

## Comparative Study on the Possibilities of Next-generation Mobile Technology in Bangladesh and Its Impact on Health

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### ABSTRACT

*There has been an unprecedented growth in mobile technologies in recent years that connect millions of people, resulting in a remarkable increase in different communication devices. 5G will be launched worldwide and in Bangladesh very soon with some fascinating features to make our life more comfortable and faster. While 5G has excellent potential worldwide, radiation from a very dense network of antennas and transmitters (5G) and cell phones poses a detrimental risk to human health. This paper focuses on those impacts on Bangladesh's perspective by considering the effect of the existing 4G technology. This survey analysis was carried out using both the primary and secondary data. The most important finding of this study is that most cell phone antennas emit radiation beyond the permissible limits. Citizens face health issues related to radiation emitted from cell phones and BTS (Base Station) tower. Another important finding is that most citizens are not aware of the radiation emission from cell phones and BTS towers. Citizens must be educated, and awareness needs to be created regarding the hazardous radiation effects of mobile phones and BTS towers in human society.*

**Keywords:** 5G; radiation; health issues; BTS towers

### 1. INTRODUCTION

“Connecting citizens in ways most meaning to them” is one of the main objectives of Digital Bangladesh. By providing connectivity, mobile operators are in a unique position to play a crucial role in developing digital societies. Mobile technology will help to achieve the goal of making Bangladesh a middle-income country and plays a crucial role in promoting the achievement of the United Nations Sustainable Development Goals (SDGs) and Vision 2021 of Bangladesh. Bangladesh has tremendous potential as the country has a demographic dividend, and the government is acting very hard to make Bangladesh a digital one. Moreover, a fast and uninterrupted internet connection network is a tool for building a digital Bangladesh.

However, the world's connectivity requirements are changing, and data usage is increasing by 30% in 2020, which cannot be covered by the existing technologies ([1] Kumar, 2018). Until the end of 2024, global mobile data demand 5 times more than usual. The current 4G networks, especially in dense urban areas, will not be able to keep up. That's where a fresh generation is going launch with a lot of features ([2] ericsson), and that is 5G, the fifth generation of mobile communication technology.

Markit and Berkeley Research Group, which assesses 5G technology's usefulness to the global economy, estimates that by 2035 5G will create 22 million new jobs worldwide, create 3.5 trillion dollars in direct economic activity, and boost sustainable long-term growth for real global GDP. By 2020 to 2035, 5G's overall contribution to real global GDP would be equal to an economy of India's size, the study says. So it's a prime opportunity for

Bangladesh to become a larger part of this projected digital economy. Grameen Phone (1997), the leading operator in Bangladesh, and three more GSM operators are (Banglalink, Robi Axiata, and Teletalk) now operating in Bangladesh. In contrast to the 20th century. Nearly 162.920 million (April 2020) people in Bangladesh use mobile phones. According to Bangladesh Telecommunication Regulatory Commission (BTRC), the total number of internet users in Bangladesh was 101.186 million by April 2020, 93.101 million using the internet over the phone, 0.002 million using the internet via WiMAX, 8.084 million using the internet via ISP+PSTN ([3] btrc).

As a result of 5G, there is a huge potential for the whole world, including Bangladesh, although there are still some health risks and the tenth most densely populated country globally. Because implementing 5G requires a much larger number of BTS towers than 3G or 4G. According to the World Population Report, 1275 people live in Bangladesh per square kilometer, and 5G network needs to be built on a small cell site infrastructure relying on a dense infrastructure of shoebox-sized “towers” every few hundred feet. So it is a significant risk factor for health issues. In other words, the number of base stations and other tools with higher frequencies would increase significantly. This raises the question of whether higher frequencies and billions of different creations are having a detrimental effect on human health and climate, which, according to studies, would mean constant exposure for the entire population, including children ([4] europarl.europa).

