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Review Article

Challenges and Opportunities of 5G Network: A Review of Research and Development

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Abstract

The advent of the fifth generation of wireless technology, commonly referred to as 5G, heralds a transformative era in communication and technology interaction. With its promise of high-speed connectivity, minimal latency, and support for massive machine-type communications, 5G networks are poised to enable a wide array of applications across various domains such as the Internet of Things (IoT), smart cities, virtual and augmented reality, Industry 4.0, and edge computing. However, the deployment of 5G networks presents numerous challenges, including infrastructure requirements, limited availability of high-frequency spectrum, security vulnerabilities, high deployment costs, and interoperability issues with existing networks. This paper meticulously examines the challenges, opportunities, and applications of 5G networks. It delves into the potential of 5G networks to offer rapid connectivity, facilitate novel applications, and revolutionize industries. Moreover, the paper scrutinizes the hurdles associated with deploying and sustaining 5G networks, underscoring the imperative need for further research in this domain to ensure the seamless adoption and integration of 5G technology. As 5G networks continue to evolve, addressing these challenges will be crucial for unlocking the full potential of this transformative technology and realizing its societal and economic benefits on a global scale. Additionally, collaboration between stakeholders including governments, telecommunications companies, technology providers, and regulatory bodies will play a pivotal role in overcoming these challenges and driving the successful deployment and adoption of 5G networks worldwide.

Keywords

5G Network, IoT, AI, Emerging Technologies, Business Models, Social Impacts, Economic Impacts

1. Introduction

The fifth generation of wireless technology, or 5G, is the latest and most advanced wireless communication technology that offers faster internet speeds, lower latency, and higher capacity than its predecessors. 5G networks are designed to support a wide range of applications and use cases, from consumer devices such as smartphones and tablets to mission-critical services such as autonomous vehicles, telemedicine, and smart cities. With the promise of faster and more

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reliable connectivity, 5G is poised to transform the way we communicate, work, and live, and is expected to drive innovation and economic growth in various industries.

The book author [1] presents a thorough overview of 5G technology, including its architecture and impact on various industries. The authors address the challenges of developing 5G networks, such as spectrum availability, energy efficiency, and security, while also discussing ongoing research and development activities and potential applications of 5G networks in smart cities, Industry 4.0, and IoT. This book is a valuable resource for researchers, engineers, and professionals in the field of 5G networks, offering comprehensive insights into the state of the art in 5G technology and its potential for the future of wireless communication. The paper [2] provides an overview of the 5G Non-Terrestrial Network (NTN) standards development and the technical challenges associated with integrating satellites with the 5G network. The paper discusses the development of 5G Non-Terrestrial Network (NTN) standards and the challenges of integrating satellite communication with the 5G network. The authors discuss potential solutions such as multi-orbit and multi-frequency satellite systems and the use of network optimization techniques. The paper provides valuable insights for researchers and engineers working in satellite communication and 5G network integration.

The paper [3] provides an overview of the state-of-the-art simulation techniques used for the development and testing of 5G networks, highlighting their strengths and limitations. The authors also discuss the key metrics used to evaluate the performance of 5G networks and the future challenges in the development of simulation techniques, such as the need for more accurate channel models and the development of machine learning-based simulation tools. The paper provides valuable insights for researchers and engineers working in the field of 5G network development and testing.

The paper [4] reviews recent developments, applications, and future perspectives of 5G networks in smart and sustainable cities. It discusses the challenges associated with urbanization and the role of 5G networks in addressing these challenges. The paper presents a range of 5G-enabled applications in smart and sustainable cities and discusses the potential of 5G networks to support the development of smart homes, smart healthcare, and smart agriculture. The paper provides valuable insights for policymakers, city planners, and researchers working in the field of smart and sustainable cities. The paper [5] discusses the key technologies essential for the development and deployment of 5G mobile communication networks, such as massive MIMO, millimeter-wave communication, and SDN. The authors also discuss the challenges associated with these technologies and potential solutions to these challenges. The paper provides valuable insights for researchers and engineers working in the field of 5G networks. The paper [6] describes 5GTN, a test network designed for the development and testing of 5G applications. The paper discusses the architecture and design of the test network, as well as its key features and capabilities, such as network slicing and edge computing. The paper also presents a range of 5G applications that have been developed and tested using the 5GTN test network, including smart city applications and virtual reality applications. The paper provides valuable insights for researchers and engineers working on the development and testing of 5G applications.

