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Engineer 5G to Transform Healthcare Industry

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The planned replacement for 4G networks, which provide the network to the majority of modern cell phones, is 5G, which wireless companies began delivering globally in 2019. The fifth-generation innovation standard known as 5G is used by broadband cell companies. There will probably be more than 1.7 billion 5G network users worldwide by 2025. 5G has been developing and changing the medical care industry, and a great deal of it is legitimised. 5G can convey gigabit speeds, inertness under 10 milliseconds, expanded inclusion, and an immense limit of as many as 1 million gadgets for each organisation. In general, when we got sick and needed clinical consideration, we might have had the option of going to a specialist or a clinic.

Keywords: 5G Networks; healthcare; infrastructure; communications

I. INTRODUCTION

The fifth generation (5G) innovation standard for broadband mobile networks, which wireless companies began delivering globally in 2019, is the planned replacement for the 4G networks that provide network to the majority of modern cell phones. More than 1.7 billion people will be using 5G networks globally by 2025 (Leong, 2022; Bretnall, 2019; IT, 2020; Media, 2020). 5G has been developing and changing the medical care industry, and a great deal of it is legitimised. 5G can convey gigabit speeds, inertness under 10 milliseconds, expanded inclusion, and an immense limit of as many as 1 million gadgets for each organisation. In general, when we fall sick and needed clinical consideration, we might have had the option of going to a specialist or a clinic. Travelling in case of illness can be exhausting and difficult for individuals in rural areas where professionals are a few kilometres away (Leong, Homer & Mandic, 2006).

However, with the advent of telemedicine and remote home check frameworks, we have been able to provide ourselves from the comfort of home. Specialists can also make suggestions or seek corrective action after a short video hangout. Nevertheless, this remote screening, along with complex imaging equipment, can put an additional burden on the network of medical networks (Leong & Homer, 2005). This builds blockages on a regular basis and reduces them. Reduce your network speed, especially if you are a medical service provider who may interact with many patients daily. The scope is not just great for those who use it. Poor quality can delay what the patient considers. It can affect results in the long run. However, the justification for using the Internet of Things (IoT) is still evolving, and knowledge of the network is only growing. Advances in 5G may help with payments. These past 5 different 5G options can support evolving medical organisations. The need for computer-aided changes is analysed. The capability of 5G advancements in the medical services industry will be investigated.

II. LITERATURE REVIEW

New mobile technology emerges after the initial iteration of the first mobile telephone contact network every 10 years, and the first 2G system service was released in 1992 in 1981. (Nebula, 2013; Leong, 2008). Also, for the third generation's 2001 and the fourth generation's 2012 debut operations. That lets everyone know that communication between generations happens once every 10 years during each of those intervals. Also, there are discrepancies between 4G users and 5G technologies, for example, which do not promote productivity maximisation:

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i. A small battery uptake.
ii. A lower likelihood of termination in the scenario where expansion coverage is recommended.
iii. Competitive prices in the service area's greater portions.
iv. Lower or no traffic fees as a result of less expensive network installation.
v. Greater simultaneous capacity for multiple users.

The 5th Generation Cellular Networks (5G) idea is used to describe a future major stage of mobile connectivity standards beyond a fourth generation of existing standards in many articles and research initiatives (Sawhney, A. 2020). In any official communication standards document published by any organisation, 5G is not defined as a necessity (Eva, 2019).

The new capabilities are still being built in line with the present 4G requirements even if the updated specifications that identify capabilities that surpass those stated in the current 4G are being taken into consideration. The candidate's key needs and technology were identified in the first fifth-generation specification, which was published at the end of 2017 (Agrawal, 2016).

A. A Contrast of 4G and 5G

And over the past year over 5G has been picking up, and a lot of it is justified. 5G can deliver gigabit speeds, latency below 10 milliseconds, increased coverage, and a vast capacity of as much as 1 million devices per network. But such improvements would not occur immediately (Gupta, 2015).