Due to the obvious differences in their anatomies and tissue structure, children consume energy differently than adults. Because of this, and since their bodies are still developing, children may be more vulnerable to mobile phone radiation exposure ([5] Gandhi, 1996) and certain tissues of a child's head, such as the bone marrow and the eye, consume considerably more energy than those in the head of an adult ([6] Christ, 2010). The same can be presumed for proximity to base station towers.

Studies have also reported headaches, sleep disturbances, dizziness, skin rashes, insomnia, decreased libido, concentration issues, changes in memory, increased risk of cancer, tremors, increased suicide rates, and other neurophysiological effects in communities near base stations ([7] Levitt, 2010).

In this paper, we investigate the various prospects of next-generation mobile communication technology in our life; What is the plan and preparation of Bangladesh with 5G, the effect of the radiation emission from the base station and portable terminals on the human body, which are going to install nearer to us are also discussed in this survey.

## **2. RESEARCH METHODOLOGY**

This study paper focuses on secondary data obtained from online sources, numerous research papers, and survey studies performed alongside primary data by renowned daily newspaper institution. We used several data collection tools, including On-Site Observations, interviews, and questionnaires, to gather information about mobile phone and internet use in general. With the aid of the questionnaire, we interviewed 100 individuals. Those people are from districts of Rajshahi, Bangladesh. The 100 samples are randomly chosen, including male-female, university professors, students of different levels, businesspeople, various government officials, housewives, and others.

To study the effect of EMF radiation from mobile towers, first it was decided to measure the radiation emission from mobile towers in Rajshahi district. We divided the city into three zones, and in each zone, total 10 sampling locations were identified. So, overall, 30 mobile towers were studied from all the zones. The following zones were taken up:

- Residential area (Zone-A)
- Commercial area (Zone-B)
- Agriculture, rural and highway area (Zone- C)

After zone wise distribution of mobile towers, observations of radiations from mobile towers were made using a mobile app known as EMF detector and the mobile tower radiation detector. The measurements were taken throughout the Rajshahi district in a residential area, commercial area, agriculture and rural area, highway, and far-flung area from December 2019 to February 2020. A total of 30 observations have been recorded using a detector.

### **3. EVOLUTION OF MOBILE COMMUNICATION SYSTEM**

The evolution of wireless mobile communication system is defined by changing the fundamental nature of provided service, non-backward compatible transmission technology, and new frequency bands. The evolution of the mobile communication system has been categorized into ‘generations’ as:

#### **3.1. First-generation (1G)**

This generation was launched by Nippon Telephone and Telegraph Company (NTT) in Tokyo and become in operation in the world during 1979. The system of this generation used an analog communication system for speech service with operation frequency of 800 MHz and 900 MHz, and bandwidth of 10 MHz ([8] rfpape).

#### **3.2 . Second-generation (2G)**

2G was introduced at the end of the 1980s with digital multiple access technologies. This generation offered enhanced security, SMS services, higher spectrum efficiency, first internet at a lower data rate with better data services, and more advanced roaming ([9] Mousa, 2012). 2G communication is generally associated with a global system for mobile (GSM) services ([10] Shukla, 2012).

#### **3.3. Third-generation (3G)**

3G was launched around 1991 with higher data rate, video calling, TV streaming, multimedia message support, enhanced security, number of users and coverage. UMTS and cdma2000 were the two leading technologies in 3G mobile communication systems ([11] Holma, 2000).

#### **3.4. Fourth-generation (4G)**

The first successful field trial for 4G was conducted by NTT Do Co Mo in Tokyo, Japan, on June 23rd, 2005, and achieved 1Gbps real-time packet transmission that was developed by IEEE. This generation offers a higher data rate and capable of handling more advanced multimedia services. WiMAX ([12] Aown, 2012) ([13] Islam, 2014) ([15] Islam, 2016) ([16] Tai, 2016) ([20] Islam, 2009) ([21] Halim, 21012), DNT ([17] Kumar, 2018) ([18] Roy, 2019) ([19] Roy, 2019) and LTE ([14] Islam, 2014) are the key technology in 4G.