2. Exploring 5G Networks: Challenges, Opportunities, and Applications

Challenges, Opportunities, and Applications of 5G Network refer to the various aspects related to the development, deployment, and utilization of 5G networks.

The challenges of 5G networks include infrastructure investment, technological complexity, and lack of standards for certain applications. Understanding these challenges is essential for developing strategies to overcome them and ensure successful deployment of 5G networks. It can also inform the development of innovative solutions and identify potential risks and vulnerabilities in the network infrastructure. Studying the challenges of 5G networks is crucial for the successful implementation and deployment of 5G networks and for improving their performance and capabilities [7-10]. Figure 1 shows 5G technology faces challenges in offering services to heterogeneous networks, standardization, infrastructure, communication, navigation, sensing, security, privacy, and legislation of cyberlaw. These challenges need to be addressed to ensure the success of 5G and protect personal data.

Figure 1. *5G network Common Challenges.*

Studying the opportunities of 5G networks is crucial as it can

help inform the development of new applications and services that take advantage of the increased data rates, lower latency, and increased capacity offered by 5G networks. This can create new markets and business models, leading to economic growth and job creation. Additionally, understanding the opportunities of 5G networks can help stakeholders identify potential benefits in sectors such as healthcare, transportation, and manufacturing, leading to strategies that improve the efficiency and effectiveness of these sectors. Finally, studying the opportunities of 5G networks can inform the development of new technologies and solutions that can improve the performance and capabilities of 5G networks, leading to innovative solutions. Overall, studying the opportunities of 5G networks is critical to drive innovation, economic growth, and societal improvements. Figure 2 illustrates that 5G provides higher spectral efficiency, ultra-reliable and low latency signals, and a new network architecture, which leads to increased connectivity. This increased connectivity can help organizations to explore new revenue streams and offer better products and services to their customers and other businesses.

