Beyond the buzz: Making 5G a success in Saudi Arabia

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Executive summary

5G is more than the evolution of an existing technology standard – it enables multiple use cases that were previously impossible within the mobile environment. This is due to its combination of extremely low latency, ability to connect a large number of devices and greater throughput, as well as the fact it can operate on a higher number of spectrum bands. However, these use cases and possibilities are still evolving as technology rollouts intensify.

Regardless of this uncertainty, 5G is already being rolled out on a limited scale, and countries must prepare now to realize the future advantages it brings. For example, 5G can enable tangible improvements in competitiveness for multiple industry verticals in the Kingdom of Saudi Arabia, both by underpinning new use cases and by enhancing the customer experience for existing ones. Responding to this, mobile network operators (MNOs) in KSA have begun early 5G investments, although delivering a country-wide commercial rollout will be a challenge.

To succeed in establishing a viable 5G environment, key issues associated with 5G deployment must be addressed. These include making nationwide rollout easier, lowering deployment costs, successfully managing cybersecurity threats, building a skilled workforce and developing products that leverage 5G's unique capabilities. A collaborative approach between not only private sector players, but also government authorities, is required to unlock the greatest value from 5G for KSA. Our work highlights that collaboration can potentially deliver double the value of following a stand-alone strategy.

This report looks at the opportunities that 5G creates, as well as the elements required for developing a successful 5G environment in KSA. It analyzes the impact of these elements and provides a 5G development framework.

1. 5G to boost productivity and enable new use cases in KSA

5G is a step change from previous 3GPP[1] mobile standards. It provides a connectivity platform for data-driven use cases that have not been possible within current mobile environments. For example, 5G will be required for autonomous vehicles, the Internet of Things (IoT), smart cities and immersive entertainment. In addition, by allowing devices to offload computing to the cloud, it will enable advances in complex AI processing. However, although the "buzz" around 5G is loud, the business cases remain to be proven. Nonetheless, if we look beyond the hype, 5G can bring specific opportunities for Saudi Arabia by creating value in two key areas:

1. Increasing enterprise efficiency and productivity by enabling real-time communication between data-intensive devices and computing applications.
2. Transforming Saudi Arabia into a Gigabit society by promoting new use cases such as smart manufacturing and smart city applications, while enhancing the experience of existing use cases.

1 3rd Generation Partnership Project

2. 5G: The catalyst for competitive KSA sectors

The three themes of Vision 2030 – *Thriving Society, Thriving Economy and Ambitious Nation* – require a state-of-the-art connectivity solution. In Saudi Arabia, the first wave of 5G enterprise use cases are expected to address these goals by targeting KSA's three largest sectors – oil & gas, public sector and manufacturing.

2.1 Oil & gas

Part of the mining and quarrying sector, which makes up approximately 30 percent of GDP,[2] the volatile oil & gas market has a pressing need to find solutions that enable cost and performance optimization. The IoT is now being used by major oil & gas companies around the globe for cost optimization, with Saudi Aramco beginning to experiment with it in 2017. Thousands of real-time data points can be gathered from wells, pipelines and other drilling equipment. These can be analyzed simultaneously, which will generate valuable insight to improve asset utilization and increase productivity. More than an estimated 1.5 terabytes per day can be generated from such connected devices, which can then be used for anticipating situations such as pump failure or requirements for other equipment maintenance. This reduces downtime and potentially saves millions of dollars. Additionally, studies have shown that the use of data analytics both enables savings and increases well productivity by 30 percent.[3] Smart utilization of this data is projected to increase company profits by two percentage points, which could effectively translate into additional profits of approximately USD 7 billion for Aramco.[4] However, a 5G network is required to manage this volume and speed of data.

2.2 Public sector

The public sector accounts for approximately 20 percent of Saudi Arabia's GDP, and 5G can enable an increase in both the efficiency and quality of services. Based on a study by IHS, 5G is expected to enable up to 6.5 percent of public services globally, as making e-government services available to significant populations will require networks with much higher capacity. 5G will thus support KSA in achieving its Vision 2030 target to improve its rank on the E-Government Survey Index (EGSI) from its current position of 36 to within the top 5.

