels of taxation on mobile data and/or handsets increases the cost for the consumer, which can make them less affordable, especially those on lower incomes. What is particularly distortive is the imposition of sector-specific taxes which apply only to mobile services and not to other goods or services.
Cost of taxes on handsets	
Cost of sector specific taxes on mobile data	

Literacy	It is measure of the percentage of adults in a given population who can read and write with understanding a short, simple statement about their everyday life. It is a key indicator of a population's educational attainment and is used to assess the level of literacy or functional literacy within a specific age group.
School Life Expectancy	School life expectancy (SLE) is a statistical measure used in the field of education and demography to assess the average number of years a student entering the education system can expect to spend in school, based on the current age-specific enrollment ratios. It provides insights into the duration of formal education a person is likely to receive in a particular country or region.
Gender gap in mobile ownership	Refers to the disparity in access to mobile phones and other mobile devices between men and women. It is a measure of how mobile technology is unequally distributed among genders, with one gender group having better access and ownership compared to the other.
Gender gap in mobile internet	Refers to the disparity in access to and use of mobile internet services between men and women. It is a subset of the broader digital gender divide, focusing specifically on the differences in mobile internet usage patterns and access based on gender.
Top-Level Domains (TLDs) per person	Top-Level Domains (TLDs) are the highest level of domain names in the hierarchical Domain Name System (DNS) of the internet. They are the last segment of a domain name, appearing after the final dot (e.g., .com, .org, .net). TLDs are an essential part of internet addressing, helping to organize and categorize websites and online resources. They play a role in defining a website's identity and purpose on the web. The Internet Corporation for Assigned Names and Numbers (ICANN) oversees the management and allocation of TLDs on the Internet.
E-Government Score	GNI per capita is gross national income divided by midyear population. GNI (formerly GNP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.
Mobile Social Media Penetration	Mobile social media penetration refers to the percentage of mobile device users within a specific population or demographic group who access and use social media platforms on their mobile devices. It measures the extent to which people use mobile phones, smartphones, or tablets to engage with social networking sites and apps.

Locally developed apps per person	Refers to the average number of mobile applications created or developed by an individual. This metric is typically used to understand the level of app development activity within a specific population or demographic group.
Digital Language Support	This metric is sourced from Derivation and provides a measure of the aggregated digital capabilities for all living languages within a country, based upon the availability and accessibility of language-specific hardware/software support.
Language accessibility of top ranked apps	The indicator on language accessibility of top-ranked apps focuses on the most popular applications available in a country and measures the proportion of the population that can use them, whether in their first or second languages. For each application, GSMA estimates the proportion of the population that is able to use it based on the languages that it features.
Cybersecurity Index	The Global Cybersecurity Index (GCI) is a trusted reference that measures the commitment of countries to cybersecurity at a global level – to raise awareness of the importance and different dimensions of the issue. As cybersecurity has a broad field of application, cutting across many industries and various sectors, each country's level of development or engagement is assessed along five pillars – (i) Legal Measures, (ii) Technical Measures, (iii) Organizational Measures, (iv) Capacity Development, and (v) Cooperation – and then aggregated into an overall score.
LDC	Least Developed Countries (LDCs) are nations that face significant economic and social challenges, characterized by low income, low human development, and economic vulnerability.
LLDC	Landlocked Developing Countries (LLDCs) are countries that do not have direct access to the sea. They often face transport and trade-related challenges due to their landlocked geographical location.
SIDS	Small Island Developing States (SIDS) are countries that are small islands or low-lying coastal areas. They face unique challenges related to their vulnerability to climate change, limited resources, and economic sustainability.
ITU	The ITU, or International Telecommunication Union, is a specialized agency of the United Nations (UN) that is responsible for issues related to information and communication

