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A Review Paper on Mobile Cloud Computing in 5G

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Abstract: *Mobile computing, wireless networks, and cloud computing are three technologies that are merging to form the Mobile Cloud Computing area, which is quickly expanding (MCC). MCC services are predicted to experience a period of rapid development due to the drastically expanded capacity of 5th generation (5G) mobile networks, and to become a new hotspot of mobile services. MCC is expected to have a significant impact on people's employment routines and lifestyles in a future networked society. The majority of Internet users will access faraway servers via networked devices to employ cyberspace-based applications. MCC will have a significant impact on practically every area of our future digital lives, thanks to upcoming applications allowed by 5G.*

Keywords: Mobile Computing, 5G.

I. INTRODUCTION

Mobile Cloud Computing is a service that combines cloud computing, mobile computing, and wireless networking. This all-in-one bundle gives cell phone users, network operators, and cloud technology suppliers access to massive computational capabilities. Another goal of Mobile Cloud Computing (MCC) is to provide rich mobile execution on mobile devices with the best user experience possible (UI). Processing is done in the cloud, data is saved in the cloud, and mobile devices serve as display media in Mobile Cloud Computing (MCC).

The software that is developed to be accessible over the internet by various portable computing devices is known as a mobile cloud application. There are two sorts of mobile cloud applications that are nearly identical. Mobile Cloud Apps and Mobile Web Apps are the two types of mobile apps. Both of them run on the mobile device's external server, and data is stored externally and accessed through the Internet using a browser in both circumstances. Google's Android, Apple's iOS, RIM BlackBerry, Symbian, and Windows Mobile Phone are just a few of the Smartphone operating systems available. Third-party cloud applications are supported by each of these platforms.

Cloud computing will undergo a significant transformation as a result of 5G. The impending fifth generation (5G) technology was the focus of most of the debate during the Mobile World Congress in February. The network and communications business are predicted to be transformed by 5G, which will provide ultra-fast transmission speeds up to 100 times quicker than current 4G.

II. WHAT IS MOBILE CLOUD COMPUTING

Cloud computing is used to offer programmes to mobile devices via mobile cloud computing. The term "mobile cloud" refers to cloud-based data as well as mobile-specific applications and services. It blends mobile app development with cloud-based services, allowing cloud services and apps to be delivered to mobile consumers. A custom mobile cloud app is a software programme that combines cloud and local components in a seamless manner. Data is stored in remote data centers, and the programmes run from there. To work, cloud-based mobile apps require an internet connection.

Data is stored and computations are performed in the cloud. As a result, more devices can run apps because the device itself isn't using valuable resources. Cloud services are used to build (and update) mobile cloud apps using MCC. After that, the apps are remotely deployed to mobile devices. These mobile devices may run on different operating systems and have varied data storage capacities. MCC enables users to access programmes that they might not have been able to access otherwise due to device limits such as storage.

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Mobile consumers, mobile network operators, and cloud computing providers can access MCC's extensive computational resources. The use of cloud computing, mobile computing, and wireless networks enables the execution of rich mobile applications on a variety of mobile devices.

III. 5G TECHNOLOGY

The fifth generation of cellular networks is known as 5G. People and businesses will have never-before-seen potential thanks to 5G, which is up to 100 times quicker than 4G. Increased bandwidth, ultra-low latency, and faster connectivity are expanding civilizations, revolutionizing industries, and radically improving day-to-day experiences. E-health, networked vehicles and traffic systems, and advanced mobile cloud gaming were formerly considered futuristic. We can contribute to a brighter, safer, and more sustainable future with 5G technology.

5G uses the same radio frequencies that your smartphone, Wi-Fi networks, and satellite communications utilize now, but it allows technologies to travel far further. Aside from the ability to download a full-length HD movie to your phone in seconds (even from a busy stadium), 5G is all about linking things everywhere – consistently and without lag – so people can measure, understand, and manage things in real time. Since the initial generation of mobile technology, a lot has changed.