Table 1. Differences between 4G and 5G (RF, 2020)

4G	5G
IPV4 address is 32 binary cells	IPV6 address is a 128-digit binary
The data speed for mobile devices is 100 Mbps	The data speed for mobile devices is 1Gbps
The data speed for stationary users is 1Gbps	The data speed for stationary users is 10Gbps
The delay time in the fourth generation is up to 10ms	The delay time in the fourth generation is up to 1ms

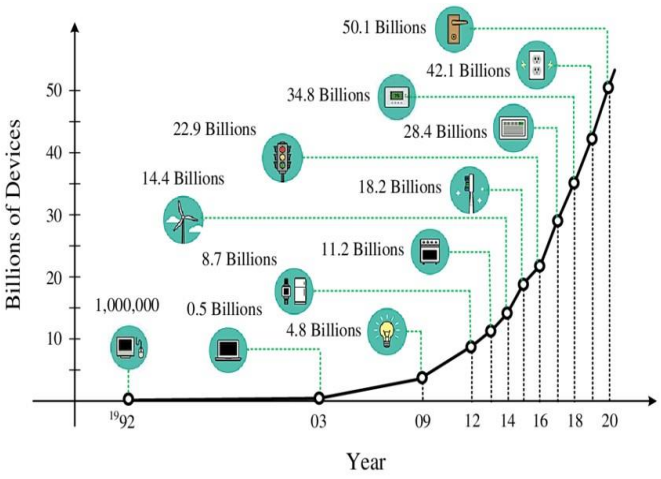

Figure 1. The rise of the fifth generation of smart devices (Nistor, 2019)

B. A Comparison of 1G, 2G, 3G, 4G, and 5G

We discover more and more every day about the distinction between improved output from new technology and speedier communication. In order to achieve the optimum performance, communications networks were starting to innovate.

1. First generation 1G

The initial generation of communication, which uses the Frequency Division Multiplexing (FDM) technology, was only focused on calls and ran on analogue waves. SMS and Internet connections are not available.

2. Second generation 2G

The Global Mobility Network, also known as GSM, is the name given to this generation, which is the most well-known in the communication industry. Since the first generations concentrated on digital signs and utilised TDMA and CDMA technologies, which opened the way to new services like SMS and E-mails, this generation relied on contemporary digital signal technology. Before 2.5G or GRPS technology started to reach 144Kbps of data speed, this connectivity generation was employed to develop new inventions.

3. Third generation 3G

This generation was reliant on UMTS technology, which enabled better data processing and a speed of up to or slightly higher than 2 Mbps. Other recent additions include GPS

capabilities and video calls. Despite the many advantages of this century, there are a few small drawbacks, including higher expenditures and increased energy use. HSDPA and HSUPA were included into the network when it evolved into 3.5G, bringing download and upload speeds up to 14.4 Mbps and 5.8 MB, respectively. Then came the HSPA 3.75 technology, which increased the download speed to 56 Mbps and then decreased it to 22 Mbps once again (Leong & Mandic, 2006).

4. Fourth generation 4G

This version is based on the LTE and WiMAX specifications and offers super-fast download speeds of up to 173 Mbps, which were built up to 25 Mbps using the most recent LTE-A specifications, allowing you to download a movie in less than a minute within an 800 MB file (Leong, 2005).

5. Fifth generation 5G

The image alone can convey what fifth-generation network upgrades can offer in terms of speed and performance. Only a speed of 1Gbps is predicted to be released commercially by 2020; the technology is currently in testing. Since the system is still being examined, we truly don't have adequate information about it. I believe we should hold off until we hear more.

C. Statistic of 5G Technology

The fifth generation, or 5G, of wireless internet networking is the newest one. The latency problems should be resolved by 5G. However, it should be highlighted that all of these concepts are hypothetical and speculative, and that significant effort by the government and mobile network operators will be required to make this research a reality. With more users and better services, 5G opens the door to a new degree of risk, but the security component needs to be worked out first (Min & Leong, 2012).

The key nations that have already launched their 5G networks are China, South Korea, Japan, and the United States (Figure 2). (Bretnall, 2019). The United Kingdom has already launched, and several more countries are making fast steps toward the launch of their 5G network. That is the worldwide example of objective 5G technology.