#### **3.5. Fifth-generation (5G)**

With 5G mobile communication systems, people can access and share information in a wide range of scenarios with extremely low latency and very high data rate ([22] Boccardi, 2014). It should achieve 1000 times the system capacity, 100 times the data rate, 3–5 times the spectral efficiency, and 10–100 times the energy efficiency concerning the current fourth-generation (4G) systems ([23] Wang, 2014).

Bangladesh has had 4G since 2018, now it is trying to run 5G. We are confirmed about some detrimental effect of mobile tower radiation, research is underway in Bangladesh also on the potentially harmful effects of the 5G bandwidth on the human body. Now we will look at the changes or upgrades required for upgrading from 4G to 5G and the features of 5G.

#### **4. EVOLUTION OF FIFTH GENERATION (5G) MOBILE COMMUNICATION SYSTEM**

4G has been installed successfully all over the world and also in Bangladesh, and try to launched 5G as soon as possible. In order to launch 5G, the 4G network needed to migrate to 5G to support the existing 4G network. The following key point might be considered when migrating from 4G to 5G:

- a. Multi-mode user terminals
- b. The choice among various wireless systems
- c. Security
- d. Network infrastructure and QoS support
- e. Attacks on Application Level
- f. Jamming and spoofing
- g. Data Encryption ([24] Hui, 2003).

##### **4.1 Key features of 5G technology**

5G Technology has the following feature that will attract customer:

- a. With AI (Artificial Intelligence) capabilities.
- b. 5G will also introduce the Internet protocol version 6 (IPv6).
- c. 5G has advanced technology such as cognitive radio technology, also known as smart radio, allowing different radio technologies to share the same spectrum efficiently ([25] Gohil, 2013).
- d. The remote diagnostics also a great feature of 5G technology.
- e. In the 5G mobile communication system, the user can simultaneously be connected to several wireless access technologies and seamlessly 5G is going to introduce a wireless mobile communication system with almost no limitation; somehow people call it the REAL wireless world.
- f. The 5G technology is providing up to 25 Mbps connectivity speeds.
- g. Some additional features such as Multimedia Newspapers, also to watch TV programs with clarity as to that of an HD TV ([26] Bhalla, 2010).

##### **4.3 The Upcoming Provided Services by 5G Technology**

5G will have a more profound impact on our lives than any technological change since the internet began. By 2020, 50 billion devices will be connected to the global IP network ([2] ericsson). The reasons are speed, low latency, and ubiquity of 5G networks that will run at higher frequencies and shorter ranges than 4G, depending every few hundred feet on a compact shoebox-sized 'towers' infrastructure. That allows them to support billions of devices. 5G is going to launch to support the customer with the following services:

- a. The Internet of Things (IoT): The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

- b. **Smart Cities:** A smart city uses digital technology to connect, protect, and enhance the lives of citizens. A smart city collects data from IoT sensors and analyzes the environment so that the city operator can decide how and when to take action.
- c. **Healthcare:** 5G networks could transform and improve all of the critical components of healthcare to provide basic connectivity levels to enable a new health ecosystem, where one can provide service to several patients simultaneously, accurately, efficiently, conveniently, and cost-effectively.
- d. **Transforming Industrial Sectors of Economies:** 5G is expected to radically transform the public and industrial sectors of economies by enabling and enhancing the critical control of production-line robotics that can be controlled, monitored, and reconfigured remotely, making manufacturing more efficient. So, when Bangladesh has 5G, it will attract much foreign investment. Bangladesh does not have much heavy industry, but with 5G, foreign investment, and automated factories, it will go for heavy manufacturing.
- e. **Autonomous Cars:** As most traffic accidents are caused by human error, removing humans from behind the wheel could save millions of lives globally. Low-latency 5G networks would make the dream of driverless cars in real life. Recently, Japan is developing a driverless car and is going to launch very soon.
- f. **Virtual Spaces:** 5G's high bandwidth and low latency, augmented and virtual reality could finally become a practical reality. Virtual Reality (VR) telepresence apps will allow colleagues in distant cities to work "side by side" or sports fans to experience the roar of the Super Bowl crowd from the comfort of their couches. We'll virtually roam shopping districts in Tokyo during lunch breaks and have the goods shipped to our homes.

