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Network Amelioration, AI Automation and Future Integration in Wireless Networks

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Abstract: ***The deployment of 5G mobile communication networks is just getting started right now. There are numerous technologies available today, each capable of fulfilling activities such as enabling voice traffic via voice over IP (VoIP), providing broadband data access in mobile environments, and so on. However, there is a pressing need to implement technology that can bring all of these systems together into a single unified system. Because it is all about smoothly integrating terminals, networks, and applications, 8G presents a solution to this dilemma. In this work, an attempt is made to provide a study of various cellular technologies, such as 4G, 5G, 6G, 7G, and FG, as well as a detailed comparison between them. With the introduction of network virtualization and the implementation of 5G/IoT, mobile networks will become more complicated and offer more diverse services. This raises concerns about a considerable increase in the workload of network operations. Meanwhile, artificial intelligence (AI) is advancing rapidly and is projected to alleviate human resource shortages in a variety of industries. Similarly, the mobile industry is gaining traction in the application of artificial intelligence (AI) to network operations in order to improve the efficiency of mobile network operations. This paper will address the idea of using AI technology to network operations and will give various use examples to demonstrate that AI-driven network operations have a bright future.***
Keywords: *5G & 6G networks, Artificial Intelligence, Next generation network, Future Advancement.*

I. INTRODUCTION

Communication technology has evolved fast in recent years, having a significant impact on how people comprehend and interact with one another and their surroundings. The most recent communication technology, known as 5G or fifth generation mobile communication technology is already in use in a number of sites throughout the world and will soon connect the entire planet. Now that 5G is up and running, the obvious question is what comes next. Researchers have already begun work on the next generation of communication technology, known as 6G.

Artificial intelligence has the potential to substantially improve the efficiency of the current economy. However, it has the potential to have an even greater impact by functioning as a new general-purpose "method of invention" that can transform the structure of the innovation process and the way R&D is organized. We find substantial evidence of a “shift” in the relevance of application-oriented learning research since 2009, distinguishing between automation-oriented applications such as robotics and the possibility for recent advancements in “deep learning” to serve as a general-purpose method of innovation.

A. What is Artificial Intelligence?

Artificial Intelligence (AI) is a method of programming a computer, robot, or other object to think like a smart human. AI is the study of how the human brain thinks, learns, makes decisions, and works to solve problems. Finally, this research generates intelligent software systems. The goal of artificial intelligence is to improve computer functions that are linked to human understanding, such as reasoning, learning, and problem-solving.

Intelligence is an ethereal concept.

It is made up of Reasoning and Learning.

Solving Issues

Perception

Linguistic Intelligence is a term used to describe a person's ability

Reasoning, knowledge representation, planning, learning, natural language processing, realisation, and the capacity to move and manipulate are all goals of AI research.

Types of Artificial Intelligence:- Weak AI and Strong AI.

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Weak AI, also known as Narrow AI or Artificial Narrow Intelligence (ANI), is artificial intelligence that has been trained to execute specific tasks. The majority of today's AI is driven by weak AI. This form of AI is anything but weak; it allows for some very sophisticated applications, such as Apple's Siri, Amazon's Alexa, IBM Watson, and driverless vehicles.

Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI) make up strong AI. Artificial general intelligence (AGI), sometimes known as general AI, is a hypothetical version of AI in which a machine possesses the same intelligence as humans and has the ability to solve problems, learn, and plan for the future. Artificial Super Intelligence (ASI), sometimes known as superintelligence, would outperform the human brain in terms of intelligence and capacity. While strong AI is currently purely theoretical, with no practical applications to yet, that doesn't mean AI researchers aren't working on it.

