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A Comprehensive Review on The Activities Of 5th Generation Mobile Communication System

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Abstract

5G is the fifth generation of mobile networks. A new wireless standard has emerged in the wake of 1G, 2G, 3G, & 4G networks throughout the world. It is possible to create a new form of the network which is meant to link almost everyone & everything together, including objects, machines as well as devices. This next generation of wireless technology, dubbed "5G," is designed to provide consumers with faster download and upload speeds up to 10 Gbps (gigabits per second), ultra-low latency, enhanced dependability, vast network capacity, and a more consistent user experience. New user experiences, as well as new industries, are enabled by enhanced performance as well as efficiency. In addition, it is anticipated that the 5G IoT (Internet of Things) ecosystem would unleash a massive 5G IoT ecosystem in which the networks will be able to satisfy the communication needs of billions of connected devices with the appropriate trade-offs between the speed, latency, as well as cost.

Keywords: 5G, 5th generation mobile network, wireless technology, Internet of Things

1 Introduction

Researchers are just now beginning to understand and appreciate how much the internet as well as other technology have changed our lives. In the United States and throughout the globe, 5G is slowly but definitely becoming a household word alongside the contemporary smartphone as a representation of

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what is going place. Most people still have no idea what 5G is or how it will help consumers & businesses in the future.

The 5th generation of cellular networks (to which the term "5G" refers) first appeared in 2016 with the introduction of the 5G wireless technology. The 5G network has been slow to catch on, but it's expected to have more than 1.7 billion subscribers by 2025, as well as its use will be increasingly tied to an ever-evolving concept known as the "internet of things" (IOT), that includes devices, networks, as well as basically anything "smart" which uses the internet. People are increasingly owning several devices and spending more time online, which has resulted in a decrease in data transmission speeds. Faster than current 4G networks, the 5G network will bring a slew of advantages to consumers, businesses, and investors alike.

Figure 16 The 5G technology

Users may anticipate higher speeds for anything from sending images and files on their phones to watching movies at home as 5G becomes more widely accessible. Once 5G becomes the standard, consumers will enjoy cheaper tech expenditures and an improved work-from-home experience. 5G technology investors stand to gain from everything from semiconductor businesses to "real estate investment trusts" (REITs), which are projected to drive most of the investment in 5G infrastructure. Semiconductor companies as well as other tech-related areas. In light of this, let's take a closer look at what 5G is as well as how it will change customers' lives in the next few years.

2 LITERATURE REVIEW

(Jijo et al., 2021) There has lately been a lot of interest in physical layer protection, that uses information theory to safeguard data secrecy. Physical layer security relies on its inherent randomness of transmission route to provide protection. Physical layer security has become a new issue in 5G wireless communication. Several 5G technologies, such as millimetre wave, microcells, massive MIMO, beamforming, and full duplex, are discussed in this study. Attenuation, antenna array design, millimeter-wave penetration, security, coverage, and scalability, among other things, have all been employed to overcome this problem. Aside from that, the author included explanations of the methods/algorithms employed, as well as aims, issues, and findings that mattered.

(Dujuan, 2021) From 4G to 5G, the evolution of mobile communication technology. 5G has postponed the introduction of risky facilities, like autopilot, true AI in portable processes, and remote-controlled

capabilities, because of its close proximity to the previous generation. It's a vital 5G technology user support near delay important service to guarantee the aim of ultra-low latency is achieved by spreading computing resources to focus on the edge of the network. The multi-access edge computing design has flaws that might lead to traffic explosions due to "regional computing resource overloads." According to study undertaken by Ovum in Amdocs software and service firms, telecoms companies, and a renowned media research provider, 5G will transform stadium experiences for home fans. In addition, 88% of European operators expect 5G to provide a new “multi-screen pay-TV” service for home watching of sports events. It is expected that 5G would increase the quality of mobile TV as well as video, hence broadening the breadth of material accessible to the mobile audiences, beyond the spectrum of consumer electronics products and services. It is our objective to provide a so-called "mixed better communication architecture" that combines the advantages of “cloud computing access edge” with those of the cloud. A discrete event simulation model is used to evaluate the proposed network architecture's performance. Last but not least, numerous benefits and drawbacks associated with a particular network design are examined.

