The Business Landscape of 5G in Bangladesh: Opportunities and Challenges

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Abstract:

The advent of fifth-generation (5G) mobile technology in Bangladesh marks a critical milestone in advancing digital transformation, with profound implications for business growth and competitiveness. Offering ultra-high data rates, low latency, and reliable connectivity, 5G has the potential to reshape industries, stimulate innovation, and support new business models. The government, in collaboration with Teletalk and Huawei, has initiated 5G deployment through a Non-Standalone (NSA) architecture, leveraging existing 4G and 3G networks. Despite this progress, significant challenges remain, including insufficient nationwide 4G coverage, spectrum limitations, high deployment costs, and the complexity of integrating millimeter-wave (mmWave) technologies. This paper critically examines the impact of 5G on Bangladesh's business ecosystem, focusing on sectors such as e-commerce, financial services, industrial automation, and small and medium enterprises (SMEs). Findings indicate that 5G can enhance productivity, enable real-time analytics, and drive the adoption of Internet of Things (IoT) and cloud-based services. Furthermore, it has the potential to optimize logistics, strengthen supply chains, and improve customer engagement, thereby facilitating both domestic growth and international market integration. However, realizing these benefits will require addressing infrastructural gaps, ensuring equitable access across urban and rural areas, and implementing supportive policies. The study highlights the importance of public-private partnerships, regulatory reforms, and workforce upskilling to enable businesses to fully leverage 5G capabilities. In conclusion, while 5G presents significant opportunities to accelerate Bangladesh's transition toward a knowledge-driven economy, its success in the business sector will depend on strategic investment, inclusive deployment, and sustained innovation. This research provides insights and data-driven analysis to guide policymakers, industry leaders, and stakeholders in harnessing 5G for economic transformation.

Keywords: 5G technology, Mobile Communications, Smart Bangladesh, Strategic Analysis, Business Prospects and Bangladesh Economy.

1. Introduction:

The introduction of 5G signifies a remarkable advancement in the telecommunications sector, featuring a plethora of enhanced capabilities compared to its predecessor. Bangladesh witnessed a surge in mobile internet usage after the implementation of 4G in 2018, escalating from 100 Mb (3G) to 700 Mb (4G) (Poorzare & Auge, 2021). This substantial improvement brought by 4G has greatly impacted the networking industry. In recent times, there has been exponential growth in the number of internet users in Bangladesh Consequently, the existing channel bandwidth support provided by 4G has become inadequate to meet the escalating demands of consumers due to the rapid expansion of internet usage(Poorzare & Augé, 2020). The COVID-19 pandemic, beginning in late 2019 and extending into late 2020, highlighted the critical necessity for high and dependable data transmission, especially for online-based communication in Bangladesh(Poorzare & Augé, 2023). Furthermore, with Bangladesh aiming to exit the Least Developed Countries (LDC) category by 2026, the urgency for technological progress becomes more pronounced. Considering these significant factors, the Bangladesh Telecommunication Regulatory Commission (BTRC), in collaboration with Teletalk and Huawei Technology, unveiled 5G on December 13, 2021, while still maintaining the existence of 4G and 3G networks (Poorzare & Auge, 2021, Islam, 2019). The introduction of 5G brings forth three primary features: high data rates, low latency, and reliable data transfer shown in **Figure 1**.

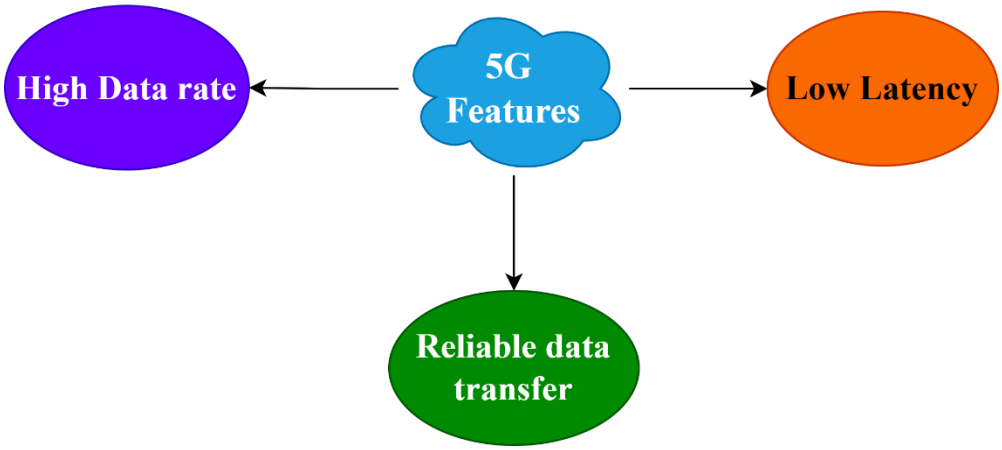


Figure 1: Major features of 5G

5G, among its diverse services, plays a pivotal role in advancing various newer technologies such as IoT (Internet of Things), AI (Artificial Intelligence), Cloud Computing, Smart Grids, Industry Automation, Machine Communication, and NLP (Natural Language Processing). Aimed at achieving speeds 1000 times faster than 4G, 5G accomplishes this feat through massive MIMO (Massive multiple input multiple output), Scalable modulation, and advanced channel coding. Operating commercially at significantly higher frequencies ranging from 24 GHz to 53 GHz, 5G

benefits from ample free spectrum, enabling end-to-end connections for users(K. T. Islam et al., 2020). The features provided by 5G are shown in **Figure 2**.