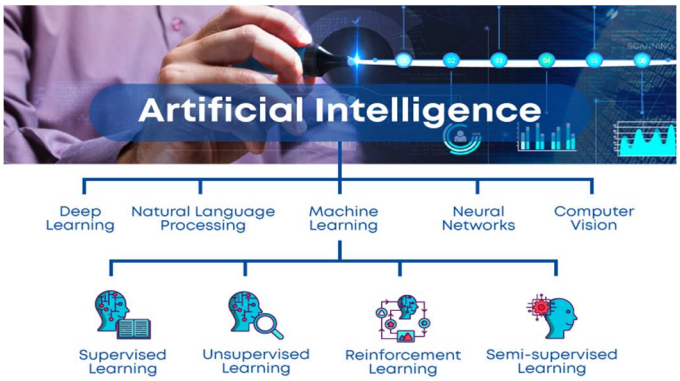


Fig 1: Types in Artificial Intelligence

B. What is 5G?

The term "5G" refers to the fifth generation of mobile technology. Beyond the future 4G standards, 5G refers to the next significant phase of mobile telecommunication standards. 5G technology can help with Product Engineering, Documentation, and supporting electronic transactions, among other things. As customers grow more knowledgeable about mobile phone technology, they will seek out a comprehensive bundle that includes all of the latest capabilities that a cellular phone can offer. As a result, the big mobile phone companies' primary goal has always been to out-innovate their competitors by seeking out new technology. A 5G-based telecommunication network would be suitable for addressing the issues that a 4G model has.

Wide-area coverage, high throughput at millimetre waves (10 mm to 1 mm) covering a frequency range of 30 GHz to 300 GHz, and a 20 Mbps data rate to distances up to 2 km are all possible with wireless systems using orthogonal frequency division multiplexing (OFDM). The millimeter-wave spectrum is the most efficient way to address the current increase in wireless Internet consumption. These specifications allow for the creation of ‘wireless world wide web' (WWWW) applications.

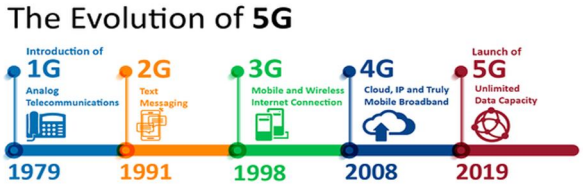


Fig 2: Evolution in 5G

II. CHALLENGES & STEPS

AI and 5G are a strong blend of technologies that will propel the fourth industrial revolution. True applications for the marriage of AI and 5G, on the other hand, have yet to materialize, which would drive widespread adoption. Adoption of these technologies is also fraught with difficulties. Artificial intelligence is already having a big impact on business and industrial processes, where robots are taking over work that humans used to do. 5G is the latest in a long line of cellular technology standards that have revolutionized the way we connect and live. Each of these generations introduced a fundamental distinction that has had a revolutionary impact on customers' communication experiences, but each also had flaws that the next generation would remedy. Some of these guidelines are still in use today. Primary 2G mobile, for example, introduced digital telephone and texting. This standard has been used to create successful company concepts. M-Pesa, a Kenyan mobile finance app, is undoubtedly one of the most successful 2G cellular technology-based business concepts.

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Spectrum availability is now posing a barrier to 5G adoption. The frequency used determines the power and speed of 5G. Using frequencies with reduced bandwidths that may have favorable features is one technique to avoid spectrum-related difficulties. For example, a frequency of 600 MHz is unlikely to lose power quickly, allowing it to reach 5G phones while overcoming physical barriers such as thick walls. Furthermore, the 5G standard is quite costly to install. Because of the large capital expenses necessary and the lack of a clear business model to recoup the investment, many mobile operators in Africa and abroad have yet to invest in infrastructure supporting 5G. Operators would have to upgrade existing base stations, install new base stations, and upgrade the backhaul high-speed, high-capacity mobile access networks (4G, 5G, etc.) that are frequently unavailable in emerging areas. Because the role of equipment integrators will be considerably larger than in earlier generations of mobile technology, 5G brings significant security challenges. As 5G architecture sends functionality that was once at the core of networks out to the "edges," where it is more difficult to regulate and subject to tampering, security threats will rise dramatically. The number of unsecured and compromised devices will grow as the number of connected devices grows.

These could be used for malicious reasons, such as in a distributed denial-of-service (DDoS) assault.

Furthermore, the volume of data created will make detecting irregular traffic more challenging.



Fig 3: AI & 5G

A. Artificial Intelligence & 5G Integration

Adopting 5G networks has numerous difficulties, and one way the industry is addressing those issues is by incorporating artificial intelligence into networks. When Ericsson polled decision-makers from 132 cellular firms around the world, more than half stated AI would be integrated into their 5G networks by the end of 2020. AI integration is primarily focused on lowering capital expenditures, improving network performance, and generating new revenue streams. By increasing network quality and giving personalised services, AI is already being utilised to improve customer service and increase consumer experience, according to 55% of decision-makers. 70% feel that implementing AI in network planning is the most effective way to repay the costs of upgrading networks to 5G. According to the poll, 64% of respondents plan to concentrate their AI efforts on network performance management. Managing SLAs, product life cycles, networks, and revenue are some areas where cellular decision-makers want to invest in AI. Of course, integrating AI into 5G networks comes with its own set of hurdles. The development of effective procedures for gathering, organizing, and interpreting the massive amounts of data accumulated by AI is required.