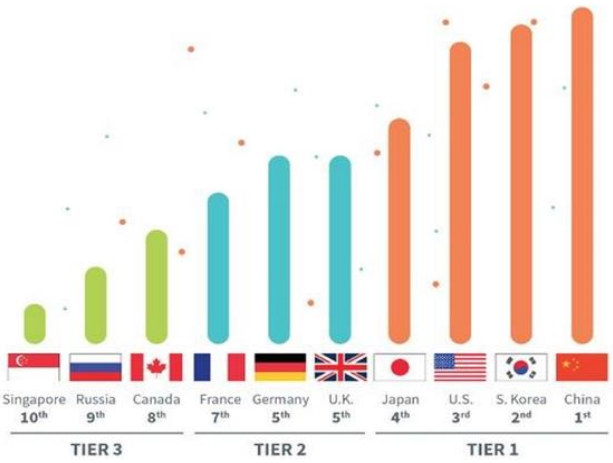

Figure 2. 5G readiness by country. Telecom analysis firm Analysis Mason was commissioned by US wireless industry organisation CTIA to rank countries with developed wireless markets for 5G readiness (Agrawal, 2016)

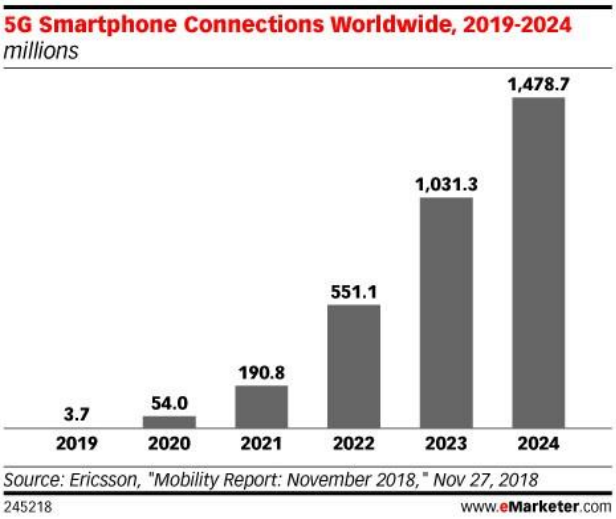

Figure 3. Statistic 5G network (Bretnall, 2019)

In Figure 3, 5G is anticipated to be available by 2020. Between 20 million and 100 million 5G associations are expected to exist by the year 2021 (Bretnall, 2019). Many evaluations estimated the amount to be 200 million. Also, it is estimated that spending on a 5G portable system will total roughly 2.3 billion US dollars in the same year.

D. Analysing Gaps and Benchmarking

Global 5G selection is currently going through a challenging period, and Channels (a company that analyses the global innovation market) predicts a bright future for cutting-edge smartphones. As the right time, in 2023, 5G competent cell phone shipments will command the market, as indicated by

notable innovation industry research organisation (Pew, 2019).

Table 2. Gap analysis and benchmarking analysis

Year	Author(s)	Analysis (objective with used techniques)
2000	Sawhney, A	Improve the ability of dual-hop energy harvesting cognitive networks to maintain confidentiality by adopting a time switching relay system with decode-and-forward relay (Sawhney, 2020).
2018	Chen *et al.*	For the purpose of maximising the achievement of practicable secrecy rates in the presence of many listeners, an unique cooperative wireless energy harvesting transmission technique was developed.
2018	Qin *et al.*	There are two secondary user selection strategies—minimal interference-based and maximal jamming rate-based—to improve primary user security.
2018	Nandan *et al.*	Using case-ceded zero-forcing beamforming technology, a two-cell MIMO NOMA-based CRN is secured for communication.
2000	mmWave Networking Group	Compared to using just one antenna, a secondary user relay with many tennis provides superior secrecy performance. When sending from the sec notary user to the secondary receiver, confidentiality is maintained (mmWave, 2020).

With no less than 1.9 billion devices shipped between 2019 and 2023 and a prediction of just under 800 million units in 2023 alone, Waterways' entire prognosis for 5G handsets involves quite large figures. This astounding number of 5G phones, if the forecast is correct, will account for 51.4% of the worldwide mobile market in 2023.

The total number of 5G phones that will be distributed in 2023 is 774 million, according to a more detailed Canals map. According to this figure, China would deploy no fewer than 263 million 5G phones, followed by North America with 145 million and Asia Pacific with 135 million. Europe is anticipated to be the final region to surpass the 100 million mark with 123 million units.

Mo Jia, a trench examiner, has discovered that this year, Chinese administrators will allocate less than $5 billion for the building of local 5G networks. This year, between 70,000 and 90,000 5G base stations will be operational throughout China. Meanwhile, it appears that many different countries are focused on limiting and lifting their bans on Huawei and ZTE, which is obstructing the uptake of 5G. (Quallcomm, 2019).

