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# Analysis of Wireless Mesh Network Based on Access Nodes, Relay Nodes and Mobile Nodes: A Comparative Study

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**Abstract:** *This paper presents a comprehensive review and comparative analysis of Wireless Mesh Networks (WMNs) with a specific focus on Access Nodes (APs), Relay Nodes (RNs), and Mobile Nodes (MNs). The study systematically examines existing research to understand how different node types influence network architecture, routing mechanisms, communication performance, and overall network efficiency. Key comparison parameters considered in this review include throughput, end-to-end delay, packet delivery ratio, energy efficiency, scalability, and mobility support.*
*The review highlights major challenges associated with WMNs, such as multi-hop interference, mobility management, limited scalability, energy constraints, and quality-of-service degradation in dynamic network environments. By synthesizing findings from a wide range of prior studies, this paper identifies how the roles and interactions of APs, RNs, and MNs affect network performance under varying deployment scenarios.*
*The comparative perspective adopted in this review reveals significant research gaps, particularly in node-aware routing strategies, mobility-adaptive mechanisms, interference mitigation, and energy-efficient designs. The insights provided aim to guide researchers and practitioners toward more robust and efficient WMN solutions and identify promising directions for future research..*

**Keywords**: Wireless Mesh Networks, Access Nodes, Relay Nodes, Mobile Nodes, Routing Protocols, MAC Protocols, Network Performance

## I. INTRODUCTION

The evolution of wireless networking technologies has significantly influenced the design and deployment of modern communication systems. Early wireless networks were primarily infrastructure-based, relying on centralized access points and wired backhaul connections. However, increasing demands for ubiquitous connectivity, higher data rates, and flexible deployment have driven the transition toward more decentralized and adaptive networking paradigms, as illustrated in Figure 1.

Despite their widespread use, infrastructure-based wireless networks suffer from inherent limitations, including high deployment costs, limited scalability, and vulnerability to single points of failure. These constraints reduce their effectiveness in dynamic environments that require rapid deployment, fault tolerance, and flexible expansion, particularly in remote or underserved regions.

Wireless Mesh Networks (WMNs) have emerged as an effective solution to address these challenges. WMNs employ a multi-hop wireless architecture in which nodes cooperate to dynamically establish and maintain connectivity with minimal dependence on fixed infrastructure. Their self-configuring and self-healing capabilities enhance network robustness, coverage, and adaptability, making them suitable for applications such as rural broadband access, disaster recovery, and smart city deployments.

A distinguishing feature of WMNs is the diverse functionality of their constituent nodes. Access Nodes (APs) serve as gateways to external networks, Relay Nodes (RNs) forward data across the mesh backbone, and Mobile Nodes (MNs) introduce mobility and dynamic topology changes. The interaction among these node types significantly affects

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network performance in terms of throughput, latency, energy efficiency, and quality of service, underscoring the importance of node-centric analysis.

Although extensive research on WMNs exists, the literature remains fragmented, with limited comprehensive comparisons of the roles and performance impacts of different node types. To address this gap, this paper presents a comprehensive review and comparative analysis of Wireless Mesh Networks based on Access Nodes, Relay Nodes, and Mobile Nodes. The paper synthesizes existing studies to examine architectures, routing mechanisms, performance metrics, and application scenarios from a node-centric perspective, and identifies key challenges and open research directions to guide future investigations.