While our smartphones have shrunk in size, the underlying algorithms that power them have remained same since the 1990s. As a result, 5G systems use significantly more energy than desired and deliver lower data rates than anticipated. Deep learning AI will substantially reduce battery consumption and increase performance by replacing standard wireless methods. This strategy will be far more important than concentrating AI on network management and scheduling. Furthermore, the bandwidth used by today's cellular networks is radio spectrum-based. Radio waves are electromagnetic waves that occur in the radio spectrum's frequency range. Radio waves, like many other modern technologies, are frequently used in telecommunication. Interference between users of different radio wavelengths is strictly regulated by national legislation, and the International Telecommunication Union (ITU) regulates the coordination of these rules. There is concern that the expanding use of wireless technologies will overcrowd the frequencies on which our devices communicate. While 5G might have been up to 20 times quicker than 4G, it offers much more than that. 5G speeds will enable developers to construct applications that take full use of increased reaction times, such as near-real-time video transmission for sporting events or security purposes, thanks to their low latency. Furthermore, 5G connectivity will expand access to real-time data from a variety of sources. 5G makes use of long-lasting Internet of Things (IoT) sensors that use significantly less electricity to operate. This could enable for remote monitoring of farmed irrigation levels and factory equipment condition changes.

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The aim of edge computing is to process and analyze data in servers that are closer to the applications they support. While IoT is gaining popularity and enabling new markets for telecom providers and other businesses, many say that releasing "connected" devices like coffee cups and pill dispensers did not cause the market to soar as projected. By merging big data, IoT, and AI, recent AI technology developments have begun to disrupt industries and the amount of value all this connectivity can bring to consumers.

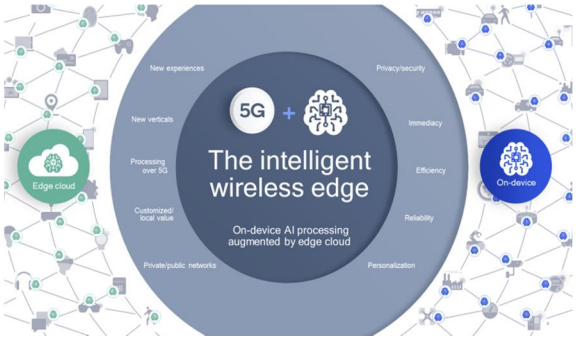


Fig 4: Integration of 5G with AI

B. What is 6G?

The successor to 5G cellular technology is 6G (sixth-generation wireless). 6G networks will be able to operate at higher frequencies than 5G networks, resulting in significantly increased capacity and lower latency. One of the goals of the 6G internet is to provide communication with a latency of one microsecond. This is 1,000 times faster than one millisecond throughput (or 1/1000th the latency).The market for 6G technology is predicted to enable significant advancements in imaging, presence technologies, and location awareness. The computational infrastructure of 6G will autonomously select the ideal area for computing to occur, using artificial intelligence (AI). The confluence of all previous aspects, such as network densification, high throughput, high dependability, low energy consumption, and huge connection, will be the major drivers of 6G. The 6G system would also carry on the previous generations' tendencies, which included new services and the introduction of new technologies. The ability to handle large amounts of data and very high-data-rate connectivity per device is the most important requirement for 6G wireless networks. In 6G, the 5G paradigm will be refined and expanded. However, the 6G system will outperform 5G in terms of performance and user QoS, as well as include some exciting new features. It can secure user data, defend the system, and provide convenient services. The 6G communication system is expected to be a world-wide communication system. Of many circumstances, it is expected that the per-user data rate in 6G will be around 1 Tbps.

The 6G technology is projected to provide 1000 times more simultaneous wireless connectivity than 5G. Furthermore, ultra-long-range communication with latency of less than 1 ms is expected. The integration of fully supported AI for driving autonomous systems is the most interesting feature of 6G. In 6G communications, video-type traffic is projected to be dominant among various data traffic systems. The THz band, AI, optical wireless communication (OWC), 3D networking, unmanned aerial vehicles (UAV), IRS, and wireless power transfer are the most essential technologies that will drive 6G. This study attempted to present a comprehensive overview of the future 6G communication infrastructure while taking into account current trends and research activities from around the world.