	technologies (ICTs).
GNI per capita USD	GNI per capita is gross national income divided by midyear population. GNI (formerly GNP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.
Access to electricity (% of population)	Access to electricity is the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources.
CPIA building human resources rating (1=low to 6=high)	
CPIA business regulatory environment rating (1=low to 6=high)	The CPIA (Country Policy and Institutional Assessment) score in the World Bank's WDI (World Development Indicators) database is a numerical rating that evaluates a country's policy and institutional quality. It ranges from 1 to 6, with higher scores indicating better policy environments. These scores help assess a country's effectiveness in promoting sustainable development, with higher scores indicating favorable conditions for growth and poverty reduction, while lower scores suggest areas requiring policy reforms or institutional enhancements.
CPIA property rights and rule-based governance rating (1=low to 6=high)	
CPIA trade rating (1=low to 6=high)	
CPIA transparency accountability and corruption in the public sector rating (1=low to 6=high)	
Consumer price index (2010 = 100)	The World Development Indicators (WDI) Consumer Price Index (CPI) is a measure used to track changes in the average prices of a basket of goods and services that are consumed by households. It's an important economic indicator that provides insight into inflation rates and purchasing power within a country.
Electric power consumption (kWh per capita)	Fixed broadband subscriptions refers to fixed subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 kbit/s. This includes cable modem, DSL, fiber-to-the-home/building, other fi

Fixed broadband subscriptions (per 100 people)	Fixed broadband subscriptions refers to fixed subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 kbit/s. This includes cable modem, DSL, fiber-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband. This total is measured irrespective of the method of payment. It excludes subscriptions that have access to data communications (including the Internet) via mobile-cellular networks. It should include fixed WiMAX and any other fixed wireless technologies. It includes both residential subscriptions and subscriptions for organizations.
GDP per capita (constant 2015 US$)	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2015 prices, expressed in U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 2015 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.
GDP per capita PPP (constant 2017 international $)	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the country plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2017 international dollars.
GNI per capita (constant 2015 US$)	GNI per capita is gross national income divided by midyear population. GNI (formerly GNP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in constant 2015 U.S. dollars.

GNI per capita PPP (constant 2017 international $)	GNI per capita based on purchasing power parity (PPP). PPP GNI is gross national income (GNI) converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in constant 2017 international dollars.
Gini index	The Gini index, also known as the Gini coefficient or Gini ratio, is a measure of income inequality within a country or a region. It is often used to assess the distribution of wealth or income among the population. The Gini index ranges between 0 and 1, where 0 represents perfect equality (everyone has the same income) and 1 represents perfect inequality (one person has all the income)
Government Effectiveness: Estimate	Government Effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
High-technology exports (% of manufactured exports)	High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.
Human capital index (HCI) (scale 0-1)	The Human Capital Index (HCI) is a tool created by the World Bank to gauge and compare the development of human potential in different nations. It evaluates health and education factors to measure individuals' capacity for productive and fulfilling lives. This index considers indicators like child mortality rates and education quality to assess health and education components. HCI typically has a range from 0 to 1, where higher values indicate better development of human capital.
ICT goods exports (% of total goods exports)	Information and communication technology goods exports include computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods (miscellaneous).
ICT goods imports (% total goods imports)	

ICT service exports (% of service exports BoP)	Information and communication technology service exports include computer and communications services (telecommunications and postal and courier services) and information services (computer data and news-related service transactions).
ICT service exports (BoP current US$)	Information and communication technology service exports include computer and communications services (telecommunications and postal and courier services) and information services (computer data and news-related service transactions). Data are in current U.S. dollars.
Inflation consumer prices (annual %)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.
Investment in ICT with private participation (current US$)	Investment in ICT with private participation is the value of commitments to information and communications technology backbone infrastructure projects (including land based and submarine cables) that have an active government component (eg, the government is a contracting authority). These are projects which have reached financial closure and directly or indirectly serve the public, including operation and lease contracts, operation and management contracts with major capital expenditure, greenfield projects (in which a private entity or public-private joint venture builds and operates a new facility), and divestitures. Movable assets and small projects are excluded.
Land area (sq. km)	Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.
Mobile cellular subscriptions (per 100 people)	Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology. The indicator includes (and is split into) the number of postpaid subscriptions, and the number of active prepaid accounts (i.e. that have been used during the last three months). The indicator applies to all mobile cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging and telemetry services.

