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### Patent Search

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#### Abstract:

[044] The present invention discloses a Quality-of-Service (QoS) aware resource allocation system for wireless sensor networks (WSNs) designed for critical applications, reliable, energy-efficient, and low-latency communication. The system comprises a traffic classification module that categorizes data into critical, semi-critical, and non-critical classes; a hybrid decision-making engine employing machine learning predictors and fuzzy logic inference; and a dynamic resource allocation unit that adaptively distributes bandwidth, channel slots, and power based on application requirements and network conditions. An energy-aware optimization module balances workload across nodes to extend network lifetime, while a cross-layer framework minimizes latency by enabling collaboration between the physical, MAC, and network layers. The invention enables differentiated QoS delivery, adaptability to network dynamics, and applicability across healthcare, industrial IoT, disaster management, and defense surveillance systems. Accompanied Drawing [FIGS. 1-2]

#### Complete Specification

Description:[001] The present invention relates to the field of wireless sensor networks (WSNs), and more specifically to a Quality-of-Service (QoS) aware resource allocation system and method designed to enhance performance, energy efficiency, and communication reliability. The invention particularly addresses scenarios in critical applications such as healthcare monitoring, industrial automation, disaster management, and defense, where uninterrupted communication, low latency, and adaptive prioritization of data are essential for mission success and safety.

#### BACKGROUND OF THE INVENTION

[002] Wireless Sensor Networks (WSNs) have emerged as a fundamental technology for real-time monitoring and control in diverse domains, including healthcare, industrial automation, smart cities, disaster response, and defense applications. These networks consist of spatially distributed sensor nodes that cooperatively collect, process, and transmit data to a central entity or gateway for further analysis.

[003] In mission-critical scenarios, the effectiveness of WSNs is highly dependent on their ability to provide reliable communication with stringent Quality-of-Service (QoS) guarantees. QoS requirements typically include parameters such as low latency, high packet delivery ratio, minimal jitter, and energy efficiency. However, conventional protocols and resource allocation strategies often fail to satisfy these requirements under dynamic and heterogeneous conditions.

[004] Existing resource allocation mechanisms in WSNs primarily focus on uniform distribution of bandwidth, power, and channel resources without considering application-specific requirements. This uniformity can cause severe inefficiencies, especially when life-critical or high-priority data competes with low-priority traffic, leading to packet delays, congestion, and degraded network performance.

[005] For instance, in healthcare monitoring applications, real-time transmission of patient vital signs such as ECG or oxygen saturation requires strict QoS compliance.

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