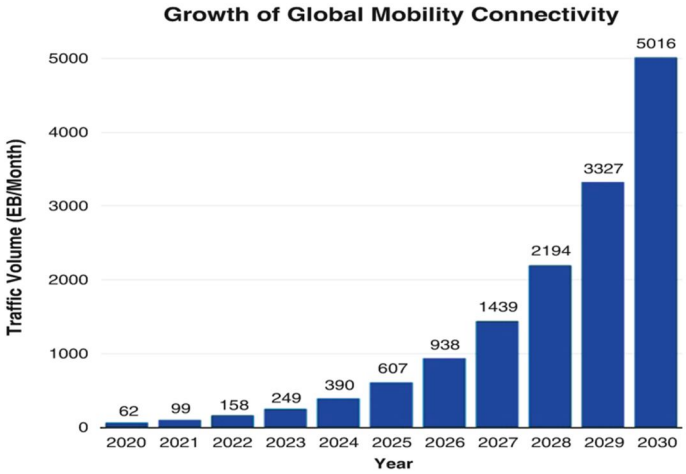


Fig 5: Mobility Connectivity

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C. 6G Technologies

A variety of technologies will power the 6G network. Below are a handful of the most anticipated 6G technologies.

AI is the most essential and recently introduced technology for 6G communication networks. For 4G communication networks, there was no AI participation. Partially or very limited AI will be supported by 5G. 6G, on the other hand, will be totally automated thanks to AI. More intelligent networks for real-time communications in 6G will be created thanks to advances in machine learning. AI in communication will make the transmission of real-time data easier and more efficient.



Fig 6: 6G Technologies

III. FUTURE ENHANCEMENT

The next decade will be a period of digital transformation into a data-driven world where artificial intelligence, 5G, and the exponential growth in data that the Internet of Things will bring and will drive change at a faster rate than ever before in human history. We will be moving into a world of more connected and interfacing (D2D) devices as well as increasing human-computer interaction use cases. The project's growth is evidenced by Gartner's prediction that 5G IoT endpoints will triple between 2020 and 2021. This in turn will generate more data.

A. The self-driving vehicles of the future must be aware of their location, their environment and how they are changing, and other road users such as cyclists, pedestrians and other self-driving vehicles. They will need to negotiate passage through intersections and improve their route in a way that reduces journey times. This is a huge arithmetic challenge. It would require cars to create rapid networks on the fly, for example, when you approach a certain road intersection - and then abandon them almost immediately.

B. At the same time, they will be part of wider networks that calculate routes, flight times, etc. Thus, interactions will be necessary in huge quantities, to solve large distributed problems where massive connectivity, large data volumes, and very low latency beyond those that 5G networks will provide will be essential.

C. This is, of course, just one example of the type of collaboration that 6G will enable. These will be based on the generation of enormous amounts of data in real time and collaborative analysis of that data. Network optimization is one apparent application, but others include financial market monitoring and planning, health-care optimization, and "nowcasting"—the ability to forecast and react to events in the near future.

D. It is apparent that artificially intelligent agents will play a significant role in our future. “Collaborative AI is the key to harnessing the true power of such agents, and by nature of the mobile society of the twenty-first century, it is evident that this collaboration can only be achieved via wireless communications.”

That's an intriguing futuristic vision. Before a set of 6G standards can be outlined, let alone implemented, there is a lot of negotiation and horse-trading to be done. Artificial intelligence will be the driving force behind the development of future communication networks.

In order to do so, artificial intelligence may be a viable option for increasing efficiency, productivity, and accuracy across the board. It sees robotics and machine learning as a threat rather than a way to improve ourselves, and sees technological advancement as a threat. Here are six ways artificial intelligence may impact our lives in the future.

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1) Improved elder care
2) Automated transportation
3) Cyborg technology
4) Solving climate change
5) Robots as companions

IV. APPLICATIONS

A. *Healthcare*

Administration: Artificial intelligence (AI) technologies are assisting with normal, day-to-day administrative chores in order to reduce human error and increase efficiency. NLP is used to transcribe medical notes and to help organise patient information so that clinicians can read it more easily.