III. METHODOLOGY

5G innovates a new healthcare ecosystem that can efficiently meet the needs of patients and healthcare providers. The 5G technology tends to be accurate, efficient, convenient, inexpensive, and on a large scale. 5G networks are poised to transform all the key components of healthcare. This change is especially important today, as pandemics place a heavy burden on healthcare systems around the world. Since the introduction of 5G testing, the potential of technology to transform the medical sector has often been cited in scenarios ranging from remote diagnosis to remote surgery. In a GSMA intelligence survey of mobile network operators in early 2020, more than 62% of those surveyed indicated telemedicine as the sector with long-term business opportunities, 12% more than security. It's expensive and almost the same as a data analysis system. Surgery performed remotely over cellular networks is probably years away, but many applications using the latest network technologies and systems are being deployed around the world, along with many other test projects.

A. A Shot in the Arm for Healthcare

Since the early days of 5G trials, the generation's capability to convert the clinical region has been regularly noted in eventualities starting from far-flung analysis to far-flung

surgery. In a GSMA Intelligence survey of cell operators in early 2020, sixty-two percent of respondents noted telehealth and telemedicine as sectors imparting long-time period commercial enterprise opportunities, 12 percent factors better than the safety and nearly as excessive as information analytics structures. Although surgical strategies have done remotely over cell networks are nonetheless in all likelihood a few years away, lots of packages the usage of contemporary-day community generation, and structures are being rolled out globally, along with many different trial projects. We agree that 5G has the electricity to remedy most of the troubles which have avoided the broader uptake of telemedicine (Leong, 2019).

In China, Telemedicine has been studied for 20 years, Communication generation stays a huge issue. However, 5G solves most of the previous connectivity issues. 5G will remedy several legacy connectivity troubles. Potentially game-converting use instances for 5G-primarily based total packages tend to contain AI and huge information. Medical professionals, scientists, researchers, and patients would gain access to clinical facts, data, and a significant portion of the results of CT and MRI scans easily (Leong *et al.,* 2020).

After a coronavirus pandemic, the post-coronavirus pandemic 5G eMBB generation provides full health support by minimising the consultation of men or women with doctors and the sick, and infected civilians. Reduce the number. For patients who do not have easy access to their healthcare provider, 5G makes it accessible to their healthcare providers through an immersive telepresence structure. Advanced 5G connectivity structures can improve collaboration between clinical professionals, for example by using scans to improve analysis. The 5G generation supports communication between terminals and simplifies real-time communication. It will make telemedicine standard for each of the docs and sufferers.

With the outbreak of the COVID-19 pandemic, people explored and understood the benefits of 5G and telemedicine. This has shown the reduced risk of spreading the virus by going to the hospital. Telemedicine can be used to provide significant assistance to local hospitals from qualified medical professionals. Patients can stay home and continue to receive prescriptions over the internet services. The medicine can be delivered to their front door without any close contact.

The Huawei-sponsored project at the National Telemedicine Center installed a telemedicine system to combat COVID-19 earlier this year. It connects 108 counties and 147 hospitals in 18 cities, encourages specialist collaboration, facilitates better resource allocation, and offers expert treatment recommendations. The technology enabled remote access to top-notch medical resources, enabled remote patient monitoring in isolation wards, and hosted online coronavirus workshops. With the assistance of large hospitals, city and county patients, medical facilities, and danger of cross-infection owing to patient movement can be improved.

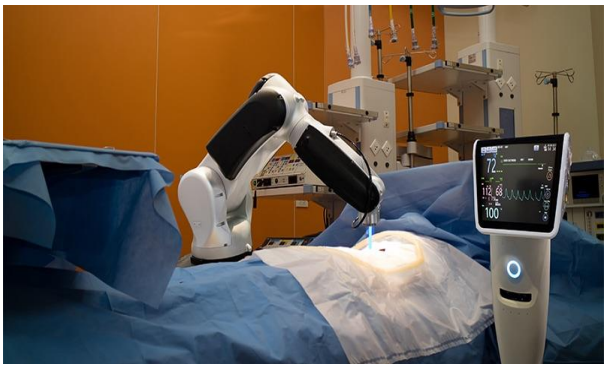

Figure 4. Robotic in Surgery (Agrawal, 2016)

1. The importance of Artificial Intelligence (AI)

As IoT networks and smart devices evolve, the opportunities for intelligence and smart, fact-based algorithms in healthcare are increasing. The 5G infrastructure makes it much easier and more reliable to use AI software programs to investigate facts about data subjects sent to cloud platforms in real-time. In fact, with the advent of 5G technology, AI is really promising and welcoming. AI lets medical doctors to investigate person-affected person statuses in real-time, presenting stepped-forward analysis and healthcare transport irrespective of in which the affected person is located (Wang, Chong & Leong, 2010).