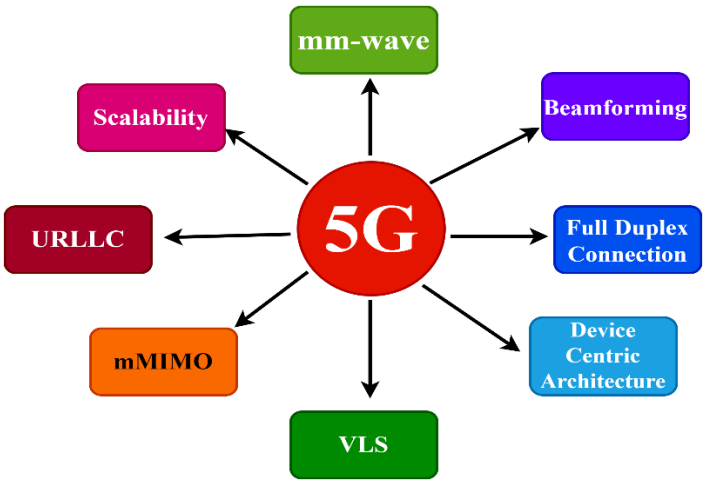


Figure 2: Technologies to implement 5G

Implementing the TCP internet protocol, 5G facilitates congestion-free networks, allowing Protocol Data Units (PDU) to traverse seamlessly, ultimately boosting the overall channel bandwidth of 5G. However, Bangladesh's national frequency allocation plan currently spans from 9 kHz to 275 GHz (Swarna, 2022), necessitating the swift adoption of this frequency range for widespread consumer use of 5G. Looking ahead, 5G is envisioned to reach its limits by 2030, paving the way for the arrival of 6G globally. Despite Bangladesh's recent launch of 5G in the capital, there remains insufficient coverage for 3G and 4G networks, with only 52% coverage using 4G by the top four network operators and 28.2% internet penetration among the population (K. T. Islam et al., 2020; Swarna, 2022). The introduction of 5G marks a technological shift with its cutting-edge architecture and the potential for integrating value-added services into service companies. However, implementing 5G poses challenges due to the integration of mm-wave technology, which operates at frequencies between 24 and 53 GHz. These high-frequency signals, despite offering high bandwidth, are susceptible to attenuation and exhibit limitations such as non-line-of-sight propagation, blockage by obstacles like pedestrians and vehicles, and orientation challenges with user equipment (Deowan et al., 2022). To expedite 5G deployment, the Non-Standalone Deployment (NSA) model integrates 5G core network equipment with existing 4G LTE infrastructure. This approach, utilized by carriers for their initial commercial 5G deployment, aims to reduce time to market and seamlessly transition from legacy cellular infrastructure.

Considering the challenges posed by mm-wave technology and the current telecommunications landscape, this paper will delve into the present scenario, major impacts, and future prospects of 5G across business sector.

The primary objectives of this paper are as follows:

- To comprehend the factors associated with 5G that influence business sectors in Bangladesh.
- To explore the prospective impacts of 5G on business sector within Bangladesh in the future.
- To present models pertinent to this sector in relation to 5G technology.
- To offer recommendations aimed at optimizing the utilization of 5G technology by proposing strategies for effective adaptation to the current state.

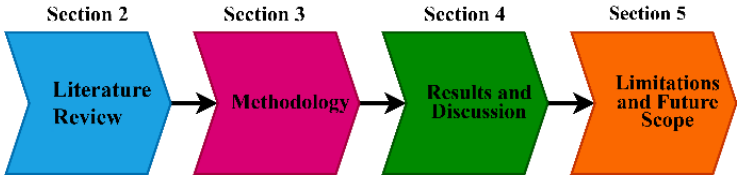


Figure 4: Structure of the paper.

Figure 4 illustrates the sequential structure of a research paper, beginning with the Literature Review, which provides a comprehensive overview of existing studies, identifies research gaps, and establishes the context for the present work. The next stage, Methodology, details the research design, data collection methods, and analytical techniques employed to ensure the study's reliability and reproducibility. This is followed by the Results and Discussion section, where the findings are presented, analyzed, and compared with previous research to highlight their significance and implications. Finally, the Limitations and Future Scope section addresses the study's constraints and proposes directions for future research. Altogether, the structure represents a logical and systematic flow from background study to conclusion, ensuring clarity and coherence in academic writing.

2. Literature Review

This literature review examines the performance of sorting algorithms across different programming languages, emphasizing their efficiency on varied dataset structures. By comparing cross-language implementations, the study aims to highlight key factors influencing algorithmic behavior and execution speed.

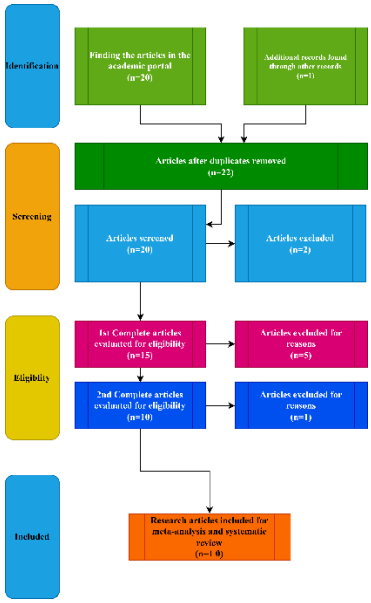


Figure 4: Preferred reporting items for systematic reviews and meta-analysis.

Table 1: Literature Review Table

Author(s) & Year	**Focus of Study**	**Key Findings**	**Limitations/Gaps Identified**
Halder et al. (2023)	Examined transformative impact of 5G on connectivity and integration of IoT, AI, and NLP.	Found reduced latency and better scalability for connected services.	Did not focus on sector-specific benefits of 5G in developing countries.
Narayanan et al. (2020)	First commercial trials of 5G across US carriers (mm-wave and mid-band).	Demonstrated performance differences between bands and importance of NSA for rollout.	Highlighted significant performance problems in mm-wave deployment.
Swarna (2022)	Analyzed 5G adoption trends and challenges in Bangladesh.	Showed low 4G penetration (~28.8%) as a barrier before 5G adoption.	Did not provide sector-wise business impact analysis.
Deowan et al. (2022)	Investigated 5G implementation in Bangladesh with efficiency and security focus.	Provided extensive view of deployment and challenges.	Lacked analysis of economic or business implications.