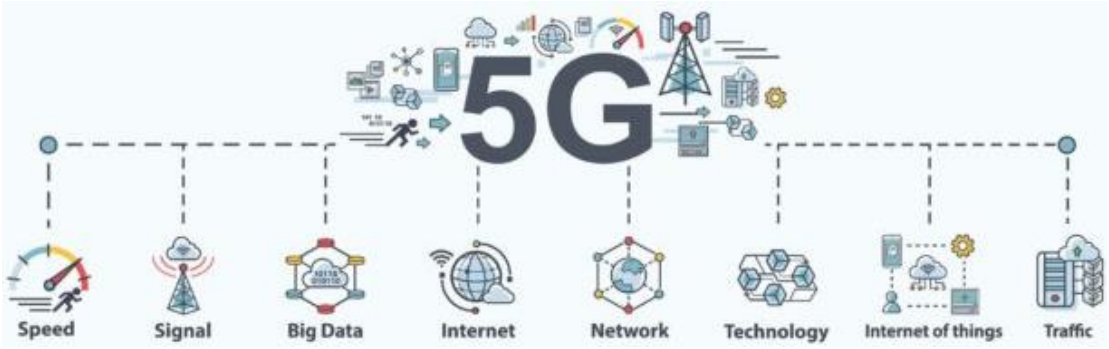

Figure 2. *Opportunities of 5G networks.*

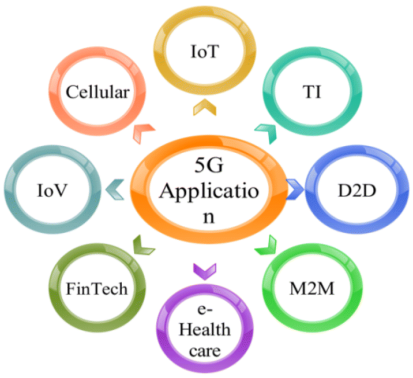

Figure 3. *Applications of 5G Network.*

Applications refer to the specific use cases and services that can be enabled by 5G networks. Figure 3 shows various applications of 5G network. These applications can be diverse, ranging from entertainment and gaming to healthcare and industrial automation. The development and deployment of 5G networks can provide new and improved capabilities to support these applications and services. Studying the challenges, opportunities, and applications of 5G networks is important because it helps stakeholders to understand the obstacles and benefits associated with 5G networks, identify potential risks and vulnerabilities, develop strategies to mitigate challenges and leverage opportunities, and inform the development of new technologies and solutions. Understanding the challenges, opportunities, and applications of 5G networks can also drive innovation, inform the development of new standards and regulations, and ensure the successful deployment and operation of 5G networks.

3. Overcoming the Challenges of Implementing and Operating 5G

The challenges of 5G networks are the obstacles, difficulties, and potential risks associated with the deployment and operation of 5G networks. Figure 4 shows the some key challenges of 5G Network.

Figure 4. *Some key Challenges of 5G Network.*

Some of the key challenges of 5G networks include [11-14]:

1. Infrastructure costs: The deployment of 5G networks requires significant investments in new infrastructure, such as base stations and fiber optic networks. This can be a major challenge for operators, especially in areas with low population density.
2. Spectrum availability: 5G networks require a large amount of spectrum to provide high data rates and low latency. However, the availability of spectrum is limited, and there may be competition between different industries and services for access to spectrum.
3. Security: 5G networks are vulnerable to various types of cyber threats, such as hacking and data breaches. This can be a major challenge for operators and other stakeholders, who need to ensure that the networks are secure and protected from attacks.
4. Interoperability: The deployment of 5G networks requires collaboration and interoperability between different stakeholders, such as operators, vendors, and regulators. However, there may be differences in technical standards, business models, and regulatory frameworks that can create barriers to interoperability.
5. Energy consumption: 5G networks require a large amount of energy to power the infrastructure, which can have negative impacts on the environment and increase operating costs.

Overall, the challenges of 5G networks are complex and multifaceted, and require collaboration and innovation from all stakeholders to overcome.

3.1. Understanding 5G Network Infrastructure Demands

The infrastructure requirements of 5G networks are significantly different from previous generations of mobile networks. Some of the key infrastructure requirements for 5G networks include [7, 15, 16]:

Dense network of small cells: 5G networks require a dense network of small cells, which are low-power base stations that can be deployed on streetlights, rooftops, and other infrastructure. This is necessary to provide high data rates and low latency, as well as to support the large number of devices and applications that will be connected to the network.

High-bandwidth fiber optic network: 5G networks require a high-bandwidth fiber optic network to connect the small cells to the core network. This is necessary to provide high-speed connectivity and low latency, as well as to support the large amounts of data that will be generated by 5G applications.

Massive MIMO technology: 5G networks require massive multiple-input and multiple-output (MIMO) technology, which uses multiple antennas to improve network capacity and coverage. This is necessary to support the large number of devices and applications that will be connected to the network, as well as to provide high data rates and low latency.

Edge computing: 5G networks require edge computing infrastructure, which is necessary to process and store data close to the user or device. This is necessary to reduce latency, improve reliability, and support new applications that require real-time processing and analysis of data.

Overall, the infrastructure requirements of 5G networks are significant and require substantial investments from operators, governments, and other stakeholders. The deployment of 5G networks will require a coordinated effort to build the necessary infrastructure, as well as to address regulatory and policy challenges that may arise.

3.2. The Challenge of Limited Availability of High-Frequency Spectrum in 5G Networks

The limited availability of high-frequency spectrum is a major challenge in the development and deployment of 5G networks. High-frequency spectrum is necessary to support the high data rates and low latency that 5G networks promise to deliver. However, the availability of high-frequency spectrum is limited, and there may be competition between different industries and services for access to this spectrum [17].

