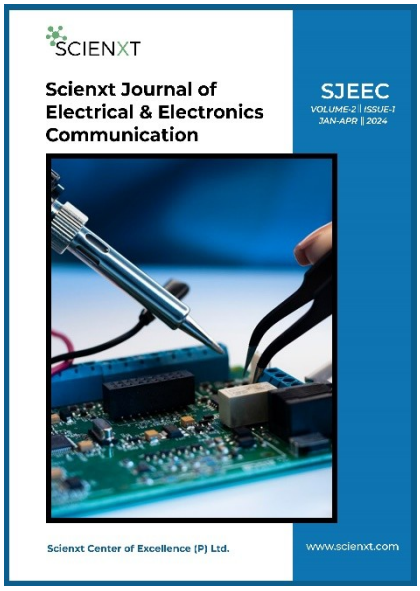

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A review paper on challenges and requirements in 5G technology for mobile communication

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Abstract:

The primary focus of this study is to advance mobile communication through the utilization of 5G technology. Previous research endeavors in global mobile communication, utilizing 5G technology, have significantly contributed to its development, spanning various approaches encompassing both hardware and software innovations. While 4G technology currently fulfills requirements, its adequacy may diminish in the forthcoming five to ten years, failing to meet the demands of emerging applications. The advent of 5G promises to augment data rates, diminish end-to-end latency, and enhance coverage, particularly benefiting applications associated with the Internet of Things (IoT) and Device-to-Device (D2D) communication, integral components of the evolving 5G architecture.

This paper's principal contribution lies in elucidating the essential aspects of mobile communication facilitated by 5G (Fifth Generation) technology, which primarily caters to consumer needs. Within the realm of 5G technology, paramount importance is placed on enhancing the mobile consumer experience, prioritizing their requirements above others. The advent of 5G technology heralds a paradigm shift, offering consumers unparalleled bandwidth capabilities, thus ushering in a new era of technological prowess. With its myriad advanced features, 5G technology emerges as the preeminent force shaping the future landscape of communication technology.

Keywords:

5G Technology, GSM, WLAN, LTE, PLMN

1. Introduction:

In recent years, there have been notable advancements in mobile and wireless networks. Currently, many mobile phones are equipped with WLAN adapters, and it is foreseeable that in the near future, Wax adapters will become commonplace alongside existing 3G, 2G, WLAN, and Bluetooth adapters. Our study focuses on the integration of IP across different generations, including 2.5G or 3G Public Land Mobile Networks (PLMN) on one side and WLAN on the other.Regarding 4G, the primary objective is the seamless integration of cellular networks like GSM and 3G. While there has been significant progress in accommodating multiple consumers' needs in 4G networks, challenges persist in establishing private security mechanisms and supporting the operating system in wireless test techniques. Despite this, the combination of different wireless networks, such as PLMN and WLAN, is currently in practice. However, there is still no integration of dissimilar wireless access technologies for simultaneous sessions, such as FTP downloads, from a single terminal. The anticipated Open Wireless Architecture (OWA) aims to provide accessible baseband processing modules with open interface parameters. OWA pertains to the MAC/PHY layers of future (4G) mobiles Novel error-control schemes can be sourced from the Internet, with a focus on enhancing customer terminals as part of the 5G mobile network evolution.5G terminals are expected to feature software-defined radios and modulation schemes, granting access to various wireless technologies concurrently. Additionally, 5G mobile terminals should adeptly merge specialized flows from different technologies. These terminals will play a crucial role in selecting the optimal mobile access network provider for a given service. The network's reliability in managing user mobility will be paramount. The paper presents the concept of a smart Internet-enabled phone, where the mobile device has the ability to prioritize optimal connections.

2. Transitioning from 4G to 5G: overcoming the challenges

Currently, "5G" is not an officially designated term for any specific specifications. It represents the upcoming standard release beyond 4G and LTE by 3GPP. "5G Technology" is a label commonly used in various research papers and projects to denote the next major phase of advancements in mobile communication, surpassing the standards set by 4G. The implementation of standards under the 5G framework is anticipated to occur around the year 2020.

The following are the primary limitations when transitioning from 4G to 5G.

2.1. Multi-mode user terminals:

The challenge posed by 4G can be addressed through the implementation of a software radio approach. This necessitates the design of a unified user terminal capable of functioning across diverse wireless networks, overcoming design constraints such as device size limitations, cost, and power consumption.

2.2. Selection among different wireless systems:

Each wireless system possesses unique attributes and functionalities. Optimal technology selection for a particular service, in a specific location, and at a precise time is determined by aligning with consumer Quality of Service (QoS) requirements, ensuring the best possible fit.

2.3. Security measures:

Designing security mechanisms with adaptive, reconfigurable, and lightweight protection is imperative.

2.4. Network infrastructure and quality of service (QoS) Support:

The challenge lies in seamlessly integrating existing non-IP and IP-based systems while ensuring Quality of Service (QoS) assurance for end-to-end services that span across different systems.

2.5. Charging and billing:

Accumulating, managing, and consolidating consumers' account information from multiple service providers poses significant challenges. Additionally, billing consumers accurately is a complex task. Application-level software attacks can introduce new features for consumers but may also introduce new bugs.

2.6. Jamming and spoofing:

Criminals may exploit these techniques. Jamming involves a transmitter emitting signals at the same frequency, disrupting GPS signals. Spoofing entails the transmission of fake GPS signals, causing GPS receivers to compute incorrect coordinates. Data encryption is crucial; if a GPS receiver communicates with the main transmitter, the communication link between them can be vulnerable to interception, highlighting the importance of encrypted data usage.

3. Essential concepts in 5G technology:

In planning for a seamless transition to 5G, it is evident that it must accommodate all types of radio access technologies. This approach not only enhances revenue opportunities for existing global operators but also facilitates improved interoperability.To ensure the suitability of 5G across diverse radio access technologies, specific fundamental aspects of 5G technology should be taken into account, including:

1. Referred to as the "REAL Wireless World," 5G represents a revolutionary advancement in wireless communication, characterized by minimal limitations. It introduces additional features such as multimedia newspapers and the ability to watch TV programs with the same clarity as that of an HD TV.
2. With data transmission speeds significantly faster than previous generations, 5G is poised to establish a nearly perfect real-world wireless environment, often referred to as the "WWWW" or World Wide Wireless Web.
3. The advent of 5G heralds a truly wireless world devoid of access limitations and geographical constraints, facilitating the integration of wearable devices with advanced AI capabilities.
4. Leveraging Internet Protocol version 6 (IPv6), 5G assigns visiting care-of mobile IP addresses based on location and the connected network, enhancing mobility and connectivity.
5. 5G aims to establish a unified global standard and persistent networks that enable ubiquitous computing. Users can seamlessly connect to multiple wireless access technologies, including 2.5G, 3G, 4G, or 5G mobile networks, Wi-Fi, PAN, or any future access technology. This concept may evolve in 5G to support multiple concurrent data transfer paths].
6. Cognitive radio technology, also referred to as smart-radio, embodies dynamic radio resource management accomplished in a distributed manner. It relies on software-defined radio, enabling various radio technologies to efficiently share the same spectrum by dynamically identifying unused spectrum and adjusting the transmission scheme to accommodate the requirements of the technologies sharing the spectrum. For further exploration, refer to the IEEE 802.22 standard for Wireless Regional Area Networks.
7. High-altitude stratospheric platform station (HAPS) systems

4. Characteristics of 5G technology:

The emergence of 5G technology marks a significant revolution in the mobile market. With 5G, worldwide cellular phone usage becomes a reality. The advent of cell phones resembling PDAs enables users to carry their entire office within their fingertips or on their phones.