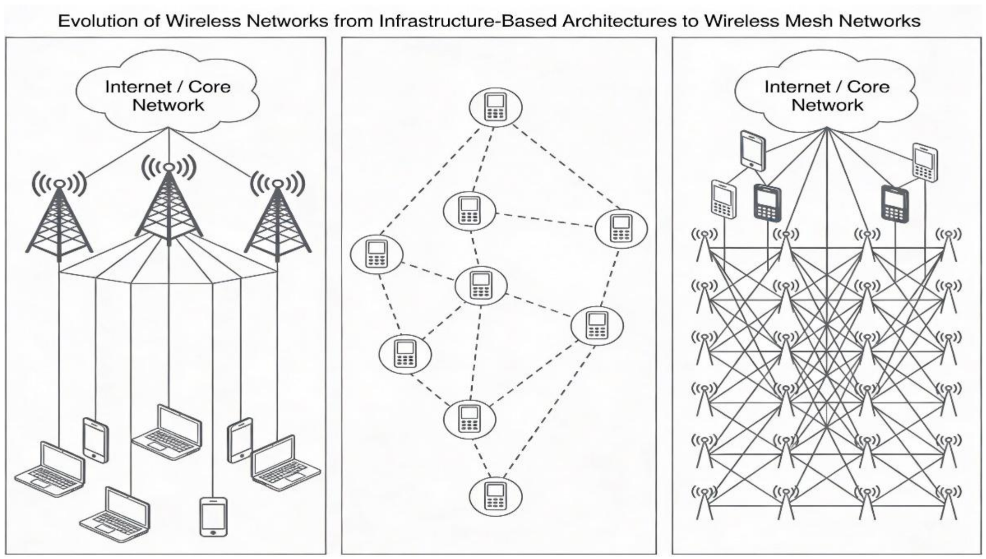


**Figure 1. Evolution of wireless networks from infrastructure-based architectures to Wireless Mesh Networks**

## II. WIRELESS MESH NETWORK OVERVIEW AND ARCHITECTURE

### 2.1 Definition and Characteristics of Wireless Mesh Networks

A Wireless Mesh Network (WMN) is a multi-hop wireless communication network composed of interconnected nodes that cooperate to forward data dynamically without relying exclusively on fixed infrastructure. Unlike traditional wireless networks that depend on centralized access points and wired backhaul connections, WMNs utilize peer-to-peer communication among nodes to establish multiple redundant paths for data transmission. This decentralized architecture enhances network robustness, scalability, and flexibility.

WMNs exhibit several defining characteristics that distinguish them from conventional wireless networks. One of the most significant features is multi-hop communication, where data packets traverse multiple intermediate nodes before reaching their destination. This capability enables extended network coverage beyond the transmission range of a single access point. Additionally, WMNs support dynamic routing, allowing the network to adapt to changing topologies, varying traffic conditions, and node mobility. Scalability is another key characteristic, as new nodes can be added to the network with minimal configuration effort. Furthermore, WMNs are typically heterogeneous, supporting a mix of stationary and mobile nodes, and often integrating multiple wireless technologies and interfaces within the same network.

### 2.2 Self-Healing and Self-Configuring Properties

One of the most critical advantages of Wireless Mesh Networks is their inherent self-healing and self-configuring capabilities. Self-configuring refers to the ability of network nodes to automatically discover neighboring nodes, establish communication links, and configure routing paths without manual intervention. This property significantly reduces deployment complexity and operational costs, particularly in large-scale or rapidly deployed networks.

Self-healing enables the network to maintain connectivity even in the presence of node failures, link degradation, or environmental disturbances. When a node or communication link becomes unavailable, WMNs can dynamically reroute traffic through alternative paths using adaptive routing mechanisms. This redundancy improves network reliability and resilience, making WMNs especially suitable for mission-critical applications such as disaster recovery, emergency response, and military communications. Together, self-configuring and self-healing properties allow WMNs to operate efficiently in unpredictable and dynamic environments where traditional infrastructure-based networks may fail.

### 2.3 Wireless Mesh Network Architecture Types

Wireless Mesh Networks can be broadly classified into three architectural categories based on node roles and connectivity patterns: Infrastructure WMNs, Client WMNs, and Hybrid WMNs. Each architecture offers distinct advantages and is suited to specific application scenarios.

#### 2.3.1 Infrastructure Wireless Mesh Networks

Infrastructure WMNs consist primarily of mesh routers that form a stable wireless backbone. These mesh routers typically have minimal mobility and are often equipped with multiple wireless interfaces to enhance connectivity and capacity. Access Nodes within the backbone serve as gateways, providing connectivity between the mesh network and external networks such as the Internet. Client devices, or Mobile Nodes, access the network through these mesh routers but do not participate directly in packet forwarding.

This architecture offers improved scalability, simplified routing, and better support for quality-of-service (QoS) requirements. Infrastructure WMNs are widely used in community networks, campus networks, and metropolitan area networks, where reliable backhaul connectivity and controlled deployment are essential.