## **5. EFFECT OF RADIATION ON HUMAN HEALTH**

The smartphone is one of the sources of the eminence of electromagnetic waves (EMF). As soon as mobile phones become an important part of our lives, mobile phones are becoming harmful to human health because of the radiation from the device and the base transceiver station (BTS).

The WHO/ International Agency for Research on Cancer (IARC) classified radiofrequency EMF as possibly carcinogenic to humans in 2011. A section of the scientific community argues that there are negative impacts from EMF exposure which will be increased with the implementation of 5G. A 5G appeal was presented to the United Nations in 2015 and to the European Union in 2017. The appeal states that many scientific publications illustrate EMF exposure effects such as an elevated risk of cancer, genetic damage, learning and memory deficits, neurological disorders etc. The appeal points out not only harmful to humans, but also the environment. The appeal recommends a moratorium on the deployment of 5G for telecommunications until potential hazards for human health and the environment have been fully investigated by scientists independent of industry. They urge the EU to follow Resolution 1815 of the Council of Europe and demand that an independent task force carries out a new assessment. In this regard, some scientists consider it necessary to establish new exposure limits that consider the new characteristics of exposure. Such limits should be based on EMF radiation's biological effects, rather than on the energy-based specific absorption rate.

Radiation appears from either cell phone or BTS tower. To more accurately discuss their influence, cell phone and BTS tower radiation's effect was analyzed separately by focusing on three zones in Rajshahi district, Bangladesh, as described in Section 2.

### **5.1 Radiation Effect from Cell Phone**

The effect of cell phone radiation on human health is the topic of recent research and analysis, as several experimental studies are underway to explore the potential harmful impact on human and animal health of mobile phone radiations. On 31 May 2011, the World Health Organization, related to the increased usage of cell phones, envisaged the long-term health risk. A study has shown that there is a chance of a rise of 40% in the incidence of gliomas (brain cancer) in people using cell phones very frequently and for long hours.

We took 100 participants as samples to observe cell phone radiation's effect on human health, where 65% were male, and 35% were female. Of these participants, 35% were 30 years of age or younger, 45% were over 30 years of age, and 20% were over 50 years of age. We have divided them into two categories in which category 1 is those who use cell phones for the long term and often bring mobile phones close to their bodies. Category 2 is those who never use cell phones for long periods and also still keep a distance from their mobile phone. After one month of observation, 25% of participants reported high blood pressure, 10% reported dizziness, 20% reported headache, and 40% reported sleep disturbance. At the same time, the rest of them have no such low effect on their bodies in category 2. From this study, therefore, it is found that the radiation from cell phones harms human health.

### **5.2. Radiation effect from BTS tower**

Another area of concern is the radiation released by the fixed infrastructure used in cell phones, such as base stations and their antennas, which connect to and from mobile telephones. This is because it is released continuously compared to cell phones and is more powerful at close quarters.

Mobile tower zone wise distribution was conducted, and radiation measurements from cell towers were recorded using a smartphone app known as the EMF detector and mobile tower radiation detector. The measurements were taken across the three-zones in Rajshahi city; Zone-A (Residential Area), Zone-B (Commercial Area), and Zone-C (Agriculture, Rural and Highway Area) as defined in Section 2. A total of 30 observations have been recorded using a detector and converting their values in the international unit of radiation measurement, i.e. microwatt or watt/m<sup>2</sup>.

It was found that more than 30% of the overall observed cell towers belong to the high-risk category, 30% to the medium risk category, and the remaining 40% to the low-risk category. It is alarming that nearly 60% of cell towers that emit radiation above the permitted limits are unaware of this fact. The ill-effects of radiation are not well understood in the short term period, or sometimes people do not take them seriously. However, in the long run, the adverse environmental and health concerns can be grave, and it is, therefore, time to take appropriate precautions.