Political Stability and Absence of Violence/Terrorism: Estimate	Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
Population total	Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values shown are midyear estimates.
Public private partnerships investment in ICT (current US$)	Public Private Partnerships in ICT (current US$) is the value of information and communications technology backbone infrastructure projects (including land based and submarine cables) that have an active government component (eg, the government is a contracting authority). These are projects which have reached financial closure and directly or indirectly serve the public, including operation and management contracts with major capital expenditure and greenfield projects (in which a private entity or public-private joint venture builds and operates a new facility). It excludes divestitures and merchant projects. Movable assets and small projects are excluded.
Real effective exchange rate index (2010 = 100)	Real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs.
Real interest rate (%)	Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. The terms and conditions attached to lending rates differ by country, however, limiting their comparability.
Regulatory Quality: Estimate	Regulatory Quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.
Rule of Law: Estimate	Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.

Secure Internet servers	The number of distinct, publicly-trusted TLS/SSL certificates found in the Netcraft Secure Server Survey. The survey examines the use of encrypted transactions through extensive automated exploration, tallying the number of web sites using HTTPS. This analysis relates to those sites found in the survey where the certificate is valid for the hostname, and the certificate has been issued from a publicly-trusted root. The indicator refers to valid, third-party certificates.
Secure Internet servers (per 1 million people)	
Strength of legal rights index (0=weak to 12=strong)	Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 12, with higher scores indicating that these laws are better designed to expand access to credit.
Surface area (sq. km)	Surface area is a country's total area, including areas under inland bodies of water and some coastal waterways.
Tax revenue (% of GDP)	Tax revenue refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue.
Time required to start a business (days)	Time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. If a procedure can be speeded up at additional cost, the fastest procedure, independent of cost, is chosen.
Trade (% of GDP)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.
Trade in services (% of GDP)	Trade in services is the sum of service exports and imports divided by the value of GDP, all in current U.S. dollars.
4G services commercially available	Means that fourth-generation (4G) wireless communication services are offered and accessible to consumers and businesses as part of standard commercial service offerings provided by telecommunications companies or service providers.

Amount of spectrum licensed for IMT systems in MHz	Refers to the total quantity of radio frequency spectrum that has been officially allocated or licensed by regulatory authorities or governments for use by IMT (International Mobile Telecommunications) systems within a specific geographic area, such as a country or region. This metric is often expressed in megahertz (MHz), which is a unit of frequency measurement. It is an essential metric for assessing the availability and capacity of radio frequency spectrum for mobile communications.
Amount of spectrum offered for IMT systems in MHz	Refers to the total quantity of radio frequency spectrum made available or offered by regulatory authorities or governments for potential use by IMT (International Mobile Telecommunications) systems within a specific geographic area, such as a country or region. This metric is typically expressed in megahertz (MHz), which is a unit of frequency measurement.
Broadband services are part of universal service/access scheme	Broadband internet services are included within a country's or region's universal service or universal access framework. This means that efforts are being made to ensure that broadband internet access is available to a significant portion of the population, if not all, to promote digital inclusion and bridge the digital divide.
Cloud computing policies	Refer to a set of guidelines, rules, and regulations established by organizations, governments, or institutions to govern the use, management, and security of cloud computing services and resources. Cloud computing policies are designed to ensure that cloud-based operations are conducted in a manner that aligns with an organization's goals and objectives while addressing security, compliance, and risk management concerns.
Counterfeit policies for the ICT sector	Counterfeit ICT products can include items such as counterfeit smartphones, tablets, computer hardware, software, networking equipment, and accessories. These counterfeit products are often produced and sold with the intent to deceive consumers, infringe on intellectual property rights, and pose various risks, including security vulnerabilities and potential harm to end-users.