In addition, high-frequency spectrum is subject to higher propagation losses and is more susceptible to interference from buildings, trees, and other obstacles. This requires the use of advanced technologies, such as beamforming and massive MIMO, to compensate for these losses and maintain reliable connections.

To address this challenge, regulators and policy makers need to allocate additional spectrum for 5G networks, and operators need to use innovative technologies to make the most efficient use of the available spectrum. This may include the use of spectrum sharing, dynamic spectrum allocation, and other techniques to maximize the use of available spectrum resources [18].

3.3. The Security Concerns and Risks Associated with 5G Network

The security risks associated with 5G networks are a major concern for operators, governments, and users. 5G networks introduce new security challenges due to their increased complexity, the large number of connected devices, and the use of new technologies.

Some of the key security risks associated with 5G networks include [14, 19]:

Cyberattacks: 5G networks are vulnerable to cyberattacks, such as denial-of-service attacks, malware, and phishing attacks. The large number of connected devices and the use of new technologies, such as edge computing and virtualization, create new attack surfaces that can be exploited by attackers.

Data privacy: 5G networks generate large amounts of data, which can include sensitive personal information. This data needs to be protected from unauthorized access, theft, or misuse. In addition, the use of edge computing and distributed

processing raises new privacy concerns, as data may be processed and stored in multiple locations.

Supply chain security: 5G networks rely on a complex supply chain, with components and software sourced from multiple vendors and manufacturers. This creates vulnerabilities in the network, as malicious actors may introduce backdoors or other security flaws into the components or software.

Network slicing security: 5G networks use network slicing to partition the network into multiple virtual networks, each with its own characteristics and security requirements. However, ensuring the security of each network slice can be challenging, as different slices may have different security requirements and vulnerabilities.

To address these security risks, operators and governments need to adopt a comprehensive security strategy that includes risk assessments, threat modeling, and the use of advanced security technologies, such as encryption, authentication, and access control. In addition, standards and best practices need to be developed and implemented to ensure the security of the entire 5G ecosystem, from devices and networks to applications and services.

3.4. The Financial Challenges of Deploying and Maintaining 5G Network"

The high cost of deploying and maintaining 5G networks is a significant challenge for operators and governments. 5G networks require significant investment in infrastructure, including new base stations, fiber optic cables, and other equipment. In addition, the use of advanced technologies, such as massive MIMO and beamforming, can add to the cost of deploying 5G networks [20].

Maintaining 5G networks can also be expensive, as they require ongoing upgrades and maintenance to ensure they meet the evolving needs of users and businesses. The use of new technologies and standards, such as virtualization and network slicing, also requires new skills and expertise, which can add to the cost of maintaining 5G networks [12].

To address these challenges, operators and governments need to develop sustainable business models for 5G networks that balance the cost of deployment and maintenance with the potential revenue from new services and applications. This may include partnering with other organizations and sharing infrastructure to reduce costs, as well as developing new pricing models and revenue streams that leverage the unique capabilities of 5G networks. In addition, governments can provide incentives and funding to support the deployment of 5G networks, such as tax credits, grants, and subsidies.

3.5. Interoperability with Existing Networks: A Challenge for 5G Network Integration

One of the challenges of deploying 5G networks is ensuring interoperability with existing networks, including 4G LTE, Wi-Fi, and other legacy systems [21]. Interoperability is the ability of different systems to work together seamlessly, allowing devices to connect and communicate across different networks and technologies.

Interoperability between 5G networks and existing networks is crucial for accessing full range of services and reducing deployment cost. It also fosters competition and innovation. However, achieving interoperability can be challenging due to different standards and legacy systems. To address this, operators and vendors must develop standards and protocols for seamless communication. Governments can also promote interoperability through regulations that encourage collaboration and competition.