#### 2.3.2 Client Wireless Mesh Networks

In Client WMNs, all nodes act as both hosts and routers, participating actively in packet forwarding and routing decisions. There is no dedicated mesh backbone; instead, client nodes collaboratively form the network topology. This fully distributed architecture maximizes flexibility and reduces deployment costs, as no specialized infrastructure nodes are required.

However, Client WMNs face challenges related to scalability, routing overhead, and energy efficiency, particularly in scenarios with high node mobility. Despite these limitations, client-based architectures are well-suited for small-scale, ad hoc, and temporary networks, such as those deployed in emergency response or military operations.

#### 2.3.3 Hybrid Wireless Mesh Networks

Hybrid architectures offer a balance between performance, scalability, and flexibility. They support high throughput and reliability while accommodating node mobility and dynamic topology changes. Consequently, hybrid WMNs are increasingly adopted in smart city deployments, large-scale IoT networks, and heterogeneous wireless environments.

| Architecture Type | Node Roles | Scalability | Reliability | Deployment Cost | Typical Applications |
|---|---|---|---|---|---|
| Infrastructure WMN | Dedicated routers + clients | High | High | Moderate–High | Campus, metro networks |
| Client WMN | Clients act as routers | Low–Moderate | Moderate | Low | Ad hoc, emergency networks |
| Hybrid WMN | Routers + client routing | High | High | Moderate | Smart cities, IoT |

**Table 1. Comparison of Wireless Mesh Network Architectures**

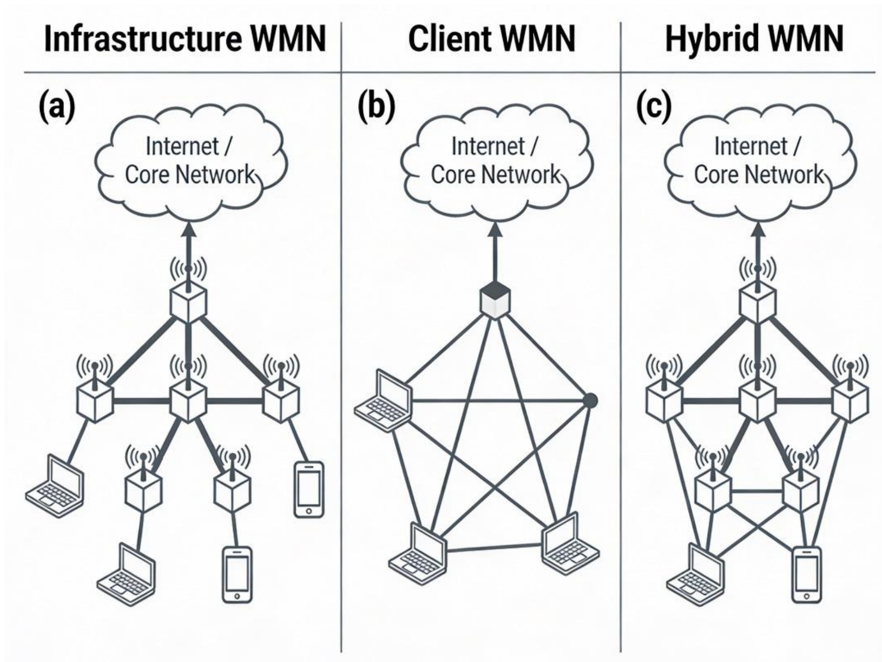


**Figure 2. Wireless Mesh Network architecture types:**
**(a) Infrastructure WMN, (b) Client WMN, and (c) Hybrid WMN**

### 2.4 Architectural Comparison and Discussion

The choice of WMN architecture significantly influences network performance, deployment complexity, and application suitability. Infrastructure WMNs provide high reliability and scalability but require careful planning and deployment. Client WMNs offer maximum flexibility and minimal infrastructure cost but may suffer from performance degradation in dense or highly mobile environments. Hybrid WMNs strike a balance by leveraging a stable backbone while retaining the adaptability of client participation.

## III. NODE CLASSIFICATION IN WIRELESS MESH NETWORKS

Wireless Mesh Networks operate through the coordinated interaction of heterogeneous node types, each performing distinct functions within the network. Access Nodes, Relay Nodes, and Mobile Nodes collectively determine network connectivity, performance, and adaptability. Understanding their roles is essential for node-aware network design and performance optimization.