Islam (2019)	Studied the impact of 4G on business in Bangladesh.	Showed 4G enabled business growth in early digital transformation.	Pre-5G study, limited relevance for future-oriented strategies.
Ge et al. (2020)	Proposed clustering and multipath approaches for 5G SLAM.	Improved complexity reduction for end-to-end processing.	Technical focus, no discussion of business-sector impact.
Reza et al. (2020, 2021)	Studied TCP implementation challenges in 5G mm-wave networks.	Showed improved throughput with specific TCP variations.	Focused on protocol-level analysis, not socio-economic outcomes.
Mei et al. (2022)	Proposed real-time handoff predictions for 4G/5G coexistence.	Achieved >80% accuracy in bandwidth/handoff prediction.	More technical; lacked connection to business and regional adaptation.

Halder et al., 2023 emphasized the transformative impact of 5G technology in enhancing connectivity to address increasing demands for seamless internet experiences. By integrating Internet of Things (IoT), natural language processing (NLP), and artificial intelligence (AI) into network infrastructure, 5G delivers reduced latency and enhanced scalability, facilitating the widespread adoption of connected devices and innovative services. Despite these advancements, implementation challenges such as distance, orientation, and protocol utilization remain. Leveraging datasets and machine learning techniques, their research aims to address these challenges, particularly in densely populated regions of developing countries. However, the paper lacks emphasis on how various sectors can benefit from the performance enhancements offered by 5G. Narayanan et al., 2020 tested the first commercial use of 5G. They carried out their trials throughout several US states. In their experiment, four carriers were used (Verizon, AT&T, T-Mobile, and Sprint). In their studies, three carriers employed mm-wave 5G, and one used mid-band 5G. Their whole experiment focused on their mm-wave 5G experiences. They found several significant problems. Finally, they have shown how crucial NSA 5G for implementation is first step. (Swarna, 2022) have first-hand knowledge of 5G and next-generation wireless networks in Bangladesh. She also discussed about trends, possibilities, and difficulties associated with adopting 5G in underdeveloped nations like Bangladesh. According to her research, 28.8% of Bangladesh's general population utilizes 4G as a 5G testbed. The experimental findings indicate that before 5G architecture is implemented, all parts of Bangladesh must be connected to the current connections (4G & 3G). The Aspects of Bangladesh's 5G Implementation by Deowan et al., 2022were described in this study. Here the author provides an extensive analysis of all factors for improved efficiency with 5G technology. Additionally, the extent, security concerns, and difficulties of 5G technology were examined. (K. T. Islam et al., 2020) talked about how 4G would affect business in Bangladesh in the future. The main goal of this research is to investigate the four aspects of 5G technology that have an impact on Bangladesh's business, to present a 4G-related business model, to make suggestions for the best way for an existing business to utilize 4G

technology, and to investigate the potential future impact of 4G on Bangladesh's business. For 5G SLAM, (Wang et al., 2022a)explain how to employ clustering, assignment, and diffuse multipath. By breaking an issue down into simpler components, its complexity can be decreased. The end-to-end processing chain results in several operational drawbacks. By using the results of simulations, the effectiveness of the suggested technique is shown. A study by Poorzare & Auge, 2021 examined difficulties with TCP implementation over 5G networks. This study examines the robustness of end-to-end communications in 5G networks, focusing specifically on the implications of TCP in 5G mm-wave networks. The article addresses current challenges, proposes solutions, and offers recommendations for enhancing the reliability of 5G networks. Additionally, the researchers conducted a feasibility study on leveraging machine learning approaches to improve the dependability of end-to-end communication in these networks. The Sufficient Deployment of TCP in 5G mm-Wave Networks across Urban Deployments was also proven by Poorzare & Augé, 2020 TCP was discovered to gain from these benefits as a result of the smaller control loop on edge servers and the increased maximum segment size. Furthermore, different TCP variations handle different RLC buffer widths in different ways. However, larger buffers are frequently linked to decreased latency, improving throughput. Real-time mobile bandwidth and handoff forecasts for 4G and 5G networks were created by (*Prospects and Setbacks for Migrating towards 5G Wireless Access in Developing Bangladesh_ A Comparative Study _ Enhanced Reader*, n.d.). They routinely outperform both univariate and multivariate bandwidth prediction algorithms. They suggest a novel handoff prediction challenge for 4G & 5G coexisting networks for low-latency 5G applications like self-driving. Based on classification and regression algorithms, a recent 5G dataset demonstrated more than 80% accuracy in predicting 4G and 5G handoffs.(Md. N. Hossain et al., 2023) spoke in her another study about FB-TCP, a 5G mm-Wave TCP protocol that is suitable for metropolitan areas. The protocol regulates the transmission rate following the current network circumstances to obtain the greatest performance. To accomplish this, it also makes an effort to reduce latency and average transmission rate to prevent buffer depletion. Based on comprehensive simulations, the new protocol outperformed BBR, High-speed, Cubic, and New Reno in the urban environment in terms of throughput, RTT, and sending rate adjustment.This study examines the effects and potential difficulties of adopting 5G in Bangladesh after taking into account all of the available research. This study investigates 5G and its effects on four distinct industries [Figure 2], especially focusing on Bangladesh’s development.

Novelty and Importance of This Study

While prior research has largely addressed technical aspects of 5G (e.g., mm-wave, TCP performance, handoff predictions) and broad adoption challenges in Bangladesh, few studies have systematically examined how 5G will directly transform business sectors in a developing country context. Existing works either stop at connectivity analysis or remain limited to 4G.

This paper is important because it bridges the gap between technical performance research and sector-specific economic implications. By focusing on the business landscape of Bangladesh, it highlights how 5G can reshape industries such as e-commerce, financial services, and SMEs while

also providing policy recommendations. This makes the study novel, timely, and directly relevant to Bangladesh's transition towards a digital economy.

3. Methodology

The research has been conducted using an exploratory research design. The research's goals are to understand and investigate the 5G-related aspects that would affect Bangladesh's highlighted sectors in the future. The numerous aspects of 5G technology that affect development have been identified using secondary data and expert debate. The majority of the national and international research on the effects of 5G technology, particularly on Bangladesh's various industries, was also evaluated in this study.