(Taboada & Shee, 2021) It is thought that the high bandwidth as well as low latency qualities of the 5G network would allow many devices to communicate in real time. Although 5G wireless technology has the potential to revolutionize supply chain management, there is a lack of research on the topic. As a result, a comprehensive analysis of the literature is conducted in this research to examine the role of 5G as well as its implications for “supply chain management”. “Industry 4.0 & Supply Chain 4.0” technology, as well as components of the supply chain, are all explored in this report. According to bibliometrics, 5G-enabled "supply chain management" is a relatively new area of study with just a small number of papers published on it. Research on the influence of 5G on industry & supply chain 4.0 tends to concentrate on the technical aspects of 5G and its potential impact on these two industries. Research topics for 5G supply chain management will be addressed.

(Onishi et al., 2020) An evaluation of the incidence power density (PD) above 6 GHz when the wireless devices, like the "5th generation mobile communication system" (5G), are utilised in close proximity to head as well as body is described in this study, which discusses current activities. The "International Electrotechnical Committee" (IEC) and the "Institute of Electrical and Electronics Engineers" (IEEE) have collaborated on several projects (IEEE). Due to a lack of precise description, definitions of the PD are briefly discussed. Measurement and calculation methods are then integrated into the curriculum.

(Storck & Duarte-Figueiredo, 2020) Designed to boost the speed and responsiveness of wireless networks, the "Fifth-Generation Network" (5G) is capable of transmitting a large amount of data. End-user and corporate services are supported through wireless broadband connections. Designed primarily for use in the Internet of Vehicles, it ensures lightning-fast connectivity while still providing a high level of security. Vehicle-to-Everything (V2X) connectivity and apps on autonomous cars may be supported by the 5G network technology. People, cars, and infrastructure may communicate data with this technology. A more pleasant and secure environment, as well as precise traffic information, may be

provided by this technology. It is possible to reduce pollution & accident rates by improving traffic flow. For better road safety as well as autonomous driving, the cellular network may be used as a communication base for V2X, as well as for the Internet of Things. IoV has compiled a report on the growth of 5G technology, standards, as well as infrastructure for the V2X ecosystem. Also included are an overview of IoV features and protocols enabled by 5G V2X communication as well as an analysis of various modes, evaluations and technical support in this context. Systematized research on the interactions between IoV, 5G, & V2X is the paper's main contribution. Concepts, criteria, and methods for overcoming obstacles were presented in 84 works. New 5G-V2X services as well as technology specialised to vehicle communications are expected to be developed as a result of this study, which is also expected to provide a roadmap for future developments.

(Ahmad et al., 2020) Small-cell and Internet-of-Everything device adoption has skyrocketed, resulting in massively increased traffic. The present network has been transformed into 5G technology, that requires enhanced capacity, high data rate, & ultra-low latency. Spectrum exploration and maximising use of its bands will help address these needs. An efficient management strategy will be difficult to achieve because of the "scarcity of the spectrum resource". An in-depth analysis of contemporary "spectrum sharing" (SS) technologies including recent 5G-enabling technologies is the goal of this work. Studies on 5G network-relevant SS methodologies, including SS surveys and associated research, are evaluated and categorised. Network design, spectrum allocation behaviour, and spectrum access method are used to classify surveys and research into one of the primary SS approaches. An extensive study of "cognitive radio" (CR) technology in SS in relation to 5G deployment is also carried out, The present deployment of SS & CR and the measures to promote effective 5G progress are discussed in a comprehensive study.

(Fotouhi et al., 2019) "Unmanned aerial vehicles" (UAVs) are exploding in popularity among consumers, which is offering new commercial prospects for mobile phone providers. As new forms of user equipment, unmanned aerial vehicles (UAVs) may be linked to cellular networks and so generate large income for the operators who can ensure their rigorous service needs. An unprecedented opportunity is offered by UAVs to the “UAV-mounted flying base stations” (BSs) which can dynamically adjust themselves to improve coverage, spectrum efficiency, as well as user quality of experience are an entirely new possibility made possible by UAVs. Commercial UAVs may be served by cellular networks, as standards committees are now considering. Earlier prototypes of the flying BSs or the user equipment are being tested by industry, while academics are working hard to find mathematical and algorithmic answers to exciting new cellular network issues. All of the recent innovations that have made it easier for unmanned aerial vehicles (UAVs) to operate in cellular networks are discussed in detail in this article. To that end, we look at: “1) the types of consumer UAVs currently available off the shelf; 2) the interference issues and potential solutions addressed by standardisation bodies for serving aerial users with existing terrestrial networks; and (3) the challenges and opportunities for aiding cellular communications with flying relays and BSes. 4) the ongoing prototyping as well as test bed activities; 5) the new regulations being developed to manage commercial use of UAVs”.

