A Study of future analysis of 4G and 5G Communication Networks

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ABSTRACT
The fifth generation (5G) of mobile cellular communications is intended to be a unified system that can support many contributors while upholding service quality. The linked sources network 5G is regarded as the wireless industry’s following step after taking into account today’s instructions, which incorporate amazing strategies for effectively utilising sources to cover the above frequency range. Various surveys on prospective characteristics that could be included in the currently under debate 5G technology have been completed, and the 4G LTE specification has also been finalised. In recent years, cellular services have expanded quickly, improving in many facets, including rates, customers, information, and capabilities. As stated and based on data and information gathered from the obtainable discussion related, this research provides an overview of potential modifications to the current architecture as well as likely updated attractive attributes expected in 5G technology. The final effect clearly demonstrates the difference between advances 4G LTE and 5G.

Keywords: communication, networks, cellular services, 5G, 4G, technology

INTRODUCTION
The 4th and 5th generation of cellular technology, which are both industrial behemoths, are the foundation of the quickly developing mobile network technology. The IoT paradigm’s integration into 4G and 5G platforms makes it more challenging to navigate this wireless maze. In the near future, there will be 5G, a fifth generation broadband access innovation based on the IEEE 802.11ac protocol. The current 4G network will be replaced by the 5G one, which will offer more coverage and better speeds. According to expectations, 5G will employ a 5 GHz signal and offer speeds of up to 1 Gb/s for thousands of interconnections or tens of Mb/s for hundreds of thousands of connections. [1-4] 4G is related to LTE technology, an advancement of the present 3G wireless standard. LTE, which is actually a more developed form of 3G, heralds a radical shift away from hybrid voice and data networks and toward an IP network that is only for data. Two essential
technologies, MIMO and OFDM, enable LTE to outperform earlier 3G networks in terms of transmission rate. [5] A transmission technique called OFDM makes use of numerous closely spaced carriers that are controlled with little latency. It is a thermal efficiency technique that permits multiple users to use a single channel while preserving fast data rates. The MIMO technology boosts transmission rate and spectrum efficiency by using several antennas at the transmission and reception. Using intricate signal processing techniques, multiple data channels are constructed on the same channel. [6] Both FDD and TDD are used in the LTE standard. One final note on the LTE categories. There are various LTE network types, and they mainly differ from the perspective of the client in terms of the maximum theoretical speed possible. As a bridge between 4G and 5G, LTE-Advanced is the development of the initial connectivity to even faster speeds. The five parts that make up LTE-A, which claims around three times the performance of the normal LTE network: Aggregation of Carriers is the initial phase. MIMO has been boosted. 3. Relay Station No. 4 for Multipoint Coordinates (CoMP) An example of a communication environment is a hybrid network. HetNet or the S Network [7-9] [10] A transmission technique called carrier aggregation, often referred to as channel accumulation, combines up to 20 streams of data from different spectrums into a single stream. Then, utilising the beamsteering approach, LTE-A increases the MIMO bar to 88 array configurations to enhance the frequency of radio channels. [11-12]

[13] It's worth mentioning that, while the LTE-A standard serves as a link between the 4G and 5G realms, the concept of HetNet acts as a glue between the two worlds in many respects. That is why many in the cellular industry consider 5G to be an improved version of LTE-A. That makes complete sense, because the basic goal behind 5G systems is to take the small cellular modem concept to the next level by creating a super dense system with tiny cells in every area. 5G is defined by the NGMN Alliance as follows: "5G is an E-E system that will enable a truly mobile and linked society," says the company. It enables value creation for clients and stakeholders by delivering consistent experiences and enabling long-term sustainability through existing and emerging use cases.

