e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Conference:01/March-2023 Impact Factor- 7.868 www.irjmets.com
National Conference on Trending Technology for Achieving Sustainable Development Goals
NCTTASDG 2023 Organized by Shri Shankarprasad Agnihotri College of Engineering, Wardha

4G AND 5G NETWORK ANALYSISAND TECHNLOGICAL COMPARISON

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ABSTRACT

Users now can access the Internet while they are go thanks to mobile cellular data networks. This technology is utilized by variousorganizations in their merchandise.Home Smart Meters and Tesla cars with their "over the air updating" are two examples of this. These businesses both make use of the 4G and 5G networks. The LTE Advanced technology and protocols used in this experiment will therefore provide a technical overview networks with 4G and 5G, as well as information on how these networks' services are delivered to users and data is moved between them. There are variance test in the systems integration of the 4G and 5G systems as well. This study will discuss some of the various components of these two systems as well as some of their difficulties.

Keywords: Protocols, Networks, CellularTechnologies For 4G and 5G.

I. INTRODUCTION

1. The 4G and 5Core network characteristics

1.1 Opening of a 4G connection

FDD-LTE is a mixture of TD-LTE, 4G (short for evolution of mobile communication system), third-generation mobile communication system (3G), and WLAN. It's crucial to keep in mind that LTE is just an improved version of 3G at this point and hasn't yet reached the 4G standard. The enhanced version of LTE Advanced is the 4G protocol that fits with the ITU's concept of 4G. The benefit the ability to deliver data quickly and with high-quality video, audio, and image. The 4G network transmits data at a fairly quick rate. Consequently, we consider 4G to be communication technology that can transmit data at speeds beyond 100 Mbps, or roughly 12.5 to 18.75 MB/s for download. This technology can satisfy the needs of the majority of consumers for wireless services and is around 20 times more advanced than home broadband ADSL. For the general public, 4G offers significant convenience in terms of communication, entertainment, and enterprise. 4G has unmatched advantages over earlier generations of communication technologies, particularly because it can be installed in areas that are not serviced before being spread to the entire region by DSL and CATV modems. Indeed, 4G is just a and LTE technologies are both extensions of the 3G wireless communication standard. To put it another way, 4G is a developed version of 3G [1]. LTE Advanced, the most significant 4G communication protocol, has TD-LTE and FDD-LTE as its two independent standards. There seem to be multiple opposite duplex modes, TDD and FDD. these two modes relate to. We refer to TDD as time division duplex. Additionally, FDD, also known as Frequency division duplex refers to the reliable optimization of uplink and downlink in various frequency bands. Layout can be facilitated and spectrum resources used more successfully as a result. Further, it implies that, in accordance with time allotment, uplink and downlink are crossed in the same passband. The FDD mode's enhanced data transmission capabilities are its main benefit. In actuality, SC-OFDM is considerably different from 3G for uplink modulation while OFDM is used for downlink modulation in 4G [2].

II. NEW 5G TECHNOLOGY

2.1. Organization and Development of the 5G Protocol

IMT-2020 is the colloquial name for 5G, the fifth generation mobile necessary to fully understand developed by the International Telecommunication Union. In terms of the creation of the 5G protocol, the previous multi-standard parallel standard has already been replaced with a single industry standard. It may be argued that numerous organisations, including 3GPP, which is the most significant group in standardisation work, worked together to create 5G. In fact, the 3GPP was founded with the intention of customising reports and technological

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requirements for the third generation of mobile communication systems.Over time, the organisation has grown into the preeminent institution for formation. Release specified by 3GPP as a standard can finish the specification of one R15 is the name of the first 5G standard version, which typically comes out every one to two years [3].

2.2. Communication architecture in 5G

Phase 1 research for 5G is mostly conducted using R15, the first 5G standard from the 3GPP.