(Zong Chen, 2019) 5th generation technology is a new network platform that not only improves the mobile paradigm, but expands the network to support a wide variety of heterogeneous devices as well as services. This new technology will revolutionise the globe by delivering a seamless connection with expanded capacity, reduced latency, and better speeds. 5G technology and its improvements in linked life are examined in this study.

(Adriano et al., 2019) Using 5G technology in an educational setting is the topic of this article. AR and VR-based activities are examined (VR). In the next section, we'll outline the major aspects of 5G and provide an instance of its use in music instruction.

(Li, 2019) Despite significant efforts, meeting the healthcare needs of an ever-increasing elderly population remains a huge issue. There are growing worries about rising healthcare expenses, an imbalance of resources, ineffective management of the healthcare system and uncomfortable medical procedures. Nevertheless, cutting-edge technologies are being developed to address these challenges, such as, but not limited to, “big data, the Internet of Things (IoT), artificial intelligence, as well as 5G wireless transmission technology”, to improve patient experience as well as quality of the healthcare services while reducing the total cost of health care. This isn't a pipe dream; new technologies are already having a subtle influence on healthcare and reshaping it. Despite the fact that the aforementioned technologies have been merged, we will concentrate on the use of the “5G wireless transmission technology” in the healthcare in this assessment. There are also possible disadvantages to 5G technology's availability.

(Kumar & Gupta, 2018) In 2020, several nations will begin deploying 5G mobile communication, which aims to create a wireless world free of current communication system barriers, which is a major driving element for all researchers, academics, and engineers. To ensure the effective rollout of 5G, researchers from across the globe are hard at work developing a new technology. Technology that provides high speed and capacity, spectrum efficiency and energy efficiency, as well as pseudo outdoor communication is being researched to tackle the existing challenges in the mobile communication systems. Key technologies, difficulties, spectrum allocation, initiatives, and current scenarios for 5G are examined in this article. The current report provides an in-depth investigation of the problems and developments associated with the rollout of 5G.

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(Panwar et al., 2016) Designers need to reevaluate the present generation of mobile communication systems due to the proliferation of devices, increased volume of data, and increased speed of data transfer. Cellular networks of the fifth generation (5G) are intended to fulfil the most stringent specifications. There are three distinct characteristics of the 5G networks: pervasive connection, minimal latency, and fast data transmission speeds. New architectures and technologies would be provided by 5G networks, which would go beyond and beyond the capabilities of current architectures and technologies. To address the question, "What and how will 5G do?," we've written this study. We look at and explore some of the significant drawbacks of 4G cellular networks, as well as some of the exciting new capabilities of 5G networks. New technologies for the 5G networks are identified, and we give a comparative evaluation of the suggested designs based on network hierarchy, energy efficiency, and network kinds. 5G networks are impacted greatly by implementation challenges such as interference and QoS, handoff and security-privacy, as well as channel access as well as load balancing. A review of existing real-world trials and testbeds also serves to illustrate the viability of our models.

3 UNDERLYING TECHNOLOGIES THAT MAKE UP 5G

For the purpose of reducing interference, 5G uses “Orthogonal frequency-division multiplexing” (OFDM), a technique in which a digital transmission is modulated over many distinct channels. OFDM and 5G NR air interface are both used in 5G. Sub-6 GHz as well as mmWave technologies are also used in 5G. 5G OFDM follows the same concepts of mobile networking as 4G LTE. With 5G NR air interface, OFDM's scalability and adaptability may be greatly increased even more. This might expand the reach of 5G to a wider range of people and things, allowing for a wider range of possible applications. The utilisation of spectrum resources will be expanded in 5G from the sub-3 GHz, which is now utilised in 4G, to 100 GHz and even beyond. 5G's flexibility to operate in both lower as well as higher frequency bands will enable it to achieve multi-gigabit speed, extreme capacity, plus low latency (e.g., sub-6 GHz and mmWave).