### 3.1 Access Nodes

Access Nodes (APs) act as gateways that connect the wireless mesh backbone to external networks such as the Internet. These nodes aggregate traffic from multiple Relay and Mobile Nodes and forward it through wired or high-capacity wireless backhaul links. As a result, Access Nodes significantly influence network throughput, latency, and reliability.

Backhaul connectivity is a critical design aspect of Access Nodes. While wired backhaul offers high bandwidth and stability, it increases deployment cost and limits flexibility. Wireless backhaul reduces infrastructure dependency but introduces challenges related to interference and spectrum availability. Moreover, scalability remains a key concern, as increasing numbers of connected nodes can cause gateway congestion. To address this, multi-gateway deployment and load-balancing strategies are commonly explored in the literature.

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### 3.2 Relay Nodes

Relay Nodes (RNs) form the core of the wireless mesh backbone by enabling multi-hop packet forwarding between nodes beyond direct communication range. These nodes extend network coverage and support self-healing by providing alternative routing paths during link or node failures.

Interference and load imbalance are major challenges for Relay Nodes, particularly in dense deployments where simultaneous transmissions share limited wireless spectrum. Interference-aware routing, channel assignment, and power control mechanisms have been widely studied to mitigate these effects. Additionally, energy consumption is a critical issue, especially when Relay Nodes operate on limited power sources. Energy-aware routing and duty-cycling techniques are therefore essential to prolong network lifetime while maintaining performance.

### 3.3 Mobile Nodes

Mobile Nodes (MNs) represent end-user devices that access services through the mesh network and introduce dynamic topology changes due to mobility. Common mobility models, such as random waypoint and vehicular mobility, are used to study the impact of movement on network performance.

Mobility leads to frequent handoffs between Relay and Access Nodes, which can cause increased latency, packet loss, and throughput degradation if not properly managed. These dynamics directly affect Quality of Service (QoS), particularly for real-time and multimedia applications. Consequently, mobility-aware routing and adaptive QoS mechanisms are critical for maintaining reliable communication in WMNs.

### 3.4 Comparative Discussion

Access Nodes primarily affect external connectivity and scalability, Relay Nodes determine coverage and forwarding efficiency, and Mobile Nodes introduce mobility-related challenges that impact QoS. The interaction among these node types defines the overall performance and robustness of Wireless Mesh Networks, highlighting the need for node-centric design and optimization approaches.

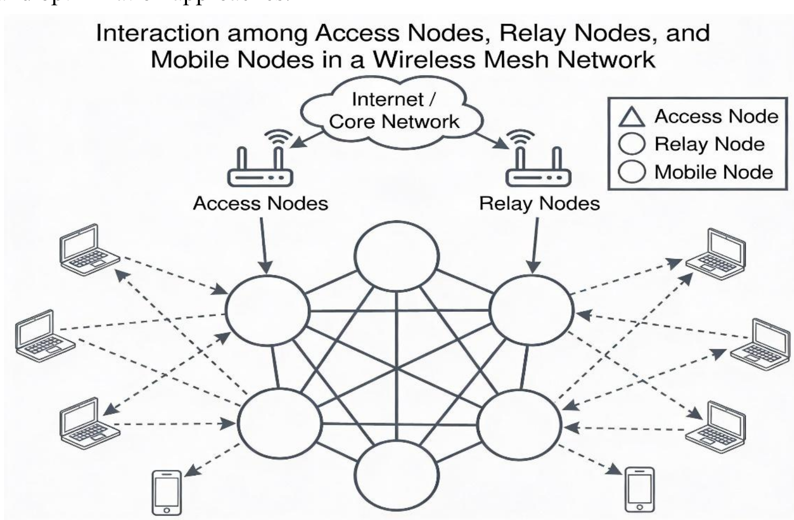


**Figure 3. Interaction among Access Nodes, Relay Nodes, and Mobile Nodes in a Wireless Mesh Network**

| Node Type | Primary Function | Key Challenges | Performance Impact |
|---|---|---|---|
| Access Nodes | Gateway & backhaul | Scalability, congestion | Throughput, latency |
| Relay Nodes | Multi-hop forwarding | Interference, energy | Coverage, PDR |
| Mobile Nodes | End-user access | Mobility, QoS | Delay, packet loss |