4. Unlocking the Potential: Opportunities Offered by 5G Network

The opportunities of 5G networks are numerous and significant, and include [1, 12, 22]:

1. Enhanced Mobile Broadband: 5G networks promise to deliver faster data speeds and more bandwidth than previous generations of wireless technology, enabling users to stream high-quality video and download large files quickly and easily.
2. Internet of Things (IoT): 5G networks are designed to support a massive number of IoT devices, from smart homes and wearables to industrial sensors and autonomous vehicles. This will enable a wide range of new applications and services that can transform industries and improve quality of life.
3. Mission-Critical Communications: 5G networks are expected to provide ultra-reliable, low-latency communications that can support mission-critical applications, such as emergency services and industrial automation.
4. Augmented and Virtual Reality: 5G networks will enable immersive experiences that combine augmented and virtual reality (AR/VR) with real-world environments, opening up new opportunities in entertainment, education, and healthcare.
5. Smart Cities: 5G networks can enable the development of smart cities, where interconnected devices and sensors can help manage traffic, energy, and public safety, improving the quality of life for residents.
6. Edge Computing: 5G networks will enable edge computing, where data is processed and analyzed closer to the source, reducing latency and improving the performance of applications and services.
7. New Business Models: 5G networks will enable new business models and revenue streams, such as network slicing, which allows operators to offer customized network services to different customers, and private networks, which enable enterprises to build their own dedicated 5G networks.

Overall, the opportunities of 5G networks are vast and transformative, and have the potential to drive innovation and growth across industries and society as a whole.

4.1. The potential of 5G Network to Offer High-Speed Connectivity

The potential of 5G networks to provide high-speed connectivity refers to the capability of this technology to deliver faster data speeds and greater bandwidth than previous generations of wireless technology. 5G networks use advanced radio technologies, including massive MIMO (multiple input multiple output), beamforming, and millimeter-wave frequencies, to achieve higher data rates and lower latency. With 5G, users can expect to experience faster downloads and uploads, smoother streaming of high-definition video content, and improved performance of bandwidth-intensive applications, such as virtual and augmented reality, cloud gaming, and telemedicine. The potential of 5G to provide high-speed connectivity is a key driver of its transformative power and its ability to enable new applications and services that were previously impossible or impractical with previous wireless technologies [23].

4.2. The Potential of 5G Network for IoT and Smart Cities

The potential of 5G networks for IoT and Smart Cities refers to the capability of this technology to support a massive number of connected devices and sensors in urban areas, enabling the development of interconnected and intelligent systems that can enhance the quality of life for residents and improve the efficiency of city operations. With its high-speed connectivity, low latency, and support for massive device densities, 5G networks can enable a wide range of IoT applications, from smart homes and wearables to industrial sensors and autonomous vehicles. In addition, 5G networks can enable the development of smart cities, where interconnected devices and sensors can help manage traffic, energy, and public safety, improving the quality of life for residents [24]. This potential of 5G for IoT and Smart Cities is a key driver of its transformative power and its ability to enable new applications and services that can transform industries and society as a whole.

4.3. Exploring the Potential of 5G Network to Enable Virtual and Augmented Reality Applications

The potential for 5G networks to enable virtual and augmented reality applications refers to the capability of this technology to support high-speed, low-latency connectivity that can enhance the immersive experience of VR and AR. 5G networks can deliver faster download and upload speeds, lower latency, and greater bandwidth than previous wireless technologies, which can enable the development of more sophisticated VR and AR applications [25]. For example, 5G networks can support the streaming of high-quality, immersive video content, which can enable real-time interactions and collaboration in virtual environments. Additionally, 5G networks can enable the development of low-latency, high-quality AR applications that can overlay digital information onto the physical world in real-time, opening up new possibilities for entertainment, education, and commerce. The potential of 5G to enable VR and AR applications is a key driver of its transformative power and its ability to enable new applications and services that can transform industries and society as a whole.

4.4. Exploring the Potential of 5G Network for Industry 4.0

The potential of 5G networks for Industry 4.0 refers to the capability of this technology to support the digital transformation of industrial processes and enable the development of more advanced, connected and automated manufacturing systems [25]. With its high-speed connectivity, low latency, and support for massive device densities, 5G networks can enable the development of smart factories where machines and sensors can communicate and collaborate in real-time. Figure 5 shows 5G communication opportunity for Industry 4.0.