- Briefcase-sized phones and quick chats between a small number of professionals characterized the 1G period.
- The demand for mobile services developed rapidly in the years leading up to 2G and never stopped.
- Pocket-sized phones, SMS, and mobile internet access were all characteristics of the 3G era.
- We have cellphones, app shops, and YouTube thanks to 4G.
- 5G is now fully transforming both our professional and personal life by enabling new use cases such as connected vehicles, augmented reality, and better video and gaming.

5G will do a lot more than just speed up your network connection. It opens up new possibilities for us, allowing us to develop ground-breaking solutions that benefit society as a whole. Imagine billions of linked gadgets collecting and exchanging data in real time to reduce traffic accidents; or life-saving applications that can take off thanks to lag-free assured connections; or production lines that are so predictive that they can eliminate interruptions far before they happen.

IV. 5G WILL ACCELERATE

Cloud computing will undergo a significant transformation as a result of 5G. The impending fifth generation (5G) technology was the focus of most of the debate during the Mobile World Congress in February. The network and communications business is predicted to be transformed by 5G, which will provide ultra-fast transmission speeds up to 100 times quicker than current 4G.

By the first half of this year, the first commercial 5G devices will be available. According to a recent Ericsson Mobility research, there will be 1 billion 5G subscriptions in 2023, accounting for approximately 20% of all mobile data traffic. The benefits of 5G will be felt across a wide range of businesses. From healthcare to automotive, smart homes to smart cities, and beyond, 5G's features transform the environment, enabling for a variety of applications that 4G couldn't manage. Cloud services will be in higher demand as the number of possible sectors, both tech and non tech, grows. Wearable gadgets, for example, that lack sufficient internal storage and must rely on synchronized bigger devices such as smartphones will be able to work independently thanks to 5G's low to nil latency [1].

Businesses can take advantage of the communication potential in a variety of ways. IBM and Vodafone, for example, recently signed a B2B (Business-to-Business) partnership geared at cloud hosting, with another half delivering solutions in a variety of domains, including IoT, AI, and other 5G-beneficial applications. In essence, 5G is a welcoming force for cloud-dependent industries and cloud industries themselves. The widespread use of fifth generation technology to a variety of advances will drive cloud business investment.

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V. The Impact Of 5G On Mobile Cloud Computing

5G, with its promised high-speed, low-latency capabilities, is arrived, and with it comes a slew of exciting cloud computing advances. It is a near-future technological windfall that cannot be overstated, as 5G's impact on the ability to create, store, use, and exchange data will be felt across most corporate sectors, particularly those that leverage IoT, AI, and machine learning. As innovation drives and generates additional technology applications for digital business transformation, 5G will also change the role that cloud computing and networks play in storing, transporting, and accessing data.

Cloud computing has been an essential aspect of sustaining healthy IT infrastructures during the last ten years, as organizations expect better, faster collaboration and productivity from their scattered workforce. The cloud has shown to be a great workaround for universally sluggish network rates, allowing for easy transmission and sharing of huge files between devices while simultaneously providing backup and recovery services to protect that data in the event of a cyberattack or natural disaster.

With the launch of independent 5G networks expected in 2021, the cloud will be given a new lease on life. Mobile devices will be able to easily transport massive amounts of data thanks to 5G. To manage the rise in storage required for these devices to hold the avalanche of data, the cloud and its various architectures (hybrid, on-premises, and public) will be required. This is especially true for businesses, forcing cloud providers to increase storage capacity and change costs correspondingly. Edge computing and the Internet of Things (IoT) are the twin engines of Industry 4.0, the fourth iteration of the Industrial Revolution, which will see automation and smart technology transform manufacturing practices, allowing for autonomous cars, smart cities, telehealth care, and better data analytics. Network congestion is nearly unavoidable at the moment, with 20 billion IoT devices in use and other future-forward technologies demanding low latency for key processes. By localizing the processing and storage of their systems, 5G and edge computing are poised to set each of these technologies on new paths of innovation.

A variety of industries, particularly cloud enterprises, will benefit from the combination of 5G with cloud technology, which will increase capacity, functionality, and flexibility. This combination will enable network operators to provide competitive services that non-cellular IoT (Internet of Things) network providers won't be able to match. These advancements will open up a slew of new investment prospects for cloud enterprises. Here are some of the ways that 5G's improved cloud technology will assist various inventions.