**Table 2. Comparison of Node Types in Wireless Mesh Networks**

## IV. ROUTING AND COMMUNICATION MECHANISMS IN WIRELESS MESH NETWORKS

Routing and communication mechanisms are fundamental to the performance and reliability of Wireless Mesh Networks (WMNs). Due to the multi-hop and decentralized nature of WMNs, efficient routing is required to manage data transmission among Access Nodes, Relay Nodes, and Mobile Nodes. Existing routing approaches in WMNs are broadly classified into proactive, reactive, and hybrid protocols, with recent studies emphasizing node-aware routing strategies to address network heterogeneity.

### 4.1 Proactive Routing

Proactive routing protocols maintain routing tables through periodic exchange of control messages. Optimized Link State Routing (OLSR) is a widely used proactive protocol in WMNs, particularly effective for relatively static nodes such as Access Nodes and Relay Nodes. OLSR enables low-latency data transmission by maintaining pre-established routes, but the continuous exchange of control information increases routing overhead and energy consumption, limiting its suitability for highly mobile environments.

### 4.2 Reactive Routing

Reactive routing protocols establish routes only when required, reducing control overhead in dynamic topologies. The Ad hoc On-Demand Distance Vector (AODV) protocol is commonly applied to scenarios involving Mobile Nodes. While AODV adapts well to frequent topology changes, the route discovery process introduces additional delay, which may degrade performance in latency-sensitive applications and dense mesh deployments.

### 4.3 Hybrid Routing

Hybrid routing protocols combine proactive and reactive strategies to balance responsiveness and overhead. The Hybrid Wireless Mesh Protocol (HWMP), defined in IEEE 802.11s, employs proactive routing within the relatively stable mesh backbone and reactive routing for mobile or dynamic nodes. This approach is well-suited for infrastructure and hybrid WMN architectures, though it introduces additional protocol complexity.

### 4.4 Node-Aware Routing Strategies

Conventional routing protocols often treat all nodes uniformly, overlooking differences in mobility, energy capacity, and traffic load. Node-aware routing strategies incorporate node-specific characteristics into routing decisions, improving load distribution, reducing congestion at Access Nodes, and enhancing route stability in the presence of Mobile Nodes. Such approaches have demonstrated improved throughput, reduced delay, and better quality of service in heterogeneous WMN environments.

**Table 3. Routing Protocol Comparison**

| Routing Type | Protocol | Best-Suited Nodes | Key Strength | Limitation |
|---|---|---|---|---|
| Proactive | OLSR | APs, RNs | Low latency | High overhead |
| Reactive | AODV | MNs | Adaptive routing | Route setup delay |
| Hybrid | HWMP | APs, RNs, MNs | Balanced performance | Protocol complexity |

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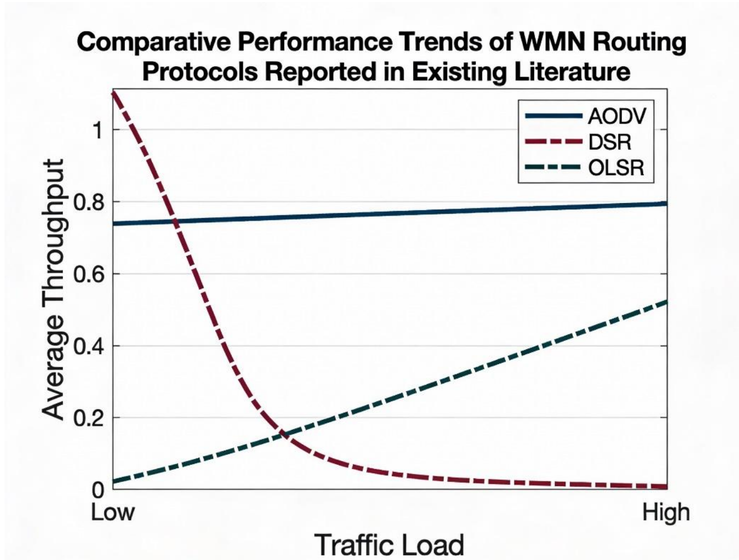


**Figure 4. Comparative performance trends of WMN routing protocols reported in existing literature**

## V. PERFORMANCE METRICS AND COMPARATIVE ANALYSIS

Performance evaluation in Wireless Mesh Networks (WMNs) is primarily based on a set of key metrics that reflect network efficiency, reliability, and scalability. This section synthesizes findings from existing studies to analyze how Access Nodes, Relay Nodes, and Mobile Nodes influence network performance and the trade-offs involved.