Cybersecurity legislation/regulation exist	Cybersecurity legislation and regulation refer to laws, rules, and government policies enacted to address various aspects of cybersecurity. These legal measures are put in place to protect critical infrastructure, data, information systems, and the digital assets of organizations and individuals from cyber threats and attacks. Cybersecurity legislation and regulation can vary significantly from one jurisdiction to another but generally aim to establish standards, requirements, and mechanisms to enhance the security of cyberspace.
Digital Dividend spectrum reallocated	Refers to the process of reallocating and repurposing radio frequency spectrum that becomes available as a result of the transition from analog to digital television broadcasting. This transition, often referred to as the "digital dividend," occurs when countries or regions switch from traditional analog television broadcasting to digital terrestrial television (DTT) broadcasting.
Foreign ICT service providers treated differently in terms of taxation	Foreign Information and Communication Technology (ICT) service providers are subject to distinct or varying tax regulations, rules, or rates compared to domestic ICT service providers when conducting business in a particular country or jurisdiction. This differential treatment can have significant implications for how foreign ICT companies operate, report taxes, and compete in the local market.
Households with Internet access at home	Refers to the proportion of households with Internet access at home. Access can be via a fixed or mobile network. If one member of the household has a mobile phone with connection to the Internet and makes it available for all members, then it should be considered that the household has access to the Internet.
ICT consumer protection legislation	Refers to laws and regulations that are put in place to safeguard the rights and interests of consumers in the context of information and communication technology products and services. These laws are designed to ensure that consumers are treated fairly, provided with accurate information, and protected from fraudulent or harmful practices by businesses operating in the ICT sector.

IMT (3G/4G) spectrum assigned	Measures the amount of radio spectrum that has been allocated or assigned to mobile operators or service providers for deploying 3G and 4G networks within a given region or country. It is a key indicator of a country's or region's readiness to support advanced mobile services and data connectivity. The availability of sufficient and appropriate spectrum is critical for ensuring the quality and capacity of mobile networks, as it directly affects the speed, coverage, and performance of mobile broadband services.
Information on spectrum publicly available	Refers to average usage of all international links including fiber-optic cables, radio links and traffic processed by satellite ground stations and teleports to orbital satellites (expressed in Mbit/s)
International bandwidth usage	Refers to average usage of all international links including fiber-optic cables, radio links and traffic processed by satellite ground stations and teleports to orbital satellites (expressed in Mbit/s)
Lit/equipped international bandwidth capacity	Refers to the total lit/equipped capacity of international links, namely fiber-optic cables, international radio links and satellite uplinks to orbital satellites in the end of the reference year (expressed in Mbit/s).
Mobile data and voice high-consumption basket	Combined time series data: from 2018 to 2020, the basket is based on a monthly usage of a minimum of 140 voice minutes, 70 SMSs and 1.5 GB of data using at least 3G technology. From 2021, the basket is based on a monthly usage of a minimum of 140 voice minutes, 70 SMSs and 2 GB of data using at least 3G technology.
Mobile data and voice low-consumption basket	The basket is based on a monthly usage of a minimum of 70 voice minutes, 20 SMSs and 500 MB of data using at least 3G technology.
National broadband plan exists	Refers to a government initiative or policy framework that outlines a comprehensive strategy for the development, expansion, and improvement of broadband internet infrastructure and access within a specific country. A National Broadband Plan is a strategic roadmap that typically addresses various aspects of broadband deployment and adoption, aiming to ensure that high-speed internet is accessible to a significant portion of the population.

National development strategy digital agenda or digital stimulus strategy incl. broadband	Refers to a government's comprehensive plan or policy framework aimed at advancing the development and utilization of digital technologies and broadband infrastructure to foster economic growth, innovation, and societal progress within a specific country. These strategies are typically designed to harness the potential of the digital economy, promote digital inclusion, and ensure that the nation remains competitive in the global digital landscape.
National strategy policy or initiative focusing on emerging technologies	Refers to a government's deliberate and comprehensive plan or framework that is developed to address and harness the potential of emerging and disruptive technologies within a specific country or region. These strategies or policies are designed to guide the development, adoption, and regulation of technologies that have the potential to significantly impact various aspects of the economy, society, and governance.
National Table of Frequency Allocations	Referred to as a National Frequency Allocation Plan (NFAP), is a comprehensive document or regulatory framework created by a government or regulatory authority that specifies how radio frequency spectrum within a particular country is allocated and assigned for various uses, services, and applications. This plan is a critical component of spectrum management and ensures the efficient and organized use of the radio frequency spectrum, which is a finite and valuable resource for telecommunications and other wireless services.
Population coverage by mobile network technology (At least 2G)	Refers to the percentage of inhabitants within range of a mobile-cellular signal, irrespective of whether or not they are subscribers or users.
Population coverage by mobile network technology (At least 3G)	Refers to the percentage of inhabitants that are within range of at least a 3G mobile-cellular signal, irrespective of whether or not they are subscribers.
Population coverage by mobile network technology (At least 5G)	Refers to the percentage of inhabitants that are within range of at least a 5G mobile-cellular signal, irrespective of whether or not they are subscribers.
Population coverage by mobile network technology (At least LTE/WiMAX)	Refers to the percentage of inhabitants that are within range of at least a 4G/ LTE mobile-cellular signal, irrespective of whether or not they are subscribers.
Restriction to foreign participation or ownership in the ICT sector	Refers to government policies or regulations that limit or control the extent to which foreign entities or individuals can invest in, own, operate, or participate in Information and Communication Technology (ICT) businesses and activities within a specific country or jurisdiction. These restrictions are often put in place to safeguard national security, protect

