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Role of 5G in IoT and WSN - A Review

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Abstract: - The evolution of high-speed wireless communication in the smart Internet of Things (IoT)-based network promises a number of advantages to consumers, including scalability, reliability, and analytics. The most significant difficulty in an IoT-driven network is the transmission of the massive amounts of data created by sensor devices, which will compromise the node's longevity owing to high communication power consumption. To achieve the greatest version of this technology, the research community is continually attempting to comprehend and address its issues. As a result, finding solutions for network-based crises involving energy conservation, dependable routing, congestion avoidance, network heterogeneity, security, and quality of service has become critical. Recent research has focused on improving the energy efficiency of sensor nodes in order to extend sensor life. This article covers a wide range of energy-saving protocols and techniques, including the IPv6 Routing Protocol for Low Power and Lossy Networks (RPL), Energy Harvesting, Bio-Inspired routings, Fuzzy Logic-based approaches, and Sustainable Computing.

Keywords: - Internet of things; Wireless Sensor Networks; Sustainable computing; Energy harvesting

1. Introduction

IoT is one of the most recent technologies in this period, paving the way for a variety of services and technical advancements. Identification, sensing, communication, processing, services, and semantics are all integrated into the system. There are several IoT applications that may be classified into categories such as healthcare, Smart Cities, Agriculture, smart meters, and so on. We now have a ubiquitous network environment, often known as Pervasive Networking. This allows smart items to be dispersed via a distributed infrastructure with wireless communication. Because of the rapid increase in the number of people moving to the city for work, there has been a significant increase in the use of smart devices such as sensors, smartphones, and smart appliances, all of which contribute to the Internet of Things' goal of connecting everyone and allowing anyone to exchange data over the internet.

The perception layer, which comprises devices such as sensors, actuators, and smartphones, is part of the traditional IoT architecture. An IoT system's endpoint is represented by these linked devices. The Network layer, also known as the connectivity or edge computing layer, allows smart devices to communicate with one another. Additionally, the acquired data is sent to a cloud platform for data processing, which includes mining, machine learning, and data reporting. Finally, the application layer interprets the data and displays it to end users in a graphical format, which aids business, decision-making, and collaboration by utilizing data collected via IoT computing. There are several IoT applications that use WSN as their underlying architecture. WSNs are now the subject of a lot of research and development. The most important factor to consider is energy efficiency.

The network lifetime is directly proportional to the node energy. The nodes' primary goal is to sense information about a physical phenomenon and turn it into signals that can be processed and studied further. Various operations like as communication, sleep, idle listening, control overhead, and collision use a significant amount of energy [1]. Transmission and reception require the most amount of energy of all the activities. WSN-based IoT applications are numerous and diversified, making people's daily lives simpler. Applications may be roughly classified into three domains: society-based applications, environment-based applications, and industry-based applications [2].

2. Role of IoT in WSN

Several research articles and studies have backed up significant categorization views and surveys of WSN and IoT-based energy-saving devices. Some of these great literary works are discussed in this part, which presents their primary topics and other categories designated by them:

The research [11] described the design and implementation of a solar energy-powered precision agricultural (PA) network with the WSN using IoT architecture to meet the need for developing highly effective approaches to manage a smart agriculture system. This system provides farmers with vital information on saltwater intrusions, soil moisture, water level, wet conditions, temperature, and the overall state of the land in a user-friendly and easy-to-access manner via real-time data transfers via IoT.

The Authors of [12] conducted research on IoT data collection and decision-making ideas. The Chaotic Whale Optimization Process was recommended in the research [13] as a way to improve energy use in WSN-IoT environmental activities. Energy efficiency outcomes were attained in comparison to other standard procedures. The findings showed that the proposed technique delivers greater energy efficiency in the WSN-IoT integrated system.

From the perspective of a WSN, a survey was conducted in [14] on delays, energies, jitters, throughput, and packet-delivery ratios (PDR), and the performance of routing protocols were tested using latencies, bandwidth, jitter, and delay. In the IoT, an algorithm was created to optimize AODV routing. For protocol optimization, two tables, namely the table of routing and the table of internet access, were consolidated into one. The major goal of this research was to look at simulation studies of the IoT AODV routing protocol and use the NS2 simulator to improve AODV and IoT AODV performance.

WSN-assisted IoT also has a number of constraints, making it impossible to employ classic routing protocols directly. For WSN-assisted IoT devices, energy is a critical restriction. More power is used to communicate among sensor nodes than is used for sensing and computing. As a result, to extend the network's life, appropriate energy management strategies are required. The author proposed an energy-conscious multi-user & Multi-Hop Hierarchical Routing Protocol (EAMMH-RP) in paper [15], which covers Communication with Multi-Hop, a novel sequence of algorithms for cluster adaptation and rotating, and a novel energy consumption reduction mechanism for long-range communications.

The sensors can track the atmosphere and send back data for a longer period of time. [16] Suggested a protocol that includes a robust routing mechanism for IoT sensor networks. Initially, a meeting place was constructed in the network field's centre. Clustering and multipath methods were used because they reduce energy consumption and increase dependability. The presented protocol was simulated in the Castalia simulator in order to achieve efficiency under various scenarios, including packet transmission, average energy use, end-to-end latency, and network lifetime.