### 5.1 Throughput

Throughput represents the rate of successful data delivery across the network. Studies consistently report that throughput is strongly influenced by the placement and capacity of Access Nodes, as they serve as gateways to external networks. Relay Nodes affect throughput by determining the efficiency of multi-hop forwarding paths, while congestion or interference at intermediate nodes can degrade performance. Mobile Nodes introduce variability due to dynamic topology changes, often leading to reduced throughput in highly mobile scenarios.

### 5.2 End-to-End Delay

End-to-end delay measures the time required for a packet to traverse the network from source to destination. Literature indicates that delay increases with hop count and network congestion, making Relay Node density a critical factor. Access Node congestion can further increase latency, particularly in large-scale deployments. Mobility of Mobile Nodes contributes to additional delay due to route discovery and handoff processes, especially under reactive routing mechanisms.

### 5.3 Packet Delivery Ratio

Packet Delivery Ratio (PDR) reflects the reliability of data transmission. High PDR is generally achieved in networks with stable Relay Nodes and efficient routing paths. Studies show that frequent topology changes caused by Mobile Nodes can reduce PDR due to packet loss during handoffs or route failures. Effective load balancing and node-aware routing strategies are reported to improve PDR across heterogeneous WMNs.

### 5.4 Energy Efficiency

Energy efficiency is a critical metric, particularly for Relay and Mobile Nodes operating on limited power sources. Continuous packet forwarding and control message exchanges increase energy consumption at Relay Nodes. Mobile Nodes experience additional energy drain due to frequent reconnections and route maintenance. Research highlights energy-aware routing and power control mechanisms as effective approaches to extending network lifetime.

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### 5.5 Interference

Interference arises from simultaneous transmissions over shared wireless channels and significantly impacts overall network performance. Dense Relay Node deployments and high Mobile Node activity increase co-channel interference, leading to reduced throughput and higher packet loss. Studies emphasize interference-aware channel assignment and transmission power control as key techniques for mitigating these effects.

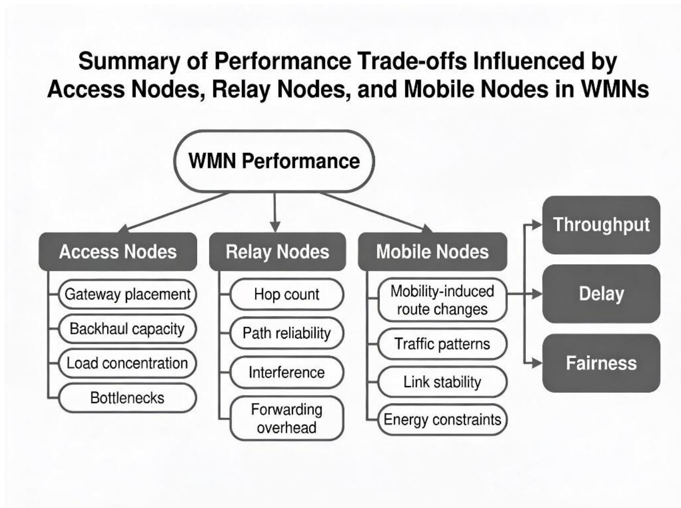


**Figure 5. Summary of performance trade-offs influenced by Access Nodes, Relay Nodes, and Mobile Nodes in WMNs**

## VI. APPLICATIONS OF WIRELESS MESH NETWORKS

Wireless Mesh Networks (WMNs) are widely adopted across diverse application domains due to their scalability, resilience, and flexibility. The effectiveness of WMNs in these applications largely depends on the coordinated roles of Access Nodes, Relay Nodes, and Mobile Nodes. This section briefly reviews key application areas and maps them to the corresponding node functionalities.