This results in cost savings, a shorter wait time for care admission, and flexibility for the stop user. Because there are so many facts, analysing scientific images is a terrifying task. Doctors must understand these dynamic changes and complexity, which might take a lot of time and make mistakes

because of obvious exhaustion. Recent improvements in machine learning algorithms have demonstrated that AI is capable of extracting more information from images more reliably and accurately, as well as recognising features that are not always easy to see with the naked eye. Applications vary from analysing big numbers of pics from screening applications to the improved analysis of particular issues inclusive fractures.

The big quantities of facts utilised in real-time device getting to know to require ultra-dependable excessive-bandwidth networks, in particular, if clinicians desire to get admission to facts from cellular devices (Huang *et al.,* 2008). By switching to excessive ability 5G networks, healthcare corporations can use device-getting-to-know structures to offer satisfactory care viable from anywhere they are withinside the clinic or clinic. 5G networks can assist the ideal real-time transmission of huge facts, ensuring the accuracy and reliability of scientific facts thru AI structures (Rajah, 2019).

5G and AI will dispose of limitations for hospitals to interconnect and allow superior analysis and remedy stories to be shared among big and small hospitals, which allows you to advantage of underserved rural regions. It is frequently hard for scientific centres in rural regions to put in and use AI programs because of monetary and technical limitations, however, 5G will allow them to hook up with larger hospitals to utilise their AI programs.

B. Obstacles in the Healthcare Industry

Despite numerous obstacles, the advantages are obvious. Currently, Lu is taking part in a Chinese national research initiative that aims to solve these issues and lay out strategies for assisting nurses in utilising 5G to deliver medical applications. There is a significant issue with connecting older equipment to 5G networks on the hospital side. It emphasises the necessity of upgrading the present CT and MRI scanning equipment with 5G networking modules. By improved collaboration and efficiency, the ICT platform gives doctors, managers, and patients simple access to real-time information, saving time and money.

The absence of detailed specs is one of 5G's present difficulties. Not simply the quicker, bigger models from the previous generation are included. As opposed to previous generation networks, 5G will be delivered as a set of services that can incorporate M2M, audio and video capabilities, and other far wider services. Most treatment systems will be connected to 5G in the future due to the real-time network connection. Your doctor can contact a specialist in real-time, and patients have real-time access to your doctor. Communication about treatment will be easier and it will be much easier for the GP to get help. The entire healthcare system will now benefit. Benefits for patients include faster travel times, lower costs, and fewer days lost. Telemedicine is supported by the government and guidelines are in place to encourage its use. As China launches 5G in healthcare facilities, low-latency, high-bandwidth connectivity technology will support advanced telemedicine and support hospital logistics around the world.

The 5G also provides the basis for experimenting with advanced applications, such as operations performed remotely by professionals using robotic arms connected over a communication network. These applications could also be a new source of revenue for operators who play a central role in enabling this exciting use of the latest network technologies.

Because of the technology's capabilities, potential applications, and capacity to kickstart the digital transformation, 5G has created a stir. Insiders in the healthcare sector think that 5G and the excitement around it will promote innovation, adoption, and deployment of new technology.

C. 5G + Artificial Intelligence (AI) for Connected Intelligent Edge

Future breakthroughs are fuelled by 5G and AI, two key components that work in concert to boost system performance and efficiency. Meanwhile, the proliferation of 5G-connected devices can foster dispersed intelligence through further advances in AI learning and inference. The change of the connected intelligent edge has started, and it is essential to achieving the full potential of our 5G future as the importance of on-device intelligence grows (Business, 2020).

AI processing needs to happen closer to the end consumers, on gadgets like a smartphone, a car, a laptop, or XR glasses, in order to scale intelligence effectively. By processing data at the edge, we can achieve greater system efficiency, increased privacy, higher speed, and new degrees of personalisation.

On-device AI will continue to improve and be complemented by the edge cloud, which will add new capabilities and enhance the system's processing power. A 5G connection with high bandwidth and low latency will be used to connect the edge cloud (The 34GG Blog, 2020).