In figure 1, the proportion of towers according to the factor of emitting radiation is displayed. 30% of high-risk towers are in the blue colored, 30% of medium-risk towers are orange-colored, and 40% of low-risk towers are gray.

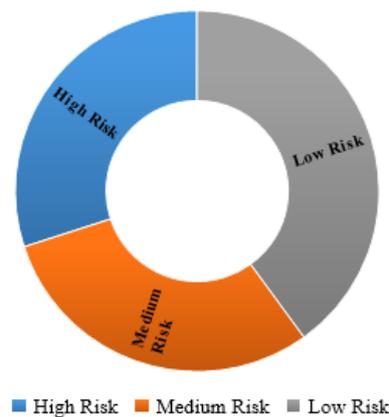


Fig. 1: Radiation from BTS

## 6. HOW CAN BANGLADESH UTILIZE 5G?

Mobile technology and services have a significant role in Bangladesh's GDP since 2015 by providing millions of jobs to Bangladeshi citizens and also made an enormous contribution of billions of dollars to state funding. One-third of the jobs were created directly in the area, and the rest was provided by the effects of the knock-on ([27] gsma). Moreover, the upcoming 5G technology is expected to expand this range of employment and earnings further.

The government of Bangladesh has already adopted the UN Sustainable Development Goals (SDGs) and integrated the priorities into the plans for Vision 2021, which is the government's blueprint for Bangladesh to be a middle-income country where poverty would be entirely eradicated by 2021–Bangladesh's 50th celebration of its independence. One of Vision 2021 is Digital Bangladesh, which aims at bringing socio-economic transformation through information and communication technology (ICT). And it is predicted that in implementing Vision 2021, the coming 5G will become a crucial tool.

The government of Bangladesh has taken steps to introduce 5G service in three phases. In the first phase, from 2020 to 2021, 50% of the city's high-value area. In the second phase Bangladesh will enjoy the company's Internet access system from 2022 to 2024. The third stage will put the environment under broadband, guaranteeing 100 Mbps coverage everywhere. The speed of download will be 10 GB and the payload will be 100. By 2026 the BTRC plans to cover the entire country by 5G ([28] the independent bd).

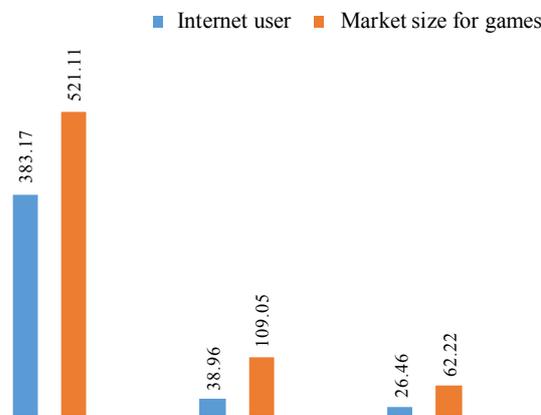
5G can revolutionize a considerable number of industries, including one of the world's oldest: farming. In 2019, the share of agriculture in Bangladesh's GDP was 12.68% ([29] statista). Agriculture is an industry where crop issues are only discovered when the damage has already occurred. To avoid this, Bangladesh farmers will use transformative 5G technology to monitor environmental and field conditions piloting agricultural drones, and be notified at the optimal time for watering, pesticides or fertilizer, and health monitoring. They will also use self-driving tractors for plowing and sowing autonomously. Instead of 4G, the high bandwidth of 5G will support many sensors with low latency. As a result, better quality production and higher profit will be confirmed.

Due to the Coronavirus pandemic, educational activities in Bangladesh are now running online. These activities will be uninterrupted and time saver if 5G with a low latency

facility is introduced. The government's Department of Posts and Telecommunications wants to use the country's mobile towers as WiFi towers. Initially, government's initiative to provide free broadband internet to the students through this can be accelerated. Simultaneously, the upcoming millimeter-wave communication technology of 5G is expected to play a role in reducing radiation.