Telemedicine: Patients can use a hospital's AI system to analyse their symptoms, input their vital signs, and determine if medical assistance is required in non-emergency scenarios. This decreases medical personnel's workload by only presenting them critical instances.

B. *E-commerce*

Better recommendations: When people are asked about commercial applications of AI, this is frequently the first example they provide, and it's because it's an area where AI has already delivered excellent results. Most major e-commerce companies have implemented Artificial Intelligence to create product recommendations that consumers may be interested in, which has resulted in significant revenue growth.

Chatbots: Another well-known example, based on the widespread use of Artificial Intelligence chatbots in a variety of businesses and on seemingly every other website we visit. These chatbots are now serving consumers at all hours of the day and night, alleviating the bottleneck caused by a lack of human resources.

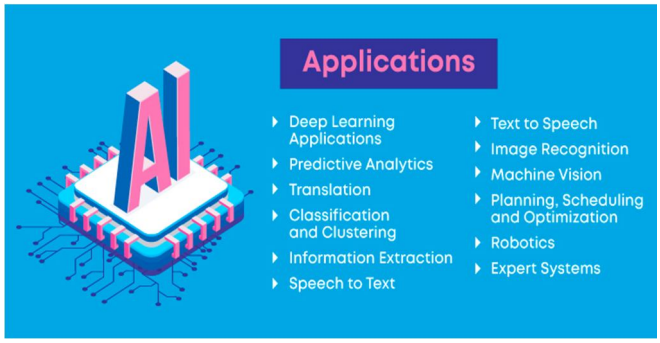


Fig 7: Applications of AI

C. *AI & 5g*

1) *Smart Network Construction is Enabled through Precision Network Planning:* Carriers will encounter a fundamental difficulty in 5G deployment: how to disperse cell sites. Network simulation, drive tests, and a complaint trigger mechanism are all used in traditional site layout. This is dependent on professional knowledge and a large amount of manpower. However, as 5G becomes more widely available, existing deployment modes will encounter more constraints and obstacles, particularly in hybrid scenarios involving different systems, frequency bands, and cells. Machine learning and AI algorithms can be used to assess multidimensional data, particularly cross-domain data, in smart network design and building.
2) *Smart Massive MIMO Enables Higher Efficiency and Great user Experience:* Massive MIMO is one of the most important 5G technologies. To maximize the benefits of massive MIMO sites (hereafter referred to as MM sites), meet coverage requirements, and deliver an optimal user experience, beamforming for massive MIMO channels must match cell user distribution while minimizing interference from surrounding cell broadcast channels. The beamforming effect is heavily influenced by the weight setting for an MM location. The weight setup and adjustment of the MM site is critical in enhancing coverage quality and efficiency for different coverage regions or different scenarios within the same coverage area.