Additionally, 5G is predicted to establish new service areas, such as mission-critical communications and connecting the massive Internet of Things (IoT), in comparison to 4G LTE (IoT). A self-contained TDD subframe architecture for the 5G NR air interface makes this achievable.

The previous generations of the mobile networks are 1G, 2G, 3G, & 4G.

- “First generation - 1G 1980s: 1G delivered analog voice.
- Second generation - 2G Early 1990s: 2G introduced digital voice (e.g. CDMA- Code Division Multiple Access).
- Third generation - 3G Early 2000s: 3G brought mobile data (e.g. CDMA2000).
- Fourth generation - 4G LTE 2010s: 4G LTE ushered in the era of mobile broadband”.

With 5G, humans have arrived at the conclusion of the past 4 generations of the mobile networks. As a result, 5G is the name given to a single, stronger air interface. Because of this, it has been designed with a higher capacity to accommodate new user experiences, deployment patterns as well as new

services. Because of its high speeds, reliability, plus low latency, 5G will expose the mobile environment to the new possibilities. Everything from safer mobility to remote treatment to computerised logistics will be possible thanks to 5G.

4 5G TECHNOLOGY IS DRIVEN BY 8 SPECIFICATION REQUIREMENTS:

Consumers can store and transfer larger amounts of data more rapidly on the 5G networks because of the increased bandwidth. However, 5G & 4G do not just vary in terms of speed & bandwidth. The internet as we know it is set to be replaced by the full 5G network. It is possible that cable internet connections might be replaced by 5G in the future, unlike 4G, that is largely used for mobile devices. In the long run, costs connected with 5G adoption are expected to decrease, which is a significant change from its predecessor one which won't happen immediately (and will be pricey).