IV. CONCLUSIONS

Driven by advances in robotics, IoT, and AI, as the use of 5G in health care and its applications increases, a new connected ecosystem for health care will be formed. This ecosystem, in our opinion, is founded on the relatively recent concept of 4P medicine. It is interactive, personalised, preventative, and predictive. Forecast Devices with a consistent stream of real-time patient alarms and vital sign data, along with data on lifestyle choices and social factors, are better able to anticipate patient risk in the new healthcare ecosystem. (Shi, 2020).

Also, it will give medical professionals early notice of patients' issues. These insights can then be used by medical professionals and nurses to act quickly and effectively before a situation gets worse. Although 5G will not be essential to the prediction process in and of itself, it will support the ecosystem's scalability and all-pervasive interconnectedness.

A. Preventative Strategy

The capacity to take preventive action is enhanced by being predictive. The capacity to track the location and closeness of huge groups of people with exceptional accuracy via a smartphone app has been proven in South Korea, which is particularly relevant to the state of COVID-19 outbreaks. This geolocation information can be used in conjunction with diagnostic profiles and ongoing testing results to identify individuals who are most at risk and who might be unintentionally spreading the as-yet-asymptomatic sickness to others during a contagion. It is then possible to start individualised notifications and interventions to stop the outbreak from spreading.

B. The Future of 5G

In terms of networking dependability, speed, and scalability, 5G has the potential to fundamentally revolutionise healthcare, patient services, therapies, and wellness programmes. The three main benefits of these networks—ultra-fast broadband, ultra-low latency, or a combination of the two—would significantly enhance them. Low power consumption—should be considered by healthcare organisations and technology providers when evaluating their proposed 5G applications. This is because there are so many novel concepts being debated in this field, especially in light of the recent epidemic that has highlighted the potential importance and vulnerability of our healthcare systems in the case of a natural disaster.

C. 5G Technology: Transforming Industry at a Breakneck Pace

By the end of 2024, Malaysia is anticipated to have roughly 80% of its 5G network coverage in populated locations, starting with a 10% target for Kuala Lumpur, Putrajaya, and Cyberjaya. By 2025, Malaysia is predicted to have 2.1 million mobile 5G subscriptions, with a penetration rate of 6.6 mobile 5G subscriptions per 100 persons (Teschler, 2017).

The Malaysian Institute of Economic Research (MIER) estimates that between 2021 and 2025, the GDP will increase by an additional RM12.7 billion due to 5G-related economic activities. The contribution of 5G to the Malaysian GDP is anticipated to reach RM5.3 billion in 2025 alone, and it is anticipated that 5G and Industry 4.0 activities enabled by 5G would continue to contribute more and more to the country's GDP in the next years.

The demand for 5G will affect a wide range of manufacturing industries, particularly semiconductor component and module producers including Outsourced Assembly and Test (OSAT) firms and Automatic Test Equipment (ATE) makers. Given their exposure to, businesses like Inari Amertron, Malaysian Pacific Industries (MPI), and Aemulus are poised to be major winners.

D. Why Are We So Far Behind in 5G in Malaysia?

Malaysia was given the responsibility of being one of the first countries in Southeast Asia to roll out the technology, with plans to begin commercial 5G services in Q3 2020. Malaysia's 5G rollout did not start until the latter half of 2021 as a result of multiple delays and a change in strategy.

YTL Communications' Yeah 5G is currently Malaysia's first and only provider of commercial 5G services. The top four carriers—Celcom, Digi, Maxis, and U Mobile—have not yet made their 5G services accessible to customers. Where did we come from? What function does the Single Wholesale Network (SWN) of Digital Nasional Berhad perform?

The Ministry of Communications and Multimedia and the Ministry of Finance decided that the Malaysian government will roll out 5G via Digital Nasional Berhad (DNB) in a Single Wholesale Network (SWN) model. This concludes the discussion on whether Malaysia should consider a Dual Wholesale Network (DWN) model. This will allow private telecom companies to form a consortium to develop another 5G network to compete with DNB.

Overall, the message is clear. Combining 5G with other state-of-the-art technologies will transform many aspects of patient care while facilitating the emergence of new, smarter, resource-efficient healthcare ecosystems that are more connected than current systems. You can create opportunities. Before 5G networks are widely used in healthcare, there are still many institutional, cultural, and technological obstacles to be addressed. The success of 5G-enabled applications, however, will likely depend on considering what patients—who are, in fact, the core of the healthcare ecosystem, whether it is new or not—need and want.

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