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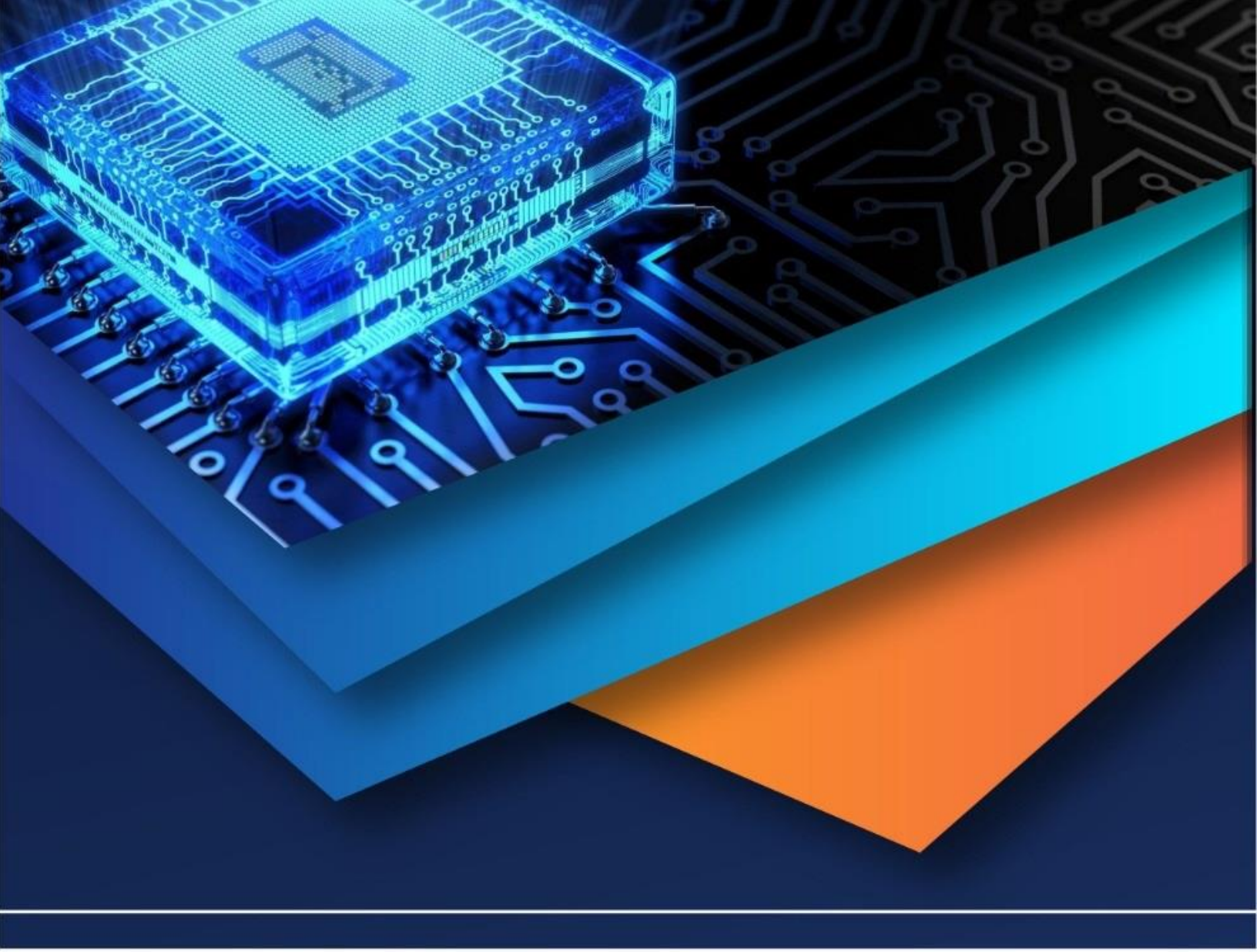
V. CONCLUSION

Following the completion of the 4G network, network providers began offering true broadband mobile Internet at speeds of up to 600 Mbps. However, service and subscriber expectations have risen to an unprecedented degree of demand for greater service quality. Virtual and augmented reality necessitates extremely high capacities, whereas the Internet of Vehicles necessitates ultra-reliable connection and extremely low latency. This prompted cell network operators to begin the transition to 5G. Through new radio interfaces, massive MIMO, beam-forming, and other advanced technologies, 5G was able to achieve bit speeds of over 1Gbps. However, operators must improve the intelligence of their network in order to learn more precisely about their operational environment and foresee its evolution in order to optimise resource consumption, adapt and configure the network automatically to cope with a wide range of services. We demonstrated in this chapter how this was made possible by combining artificial intelligence and several machine learning methodologies. We've provided some intriguing use cases for self-healing and self-upgrading networks, which the operator can implement. Now that 5G communications are being deployed, it's time to think beyond 5G and create a roadmap to take a quantum leap forward in terms of development for the next generation, which is expected to hit the market by 2030. We discussed the necessity for 6G communication technology and the capabilities that it is predicted to have in this paper. Furthermore, we combined artificial intelligence with 6G communication to examine a variety of applications that will change how people interact with one another and with communication equipment. AI is a vital enabler for next-generation 6G mobile networks, and security is a critical factor for achieving the 6G vision. 6G security with AI provides intelligent and reliable security solutions. This article presents an overview of the numerous benefits and challenges of incorporating intelligent security and privacy into 6G systems as part of AI's role. It also suggests future research directions by examining and suggesting possible solutions to difficulties in AI-based security and privacy offering. This research began by outlining a vision and critical attributes for future 6G in the areas of energy efficiency, intelligence, spectral efficiency, security, secrecy, and privacy, affordability, and customization. Then we spoke about the various issues that could arise as a result of this. During the global rollout of 5G networks, a collaborative effort between industry and academia has begun to design the next generation of wireless communication systems (6G), which will answer the issues posed by the massive rise in wireless data traffic. Apart from delivering a collection of new services, 6G technology provides bitrates of up to Tbps with a latency of less than 1 ms.

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