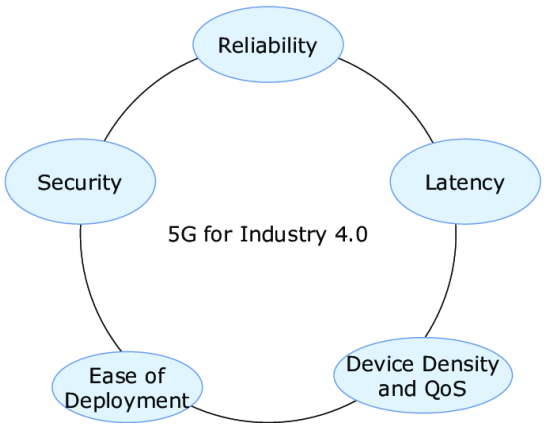

Figure 5. *5G communication opportunity for Industry 4.0.*

This can enhance efficiency, productivity, and quality control in manufacturing processes [26]. For example, 5G networks can enable real-time monitoring of machines and equipment, reducing downtime and enabling predictive maintenance. Additionally, 5G networks can enable the development of autonomous robots and machines that can work collaboratively with humans and each other, opening up new possibilities for advanced manufacturing. The potential of 5G for Industry 4.0 is a key driver of its transformative power and its ability to enable new applications and services that can transform industries and society as a whole.

4.5. Exploring the Potential of 5G Network for Edge Computing Applications

The potential of 5G network for edge computing applications refers to the capability of this technology to support the processing and storage of data closer to the edge of the network, reducing latency and enabling faster and more efficient data processing [27]. 5G networks enable edge computing, which processes data on devices closer to the source instead of sending it to a centralized data center. This reduces network congestion and enables faster response times [28].

5G networks support edge computing applications by providing high-speed, low-latency connectivity and enabling real-time data processing. This enables the development of applications like autonomous vehicles, industrial automation, and remote healthcare monitoring, and real-time analytics of sensor data from IoT devices in smart cities. [29]. 5G's potential for edge computing applications is a major driver of its transformative power, enabling faster and more efficient data processing that unlocks new possibilities for innovation and drives the development of new products, services, and business models.

5. Exploring the Various Applications of 5G Network

The applications of 5G network refer to the various use cases and scenarios where the capabilities of 5G technology can be applied to deliver new services and enhance existing ones.

Some of the applications of 5G network include [30-32]:

1. Enhanced Mobile Broadband (eMBB): 5G networks can deliver faster download and upload speeds, higher capacity, and lower latency compared to previous generations of mobile networks, enabling new applications such as high-quality video streaming, virtual and augmented reality, and immersive gaming.
2. Internet of Things (IoT): 5G networks can support a large number of connected devices, with low latency and high reliability, enabling applications such as smart homes, smart cities, and industrial automation.
3. Smart cities: 5G networks can enable real-time monitoring and management of city infrastructure, such as traffic lights, parking, and public transportation systems, to improve efficiency and reduce congestion.
4. Industry 4.0: 5G networks can enable real-time data processing and analysis, enabling new applications such as predictive maintenance, remote monitoring and control of industrial processes, and autonomous vehicles.
5. Telemedicine: 5G networks can enable remote healthcare monitoring and telemedicine, enabling healthcare providers to deliver better care to patients in remote or underserved areas.
6. Public safety: 5G networks can enable new applications such as real-time video surveillance, emergency response, and disaster management, enhancing public safety and security.

The applications of 5G network are diverse and varied, with the potential to transform industries and society as a whole, enabling new services, products, and business models.

5.1. Exploring the Potential of Enhanced Mobile Broadband (eMBB) Application in 5G Network

The Enhanced Mobile Broadband (eMBB) application of 5G network is focused on delivering faster data speeds, higher capacity, and lower latency to support data-intensive applications such as high-quality video streaming, virtual and augmented reality, and immersive gaming [33]. With eMBB, users can experience smoother and more immersive multimedia experiences, with less buffering and faster download and upload speeds.

5G offers faster data speeds up to 20 times faster than 4G LTE through new radio technologies such as mmWave, massive MIMO, and beamforming. It also has lower latency, reducing delay in data transfer by up to 90%. eMBB is an important application of 5G, enhancing user experiences and enabling new multimedia applications and services that were not possible before.