In the last couple of years, Bangladesh is experiencing tremendous E-commerce growth, especially in online shopping. So, there should be a fast and easy interactive customer service essential to make this sector flourished and vibrant. So the E-commerce sector will become beneficiary from the coming 5G.

Bangladesh is the third largest video gaming market in South Asia, and the 61st in a worldwide 100-country ranking. Rapid growth of Internet users and smart phone penetration has made it possible. As seen in Figure 2, blue color indicates internet user and the orange indicates market size for games. In Bangladesh, Internet users are 26.46 million and the market size for Games is 62.22 million. Bangladesh is going to hold the upper place very soon by properly utilizing 5G.



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Fig. 2: Top south asian countries (In terms of market size for games)

We obtained information about people's perception on 5G, radiation from cell phone and mobile towers from the survey. Survey shows that Only 40% of respondents have an idea about 5G. They know about the practical benefits of 5G. In addition, 45% of high user think that they have daily needs (study, video conferencing, video chatting, 4K movie downloading, online movie watching), which all are possible in existing 4G. But their complaint is that the internet service is not uninterrupted and data speed is so unstable. 60% respondents keep some ideas about the radiation emission from cell phone device and BTS tower. But most of them are not aware of health issues related to cell phone radiation, because 78% of the respondents keep their cell phones beside their head while sleeping. 68% of the respondents accepted that installation of mobile towers in their locality have affected their lives in some or the other way, while 32% were not sure about mobile towers which have any negative effect or not in their life. In the figure 3 blue area of 68% respondents feel negative about mobile tower while 32% in maroon colored have no idea about any effect of mobile tower.

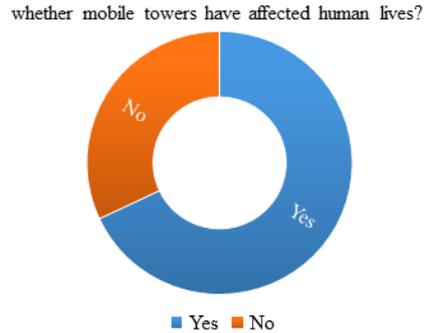


Fig. 3: Mobile towers effect on human lives

## 8. CONCLUSION

The world is running behind the digital economy. Bangladesh has prime opportunity to become a more significant part of this expected digital economy, and with the help of ICT, the government is working very hard to make Bangladesh digital. Studies confirm that the forthcoming low latent, super-fast 5G mobile technology will make this journey faster. 5G will help boost productivity and save time and cost in agriculture, education, health, e-commerce, and every sector by running AI, the Internet of Things, and robotics. 5G is going to increase GDP. This upgraded technology requires much closer antennas and transmitters than the current 4G, which might be a greater health risk for populous Bangladesh. The research found that more than 50% of existing 4G BTS towers are emitting radiation beyond the permissible limits. That's why nearer residents are facing radiation-induced diseases. It is also very significant that people are ignorant about the radiation from mobiles and mobile towers. Now we have to see how the infrastructure of 5G network is going to be established by Bangladesh. And whether the health risk associated with radiation increases after the installation of this network. Bangladesh will take all the benefits properly from the upcoming 5G and use them to make truly digital Bangladesh.

## 7. RECOMMENDATION

- 1) The long-term policy to minimize radiation from BTS towers is urgent in Bangladesh.
- 2) 5G needs to be set up in rural agricultural areas to get the benefit of technology in agricultural production.
- 3) Cell phone operators should share one high-quality tower for their network coverage without installing separate towers. BTRC can build these types of towers. In this way, the government can achieve a high level of revenue. At the same time, if the mobile tower is reduced, the possibility of lightning is also reduced.
- 4) When on a call, use a wired headset or speakerphone mode, which emits a smaller radiation amount.
- 5) Avoid using a mobile phone in a moving car, train, bus, buildings, steel structures, or rural areas at some distance from a cell tower. Distance from a cell tower will increase the cell phone's radiation output.

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