In this moment, our focus is mostly on understanding the description of the NR framework, as well as the waveform, The worldwide 5G standard, based on OFDM, uses a flexible duplex mode of communication systems and a frame structure. Solutions like CU-DU separation, uplink and downlink decoupling, and others are fully defined by the architecture. NSA/SA connectivity, etc. The service types of 5G uRLLC are also outlined. The new multiple access NR technology will be explored in Phase 2 of the R16 protocol, and the NR protocol's framework will be further enhanced on the foundation of R15. AdditionallytooptimizinguRLLC will continue to demonstrate R16's specific competitiveness in further vertical industries based on R15. The illustration below provides an overview (Figure 1). Research on eMBB, mMTC, and uRLLC is emphasized by 5G in order to deliver services to clients. Enhanced mobile broadband, or EMBB, is a technology that can give customers quicker wireless access rates and greater system capacities for a better incredibly clear experience. In order to prepare for the future general popularisation of the Internet of Things, the term "mass Internet of Things" (MMTC) is used. This research can help with intelligent logistics, smart cities, and even people's daily fitness. High reliability and low delay are referred to as URLLC. It is anticipated that this research will have a significant impact on human existence in the future [4]. It has been used for emergency personnel tracking, UAV (refers to drone driving advanced technologies) remote monitoring, and industrial production precision control.

III. NETWORK INSTITUTIONS COMPARSION

3.1. Design of 4G networks

The UE, eNB, and EPC are the three elements that form the architecture of the 4G networksystem,

Among them, EPS is composed of the EPC and the radio access network E-UTRAN, also known to as the 4G network system.The primary responsibilities of the core network EPC are user data management, user data transmission, and user identity verification. The radio component (E-UTRAN) of the 4G system primarily consists of some eNB and NodeB functions as well as some core network services. Figure 2 depicts the specific framework in detail. Actually, the LTE, SAE, and IMS components of the 4G network architecture may be comprehended. According to SAE, LTE is an acronym for long-term evolution of the air interface, while IMS largely deals with the issue of supplying telephony and other multimedia services to 4G networks. verification. The radio component (E-UTRAN) of the 4G system primarily consists of some eNB and NodeB functions as well as some core network services. Figure 2 depicts the specific framework in detail. Actually, the LTE, SAE, and IMS components of the 4G network architecture may be comprehended. According to SAE, LTE is an acronym for long-term evolution of the air interface, while IMS largely deals with the issue of supplying telephony and other multimedia services to 4G networks.

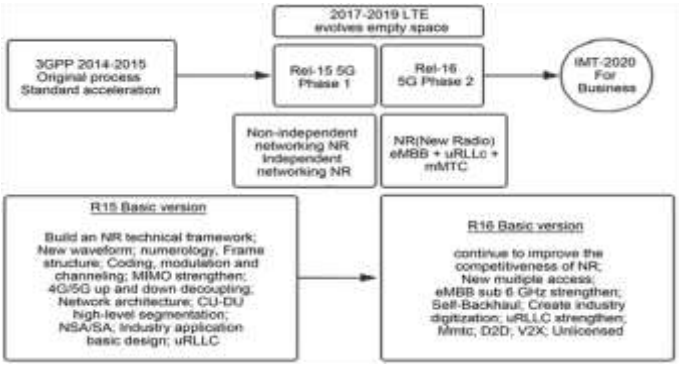

Figure 1. Communication architecture.

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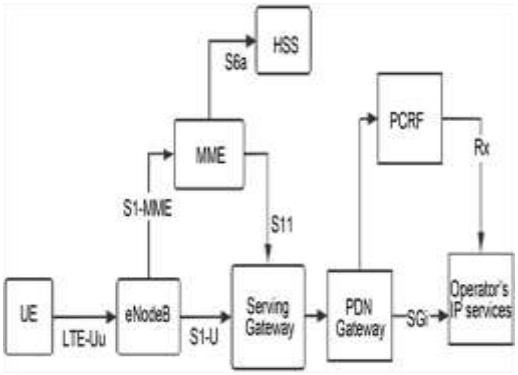

Figure 2. Configuration for EPS.