In [17], the routing algorithms and models were examined in terms of succession characteristics such as minimizing latency, lowering energy consumption, and improving the data delivery ratio. The energy consciousness, latency, throughput, data transmission, and packet loss aware IoT and WSN algorithms were classified into two classes for classification. The paper [18] improved on the traditional routing protocol by introducing a revolutionary protocol with features such as a new data transfer mechanism and a more effective technique of CH selection. As a result, the WSN gap in the real world and the actual heterogeneous setting were linked. The conclusion of simulation demonstrated the discrepancy between present Hy-IoT and anticipated protocol using performance measures.

3. Challenges of WSN in IoT

Different heterogeneous artifacts exhibited and communicating in various situations add to the IoT's complexity and make security mechanism implementation even more difficult. Existing WSN security research focuses on solving subjective problems, rather than considering the influence of IoT concepts and characteristics, which are discussed in this document.

A. Real time management

It's a challenging problem for resource-constrained sensor networks. In such instance, smart data-driven middleware architecture and an efficient service gateway design in the IoT system are required to reduce the quantity of data to be communicated by continually evaluating user data and communicating real-time information only when readings exceed a threshold [19].

B. Security and Privacy

Safety, trust, and privacy are also essential considerations in real-world applications. The path to various levels of safety is both arduous and easy. These security solutions are appropriate for M_2M deployments in which the device and the server already have a trust relationship [20].

Sensor nodes with this "IP to the field" paradigm have extra tasks in addition to their typical sensor functions. As a result of this increased responsibility, the sensor nodes will face new responsibilities or problems. Security, service quality (QoS), and network configuration are three potential responsibilities that will be explored. The following issues are dealt with.

C. Quality of Service

All heterogeneous IoT devices must contribute to the quality of service provided to sensor nodes in terms of intelligence. This heterogeneous device allows for task distribution amongst nodes with resources available. Due to changeable network setups and connection properties, the current QoS techniques available on the Internet still require enhancement [21].

D. Configuration

Sensor nodes must manage a variety of responsibilities in addition to QoS management and security, such as networking for new nodes joining the network [22], ensuring self-healing by recognizing and eliminating faulty nodes, and addressing management for the construction of scalable networks, among others. However, self-configuring the most recent Internet node is not a standard feature. If this network configuration is to perform well, the user must install the relevant software and take proper precautions to prevent device failures.

E. Availability

The presence of hacked nodes can provide access to WSNs [23]. An additional expense would be levied to integrate an encryption algorithm for WSN security. However, researchers have devised significant ways, with some modifying and reusing code and others relying on supplemental communications to achieve their objectives. Aside from that, strategies for accessing the data have been developed. As a result, maintaining WSN operating services need availability. It also aids in the upkeep of the entire network till it is terminated.

F. Data Integrity

When a hostile node enters the network and injects incorrect data, or when a vacillating wireless channel corrupts the original data, WSN can be infiltrated [24]. For example, if a mobile node transmits fake data to packets received by the BS, the data integrity will be compromised. However, data loss or data tampering might be triggered by a defective network. As a result, data integrity must be maintained throughout the data packet transmission process.

G. Confidentiality

IoT security is complicated by a number of issues, the most important of which is confidence. The data is kept private by using encryption techniques such as the Blowfish; AES block cypher, and Triple DES [25], which use common and shared secret key encryption algorithms. However, as a security mechanism, encryption is insufficient to protect the privacy of data and information. The attacker can do a traffic analysis for the encrypted data in order to successfully disseminate sensitive information.

4. Data Aggregation

WSNs, as previously said, are critical IoT building blocks that have proliferated in a variety of real-time applications. WSN nodes are typically tiny, battery-powered devices. As a result, network lifespan is a significant issue for WSN data aggregation. Several issues, such as increased energy use, i.e. energy ineffectiveness, and longer lifetime, were discovered throughout the data gathering process [26].

To maintain acceptable service efficiency in the dissemination of sensed data, data aggregation algorithms are commonly utilized. The goal of the data collection is to efficiently incarcerate and disseminate data packets in order to reduce energy consumption, traffic congestion, network life, data consistency, and so on [27].

5. Conclusion

Advances in computer technology have aided the evolution of WSNs, which can sense the required parameters at any moment. In recent years, IoT-based WSN systems have gotten a lot of interest. Despite this, these systems have limited bandwidth, power, and resources when transmitting point-to-point. Data collection is an illustrious way for resolving this issue. How critical information may be handled in a more energy-efficient manner is a significant topic in sensor networks. As a result, several data aggregation methods were utilized to reduce power consumption, as discussed in this work. The existing works outlining the function of IoT in WSN are examined in this study, followed by a presentation of the various data aggregation methodologies provided in earlier works. The strategies for data aggregation are focused on network energy conservation, lifespan enhancement, higher QoS, and high-level security.

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