### 6.1 Smart Cities

In smart city environments, WMNs support applications such as intelligent transportation systems, environmental monitoring, surveillance, and public safety communications. Access Nodes provide connectivity to centralized data centers and cloud services, while Relay Nodes extend coverage across urban infrastructure. Mobile Nodes, including vehicles and wearable devices, generate dynamic traffic patterns, requiring adaptive routing and low-latency communication.

### 6.2 Disaster Recovery

WMNs play a critical role in disaster recovery scenarios where existing communication infrastructure is damaged or unavailable. Relay Nodes enable rapid multi-hop network formation, while Access Nodes facilitate external connectivity when available. Mobile Nodes carried by rescue teams introduce mobility, making self-healing and robust routing essential for maintaining reliable communication.

### 6.3 Rural Broadband Access

In rural and remote areas, WMNs provide cost-effective broadband connectivity by reducing reliance on extensive wired infrastructure. Access Nodes act as Internet gateways, Relay Nodes extend network reach across large geographical areas, and Mobile Nodes allow end users to access network services. This architecture supports scalable and economically viable rural connectivity solutions.

### 6.4 Military Networks

Military communication systems benefit from WMNs due to their robustness and adaptability in hostile environments. Relay Nodes form resilient backbones capable of maintaining communication under node failures, while Mobile Nodes such as vehicles and soldiers' devices require secure and low-latency connectivity. Access Nodes enable integration with command and control systems when available.

### 6.5 IoT Backbones

WMNs serve as efficient communication backbones for large-scale Internet of Things (IoT) deployments. Relay Nodes aggregate data from numerous IoT devices, Access Nodes provide backhaul connectivity to data processing platforms, and Mobile Nodes include mobile sensors and actuators. The mesh architecture supports scalability and fault tolerance required in IoT ecosystems.

## VII. CHALLENGES AND RESEARCH GAPS

Despite the significant advantages of Wireless Mesh Networks (WMNs), several technical challenges continue to limit their performance, scalability, and widespread adoption. These challenges are closely tied to the heterogeneous roles of Access Nodes, Relay Nodes, and Mobile Nodes. This section highlights key challenges and identifies open research gaps that require further investigation.

### 7.1 Mobility Management

Mobility management remains a major challenge in WMNs due to frequent topology changes introduced by Mobile Nodes. Existing routing and handoff mechanisms often fail to maintain seamless connectivity, leading to increased packet loss and latency. While several mobility-aware routing approaches have been proposed, there is still a lack of lightweight, node-aware mobility management techniques that can scale efficiently in dense and highly dynamic networks.

### 7.2 Scalability

Scalability is a persistent concern, particularly in large-scale WMNs with high node density. Access Nodes often become bottlenecks due to concentrated traffic, while Relay Nodes may experience uneven load distribution. Current solutions, such as multi-gateway deployment and hierarchical routing, improve scalability but introduce additional complexity. Research gaps remain in adaptive, self-organizing scalability mechanisms that consider node roles and traffic patterns.

### 7.3 Security

Security in WMNs is challenged by their decentralized architecture and multi-hop communication model. Relay Nodes are vulnerable to attacks such as packet dropping and routing manipulation, while Mobile Nodes increase the attack surface due to mobility and open wireless links. Although several security frameworks have been proposed, there is limited research on lightweight, node-aware security mechanisms that balance protection, performance, and energy consumption.

### 7.4 Energy Efficiency

Energy efficiency is particularly critical for Relay and Mobile Nodes operating on limited power sources. Continuous packet forwarding, control message exchange, and mobility-induced signaling significantly increase energy consumption. Existing energy-aware routing solutions improve network lifetime but often trade off performance or QoS. There remains a need for holistic energy optimization strategies that jointly consider routing, mobility, and traffic dynamics.

### 7.5 Quality of Service (QoS) Support

Providing consistent Quality of Service in WMNs is challenging due to variable link quality, interference, and dynamic network conditions. Mobile Nodes and congested Access Nodes often experience degraded QoS, affecting real-time and multimedia applications. Current QoS mechanisms are largely protocol-specific and lack adaptability to heterogeneous node roles. Research gaps exist in unified, node-aware QoS frameworks capable of supporting diverse application requirements.