The following essential components make up the 4G basic architecture as described by GPP: The 4G network architecture's control core, known as MME, is in charge of managing control signalling like control over user access, service bearer access, and handover access. Serving Gateway serves as a buffer for downlink data packets and is primarily charged with transmitting information between base stations and public data gateways. Serving Gateway serves as the anchor point while switching between local base stations. Following that, the PDN Gateway, acting as the data bearer's anchor point, can perform operations such as packet forwarding, packet processing, billing for basic ancillary services, economic QoS control, and others. This server's full name is The Home Subscriber Server. It is a database used to store user-signed contracts, and the information it holds includes user security controls. information, such as user identification details, user geographical details, anddescription about user policy rules. The full name of PCRF is thus Policy and Charging Rules Function. Itskey dutiesinclude overseeing fees and policies. This means that the user chooses their service consumption and billing strategy in accordance with the contract they picked and signed, transmits their vote to the policy executor in the gateway, and the strategy is then put it into practice.

3.2. 5G Network Architecture

The 5G core network uses the SBA, or service-based architecture. In actuality, the 5G network is a user-centered, intelligent elastic network that divides the original total into numerous individuals with independent functions. These people then act out their own parts. The 5G network is next specifically examined. We begin by looking at the CU billing and consumption strategy, which is selected in line with the contract they have selected and signed, conveyed to the policy executor with in gateway, and then the strategy is implemented specifically. We begin by looking at the limitless internet protocols of the 5G network, the CU, DU, and AAU. CU is used to manage nonrealtime services. DU is in charge of handling existing work and physical requirements. The AAU is composed of the RRU, passive wireless, and a piece of the

BBU physical layer. The design of the 5G unlimited network is illustrated in Figure 3.

3.3. Network comparison between 4G and 5G

Analysis and comprehension of 4G and 5G will be proceeded by a comparison of

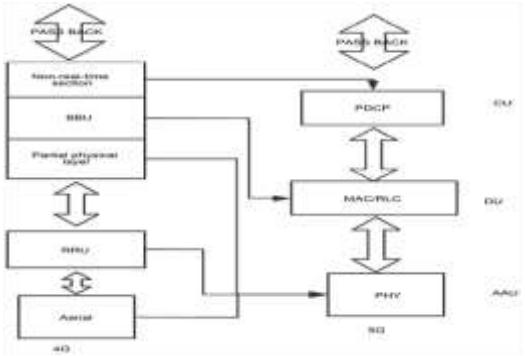

Figure 3.5G access network with no limits.

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The two connectivity systems. Furthermore, we are wary of electromagnetic waves serve as the network communication's primary carrier, but these waves have a certain amount of frequency resources. Accordingly, The bandwidth will be larger and the speed will be greater the higher the frequency. Although, 4G utilizes a low available bandwidth, there will be congestion when a lot of people use the network, which will result in a reduced rate. However, 5G does use the higher bandwidths. There won't be a rate reduction even if many users utilise the 5G network in this scenario, and then using high frequency can help improve use of the resources available. Additionally, the 5G data transfer rate might reach 10Gbps, whereas the speed of 4G is approximately 100 Mbps—100 times higher than that of 3G. After all, the development of 5G is the main foundation for emerging virtual industries like VR. The benefits of a 5G network also include increased capacity, reduced latency, and enhancedcomputational power. The communication sector is the one that draws the most attention at the moment, and 4G and 5G are its hottest segments. 5G is now in the developing stage. In terms of transmission rate, frequency band, channel bandwidth, and peak value, we compare the performance of 4G and 5G [5]. Here is a comparison of how well 4G and 5G perform (Figure 4).