[14] Take Massive MIMO technology, for example, where 5G increases the threshold to a huge array of radiation pattern that expands the antenna matrix to a new level—1616 to 256256 MIMO—and puts a bet on wireless network speed and coverage. Beam forming technologies and small cell base units are a big part of the early 5G experimental network plan. The following value points highlight the objectives of 5G technology: • Support for 100+ billion interconnections • 1,000x increase in capacity • Speeds of up to 10 Gbit/s • Latency of less than 1 millisecond[15]

**MOBILE NETWORK ARCHITECTURE FOR 4G TO 5G**
The All IP Network (AIPN) is a 3GPP-developed system aimed at increasing need in the mobile communications market. It's a multi-program that may be used for a variety of radio access
technologies. AIPN initially focused on packet switching technology advancements, but it now provides continuous evolution and cost control in both performance and price. The key advantages of the AIPN design include a variety of access mechanisms, lower costs, international seamless access, increased user satisfaction, and reduced system latency. Furthermore, some dangers have emerged as a result of IP: data flow has grown more liberated, and the internet is now exposed to all types of viruses and thieves, implying that it is not only accessible to them. Then developers and employers confronted a new modern dilemma that needed to be totally solved, so 5G RAN innovation must be an efficient mesh network that relies on IP backhaul. In 5G networks, there can be many multiple kinds of base stations, including D2D, UDN, and massive MIMO classical macro, and these different base stations will often restrict together laterally more than they did in 4G networks, and will pursue effective and accommodative wireless grid.

In contrast to 4G, the 5G station will include software to integrate transmission controllers and transmitters, as well as a new error correction planner that can be downloaded over the internet. The evolution is seen across user sites as a concentration of 5G mobile networks, with these stations being able to access several communications technology at the same time, and the station being able to join numerous flows from various technologies. In 5G, each network will be in charge of handling user mobility, while the terminal will be the last point of contact for specialised services across multiple mobile wireless network access providers. This decision will be based on whether or not the mobile phone's smart middleware is enabled.

2.1. ARCHITECTURE OF A 5G MOBILE NETWORK DESIGN

5G mobile networks are in the early stages of development. Both public and business are consulting and making suggestions to choose which service should be displayed and what features it should have. Pervasive Networking is a feature of 5G technology. It aspires to expand real-WWWWWW [1,8,9]. Figure 1 depicts the model of the system that proposed a network architecture for the 5G portable device, between as an a whole IP shaped model for wi-fi and mobile networks connectivity, the law includes user stations (which play an important role in today's architecture) then gather concerning separate, independent radio access technology. Every radio station has access to technological know-how that is demonstrated in accordance with the outside internet world, specifically an IP link. However, there should be various radio interfaces for RAT inside the cellular terminal, for example, if we bring an action in emulation of have direct exposure after IV more than a few RATs, then we desire after have four more than just few access, specific functionality inside the cellular depot, then leave all of them active at the same time, then the goal is to keep this design and architecture after keep reasonable.
The radio access technologies are introduced at the first two OSI levels (data link and physical levels), which are provided with quite some QoS support mechanisms, depending on the connectivity. The network layer sits on top of the OSI-1 and OSI-2 layers, and in today’s information memorandum, this layer is IP (Internet Protocol), either IPv4 or IPv6, irrespective of the radio access network. IP's goals are to ensure total control information in the header of IP packets, as well as appropriate routing of IP packets pertaining to assured program connections. Mobile and wireless communication networks are moving toward an all-IP standard. As a result, there will most likely be several RATs in the future compared to the ones that are presently in use, but the underlying technology is IP. For access and core portions, All-IP is a foundation of the 4G standard. Similarly, many responsibilities are assigned to divide the transmission and service layers in NGN. As a result, future wireless mobile technology must be compatible with NGN. As user terminals become more computationally capable of supporting numerous complicated functions, 5G technology is projected to become more user-centric as envisioned.