	domestic industries, or address other economic and regulatory concerns.
Quality of Service (QoS) regulatory framework - Services subject to QoS monitoring	A QoS regulatory framework refers to a set of rules, standards, and regulations established by a government or regulatory authority to ensure that telecommunications services provided within a country meet certain quality and performance criteria. The framework defines the expectations for the quality of services offered by telecommunications operators and often includes provisions for monitoring and enforcing these standards.
Spectrum licences technology-neutral	Refers to a regulatory approach in the allocation and licensing of radio frequency spectrum that does not prescribe or restrict the specific technologies or services that can be deployed within the assigned spectrum. In other words, when spectrum licenses are technology-neutral, the license holders have the flexibility to use the allocated spectrum for a wide range of technologies and services, allowing them to adapt to evolving technological advancements and market demands.
Spectrum or license fees subject to value-added taxes (VAT)	Means that fees paid for the acquisition or use of radio frequency spectrum licenses or telecommunications licenses are liable for value-added tax (VAT) in the context of taxation. Value-added tax is a consumption tax that is typically applied to the value added at each stage of the supply chain, from production to distribution to the final consumer. When these fees are subject to VAT, the entity paying for the license is required to include the VAT amount in the total cost.
Device Pricing	Price of reference device in US dollars. Of all the devices available with internet capability, smartphones are generally the least expensive with characteristics that offer more than a basic connectivity. Because of this, they serve an important role in providing people with meaningful connectivity – a crucial element in the development of digital economies.
Individuals using the Internet (% of population)	Internet users are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.

Logistics performance index: Overall (1=low to 5=high)	The Logistics Performance Index overall score reflects perceptions of a country's logistics based on efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach the consignee within the scheduled time. The index ranges from 1 to 5, with a higher score representing better performance.
Medium and high-tech manufacturing value added (% manufacturing value added)	The proportion of medium and high-tech industry value added in total value added of manufacturing. The indicator is calculated as the share of the sum of the value added from medium and high-tech industry economic activities to manufacturing value added.
Mobile cellular subscriptions	Refers to the number of subscriptions to a public mobile-telephone service that provide access to the public switched telephone network (PSTN) using cellular technology. It includes the number of postpaid subscriptions and the number of active prepaid accounts
Population density (people per sq. km of land area)	Population density is midyear population divided by land area in square kilometers. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.

APAC Statistics (2022)

Country (2022)	Region	Infrastructure Index	Affordability	Consumer Readiness	Content & Services	Spectrum	Cyber security	Real GDP per capita (USD)	e-Governm
Afghanistan	South Asia	43	30	27	24	33	5	426*	
Australia	East Asia & Pacific	90	88	93	92	86	97	60,798	
Bangladesh	South Asia	61	43	48	55	25	81	1,785	
Bhutan	South Asia	64	56	73	41	71	18	2,977*	
Brunei Darussalam	East Asia & Pacific	64	78	82	63	33	56	28,954	
Cambodia	East Asia & Pacific	58	51	62	49	37	19	1,488	
China	East Asia & Pacific	88	77	80	78	34	93	11,560	
India	South Asia	62	62	54	67	42	98	2,085	
Indonesia	East Asia & Pacific	64	71	67	70	44	95	4,074	
Iran	Middle East & North Africa	63	50	67	57	33	81	5,453	
Japan	East Asia & Pacific	83	85	82	88	71	98	36,032	
Laos	East Asia & Pacific	60	43	72	41	34	20	2,599	
Malaysia	East Asia & Pacific	74	65	82	76	71	98	11,372	
Mongolia	East Asia & Pacific	63	60	87	55	96	26	4,242	
Myanmar	East Asia & Pacific	63	40	57	36	33	36	1,347	

Nepal	South Asia	58	36	73	50	41	45	1,083
New Zealand	East Asia & Pacific	85	80	97	90	81	84	42,272
Pakistan	South Asia	56	50	31	47	40	65	1,536
Philippines	East Asia & Pacific	73	47	77	59	100	77	3,528
Singapore	East Asia & Pacific	91	99	94	89	71	99	67,360
South Korea	East Asia & Pacific	88	65	94	92	33	99	33,645
Sri Lanka	South Asia	58	56	68	56	33	59	3,988
Thailand	East Asia & Pacific	82	59	86	71	95	87	6,278
Vietnam	East Asia & Pacific	63	61	74	77	33	95	3,655

Country (2022)	Population	Gender equality	Population Coverage 2G	Population Coverage 3G	Population Coverage 4G	Population Coverage 5G
Afghanistan	41,128,771	0	90	70	72	0
Australia	25,978,935	87	100	100	100	82
Bangladesh	171,186,372	24	100	96	98	0
Bhutan	782,455	100	98	90	85	13
Brunei Darussalam	449,002	100	99	90	85	0
Cambodia	16,767,842	64	100	90	98	0
China	1,412,175,000	75	100	98	99	63
India	1,417,173,173	41	99	99	99	1
Indonesia	275,501,339	68	99	95	96	12
Iran	88,550,570	62	97	92	83	19
Japan	125,124,989	74	100	100	100	92
Laos	7,529,475	100	95	90	98	12
Malaysia	33,938,221	93	99	96	96	21
Mongolia	3,398,366	100	100	95	85	0
Myanmar	54,179,306	51	97	94	94	0
Nepal	30,547,580	91	93	90	88	0
New Zealand	5,124,100	100	98	99	98	65

Pakistan	235,824,862	12	89	80	76	0
Philippines	115,559,009	100	99	93	99	70
Singapore	5,637,022	100	100	100	100	77
South Korea	51,628,117	99	100	99	100	98
Sri Lanka	22,181,000	66	99	96	95	0
Thailand	71,697,030	99	99	98	98	86
Vietnam	98,186,856	87	100	98	98	0

Country (2022)	Region	Infrastructure Index	Affordability	Consumer Readiness	Content & Services	Spectrum	Cyber security	Real GDP per capita (USD)	e-Government
Fiji	East Asia & Pacific	66	46	88	47	52	29	5,131	4
Maldives	South Asia	69	43	77	46	48	3	10,965	4
Papua New Guinea	East Asia & Pacific	52	52	47	28	73	26	2,471	3
Samoa	East Asia & Pacific	58	42	80	64	26	29	3,564	3
Solomon Islands	East Asia & Pacific	40	34	62	27	86	7	1,893	3
Timor-Leste	East Asia & Pacific	53	53	60	30	36	4	1,675	3
Tonga	East Asia & Pacific	42	50	80	57	26	21	4,481*	3
Vanuatu	East Asia & Pacific	54	45	71	40	19	13	2,576	4

Country (2022)	Population	Gender equality	Population Coverage 2G	Population Coverage 3G	Population Coverage 4G	Population Coverage 5G
Fiji	929,766	98	98	97	96	0
Maldives	523,787	97	100	100	100	51
Papua New Guinea	10,142,619	47	89	76	74	0
Samoa	222,382	100	97	98	98	0
Solomon Islands	724,273	75	95	78	30	0
Timor-Leste	1,341,296	61	97	95	90	0

Tonga	106,858	100	99	95	95	0
Vanuatu	326,740	100	98	96	91	0

(* is 2021)