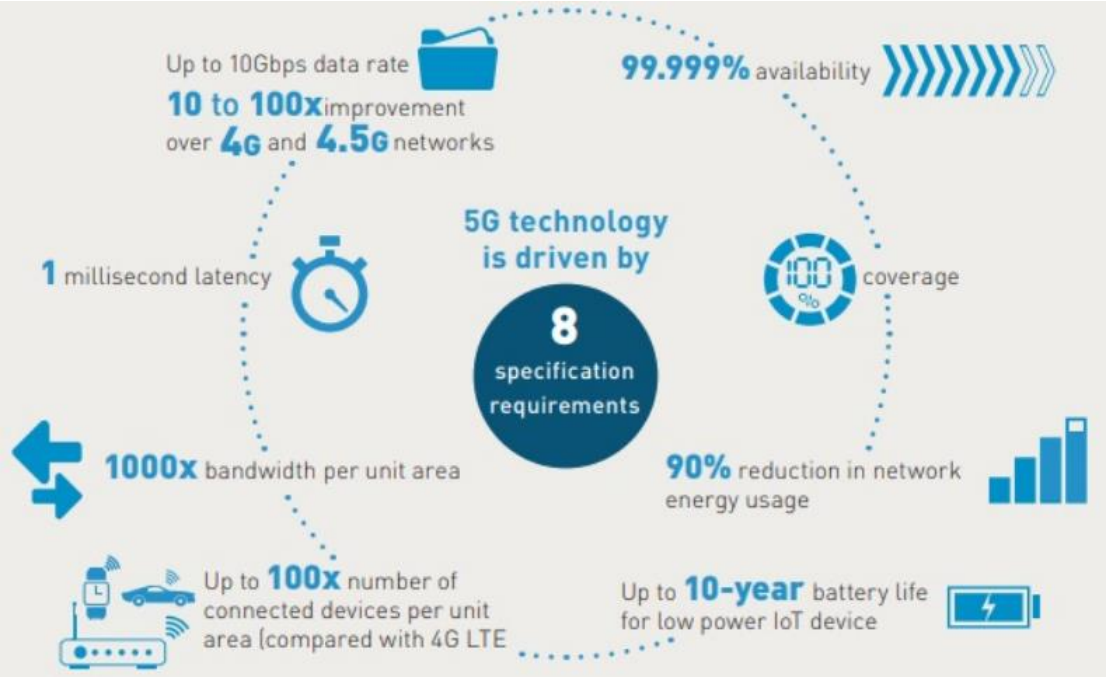

Figure 17 Specifications of the 5th generation mobile communication

Although 5G is expected to be more costly in the beginning, it is expected that the improvements would gradually lower the prices of the technology. According to Nokia, after 5G reaches full capacity, the cost per bit would drop by 70%, allowing carriers to reduce the cost of extra services. As more smartphone manufacturers add 5G capabilities to their models, the overall cost will come down. As many as 2.8 billion devices might be 5G-ready by 2025, allowing for more supply and hence lowering prices. As a result, 5G will undoubtedly change the way people interact with technology, but what particular advantages will it provide consumers & investors?

- “Up to 10Gbps data rate - > 10 to 100x speed improvement over 4G and 4.5G networks

- 1-millisecond latency
- 1000x bandwidth per unit area
- Up to 100x number of connected devices per unit area (compared with 4G LTE)
- 99.999% availability
- 100% coverage
- 90% reduction in network energy usage
- Up to 10-year battery life for low power IoT device”

5 HOW IS 5G BETTER THAN 4G?

There are a number of advantages that 5G will have over 4G:

- “5G has significantly lower latency than 4G
- 5G is significantly faster than 4G
- 5G is a unified platform that is more capable than 4G.
- 5G has more capacity than 4G
- 5G uses spectrum better than 4G
- 5G is a unified platform that is more capable than 4G”

Emerging services like as mission-critical phone calls and the “Internet of Things” (IoT) will also benefit from 5G's more unified, more powerful platform than 4G LTE, which focuses on offering significantly faster mobile internet. A broad variety of deployment models (from typical macro-cells to hotspots) and novel methods of the interconnecting (like device-to-device & multi-hop mesh) are also natively supported by 5G, which can also handle all spectrum types (licenced, shared as well as unlicensed).

6 5G uses spectrum better than 4G.

Five-generation (also known as 5G) networks are designed to make the most of all available spectrum in a variety of frequency ranges as well as regulatory frameworks, from the low bands below 1GHz up to the mid- as well as high millimetre wave bands (mmWave).

- “As a result, 5G is more faster than 4G.
- Up to 20 Gigabits per second (Gbps) peak and 100+ Megabits per second (Mbps) average data speeds can be delivered by 5G, making it far faster than 4G.
- The capacity of 5G is more than that of 4G.
- There will be a 100x improvement in traffic capacity as well as efficiency with 5G.
- 4G has a higher latency than 5G.

- There is a 10x reduction in end-to-end latency down to 1ms in 5G, allowing for faster, real-time access".

7 WHAT ARE THE REAL 5G USE CASES?

As wireless networks advanced, so did the number of uses they could support.

- IoT as well as critical communications applications are the primary emphasis of the next generation of 5G networks.
- On a timeline, we may point to the following usage cases:
- The use of a wireless network that is permanently installed (from 2018-2019 onwards)
- Improved mobile broadband with the 4G fall-back capability (from 2019-2020-2021)
- Huge M2M / IoT (from 2021-2022)
- Critical IoT connections with ultra-low latency (from 2024-2025)
- Self-driving vehicles, for example, need highly aggressive latency (quick reaction time), but they do not necessitate high data rates.

Enterprise cloud services that analyse large amounts of data, on the other hand, will need greater improvements to latency than to speed.

8 CONCLUSION

Many people have a hard time adapting to new situations. However, whether people like it or not, the 5G network's eventual supremacy is also unavoidable. In the present world, there is little question that technology advancements will continue to play an important role. As an example, consider the generation of young adults who were raised exclusively on their mobile devices, such as smartphones, tablets, as well as laptops. Even if we don't like the high-tech society we live in, we can't stop it. To be successful in the future, you'll need to get familiar with current technology developments, such as 5G.