2.3 Manufacturing

5G enables real-time communication between millions of devices, supporting the move to smart manufacturing. Additionally, 5G's ability to provide tailored connectivity and slice itself into multiple virtual networks delivers significant benefits. Tailored connectivity ensures that the network can be adapted to the specific speed, capacity, coverage and encryption requirements of different machines and operations. Companies that previously had their own networks can now create agreements with network operators to lease slices of overall 5G capacity. This brings added flexibility and cost reduction for industry verticals and can also help operators cover their deployment costs.

2 General Authority for Statistics (2018)
3 Global IoT in Oil and Gas Market 2018, published by BIS Research
4 Importance and Benefits of 5G for the Arab Region', Intel (2017)

3. KSA: A Gigabit society

5G has the potential to transform Saudi Arabia into a Gigabit society by connecting consumers with speeds that could be up to 100 times faster than those of 4G networks and latency as low as 1ms. 5G is a great opportunity for telecom operators to alleviate network congestion in high-density areas, which will enhance the consumer experience at lower per-bit cost. For example, in China and South Korea, operators are already running out of LTE capacity in cities, and 5G enhanced mobile broadband (eMBB) appears to be the optimal solution to this issue. In Saudi Arabia, given the limited number of fiber-to-the-home/building (FTTH/B) subscribers (approximately 12 percent), 5G fixed wireless access (FWA) can complement fiber deployment plans. This will bridge the digital divide and enable a new set of use cases to deliver enhanced content and services on the widest-possible scale. In an event demonstrating this, 5G was deployed around the holy sites in August 2019, for the first time in the history of Hajj, to allow users to transfer data at high speeds.

Based on a survey of new use cases, Saudi consumers are expected to strongly adopt use cases related to enhanced video entertainment, including real-time interactive and immersive video, gaming, and VR-based shopping experiences. An example of Saudi Arabia's close affinity with enhanced video entertainment is its thriving e-sports industry. This has grown with the formation of the Saudi Arabian Federation of Electronic and Intellectual Sports and is valued at more than SAR 10 billion across the Middle East and North Africa (MENA). 5G will primarily transform the e-sports industry in two ways: eradicating lag issues and allowing gaming from any location.

5G is crucial to Saudi Arabia's aspirations of becoming a global leader in smart-city development. It plans to have three cities in the top 100 globally, and 10 smart cities in total. With the announcements of NEOM, a USD 500 billion mega project, and Al Qiddiya, which aims to become KSA's entertainment, sports and cultural destination, Saudi Arabia has set ambitious targets. Most current smart-city use cases can be addressed with 4G+, but as widespread IoT adoption takes over in everything from autonomous vehicles to real-time video surveillance with AI/VR and smart grids, a 5G network that can manage this vast amount of real-time data will be required. Smart grids are key components of smart cities. They are connected to multiple distributed energy sources, which they can automatically switch between to make the most efficient use of energy. 5G enables the transfer of high-quality data at ultra-low latency to allow for real-time and automated grid switching. This increases its efficiency and reliability within smart city environments.

In addition to smart-city developments, there are currently 29 industrial cities across KSA, which are home to factories and other manufacturing industries. For example, Riyadh 2nd Industrial City has a total area of 19 million square meters, 1,091 factories, and a comprehensive network of infrastructure and services. Such industrial cities will be one of the first drivers of 5G rollout in KSA, as Industry 4.0 and further automation of factories and industrial processes will require its connectivity and capabilities.

4. Building a 5G ecosystem in KSA: The four building blocks

Recent developments, such as STC's commercial 5G launch and Zain's successful call on 5G, show that telecom operators in Saudi Arabia are ambitious around 5G and working towards getting a head start on its deployment.

However, for KSA to effectively deploy 5G, private and public sector stakeholders must come together and go beyond limited network deployment to build a more holistic ecosystem. This must focus on developing four building blocks for 5G in parallel:

1. Infrastructure development is at the heart of the ecosystem.
2. This will require skilled and talented people to design and support it.
3. Mitigation measures must be put in place to address the new security and risk concerns that come with 5G.
4. Finally, 5G will only be relevant if there are product & service offerings that can fully leverage the enhanced network capability and capacity, and that customers are willing to pay for.