## VIII. FUTURE RESEARCH DIRECTIONS

Wireless Mesh Networks (WMNs) continue to evolve to meet the increasing demands of next-generation communication systems. While existing research has addressed several architectural and performance challenges, emerging technologies present new opportunities to enhance the efficiency, scalability, and adaptability of WMNs. This section outlines key future research directions that can guide the advancement of node-centric WMN design.

### 8.1 AI-Based Routing and Network Optimization

Artificial intelligence and machine learning techniques offer promising avenues for improving routing decisions in WMNs. AI-based routing can enable networks to learn from historical traffic patterns, mobility behavior, and interference conditions to dynamically optimize path selection. Such approaches have the potential to enhance throughput, reduce latency, and improve adaptability in heterogeneous environments involving Access Nodes, Relay Nodes, and Mobile Nodes. Future research should focus on lightweight, distributed learning models suitable for resource-constrained mesh nodes.

### 8.2 Software-Defined Networking Enabled WMNs

The integration of Software-Defined Networking (SDN) with WMNs can provide centralized control and global network visibility while retaining the distributed nature of mesh architectures. SDN-enabled WMNs allow dynamic traffic engineering, efficient resource allocation, and simplified network management. Future studies may explore hybrid control frameworks that balance centralized intelligence with local autonomy to improve scalability and fault tolerance.

### 8.3 UAV-Assisted Relay Nodes

Unmanned Aerial Vehicles (UAVs) present a novel opportunity to enhance WMN coverage and resilience by acting as mobile Relay Nodes. UAV-assisted WMNs can provide on-demand connectivity in disaster recovery, rural areas, and temporary events. Research is needed to address challenges related to UAV mobility management, energy constraints, and seamless integration with ground-based mesh nodes.

### 8.4 Integration with 6G Networks

As wireless communication progresses toward 6G, WMNs are expected to play a supporting role in ultra-dense, high-capacity network environments. Future research may investigate the integration of WMNs with 6G technologies such as ultra-low latency communication, terahertz bands, and intelligent surfaces. Node-aware designs will be essential to ensure interoperability and performance in such advanced network ecosystems.

### 8.5 Green and Sustainable WMNs

Energy efficiency and sustainability are becoming increasingly important considerations in network design. Green WMNs aim to reduce energy consumption and carbon footprint through energy-aware routing, renewable energy integration, and adaptive power management. Future research should focus on holistic green networking frameworks that balance performance, reliability, and environmental impact across all node types.

## IX. CONCLUSION

This paper presented a comprehensive review and comparative analysis of Wireless Mesh Networks (WMNs) with a specific focus on the roles of Access Nodes, Relay Nodes, and Mobile Nodes. By synthesizing findings from existing literature, the review examined WMN architectures, routing and communication mechanisms, performance metrics, application domains, and emerging challenges from a node-centric perspective. This approach enabled a clearer understanding of how different node types collectively influence network behavior and performance.

The review highlighted several key insights. Access Nodes play a critical role in external connectivity and scalability but are susceptible to congestion and backhaul limitations. Relay Nodes form the backbone of WMNs, significantly impacting coverage, multi-hop efficiency, and network resilience, while facing challenges related to interference and energy consumption. Mobile Nodes introduce dynamic topology changes that affect routing stability, quality of service, and overall reliability. The comparative analysis of routing protocols and performance metrics revealed inherent trade-offs between throughput, delay, energy efficiency, and adaptability, emphasizing the importance of node-aware design strategies.

From an academic perspective, this review addresses the fragmentation in existing WMN research by providing a structured, node-centric synthesis of prior studies. It identifies critical research gaps in mobility management, scalability, security, energy efficiency, and QoS support, thereby offering a foundation for future investigations. From a practical standpoint, the insights presented can assist network designers, practitioners, and policymakers in selecting appropriate architectures, routing strategies, and deployment models tailored to specific application requirements.

Overall, this review underscores the necessity of considering the heterogeneous roles and interactions of Access Nodes, Relay Nodes, and Mobile Nodes in the design and optimization of Wireless Mesh Networks. By highlighting current challenges and future research directions, the paper aims to contribute to the development of more efficient, scalable, and resilient WMN solutions for next-generation wireless communication systems.

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