2.2. Features
The above feature is based on the presumption that the user unit will be able to access many RATs from a central monitoring device at the same time; however, this capability has recently been observed in reality. Furthermore, the assumption includes the establishment of modern organizations in the network for the purpose of enabling strategy-based routing between several IP subways and client station appliances via various RATs in the network's service layer. Various techniques have been proposed to make the 5G network planned architecture fully functioning.
2.2.1. Interoperability of Heterogeneous Wireless Networks

Controlling the flexibility of employing spectrum, necessary space, capability, and so on in a certain platform is the primary defiance in developing a user terminal. The new approaches with tunability will allow the premier system to dynamically adapt for battery, frequency, and other resource consumption efficiency. Checking concepts on heterogeneous networks leads to the creation of a modern developed system that is simple to operate between multiple RATs without requiring any modifications, while also introducing reliable control in the core network. To collect applications that connect with needs, two methods for interoperability are frequently considered:

For requesting a columnar changeover between many access methods for developing heterogeneous range, it requires a guaranteed grade of incorporation among RATs, the various analyses supplied, and different protocols were created in defining the interconnection levels of design. It denotes a radio access compatibility standard for lower levels of telecommunication. This approach is used in mutual networks or networks with RATs controlled by the same operator. Some networks have strict rules of order in the scope of columnar handover, relying on the RANs Conditions or adhering to operator preferences.

2.2.2. Interoperability Model on the Internet

It also calls for evolution and emphasises the importance of service continuity in terms of offering different RATs to user stations, as well as network access. As a result, interoperability is established at a common level for all RATs. It has become more open and capable of cooperating with other servant operators in any situation. Regardless of any adjustments in the underlying variety procedures on the access level, both strategies must transport client information plainly among multiple users apps and the focused application servers. Every RAT is well-designed with reference to RRM Extra Utilization; the system adjusts for appropriate resource allocation based on the quality of operations desired.

2.2.3. Structure Proposed Functionalities and Functional Entities

The proposed network layer in the design provides functions that interconnect security, connection, and other operations that are initiated by the user. Separated logically into numerous mutual software systems that perform certain functions. There are little differences in server and client capabilities at the virtual network layer. Every software system will have its own set of suggested flexibility and architecture, which is enabled by clearly defined links and interfaces among standard peer modules. The network layer workforce is broken down as follows:

Only dedicated to the user, it ensures the customer's service continuity while taking into account the quality application requirements, customers, and network in the form of established policies or information obtained by the user services. It appears as an ITHC component on the client side, interfacing directly with another unit at the network virtualization layer. If a handover is needed,
this module will start the process among linked tunnels using applicable internet protocols.

![Software Diagram for the Virtual Network Layer](http://www.webology.org)

**Fig. 2: The Software Diagram for the Virtual Network Layer**

### 3. Difference between 4G and 5G
To begin, while LTE-based 4G networks are increasingly being implemented, 5G networks are mostly comprised of research papers and pilot projects. b) Up to 4G, mobile systems mostly focused on raw bandwidth utilization, whereas 5G seeks to develop extensive connectivity to lay the framework for speedy and dependable Internet connectivity for Internet users, whether they are on the top of a tower or below in a subway station. Although the LTE standard contains an MTC variant for IoT traffic, 5G systems are being created from the ground up to accommodate MTC-like devices. To put it another way, 5G will be designed to support a wide range of applications, including IoT, connected wearables, virtual reality, and interactive gaming. The 5G network, unlike its 4G brother, will be able to handle a high number of smart devices as well as a range of traffic types. 5G, for example, will allow for ultra-fast connections for HD streaming video as well as low-data-rate connectivity for sensing devices.
Fig. 3. The architecture of 5G applications.

New designs such as cloud RAN and virtual RAN will be pioneered by 5G networks in order to support a more centralised network setup and make the greatest use of server farms via localised data centres at the network edges. Finally, 5G will be the first to use cognitive radio technologies, which will allow infrastructure to automatically select the type of channel to be transmitted, discriminate between stationary and mobile objects, and adapt to various conditions. In other words, 5G networks would be able to provide both commercial Internet and digital apps at the same time.