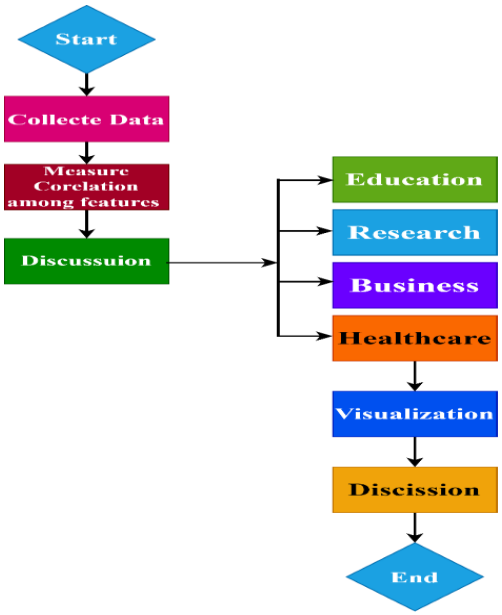


Figure 5: Flow Chart of the Research work.

The author of this research gathered the data. The dataset is made available through the websites of the Bangladesh Telecommunication Regulatory Commission (BTRC)(M. Z. Islam et al., 2023), World Bank (F. Hossain & Na, 2023), and the University of Minnesota - Twin Cities (Halder et al., 2023). To determine the future impact of 5G, the correlation and visualization of the features are shown.

3.1 Dataset

This Research used a dataset of three organizations. Firstly, to evaluate the features of 5G the dataset that is used was collected by a research group from Minneapolis, Chicago, and Atlanta of the University of Minnesota - Twin Cities. Secondly, to know the situation of internet users in Bangladesh a dataset from the Bangladesh Telecommunication Regulatory Commission (BTRC)

is used. Finally, to show the change in the economy in Bangladesh the dataset of the World Bank (WB) is used.

3.2 Code implementation

IBM SPSS Statistics 25 is used to analyze the data, and Python 3.6.9 is utilized to build the visualizations that are based on the correlation.

3.3 *Feature Selection for 5G Performance Analysis*

As shown in Figure 4, seven key features were extracted for analysis: radio type (4G = 1, 5G = 2), distance (in meters), orientation (angle between the user equipment and base station, in degrees), NLOS conditions with and without multipath, server type (CDN or Static Web Server), and web protocol (HTTP or HTTPS). Multipath enables mm-wave transmission even under obstruction, whereas without it, communication is hindered. Throughput was analysed across all these parameters, reflecting 5G's core objective of maximizing bandwidth and performance.

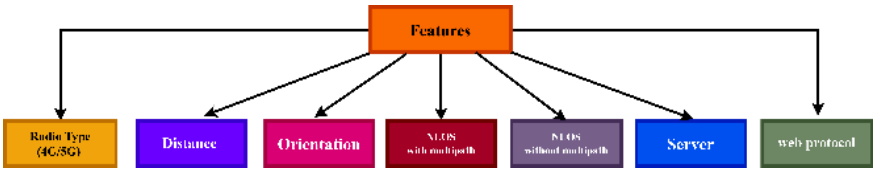


Figure 4: Features used for data analysis.

3.3 Algorithm

3.3.1 Correlation

A technique of analysis is a correlation. It describes how solid the connections are. It examines quantitative information gained via research techniques. For identifying trends in the datasets, correlation analyses are used. A rise in both variables is indicated by a positive correlation. And as other variables rise, the one that is negative falls (Halder et al., 2023; Paul et al., 2025). The bivariate correlation, sometimes referred to as Pearson's r or Pearson's correlation is a coefficient that assesses the linear connection between two sets of variables in a dataset. So that the outcome will range from -1 to 1. The outcomes are positive (outcome 1) and negative (outcome -1) (M. Z. Islam et al., 2023).

$$\rho\, X, Y = \frac{E[XY] - E[X]E[Y]}{\sqrt{E[X^2] - (E[X])^2}\sqrt{E[Y^2] - (E(Y)^2)}} \quad \text{..... (i)}$$

Kendall's T Coefficient, often known as the Kendal rank correlation, is a statistical indicator of the ordinal relationship between two items. A non-parametric statistics test for statistical

dependency based on T coefficients is known as a T-test (F. Hossain & Na, 2023; M. T. Islam et al., 2024).

$$T = \frac{(number\ of\ concordant\ pairs) - (numbers\ of\ discirdant\ pairs)}{(n\ 2\ )} \text{..... (ii)}$$

Where $(n\ 2\ ) = \frac{n(n+1)}{2}$ is the binomial coefficient for the number of ways to choose two items to form n items (Research & Sultana, 2025).

4. Result and Evaluations:

This section discusses 5G features and their potential impacts. In Bangladesh, smartphones will use data on a 5G cellular network, which is expected to provide speeds of around one gigabit per second. This high speed relies on millimeter wave radio waves, which operate at frequencies of at least 30 gigahertz, much faster than current mobile technologies (Mahmud & Shamsu Uddin, n.d.). **Table 1** indicates the technologies used form 1G to 5G.