There are difficulties in establishing a mobile network system

3.4 Difficulties using Gadgets

An experiment's core components are its hardware. In mobile communication, the hardware equipment primarily consists of RF front-end equipment, frequencies converters, and baseband digital stream processors. To achieve greater storage capacity and lower latency, the 5G network requires a more complex operating mode, which also creates more challenges for chip manufacturing. For addition, in order to cover the high frequency spectrum of the audio amplifier above 4 GHz, the chip must use GaN material, which is very expensive and challenging to fabricate. As a result,device work is necessary.

	4G	5G
Time delay	10 ms	smaller than 1 ms
Number of mobile links	eight billion	eleven billion
Channel broadband	20 MHz 200 MHz	100 MHz (lower than 6 GHz) 400 MHz (larger than 6 GHz)
Frequency band	600 MHz to 5.925 GHz	600 MHz (millimeter wave)
Date flow	7.2 Eb/month	50 Eb/month
Peak data rate	1 Gb/s	20 Gb/s
Available channel	3 GHz	30 GHz
Link density	One million links/km*2	One million links/km*2
Uplink waveform	Use SC-FDMA	Use CP-OFDM

Figure 4. Performance measurement.

3.5 Flexibility discussing Cloud Infrastructure: A Challenge

The variety of services presents new difficulties for the design and development of 5G networks because each type of service has unique network requirements. It encompasses things like function, resource use, architecture, and other things. Second, one of the obstacles the incorporation of user category adjustment, security isolation, and deployment technologies all assist to the 5G network architecture's adaptability.of the 5G network. The 5G network's bandwidth has multiplied many times over that of the 4G network, which has caused the need for network speed to rise quickly. Ultralow millisecond delays are necessary for URLLC service. This performance calls for judicious station allocation, technological optimization for it eventually satisfies the flexibility demands of the 5Gigabit ethernet for routing and forwarding.

3.6 Challenges of Terminal Technology

To meet consumer demands, the 5G terminal technology will be varied. Big data suggests that the vast majority of terminal objects in the inaugural 5G are actually mobile phones in the eMBB scene, and that the terminal planning of other scenes will gradually become clear as standards and industries expand. Future antenna proliferation will cause to issues like inadequate according to current scientific and technological advancements, terminal space and decrease antenna efficiency. To support the emergence of of the terminal industrial chain, researchers must first improve the hardware equipment and terminal design [6].

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IV. CONCLUSION

The protocols and tech used by 4G and 5Core networks, as well as the way they facilitate user services and data transfer inside the links,are covered in detail in this paper. The network architecture of the two systems is then compared. The technological difficulties in deploying mobile data connections are then described, followed by a table of the physical parameters between 4G and 5G. Finally, based on your analysis and your projection for the direction of technology, we reach a conclusion. As science and technology improve, 4G can no longer meet peoples' requirements, but 5G research may be capable to is able to address issues like network latency and storage capacity shortage. It is clear from the performance that if 5G is superior to the existing network architecture. And I believe that 5G will eventually advance towards virtual sectors like VR. Finally, it improves the convenience of human life.

V. REFERENCES

[1] Coverage and Networking Analysis of the TD-LTE System, S. Zhou, 2011. Papers 2 from: https://ieeexplore.ieee.org/document/6192901 https://doi.org/10.1049/cp.2011.0704

[2] 2017's Mobile Communications Handbook by J.D. Gibson (Electrical Engineering Handbook). CRC Press, 3rd Edition, Boca Raton, 56-83.

[3] Principles of Mobile Communication, Stuber, G.L. 2020. Berlin: Springer International, 24-47.

[4] Slice Architecture for 5G Core Network by Choi, Y.-I. and Park, N.Papers 10 from: https://ieeexplore.ieee.org/document/7993854 https://doi.org/10.1109/ICUFN.2017.7993854

[5] Mobile Communication, R. Ling, Wiley, Hoboken, 2020, pp. 21–58.

[6] Go Deep into 5G Mobile Communication by Liu, Y., Liu, H.M., Zhang, and Guo (2019).China Machine Press, Beijing, Page 9