Consumers and investors who know more about the 5G network and its potential advantages will have an advantage while purchasing or investing in a company. There are several chances for both consumers and investors to take advantage of the rise of 5G. Streaming, downloading as well as uploading data will be more enjoyable for consumers, as will their time working at home as well as driving. As more individuals switch to 5G networks, the accompanying prices are projected to fall for all users in the long run. Being at the forefront of 5G will also help investors and businesses: Knowing when and how to take chances is all that is required.

9 REFERENCES

Ahmad, W. S. H. M. W., Radzi, N. A. M., Samidi, F. S., Ismail, A., Abdullah, F., Jamaludin, M. Z., & Zakaria, M. N. (2020). 5G Technology: Towards Dynamic Spectrum Sharing Using Cognitive Radio Networks. *IEEE Access*, *8*, 14460–14488. https://doi.org/10.1109/ACCESS.2020.2966271

Baratè, A., Haus, G., Ludovico, L. A., Pagani, E., & Scarabottolo, N. (2019). 5G Technology for

Augmented and Virtual Reality in Education. *Education and New Developments 2019*, *1*, 512–516. https://doi.org/10.36315/2019v1end116

Dujuan, H. (2021). Mobile communication technology of sports events in 5G era. *Microprocessors and Microsystems*, *80*(October), 103331. https://doi.org/10.1016/j.micpro.2020.103331

Fotouhi, A., Qiang, H., Ding, M., Hassan, M., Giordano, L. G., Garcia-Rodriguez, A., & Yuan, J. (2019). Survey on UAV Cellular Communications: Practical Aspects, Standardization Advancements, Regulation, and Security Challenges. *IEEE Communications Surveys and Tutorials*, *21*(4), 3417–3442. https://doi.org/10.1109/COMST.2019.2906228

Jijo, B. T., Zeebaree, S. R. M., Zebari, R. R., Sadeeq, M. A. M., Sallow, A. B., Mohsin, S., & Ageed, Z. S. (2021). A Comprehensive Survey of 5G mm-Wave Technology Design Challenges. *Asian Journal of Research in Computer Science*, *April*, 1–20. https://doi.org/10.9734/ajrcos/2021/v8i130190

Kumar, A., & Gupta, M. (2018). A review on activities of fifth generation mobile communication system. *Alexandria Engineering Journal*, *57*(2), 1125–1135. https://doi.org/10.1016/j.aej.2017.01.043

Li, D. (2019). 5G and intelligence medicine—how the next generation of wireless technology will reconstruct healthcare? *Precision Clinical Medicine*, *2*(4), 205–208. https://doi.org/10.1093/pcmedi/pbz020

Morocho Cayamcela, M. E., & Lim, W. (2018). Artificial Intelligence in 5G Technology: A Survey. *9th International Conference on Information and Communication Technology Convergence: ICT Convergence Powered by Smart Intelligence, ICTC 2018*, *Ml*, 860–865. https://doi.org/10.1109/ICTC.2018.8539642

Onishi, T., Niskala, K., Christ, A., & Roman, J. (2020). Exposure assessment methods with respect to the 5G mobile communication systems. *Proceedings of the 2020 International Symposium on Electromagnetic Compatibility - EMC EUROPE, EMC EUROPE 2020*, 8–11. https://doi.org/10.1109/EMCEUROPE48519.2020.9245661

Panwar, N., Sharma, S., & Singh, A. K. (2016). A survey on 5G: The next generation of mobile communication. *Physical Communication*, *18*, 64–84. https://doi.org/10.1016/j.phycom.2015.10.006

Storck, C. R., & Duarte-Figueiredo, F. (2020). A Survey of 5G Technology Evolution, Standards, and Infrastructure Associated with Vehicle-to-Everything Communications by Internet of Vehicles. *IEEE Access*, *8*, 117593–117614. https://doi.org/10.1109/ACCESS.2020.3004779

Taboada, I., & Shee, H. (2021). Understanding 5G technology for future supply chain management. *International Journal of Logistics Research and Applications*, *24*(4), 392–406. https://doi.org/10.1080/13675567.2020.1762850

Zong Chen, D. J. I. (2019). Technology and Advancements in Connected Living-Comprehensive Survey. *Journal of Electronics and Informatics*, *2019*(02), 71–79. https://doi.org/10.36548/jei.2019.2.002