Table 1: Comparison table between 1G to 5G

Tech.	1G	2G	2.3G	3G	4G	5G
Stand.	AMPS, NMT, HI cap, CDPD, TACS, ETC	GSM.i-DEN, D-AMPS	EDGE, GPRS	CDMA 2000, WCD MA	Single Standard LTE-Advanced	SDN, SD-WAN
Data Band.	1.9 kbps	14.4 kbps	384 Kbps	2 Mbps	200 Mbps	1 Gbps
Core Net.	PSTN	PSTN	PSTN packet network	Packet Network	Packet Network	SDN, NFV
Multiplexing	FDMA	CDMA, TDMA	CDMA, TDMA	CDMA	CDMA, OFDMA	MIMO, NOMA
Service	Analog Voice	Digital Voice	Packetized data high capacity	High capacity board band data	Band and Data with speed	Latency-free high data rate

A. Internet Usage Trends and the Need for 5G

Table 2 shows a steady rise in mobile internet and ISP users in Bangladesh, especially post-COVID-19, driven by increased remote activity. However, 4G networks, which use OFDMA, face congestion and lack true end-to-end connectivity [**Table 1**],(Md. N. Hossain et al., 2023). Wi-Fi 6 (802.11ax) also utilizes OFDMA to enable efficient simultaneous data transmission, improving upon traditional FDM by dividing data into frequency bands carried by subcarriers, similar to 4G, 5G LTE, and Wi-Fi 6 advancements. Figures 6(a)–6(c) illustrate the continued growth in internet subscribers(Lund, n.d.). This surge underscores the limitations of 4G and the urgent need for 5G deployment. **Table 3** highlights the increase in mobile subscribers among Bangladesh's top four operators, reflecting growing demand for mobile internet. As shown in **Table 2** and **Table 3** and

Figure 6 and **Figure 7**, internet usage has risen significantly, up from 28.2% the previous year (Egghe, 2022). However, 4G bandwidth is insufficient to support this growth. In response, the government has initiated 5G deployment, offering low-latency connectivity as shown in **Figure 8**. This study further examines the features that enable these enhanced services.

Table 2: Increasing Customers in different mobile operators in Bangladesh (In million)

Month	Grameen	Robi	Banglalink	Teletalk	Tot.
Jan-22	83.02	53.57	37.41	6.78	180.78
Feb-22	83.18	53.78	37.70	6.88	180.54
Mar-22	83.87	54.07	38.09	6.89	180.92
Apr-22	84.27	54.00	38.25	6.86	183.38
May-22	84.95	54.25	38.25	6.78	184.23
Jun-22	84.80	54.53	38.37	6.75	184.45
Aug-21	83.14	52.26	36.90	6.27	178.61
Sep-21	83.78	53.04	37.02	6.41	180.25
Oct-21	84.12	53.54	37.17	6.49	181.32
Nov-21	84.04	53.72	37.21	6.56	181.53
Dec-21	83.46	53.67	37.22	6.67	181.02

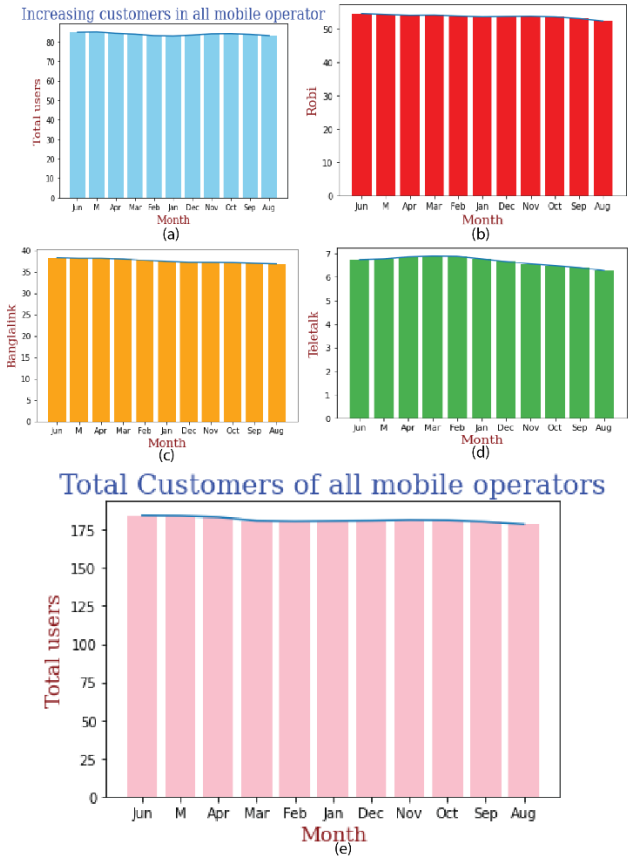


Figure 5: Trends of Mobile Operator Customers in Bangladesh (Monthly Comparison).

B. Mm-Wave Technology in 5G Networks

5G networks are expanding globally, with mm-Wave (millimeter wave) emerging as a key innovation to enhance next-generation wireless communication. Recognized under 3GPP Releases 15 and 16 (approved as ITU IMT-2020 standards in July 2020), mm-Wave offers high capacity, supports dense subscriber environments, and enables deployment through small cells due to its narrow wavelength(Henriques et al., n.d.; *Implications of Publication Requirements for the Research Output of Ukrainian Academics in Scopus In*, 1999).

Table 3: Increasing Internet subscriber in Bangladesh

Month	**Mobile Internet user(In million)**	**ISP and PSTN Internet User (In million)**	**Total**
Jan-22	111.77	10.10	121.87
Feb-22	112.69	10.10	122.79
Mar-22	113.90	10.99	124.89
April-22	113.21	10.99	124.20
May-22	114.53	10.99	125.52
Jun-22	115.07	11.14	126.21
Aug -21	115.41	10.05	125.46
Sep-21	118.71	10.07	128.78
Oct-21	119.11	10.07	129.18
Nov-21	116.53	10.07	126.60
Dec-21	113.73	10.09	123.82