5.2. Exploring the Potential of Massive Machine-Type Communications (mMTC) Through 5G Network

Massive Machine-Type Communications (mMTC) is an important application of 5G network, which is focused on enabling communication between large numbers of low-power, low-cost devices that are expected to be deployed in the Internet of Things (IoT) and Industrial Internet of Things (IIoT) applications [34].

5G's mMTC application can support up to 1 million devices per square kilometer, with low power consumption and reduced communication latency. It uses technologies such as NB-IoT and LTE-M to enable efficient device communication. mMTC can enable new use cases and applications in industries such as smart cities, healthcare, and industrial automation. It can be used for real-time monitoring and control of city infrastructure, remote diagnosis and treatment in healthcare, and monitoring and control of manufacturing equipment and processes in industrial automation. 5G's mMTC has significant potential to enable new use cases and applications that were not possible with previous mobile networks.

5.3. Exploring the Potential of Ultra-Reliable Low-Latency Communications (URLLC) with 5G Network

Ultra-Reliable Low-Latency Communications (URLLC) is another important application of 5G network that has the

potential to transform various industries. URLLC is designed to provide extremely reliable and low-latency communication services that are critical for applications that require high levels of reliability and responsiveness [35].

URLLC in 5G networks can support critical applications such as autonomous driving, remote surgery, and industrial automation. It enables real-time communication with minimal delay and high reliability, improving safety, access to healthcare services, and productivity. 5G's potential for URLLC is significant, as it can enable new use cases and applications that require high levels of reliability and low latency.

5.4. Exploring the Potential of Fixed Wireless Access (FWA) as an Application of 5G Network"

Fixed Wireless Access (FWA) using 5G networks can offer fast, reliable, and cost-effective broadband internet access to underserved areas where wired infrastructure is limited or non-existent. It is flexible, scalable, and can be deployed quickly and easily, making it an attractive option for service providers and consumers alike. The high bandwidth and low latency of 5G technology can support bandwidth-intensive activities and can also be used as a backup solution for traditional wired networks. The potential of FWA using 5G networks is significant, as it can bridge the digital divide, enable new services and applications, and provide a flexible alternative to traditional wired networks.

5.5. Exploring the Potential of Private Networks Utilizing 5G Technology

Private networks using 5G technology offer a secure and reliable platform for various applications, such as industrial automation, remote monitoring, and mission-critical communications. 5G private networks offer ultra-low latency, high reliability, massive capacity, flexibility, scalability, and security that makes them an ideal choice for organizations that need to quickly adapt to new market conditions. They provide end-to-end encryption and other security features that make them much more secure than traditional wired or wireless networks. Overall, private networks using 5G technology have the potential to transform a wide range of industries and use cases, offering a powerful platform for organizations looking to increase productivity, efficiency, and innovation.

6. Conclusion

The paper provides an overview of the potential benefits and challenges of 5G networks, including their potential to provide faster speeds, higher capacity, and lower latency. The integration of 5G with other emerging technologies such as IoT and AI will enable a wide range of new applications and use cases, but challenges such as infrastructure investment, spectrum availability, and security concerns must be addressed. Collaboration between industry, government, and academia is essential to develop and implement new technologies and standards for the widespread adoption of 5G networks. Further research is recommended in areas such as the integration of 5G with other technologies, the development of new business models, and the social and economic impacts of 5G networks. Overall, the potential benefits of 5G are vast, and its impact on society and technology is expected to be transformative in the years to come.

Abbreviations

IoT	Internet of Things
NTN	Non-Terrestrial Network
MIMO	Multiple-Input and Multiple-Output
AR/VR	Augmented and Virtual Reality
MIMO	Multiple Input Multiple Output
eMBB	Enhanced Mobile Broadband
URLLC	Ultra-Reliable Low-Latency Communications
mMTC	Machine-Type Communications
FWA	Fixed Wireless Access

Conflicts of Interest

The authors declare no conflicts of interest.

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