Given that the ambition and building blocks are clear, it is time to get started.

Figure 1: 5G development framework

Source: Arthur D. Little analysis

The launch [of 5G commercial services] confirms the group's leading position as a major pioneer in the area of digital transformation, and proves the remarkable development of the ICT sector in the Kingdom"

– STC CEO, 21st June 2019

"Our partnership with Ericsson is part of our ambition to evolve toward the next-generation mobile technology 5G and contribute to Saudi Vision 2030"

– Mobily CTO, 1st May 2019

"We are confident that our long-term partner Nokia's technologies and professional services will build a reliable and highly secure 5G network to revolutionize the way people live and work"

– Zain CEO, 27th June 2019

4.1 Infrastructure – Lowering rollout costs to achieve a capillary 5G network

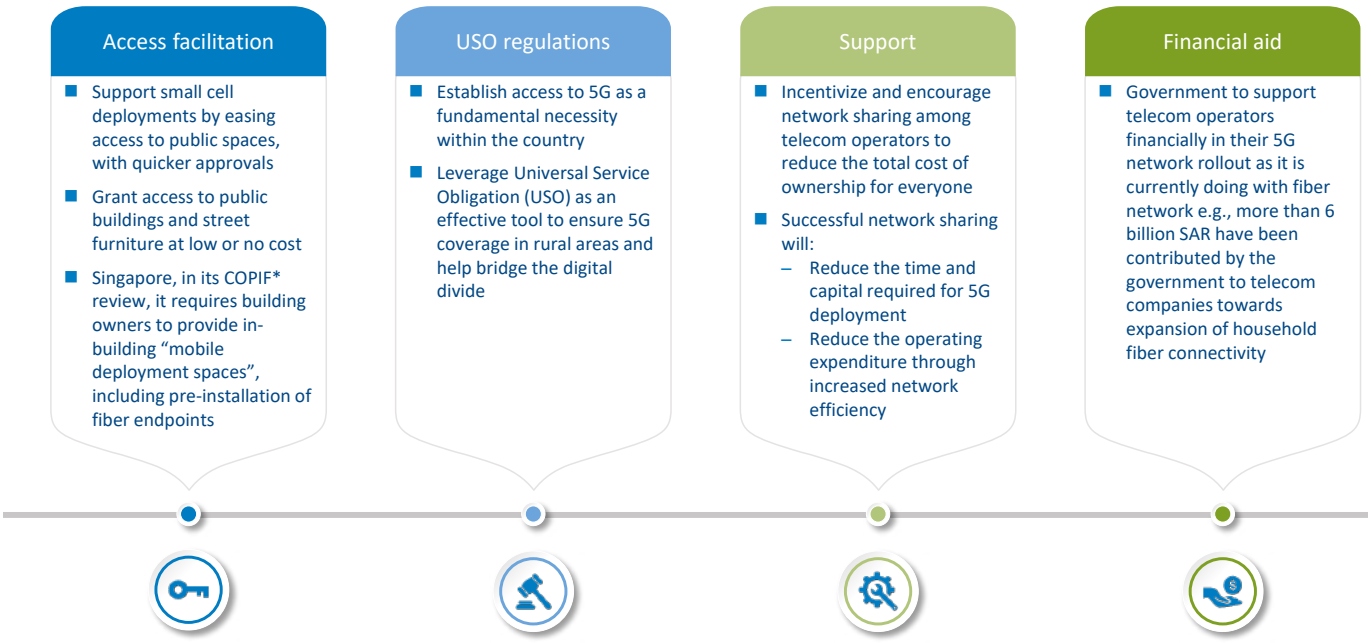
According to Timotheus Höttges, CEO of Deutsche Telekom, "Deploying 5G across Europe could require €300 to €500 billion", 1.5 to 2.5 times the total investment for 4G rollout. A Morgan Stanley report conservatively estimated total 5G investment in the US at 35 percent more than that of total investment in 4G to date. Such high costs will be driven by requirements to make networks denser, which will involve substantial investments across all infrastructure elements, both active and passive. New antennas will have to be rolled out, new base stations will have to be set up across the country and the existing base stations will need to be revamped to meet the added equipment load on them. Small cells will have to be installed across densely populated areas to achieve network capillarity. Additionally, the majority of the backhaul network will require an upgrade; this involves connecting towers with fiber or with upgraded microwave links where fiber rollout is not a commercially feasible option.