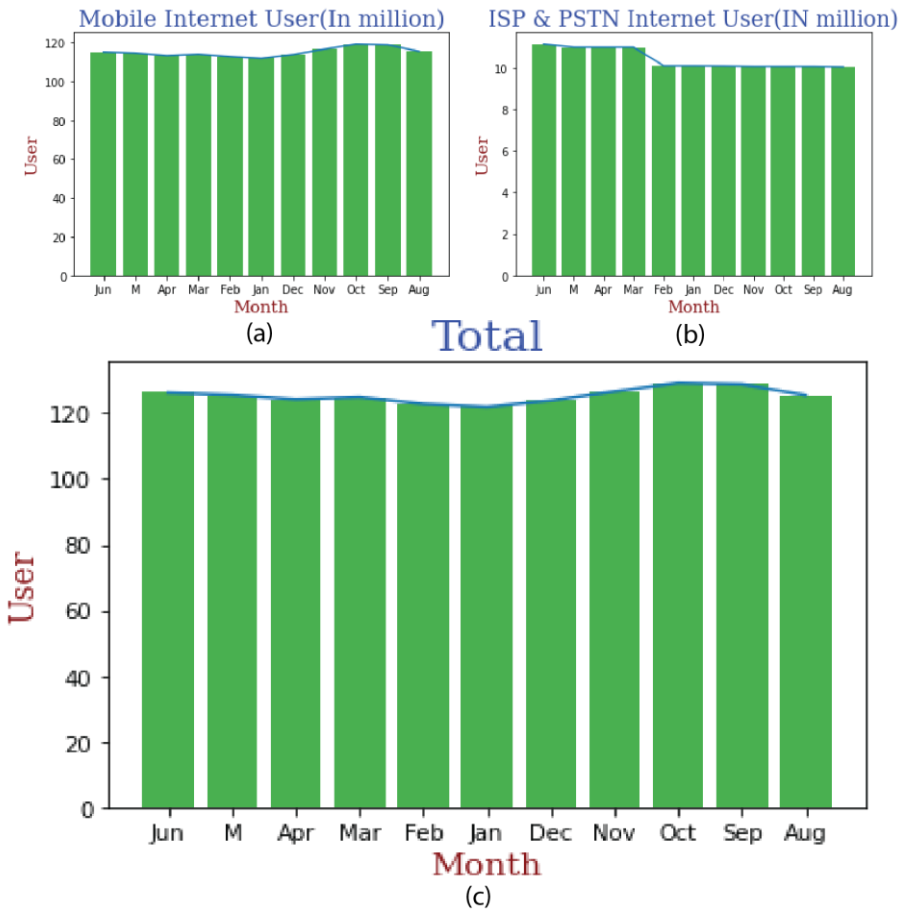


Figure 6: Monthly Internet Users in Bangladesh (Mobile, ISP & PSTN, and Total)

Despite limited range, mm-Wave overcomes line-of-sight constraints with advanced techniques like channel probing, which estimates channel parameters for optimized network performance. The technology allows cellular access up to 200–300 meters and multi-gigabit backhaul up to 400 meters (Wang et al., 2022b).

Key Enabling Features of mm-Wave 5G:

(a) Beamforming: Enhances signal directionality by enabling constructive interference for targeted transmission and reception (Wang et al., 2022b).
(b) Data-Centric Architecture: Separates data from applications to support scalable, flexible computing and efficient storage management (Chen, 2017; Wang et al., 2022a).
(c) mMIMO (Massive MIMO): Uses large antenna arrays to improve capacity, efficiency, and spectrum usage at higher frequencies (Henriques et al., n.d.; Wang et al., 2022a).
(d) URLLC: Supports ultra-reliable low-latency communication essential for IoT, automation, and critical infrastructure with latency as low as 1–5ms.

(e) Scalability: Ensures the network can accommodate growing data demands and geographic expansion efficiently (*Implications of Publication Requirements for the Research Output of Ukrainian Academics in Scopus In*, 1999).

These features collectively enable 5G mm-Wave networks to deliver low latency, high throughput, and robust scalability, making them vital for future digital infrastructure (Egghe, 2022).

Table 4: Important Features to discuss the impact of 5G.

Features	Measurements
Radio type(4G/5G)	Radio Type
	Throughput
Distance	Distance
	Throughput
Orientation	Orientation
	Throughput
NLOS (With multipath)	Obstruction
	Throughput
NLOS (Without Multipath)	Obstruction
	Throughput
Server (CDN/SWS)	Server
	Throughput
Web protocol (HTTP/HTTPS)	Web protocol
	Download time (Seconds)

C. Correlation Analysis of Throughput with Key Features

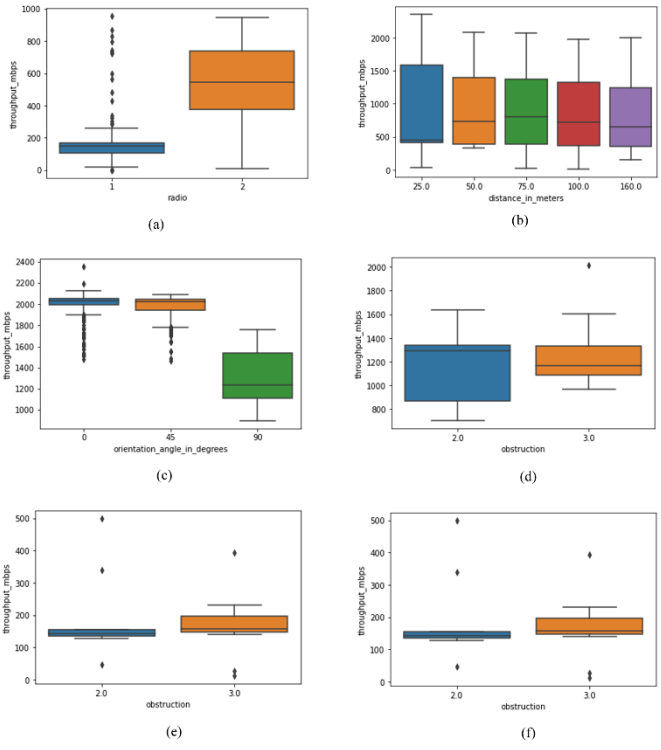


Figure 6: (a) Radio type vs. Throughput (Box plot), (b) Distance vs. Throughput, (c) Orientation vs. Throughput, (d) NLOS (With Multipath) vs. Throughput, (e) NLOS (without Multipath) vs. Throughput, (f) Server vs. Throughput.