<table>
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<tr>
<th>Specifications</th>
<th>4G</th>
<th>5G</th>
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<tr>
<td>Core networks</td>
<td>All IP Network</td>
<td>5G network interfacing, Flatter IP network,</td>
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<tr>
<td>Data Bandwidth</td>
<td>3Mbps to 2Gbps</td>
<td>2Gbps and higher, depending on the situation</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>3 to 9 GHz</td>
<td>4 to 299 GHz</td>
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<tr>
<td>Full Form</td>
<td>4th Generation</td>
<td>5th Generation</td>
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<td>Handoff</td>
<td>Vertical &amp; Horizontal</td>
<td>Vertical &amp; Horizontal</td>
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<tr>
<td>Multiple Access</td>
<td>CDMA</td>
<td>BDMA, CDMA,</td>
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<tr>
<td>Service</td>
<td>Wearable devices, HD streaming, and worldwide roaming are all examples of dynamic information access.</td>
<td>Any user demand, such as dynamic internet connectivity, wearable gadgets, HD streaming, etc.</td>
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3.1. Optimising The Antenna Design Of A Mobile Device
A mobile device antenna should be tiny and light enough to fit into the restricted area available in the design of a phone app. Because they are tiny, powerful, and efficient, PIFA are a great option for communication devices. These antennas can span a wide range of frequency bands for cellphones, WiFi, and Bluetooth® technologies, making them ideal for IoT-compatible items and devices.

Figure-4. A planar inverted-F antenna in a mobile device is modelled.
Because of the short downlink frequency band, this antenna could be represented using PEC limits for modelling. The losses on the metal are negligible due to the copper layer's strong conductivity. To absorb its outgoing energy, the PIFA is modelled in a spherical domain surrounded by matched perfectly layers. The PIFA is excited and its impedance is evaluated using the lumped port, which has a reference resistance of 50. We generated the field dispersion plot for the PIFA using simulation. The field is high at one side of the metallic surface near the top of the structure, far from the feed strip, according to the results. These are the figures.

**Figure-5. The electric field dispersion is plotted at the top of the PIFA as a result.**

The polar-formatted far-field antenna array is also calculated in the simulation. Because the antenna is now downsized and situated on only one point of the dipole antenna, the azimuthal diffraction pattern is no longer omnidirectional. VSWR is less than 2:1, as seen by the S-parameters. This indicates that the antenna input resistance is well suited to the reference resistance, a common network tester result.
Figure-6. The AWS downlink wavelength range's S-parameters are determined.

We may examine the model in a 3D radiation distribution to illustrate maximum radiation and null, in addition to the findings of 2D far-field calculations.

Figure-7 The PIFA's far-field radiation pattern in three dimensions.
Conclusions:
In this study, the transmission of wireless cellular operators from the current 4G to the upcoming 5G wireless cellular operators was addressed. Because upcoming mobile phones have more storage and computing capability, the move from 4G to 5G is crucial. As a result, applications will require high throughput will benefit; but, present 4G mobile network design will be unable to provide the data rates needed by these applications, forcing a complete architectural shift. This new design could be demonstrated through 5G wireless cellular operators. The 5G wireless operator offers much higher data rates than earlier 4G networks. 5G mobile phones have low energy consumption in addition to the high data rates, which helps with pervasive computing by letting individuals to connect to channel access inventions at the same time, such as 5G networks or WiFi, and to relocate from one connect technology's scope to the other without losing internet connectivity. As a result, the 5G mobile phone network outperforms the 4G mobile network in a number of ways. This article covers the requirements for 5G technology, which is expected to be available in 2020, and states the facts acquired from numerous ongoing studies in the field, such as requirements, design, and so on. The future components of 5G technology and architecture, with a focus on functionality, are thoroughly detailed. The contrasts between 5G and 4G networks were also examined.

References:


