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LTE/LTE-A Based Advanced Wireless Networks

Shaikhul Arefin Khan [a++*], Md. Mokarram Hossain Chowdhury [b#] and Uthso Nandy [c]

[a] *Department of Electrical and Electronics Engineering, Stamford University Bangladesh, Bangladesh.*
[b] *Stamford University Bangladesh, Dhaka, Bangladesh.*
[c] *Department of Electrical and Electronics Engineering, Stamford University Bangladesh, Dhaka, Bangladesh.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

LTE/LTE-A is a wireless broadband standard that provides quick and reliable connectivity for the Internet of Things (IoT) and other connected devices. It is the de facto standard for 4G wireless, offering high-speed communication, extensive network coverage, and low latency. LTE/LTE-A networks are crucial for real-time IoT applications, offering high-speed data transfer, extensive coverage, low latency, and scalability. However, challenges in evaluating LTE/LTE-A-based wireless networks for IoT include compatibility, cost, power consumption, network coverage, and security. Large-scale deployments are hindered by cost, power usage, real-time data transfer, security vulnerabilities, and interoperability. Network performance may be impacted by high data

[++] *Associate Professor;*
[#] *Senior Lecturer;*
**Corresponding author: Email: arefinkhn@yahoo.com;*

traffic levels, expensive setup and maintenance, and interference from other wireless devices. LTE/LTE-A networks are complex and require sophisticated network technologies and protocols, making them difficult for some IoT stakeholders to build and administer.

Keywords: LTE/LTE; wireless networks; internet of things (IoT); network coverage.

1. INTRODUCTION

Compared to its forerunners, such as 3G and HSPA, LTE (Long-Term Evolution) is a wireless broadband standard created to offer quicker and more dependable connectivity. The LTE standard has been updated with LTE-A (LTE-Advanced), which provides faster data speeds and better performance. It takes advantage of innovative technologies including carrier aggregation, QoS, and IP (Internet Protocol)-based architecture. The Internet of Things, or IoT, is a network of actual things that are connected to one another and have sensors, software, and connection built in. This allows for real-time data-driven decision-making and optimization. By enabling real-time data-driven decision-making and optimization, the Internet of Things has the potential to change sectors like healthcare, manufacturing, and transportation. The de facto standard for 4G wireless is LTE/LTE-A technology, which offers high-speed wireless communication with extensive network coverage and low latency. The digital transformation goal toward a knowledge-based economy has made broadband into a basis for economic growth, job creation, global competitiveness, and a more intelligent populace. It enhances the delivery of healthcare services, reduces costs using health information technology, provides instructors and students with digital tools for efficient teaching and learning, and helps to increase government accountability and transparency. Additionally, it aids in the social advancement of societies outside of national borders. Most internet users in developing nations are fewer than one billion in rich countries, so the increase of mobile broadband penetration in developing countries is still slow. Rural areas and the impoverished are badly impacted by digital disparities within nations, frequently because of low- income potential. In most developing countries, wireless technology is the main way to access the Internet.

In most developing nations, wireless technology serves as the main access point to the Internet. The 3GPP created the Evolved Packet System (EPS) to provide higher-quality wireless communication services. To manage inter-symbol interference and boost data speeds, the LTE system uses multiple input multiple output (MIMO) and orthogonal frequency division multiple access (OFDMA) techniques. For the core network functions, an all-IP flat architecture was created to lower mobile network operators' capital and operational costs while maintaining the competitiveness of third-generation mobile technology [1-4].

2. BACKGROUND

It is essential to evaluate the performance of LTE/LTE-A-based wireless networks for the Internet of Things to make sure that these networks can meet the various and changing communication needs of IoT applications. LTE/LTE-A networks can provide the dependable and fast connectivity that the growing demand for IoT devices, which are anticipated to number in the billions in the future years, necessitates. While ensuring the effective use of network resources, these networks must be able to support these criteria. Performance evaluation aids in network parameter and configuration optimization for certain IoT applications. As IoT applications frequently handle sensitive and vital data, such as confidential information and financial data, Quality of Service (QoS) is another crucial component. LTE/LTE-A network performance evaluation aids in the evaluation of security measures. To maintain a secure and dependable communication environment for IoT devices, performance assessment of LTE/LTE-A networks helps to evaluate the security mechanisms of these networks. When evaluating the performance of LTE/LTE-A networks, competition is another crucial issue. To analyze LTE/LTE-A networks' viability for different IoT applications, performance evaluation allows comparisons to be made with other wireless communication technologies. Identifying potential performance bottlenecks and areas for development, as well as formulating plans for improving network performance and user experience, is feasible by having a thorough awareness of these background aspects. The original purpose of LTE and LTE-A, two wireless communication technologies, was to offer mobile smartphones and tablets high-speed data services. The foundation for IoT (Internet of Things) networks is also increasingly being employed with them, though. The ability to deliver wide-area coverage is one of LTE and LTE-A's key features. This capability is crucial for IoT applications that need connectivity across sizable geographic areas. In addition, LTE/LTE-A offers fast data rates, little latency, and dependable connectivity, all of which are crucial for real-time IoT applications like remote monitoring and control. High-speed data transfer, extensive coverage, low latency, and scalability make LTE/LTE-A a key technology for the Internet of Things (IoT). IoT devices can be installed in far-off or challenging-to- reach places thanks to its extensive coverage, which enables real-time data transfer and device connectivity. LTE/LTE-A also supports numerous access technologies, including licensed and unlicensed spectrum, enabling IoT devices to connect to the network via a variety of technologies, in LTE and LTE-A networks also provide several cutting-edge technologies that are perfect for Internet of Things (IoT) applications, like Quality of Service (QoS) assurances and Machine-to- Machine (M2M) communication. LTE and LTE-A provide an all-around reliable and adaptable framework for IoT networks, enabling a variety of devices and applications. LTE and LTE-A will probably play an increasingly significant role in connecting IoT devices to the Internet and enabling a wide range of new applications and services as the number of IoT devices keeps expanding including cellular, Wi-fi, and Bluetooth, depending on their needs [5-8].

3. CHALLENGES

There are many difficulties in evaluating the performance of LTE/LTE- A based wireless networks for IoT, including problem identification, data gathering, root cause analysis, and priority ranking. Setting specific goals for the network's performance, collecting information on important performance measures, and pinpointing root causes are all parts of problem identification. LTE/LTE-A is a potent technology for IoT, but it confronts several difficulties, including compatibility, cost, power consumption, network coverage, and security. Large-scale deployments are hindered by cost, and power usage can exhaust batteries in devices. Real-time data transfer and communication may be challenging due to poor or nonexistent network coverage. IoT devices are susceptible to security vulnerabilities since they frequently gather and transfer sensitive data, which makes them a concern. Another issue is interoperability because IoT devices may employ various. Network performance may be impacted by IoT devices' high data traffic levels. The expense of setting up and maintaining LTE/LTE-A networks can be expensive, which might prevent widespread deployments. Network reliability and performance might be impacted by interference from other wireless devices or networks. Another difficulty is that LTE/LTE-A networks are complex and need sophisticated network technologies and protocols, which may be difficult for some IoT stakeholders to build and administer. Another issue with IoT devices is compatibility; some of them might not function with LTE or LTE-A networks, which would restrict their connectivity possibilities. Despite these difficulties, LTE/LTE-A gives several opportunities for IoT applications, but it also has issues that must be resolved to reach its full potential [9-11].

4. PROJECT ARCHITECTURE

The high data speeds, low latency, and dependable connectivity of LTE/LTE-A based wireless networks make them a popular choice for enabling IoT applications. According to research, several variables, such as network architecture, radio access technology, QoS, spectrum allocation, network security, and interference control, have an impact on how well these networks perform in IoT applications. For LTE/LTE-A based wireless networks to operate well in IoT applications, network architecture is essential. Distributed architectures with fog-based core networks offer better scalability than centralized systems. The functionality of these networks may be impacted by radio access technologies like LTE-M and narrowband IoT (NB-IoT). The performance of LTE/LTE-A based wireless networks in IoT applications depends on Quality of Service (QoS), with dynamic QoS allocation enhancing network efficiency and lowering latency for time-sensitive IoT applications. The performance of wireless networks based on LTE/LTE-A in IoT applications is heavily influenced by spectrum allocation. Spectrum sharing can increase network capacity and reduce interference, whilst dynamic spectrum allocation can increase the flexibility and effectiveness of the network. LTE/LTE-A based wireless networks on the Internet of Things place a high priority on network security, with secure key management enhancing network dependability and lowering the chance of security breaches. In IoT applications, managing interference is another crucial component of LTE/LTE-A based wireless networks. Beamforming and power regulation are two examples of innovative approaches that increase network capacity while minimizing interference. An in-depth knowledge of these parameters is needed to maximize the performance of LTE/LTE-A based wireless networks for IoT applications. A report detailing the study topic, objectives, methods, data collection and analysis, results, and recommendations is written as part of the work plan, which also includes creating an experimental setup, gathering data, evaluating the data, drawing conclusions, and offering recommendations. Different configurations of LTE/LTE-A networks are possible, and each has advantages and cons of its own. Examples include carrier aggregation, MIMO, tiny cells, frequency division duplexing (FDD) vs. time division duplexing (TDD), and configurations unique to the Internet of Things. Each configuration comes with trade-offs in terms of complexity, cost, and performance, so network operators must carefully weigh their options to choose the one that will best suit their needs [11-13].

5. SCIO-ECONOMIC EFFECT

To evaluate the performance of LTE/LTE-A based wireless networks for IoT applications, it is necessary to identify the most important performance indicators, compare them to other wireless networks, pinpoint the variables influencing network performance, and offer suggestions for network optimization. These elements include mobility, device density, interference, and network structure. The evaluation offers insightful information about these networks' performance traits and aids in enhancing their functionality for a range of IoT applications. The assessment has substantial social and economic ramifications, including improved quality of life, higher productivity, expanded connectedness, infrastructure investment, economic growth, and the digital divide. These consequences raise questions about the digital divide and access to these technologies for all communities, but they can also result in better connectedness, improved productivity, economic growth, and infrastructure investment.

In conclusion, the performance evaluation of LTE/LTE-A based wireless networks for IoT applications has important social and economic ramifications, including improved connection, increased productivity, economic growth, infrastructure investment, and the digital divide. The development of these networks also prompts questions regarding the digital divide and how to ensure that all communities have access to these technologies [14-19].

6. CONCLUSION

The evaluation of the performance of LTE/LTE-A-based wireless networks for IoT applications is an important study area that offers important insights into network features, critical performance metrics, variables impacting network performance, and recommendations for network optimization. It also assesses how LTE/LTE-A networks perform in comparison to other wireless networks, enabling the choice of the best technology for IoT applications. The influence of network slicing, edge computing, resource allocation algorithms, machine learning and AI, and the impact of 5G on LTE/LTE-A in IoT should all be investigated in future study on this topic. Using network slicing, network operators can build virtual networks that can be tailored to certain IoT use cases within a single physical network infrastructure.

Resource allocation methods are essential for maximizing network performance and lowering congestion, while edge computing can lower latency and increase network efficiency. AI and machine learning can increase security, forecast faults, and increase network efficiency. It's crucial to assess how 5G will affect LTE/LTE-A on the Internet of Things because 5G networks include advantages including increased bandwidth, decreased latency, and increased energy efficiency. To assess the potential effects of 5G on LTE/LTE-A networks used for Internet of Things applications and to determine the optimal transition plan from LTE/LTE-A to 5G, more research is required.

In conclusion, more study is required to solve the difficulties and possibilities of LTE/LTE-A in IoT applications, create modern technologies, and develop new algorithms to improve network performance, cut down on energy use, and increase security.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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