Table 5 presents the correlation between throughput and seven selected features using Pearson and Kendall coefficients. A strong positive correlation exists between throughput and radio type (Pearson: 0.669, Kendall: 0.492), indicating that 5G delivers higher throughput than 4G. Throughput shows a negative correlation with orientation and distance, suggesting that as angle (0–90°) or distance (0–160 m) increases, throughput decreases. NLOS conditions also negatively impact throughput, with greater reduction in the absence of multipath(Egghe, 2022). Server type shows an inverse relationship—CDNs improve throughput, while static web servers reduce it. Additionally, the use of TCP-based web protocols (e.g., HTTPS) significantly enhances throughput(*Prospective Areas of Digital Economy in the Context of ICT Usages_ An Empirical Study in Bangladesh _ Enhanced Reader*, n.d.).

Figure 6 presents box plots illustrating the relationship between throughput and six key features.

Figure 6(a) confirms that 5G (denoted by 2) achieves higher throughput than 4G (denoted by 1), largely due to mm-wave utilization and TCP-based end-to-end connections. As shown in Figure 6(b), throughput decreases with distance due to mm-wave's limited range. In Figure 6(c), increasing orientation angles reduce throughput, emphasizing the need for this section discusses the future impact of 5G across. Architectures that maintain near-zero-degree alignment between user equipment and base stations.

Figure 6(d) reveals that multipath scenarios involving blockages, such as a human hand or body (denoted by 2 and 3), reduce throughput. In contrast, environments without obstructions show higher performance, highlighting deployment challenges in dense urban settings. Figure 6(e) shows that single-channel blockage has less impact on throughput compared to multipath scenarios, where multiple signal paths help maintain performance despite obstacles.

Table 5: Correlation of features compared with throughput.

Features	**Pearson's Correlation**	**Kendall's Correlation**
Radio Type	0.669	0.492
Distance	-0.85	-0.116
Orientation	-0.782	-0.562

NLOS (With multi path)	-0.533	-0.444
NLOS (Without multipath)	-0.678	-0.507
Server	-0.787	-0.708
Web Protocol	0.758	0.653

Figure 6(f) compares CDN (1) and Static Web Server (SWS, 2) performance. CDN delivers significantly higher and more variable throughput (up to ~1000 Mbps), while SWS shows consistently lower speeds due to reliance on PDU header information. Thus, CDN integration is essential for maximizing 5G performance. This analysis highlights both the advantages of 5G and the challenges of its mm-wave deployment. The following section explores 5G's potential impact in Bangladesh across various sectors.

D. Future Impact and Proposed 5G Architecture

Four key areas (Figure 3) and proposes a suitable network architecture for Bangladesh (Figure 7). Given the challenges of full 5G deployment, this study recommends adopting a Non-Standalone (NSA) 5G architecture. In the proposed model, multiple devices—using Wi-Fi, GSM, 4G LTE, and 5G—can maintain connectivity even if the 5G tower becomes unavailable, unlike a standalone 5G setup where connectivity would be lost for most users. Therefore, a phased implementation starting with NSA 5G is considered more practical for Bangladesh(Halder et al., 2023; Paul et al., 2025).

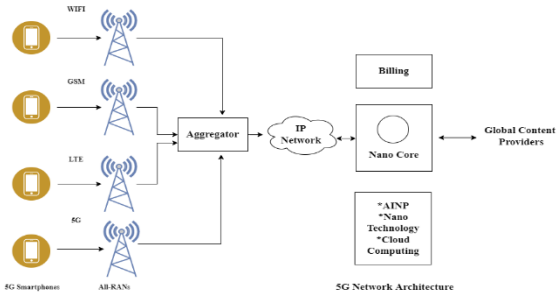


Figure 7: Network structure of 5G in Bangladesh.

A. Prospects of 5G in Business

The rollout of 5G is poised to significantly boost Bangladesh's ICT sector by enhancing digital connectivity and service delivery, with data speeds of up to 10 Gbps (M. T. Islam et al., 2024). A Qualcomm study estimates that 5G-enabled products and services could generate USD 13.2 trillion in global economic output and create 22.3 million jobs by 2035. By 2022, 750 million 5G smartphones were projected to be in use, with 2.8 billion connections expected by 2025(F. Hossain & Na, 2023).

In Bangladesh, mobile internet is vital, with 105.62 million out of 115.43 million users accessing services via mobile devices as of April 2021. Despite the 4G launch in 2018, coverage remains

inconsistent and often inadequate. Implementing 5G can address these infrastructure gaps, improve internet accessibility, and support national digital transformation efforts(Ahmed et al., 2024).

A framework for the business effect that 5G will have in the future is shown in Figure 10. One of a business's two sectors is its owner, and the other is its consumers. The images clearly show how a business is beneficial to both parties involved.

Table 6: Bangladesh phone manufacturing target

Month	2G	3G	4G	5G	Tot.	Feature Phone	Smart Phone
Jun-22	20.15	0	8.48	0.32	28.95	69.60%	30.40%
May-22	16.70	0.04	6.15	0.45	23.34	71.53%	28.47%
Apr-22	22.66	0	12.63	0.52	33.81	61.10%	38.90%
Mar-22	18.34	0	12.03	0.32	30.69	59.76%	40.24%
Feb-22	16.60	0	10.68	0.14	27.42	60.55%	39.45%
Jan-22	27.54	0	13.68	0.23	41.45	66.45%	33.55%

The aim for mobile phone manufacturers is shown in the Table 6 for 2022. As the majority of older citizens are unaware of technology, 2G smartphone production is on

The rise in this country. Other manufacturers of 3G, 4G, and 5G smartphones are developing products to meet consumer demand.