- Analytics and streaming data: To support the required storage, present Big Data processing technology makes use of cloud infrastructure. However, with today's wireless networks, systems still face significant latency difficulties when performing streaming analytics on Big Data. Because 5G networks are expected to be incredibly fast, real-time streaming issues will be considerably reduced.
- Industrial Internet of Things (IIoT): Processing and analyzing vast amounts of sensor data in realtime is critical for meaningful insights to control cost and efficiency in industrial use cases like supply chain management and process manufacturing. Given the remote and changeable nature of these workloads, 5G has the potential to lower the cost of Big Data research while also increasing its effectiveness [2].
- Computing at the edge: The performance of mobile and remote devices is greatly impacted by 5G. Remote systems relying on sensors, such as position tracking apps, home automation systems, and voice assistants, will use 5G to send 10 times more data than 4G networks.
- Artificial intelligence (AI) and natural language processing (NLP): - As more businesses use AI and NLP, they will need to be able to analyze and manage massive amounts of data. Most cloud computing service providers have the requisite processors and storage, but their real-time data intake skills need to be improved. For AI and NLP based apps to perform well, 5G will deliver the requisite degree of data transmission.
- Virtual reality (VR) and augmented reality (AR): 5G will significantly improve the quality of VR and AR applications, bringing new ideas to industries like retail, travel, and healthcare [3].

VI. Issues In Mobile Cloud Computing

Following issues are faced by MCC applications:

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- Availability
- Bandwidth
- Heterogeneity

6.1 Availability

Availability can be defined as whether something that we want to use is available or not. In MCC the availability is defined as to access the channel when it is required for the communication. The access failure of the network by the user is known as the unavailability. When we consider the MCC, there is no guarantee to access the network. Major features of availability are response time, cost, utilization, error rate, and network accuracy. If the response time will be decreased then it might increase the cost.

The network accuracy worsens by the radio interference. Due to this the throughput is also affected and remains low. So, it is the responsibility of the network management to compensate these factors. The mobiles did not have the high accuracy as compared to non-mobile devices. When the accuracy is disturbed the throughput is also affected. In recent years, some technologies were introduced which provide low error rate, network accuracy for the users. The demand of the Radio channels is too high but the accuracy is also suffered by the radio meddling. Due to this radio meddling, availability of the channel is disturbed. Another problem due to which availability is affected, is the utilization. Therefore, the availability is the main problem that is faced by the users[4].

6.2 Bandwidth

When signals from different resources travel in parallel at high speed, it is known as bandwidth. Bandwidth is the main problem of mobile communications. When the bandwidth is low the speed of the signals automatically decreases. But if we compress our data before sending on the channel, its utilization can be improved. The bandwidth utilization relay on the data that has been sent on the medium. If large data is transferred on the medium then it surely increases the latency and decreases the efficiency. The bandwidth problem is still present in 3G and 4G. The bandwidth of the wireless networks is lesser than the wired systems, as the capacity of the network depends on users of the network, and this capacity is measured by the bandwidth per cubic meter. So, the number of mobile users increases with time and they want to use more applications on their mobile. It affects the performance as the available bandwidth is not enough that can be used for these services. In previous generations of the network, lower bandwidth was available due to which the user was not facilitated by the services that were provided. Although in previous generations this problem was solved but still exists at some level [5].

6.3 Heterogeneity

Heterogeneity is a term used to describe how different cells and access technologies function together in mobile communication. While HetNets (Heterogeneous Networks) are described as when computers and other devices with diverse protocols and operating systems are connected for resource sharing.

VII. Future Of MCC In 5G

The cloud computing sector will benefit greatly from 5G technology. This is because most technological breakthroughs are more efficient when they are cloud-based. With its low to zero latency, 5G improves that integration, resulting in better connections. This technology has a wide range of applications in a variety of industries. The cloud is a helpful area for non-device storage in anything from healthcare applications to autonomous vehicles, and even down to wearables and mobile apps. These technologies will perform better if they leverage the cloud and have 5G connections. Cloud-based products and services should improve in terms of reliability, speed, and efficiency.

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