KSA currently has 35,000 to 40,000 towers, which translates into an antenna density of approximately 1–1.2 antennas per thousand people. In comparison, France and Italy each have 0.7 antennas per thousand. These two countries, however, are approximately 3.5 times smaller geographically than KSA with roughly twice the population, which makes their context quite different. France and Italy have high capillary networks across them, which they can leverage to upgrade to 5G. In KSA, the network does not have this capillarity, which means many new base stations will need to be built. From our experience, we expect operators to double or triple the number of sites that have been deployed over the last 20 years. According to Arthur D. Little benchmarks, CAPEX for each new base station is approximately SAR 300,000, which makes it a costly investment for operators. Additionally, new base stations will require fiber backhaul connectivity, and this will further increase rollout costs. The sheer size of the country will make it hard for operators to develop an attractive business case for a stand-alone nationwide 5G network rollout.

There are several options for government and regulators faced with such situations if they want to encourage 5G network rollout while optimizing its cost. Such options involve all stakeholders.

The topic of infrastructure sharing is not a new one. Back in 2011, STC and Mobily explored the possibility of setting up a joint TowerCo to manage their passive infrastructure assets, but without success. The plan was revisited in 2016, although it once again failed to deliver any concrete results. Instead, STC recently announced interest in placing its tower infrastructure assets in a separate entity. 5G network rollout could be the key reason to launch such an initiative, which would allow operators to optimize the high total cost of ownership, roll out 5G faster, reach higher coverage levels, and have more financial leeway for investing in other infrastructure elements such as edge computing.

Figure 2: 5G network rollout boosting measures



Source: Arthur D. Little analysis
* COPIF - Code of Practice for Info-communication Facilities in Buildings

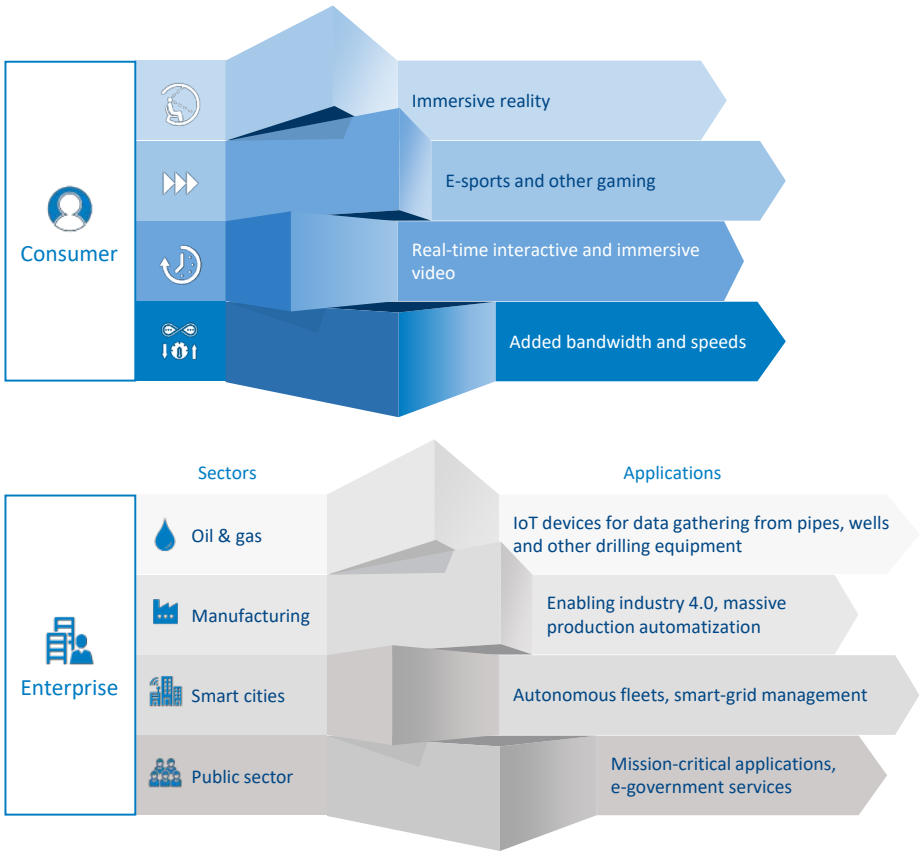
4.2 Products & services – Developing multiple use cases because there is no one killer application

5G rollout will bring about new products, services and applications for both enterprises and consumers. Enterprise applications for 5G are diverse, and will cover industries and specific applications, including:

- **Performance control through the IoT in oil & gas:** IoT devices installed across pipes, wells and other equipment will allow companies to be more flexible and responsive, which will reduce costs and keep them competitive.
- **Smart-grid management:** 5G will enable KSA's smart-city developments, including NEOM and initiatives in Riyadh and other locations, as these will require real-time energy generation and supply management.
- **Fleet management/vehicle connectivity:** Vehicle connectivity will facilitate new business models for enterprises, leveraging solutions such as fleet management, in-car payments and usage-based vehicle insurance.
- **Industry 4.0:** There are over 7,600 factories in KSA[5] that either have already begun to digitally transform their operations, or expect to start the process soon, with the aim of increasing productivity, efficiency, speed and quality. As part of this transformation, factories will need to implement a wide range of IoT sensors and devices to enable data analytics, AI and machine-learning applications.

For consumers, the focus is on providing a better broadband experience, with most use cases revolving around additional data speeds, fixed wireless access and entertainment applications. Even before 5G device penetration explodes, making eMBB mainstream, we expect fixed wireless access (FWA) to enable most 5G benefits for consumers. Early use cases for Saudi Arabia could include high-quality video and gaming experiences, live streaming and real-time immersive videos. This is in line with global forecasts for 5G use-case evolution, as well as the estimate that consumer internet video will reach approximately 87 percent[6] of KSA internet traffic by 2020. These are the five consumer use cases that we expect to be most relevant for KSA, and for which telecom operators need to explore and develop offerings:

Figure 3: Selection of 5G applications



Source: Arthur D. Little analysis

5 Saudi Industrial Development Fund
6 Cisco VNI forecast

- **Enhanced video entertainment:** High-quality video and live sports streaming will be the first use cases for consumers in the Kingdom, through the emergence of 5G FWA.
- **In-vehicle entertainment:** Live entertainment in vehicles requires latency within the 100–150 ms range, which can be served by a 5G network. In-car entertainment experiences may emerge as one of the most attractive applications, given that the high usage of current networks leads to sub-optimal performance.
- **Real-time interactive and immersive video:** According to research from Ericsson, the majority of consumers within KSA would pay a premium for an interactive and immersive entertainment experience.
- **Gaming:** Gaming use cases, such as cloud game streaming services with low lag, are expected to go mainstream within one to two years of 5G launch.
- **VR-based shopping experiences:** Although this use case can take customer experience to the next level, changing consumer behavior and driving adoption might take time for retailers and e-commerce providers.

5G rollouts, so far, are proving that consumers are generally not willing to pay a premium for data on a 5G network in comparison to 4G. To tackle this issue, increasing consumer take-up of 5G-enabled applications, such as those listed above, may be the primary lever to make the consumer business case attractive for telecom operators. Operators can potentially partner with providers of 5G-based applications, such as in the field of AR/VR mobile gaming, charging consumers for playing games – not just for 5G data usage. Similarly, operators can charge the gaming partner to guarantee low latency during e-sports events.

If operators want to consider charging consumers for specific application usage, they must innovate and embrace flexibility. Rather than adopting closed product/service pricings, they must bring in "subscription-type" products, with flexible trial periods, "pay as you play" concepts and "mix and match" possibilities. In an age of immediacy, flexibility and product/service personalization, operators cannot expect to monetize 5G products through non-personalized yearly, quarterly or monthly plans.

Clearly, global players will develop 5G-based products and solutions. However, to accelerate the adoption of 5G in Saudi Arabia, local players will have to complement them with relevant offerings targeted at the regional context. Ensuring the right supply of these localized products and solutions relies on a coordinated effort between government, telecom operators, public and private sector players, and start-ups. An industry alliance could be an option to achieve this, ensuring that:

1. Telecom operators and technology players are incentivized to develop the required network and applications.
2. Consumers and public and private businesses are educated to recognize the potential benefits of 5G.
3. Service providers have appropriate platforms to drive commercial adoption.

Such an alliance could form working groups to identify 5G-based industry requirements and use cases, set up incubation platforms to promote research and development, and help service providers to roll out and commercialize solutions.

Government and large conglomerates can further drive innovation in 5G applications by promoting investment or investing themselves in start-ups that target such applications. South Korea's SK Telecom and Germany's Deutsche Telekom have already announced plans to collaborate on developing new 5G products and solutions, as well as to invest in promising 5G startups.[7] To do so, regulators can use a "sandbox"[8] approach to enable early-adopter enterprises to start interacting with the 5G.

7 SK Telecom to set up 5G JV with Deutsche Telekom, invest in DTCP, Pulse News
8 Testing of new technology products in a controlled environment to contain the impact of failures

4.3 Skills & talent – Going from a user nation to a producer nation will require home-grown talent

Current estimates suggest that 5G will create more than 20,000 jobs in the KSA ICT sector by 2030.[9] In order for KSA's local talent to secure these jobs, their ICT skill sets must be enhanced. A 5G world can only be made possible through collaboration between people in both technical and business fields. The technical skills for 5G infrastructure will need to be developed with focus on the standard itself. However, the skills required for product/service development are equally applicable within the larger context of developing the entire ICT sector.

Upgrading the network from 4G to 5G calls for technological changes, such as a new radio and core network, densification efforts, and backhaul. These require updating of skills around radio frequency (RF) principles and fundamentals, RF conditioning products, small-cell frequency and reuse, spectrum refarming, service delivery framework (SDF), network functions virtualization (NFV), cloud radio access networks (C-RANs) and cell virtualization. For example, SDN/NFV will increase demand for hybrid engineers who are equipped with wider skill sets, including planning and architecture, as well as software and application development/integration. In contrast, today's training solely focuses on network-centric skills.

There are two key areas that should be prioritized when developing local 5G skills and talent within KSA:

- Universities and vocational/technical colleges can partner with telecom operators and equipment manufacturers to establish courses focused on the technologies and use cases enabled by 5G's technical features. Some examples of these can already be seen globally, ranging from short training programs (e.g., the University of Houston's 5G and LTE Expert Telecommunications Network course for professionals) to fully-fledged Master of Science programs (e.g., the University of Strathclyde's MSc in 5G Advanced Communications). They involve partnerships with vendors and operators such as Vodafone, EE, British Telecom, Intel and Cisco.
- 5G's ubiquitous impact offers a strong economic rationale to invest in skill/talent development across the wider ICT sector. Authorities can support this by establishing 5G "hubs", ensuring that the different skill sets required for developing a comprehensive 5G ecosystem are taught at local institutions, and monitoring the progress of their development.

4.4 Security & risks – With personal data everywhere, guard can never be lowered

The need to address security and privacy concerns will intensify, given the rapid proliferation of devices that gather large amounts of data. Additionally, 5G relies heavily on customer data as the network functions by sensing the service features of users in order to provide customized network services. With increased deployment of IoT devices, unauthorized access to them becomes a major threat; this necessitates stricter user-authentication methods. Establishing common data protection laws that classify the information gathered in categories, such as open, confidential, and sensitive/secret, becomes a national priority – ahead of the full commercial rollout of 5G and the technologies enabled by it. Data should be categorized based on the adverse impact that can result if it is shared, and rules must specify clear procedures for using each group of data. For example: Can it be shared freely, is there limited access, or is sharing prohibited?

SDN and NFV are integral to 5G networks and, given that they can be dynamically and automatically started, stopped, scaled up or scaled down, their open/flexible/programmable nature brings new compliance and security concerns. By leveraging virtualization, a network can build different virtual network slices, each of which can deliver specific services requiring varying compliance and security capabilities.

9 Ministry of Communications and Information Technology (MCIT) as cited by Saudi Gazette

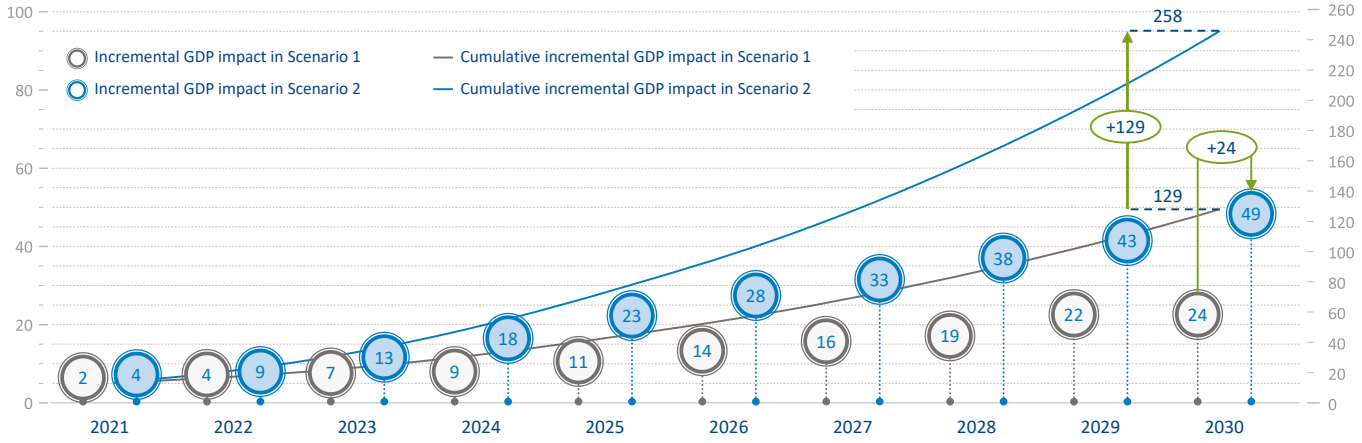
5. Collaboration can double the impact of 5G, putting approximately SAR 130 billion at stake by 2030

Never has collaboration been so decisive in the rollout of a new technology. Consequently, it is imperative to recognize the difference in impact between a collaborative strategy and a scenario in which the onus of developing a 5G ecosystem solely lies with telecom operators. Collaboration should include the four building blocks of the 5G development framework presented above and introduce elements such as infrastructure sharing and public/private partnerships. Taking this approach will have a larger impact on the GDP gain from implementing 5G and will also lead to 5G enabling a higher percentage of GDP.

A study by IHS[10] estimates that, as a result of 5G technology, global GDP growth from 2020 to 2035 will be 7 percent higher, achieving 2.9 percent compared to 2.7 percent. Based on this projection, we estimate that if telecom operators develop the 5G ecosystem in isolation (scenario 1), 5G impact in Saudi Arabia's GDP growth will be equivalent to approximately 50 percent of the forecast global average. As a result, KSA GDP could grow at a 3.5 percent higher rate between 2021 and 2030.

On the other hand, if a collaborative approach is used (scenario 2), we estimate that KSA will match the global average, which will result in GDP growing at a 7 percent higher rate between 2021 and 2030. This means a cumulative incremental GDP impact of SAR 129 billion from 2021 until 2030 is at stake. Therefore, it is imperative that all relevant stakeholders strive to realize the collaborative scenario.

Figure 4: GDP impact by 5G across scenarios over 2021–2030 (SAR billion)



Source: Arthur D. Little analysis

10 IHS Technology and IHS Economics, How 5G technology will contribute to the global economy

Abbreviations

3GPP – 3rd generation partnership project, a collaborative project aimed at developing globally acceptable specifications for third-generation (3G) mobile systems

CPEs – Customer premises equipment

C-RAN – Cloud RAN, an architecture for cellular networks

eMBB – Enhanced mobile broadband

FTTH/B – Fiber-to-the-home/fiber-to-the-building

IoT – Internet of Things

RF – Radio frequency

SDF – Service delivery framework – a way in which a corporation provides users with access to IT services

SDN/NFV – Software defined network/network function virtualization

USO – Universal Service Obligation for telecommunications services

VR/AR – Virtual reality/Augmented reality

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