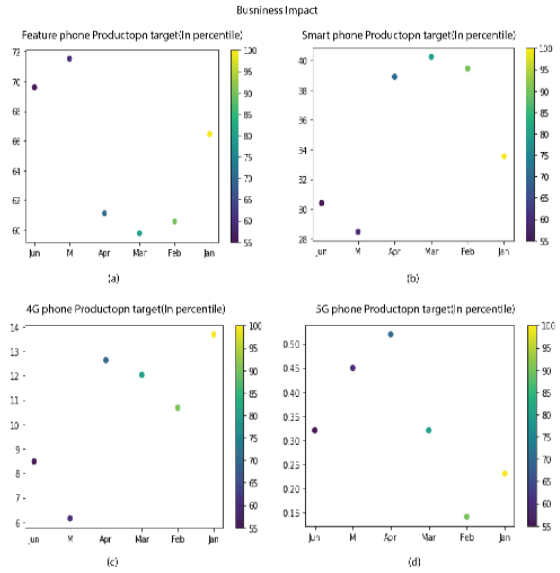


Figure 11: Bangladesh phone manufacturing target

The demand for feature phones and smartphones is rising, as seen in Figures 11 (a) and (b) (Mahmud & Shamsu Uddin, n.d.; Research & Sultana, 2025). It discusses the impact of 5G in Bangladesh. Consumers want to interact with technology. Thus, they also desire the 5G smartphones shown in (c). But because 5G is not yet fully implemented, 4G manufacturing is not any less. Still, 52% of Bangladesh is covered with 4G internet (Md. N. Hossain et al., 2023; *Prospective Areas of Digital Economy in the Context of ICT Usages_ An Empirical Study in Bangladesh _ Enhanced Reader*, n.d.). All of these factors contribute to the business sector's growth.

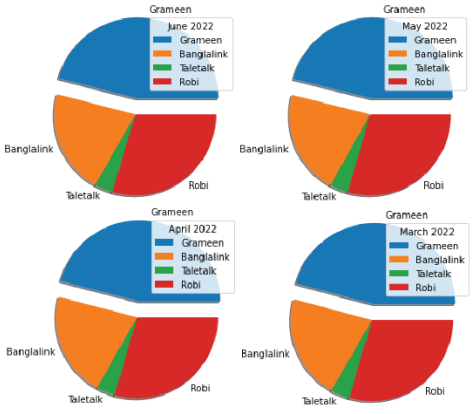


Figure 12: Increasing mobile sim subscriber for different mobile operators.

Figure shows some recent condition of mobile sim subscribers in Bangladesh. As shown, it is increasing day by day. Consumers want to be a part of upgrading technology. But the govt. operator Teletalk has less consumers than others as shown in **Figure 12**. But after their implementation of 5G their consumer also increased. If all of the operator can implement 5G their business can also flourish.

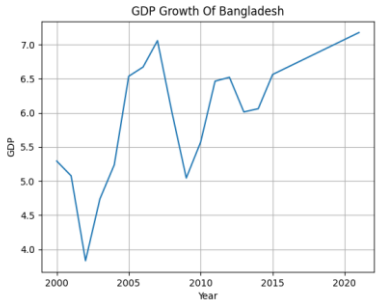


Figure 13: GDP growth of Bangladesh (2000-2021)

As illustrated in Figure 13, 5G deployment is expected to significantly boost business efficiency and economic output. Its core features—high-speed connectivity (up to 10 Gbps), ultra-low latency (under 1 ms), increased device capacity, and network slicing—offer substantial benefits across industries. High-speed data transmission enhances the performance of data-intensive sectors like media and IoT.

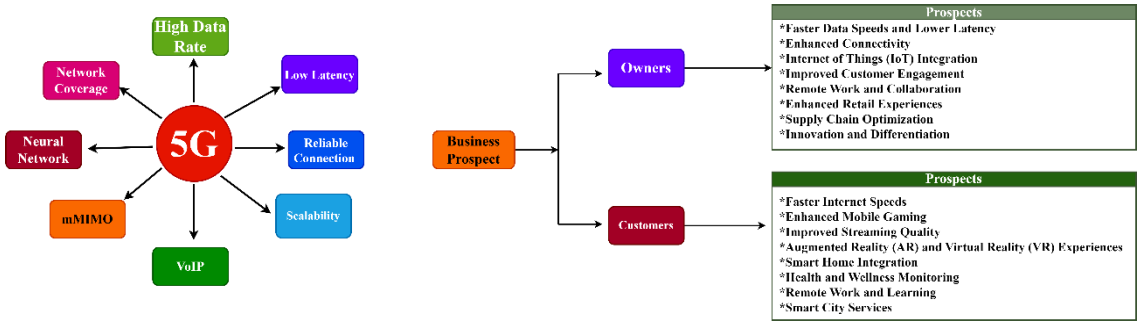


Figure 10: Conceptual Framework of 5G (Business) in Bangladesh.

Low latency supports real-time operations and decision-making, while greater network capacity improves remote collaboration and customer engagement. Network slicing enables customized virtual networks, optimizing resource use and operational efficiency. Together, these features position 5G as a key driver of business transformation and economic growth.

Limitations and Future Scope

This analysis highlights the significant potential of 5G for Bangladesh's business sector but also acknowledges several key limitations and areas for future research. One major limitation is the existing infrastructure gap, specifically the inadequate fiber optic backbone which is crucial for supporting a dense 5G network. The high cost of 5G-enabled devices and the slow adoption of 4G

in many parts of the country also present significant hurdles, as a robust consumer market is essential for driving business investment.

Future research could focus on specific sectoral case studies, such as the quantifiable economic impact of 5G in the garment industry or the healthcare sector. A deeper analysis is needed on how to bridge the skills gap, perhaps through public-private partnerships focused on workforce development. Additionally, research could explore the potential of 6G and beyond, considering how these future technologies will address the current limitations of 5G and continue to shape the business landscape of Bangladesh.

Conclusion

The integration of 5G into Bangladesh's business environment is not merely an upgrade; it is a fundamental economic driver. While infrastructural hurdles and a need for new skills remain, the business prospects are immense. From optimizing existing operations to creating entirely new markets, 5G will empower businesses to become more agile, efficient, and innovative. The successful realization of this potential will require a collaborative effort between the government, network providers, and the private sector, but the rewards—in the form of economic growth, enhanced competitiveness, and a vibrant digital economy—are well worth the investment.

Conflict-of-Interest Statement

The authors declare that they have no conflicts of interest relevant to this study.

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