5G technology boasts remarkable data capabilities, capable of seamlessly integrating unlimited call volumes and infinite data broadcasting within the latest mobile operating systems. Its promising future stems from its ability to leverage cutting-edge technologies and provide invaluable handsets to customers, potentially dominating the global market in the days to come.

Furthermore, 5G technologies exhibit remarkable capabilities in supporting software and consultancy services. The router and switch technology employed in 5G networks ensures high connectivity .Deploying 5G technology enables the distribution of internet access to nodes within buildings, facilitating seamless integration with both wired and wireless network connections..The current path of 5G technology indicates a bright future ahead.

The following points highlight the key characteristics of 5G technology:

- 5G technology will offer high-resolution capabilities to meet the demands of enthusiastic cell phone users, as well as support bidirectional large bandwidth shaping..
- The enhanced billing interfaces of 5G technology will enhance its attractiveness and effectiveness.
- 5G technology will offer subscriber management tools for swift actions.
- High-quality services of 5G technology will be based on policies to mitigate errors.
- 5G technology will enable large-scale data broadcasting in Gigabit, accommodating approximately 65,000 connections.
- 5G technology will provide a transporter-class gateway with unparalleled consistency.
- Traffic statistics provided by 5G technology will enhance accuracy.
- Through remote management facilitated by 5G technology, users can access faster and better solutions.
- Remote diagnostics will be a prominent feature of 5G technology.
- 5G technology will deliver connectivity speeds of up to 25 Mbps.

- Support for virtual private networks will be available with 5G technology.
- The introduction of new 5G technology may disrupt the delivery service industry.
- Both uploading and downloading speeds will reach their peak with 5G technology.
- 5G technology networks will offer improved and readily available connectivity worldwide.

The advent of 5G technology is imminent, poised to challenge traditional computers and laptops, impacting their market value. The telecommunications industry has witnessed significant advancements from 1G to 4G, with 5G promising further enhancements. While affordable 4G technology is currently available in the market, 5G offers even higher peak speeds and reliability compared to its predecessors.

5. Requirements of 5G technology:

Due to the combination of these requirements, various industry initiatives aimed at 5G development have identified a set of following essential prerequisites.

1. Achieving 1-10 Gbps connections to endpoints in the field (actual performance, not just theoretical maximum).
2. Ensuring 1 millisecond end-to-end round trip delay (latency).
3. Providing 1000 times more bandwidth per unit area.
4. Supporting 10-100 times more connected devices.
5. Ensuring a perception of 99.999% availability.
6. Ensuring a perception of 100% coverage.
7. Achieving a 90% reduction in network energy usage.
8. Enabling up to ten years of battery life for low-power machine-type devices.

Considering that these requirements emerge from various perspectives, they do not form a fully coherent list—it's difficult to envision a new technology capable of simultaneously meeting all these conditions.

6. Conclusion and future scopes:

In this paper, we have conducted a survey on mobile communications through 5G technology. 5G technology has been conceived as an open platform spanning various layers, from the physical layer up to the application layer. A new era in 5G technology is on the horizon, poised to challenge traditional computers and laptops, thus impacting their market value. Currently, ongoing efforts are geared towards units that offer optimal operating systems at minimal costs, catering to users who utilize one or multiple wireless technologies simultaneously on their 5G mobile phones. Significant advancements have been made in the realm of mobile communications, progressing from 1G, 2G, 3G, and 4G to the imminent 5G technology. 5G-enabled mobile phones will have access to different wireless technologies concurrently, and base stations should be capable of integrating diverse streams from various technologies seamlessly. The anticipation of affordable prices, superior performance, and enhanced reliability is already surrounding the upcoming 5G technology.With 5G technology, users will be able to stream HD TV channels on their mobile phones without any inconvenience, marking a significant advancement in mobile communication technology. The advent of 5G networks is set to usher in a new era in mobile communication, offering high-precision services to passionate consumers of mobile phones and tablet PCs. The landscape of mobile technology continues to evolve rapidly with the advent of 5G technology.

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