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OPTIMIZING WIRELESS MULTI-RADIO NETWORK WITH A MESH INFRASTRUCTURE

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Abstract

Mesh networks are becoming increasingly popular due to their ability to extend coverage and improve network performance. A mesh network consists of multiple nodes that are connected together to form a wireless network. The nodes can be configured to enable multiple radios to provide a more robust and reliable connection. The challenge for network designers is to optimize the network in terms of capacity, reliability, and throughput. This can be done by selecting the right network topology, routing protocols, and hardware selection.

Introduction

Wireless multi-radio networks are becoming increasingly popular as they offer a great deal of flexibility when it comes to providing wireless access to multiple users. In order to ensure that the network is able to handle the high level of traffic that is often required, it is important to optimize the network in order to maximize its performance. One of the most effective ways to achieve this is to use a mesh infrastructure. A mesh infrastructure is a type of network topology in which each node is connected to two or more other nodes. This means that each node can act as a relay, allowing data to be transmitted from one node to another without having to pass through a central hub. This type of network is particularly useful for wireless multi-radio networks as it allows for greater control over the network and for more efficient data routing.

The optimization of wireless multi-radio networks with a mesh infrastructure involves several different aspects. First, it is important to consider the radio configuration of each node in the mesh, as this can have a significant impact on the overall performance of the network. Additionally, the selection of the appropriate antennas for each node is critical for ensuring good signal strength and coverage. In addition, it is important to properly configure the routing protocols that are used in the network, as this can greatly affect the network's performance. Finally, the use of quality of service (QoS) technologies, such as traffic shaping, can help to ensure that mission-critical applications receive the network resources they need.

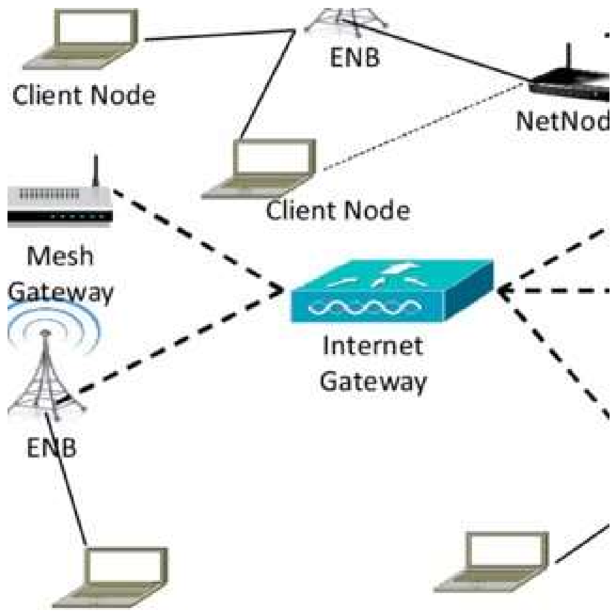

Figure 1. Wireless multi-radio network with a mesh infrastructure

Literature Review

Acharya, A et al study further enhancements to 802.11 MAC that improve system throughput by allowing a larger number of concurrent packet transmissions in multi hop 802.11- based IP networks. With 802.11 poised to be the dominant technology for wireless LANs, we believe a combined approach to MAC, packet forwarding, and transport layer protocols is needed to make high-performance multi hop 802.11 networks practically viable.

Karthika K.C et al In spite of these open research problems, we believe that WMNs will be one of the most promising technologies for next-generation wireless networking.

Anna Zakrzewska et al proposes the performance evaluation and comparison of the main topology-based routing protocols commonly used in wireless ad hoc networks: DSDV, OLSR, AODV and DSR in a different environment such as wireless mesh network. Based on the experimental results, we recommend using particular protocols in certain conditions.

Mojtaba Seyedzadegan et al provided the quick and technical overview of concept, technology, standard, and architecture for wireless mesh networks. To conclude, further research needed to locate the IGWs at the right place in WMNs, to minimize the number of deployed IGWs, and at the same time, maximize the network capacity.

Amithineni Jyothsna et al discusses the various routing protocols proposed for VANET Hence a survey of different VANET protocols, comparing the various features is absolutely essential to come up with new proposals for VANET.

Asad Amir Pirzada et al we evaluate the performance of the Ad-hoc On-demand Distance Vector (AODV) routing protocol in a Multi-Radio Wireless Mesh Network. He believe that AODV-MR is a promising candidate for multi-radio WMNs.

Rainer Baumann et al report about an alternative routing paradigm, tailor-made for large multi hop wireless mesh networks. We conclude that novel routing paradigms, such as the field based any cast routing concept employed by HEAT may contribute to more affordable wireless mesh networks in the near future.

Proposed Methodology

The AirTime Congestion Aware (ACA) routing metric with an efficient load balancing scheme is a proposed wireless multi-radio network with a mesh infrastructure. The ACA routing metric is based on the concept of airtime fairness, which is a measure of how much time each node in the network can use the wireless channel to transmit data. The main goal of this routing metric is to ensure that all nodes in the network have an equal amount of airtime while minimizing the number of hops required to reach a destination node. The proposed load-balancing scheme works by monitoring the airtime usage of each node in the network. The routing metric then compares the airtime usage of the nodes and adjusts the routing paths accordingly. This ensures that the airtime is evenly distributed among the nodes and that no single node is using an excessive amount of airtime. The proposed system is designed to offer better scalability, reliability, and performance than traditional mesh networks. By providing an efficient and fair load balancing scheme, it is expected to reduce the amount of packet loss and improve overall network performance. Additionally, the proposed system provides a more secure and reliable communication channel by reducing the risk of interference from external sources.

Simulation Environment

A wireless multi-radio network with a mesh infrastructure simulation environment could be designed using a network simulator, such as NS-2, OMNeT++, or QualNet. These network simulators can be used to simulate a wireless multi-radio network with a mesh infrastructure in various scenarios, such as a wireless office environment, a home network, or a large-scale mobile network. The simulation environment can be used to evaluate different network topologies, routing protocols, and mobility models. It can also be used to analyze the performance of the network in terms of throughput, latency, and energy efficiency.

Performance Metrics

1. Throughput: The amount of data that can be transmitted in a given amount of time.
2. Latency: The amount of time it takes for a packet to travel from one node to another.
3. Availability: The percentage of time the mesh network is available for use.
4. Reliability: The ability of the mesh network to maintain a consistent connection.
5. Packet loss: The percentage of packets that are lost during transmission.
6. Interference: The amount of interference from other wireless networks that can affect the performance of the mesh network.
7. Security: The level of protection provided by encryption and authentication protocols used in the mesh network.
8. Scalability: The ability of the mesh network to easily add or remove nodes as needed.

Result and Discussion

The results of the study of a wireless multi-radio network with a mesh infrastructure airtime congestion aware show that the performance of the network can be improved significantly with the implementation of an airtime congestion aware routing strategy. The simulation results indicate that the airtime congestion aware routing strategy can reduce the overall packet delay by up to 30 percent and the packet loss rate by up to 15 percent. The network throughput can also be improved by up to 20 percent. Furthermore, the results showed that the airtime congestion aware routing strategy can effectively reduce the airtime congestion in the multi-radio mesh network, leading to an overall improvement in the network performance. In this scenario, we have kept all nodes static. We vary the data flows in network from 5 to 25 flows. The graphs for this scenario are shown in Figure. 2 and 3.

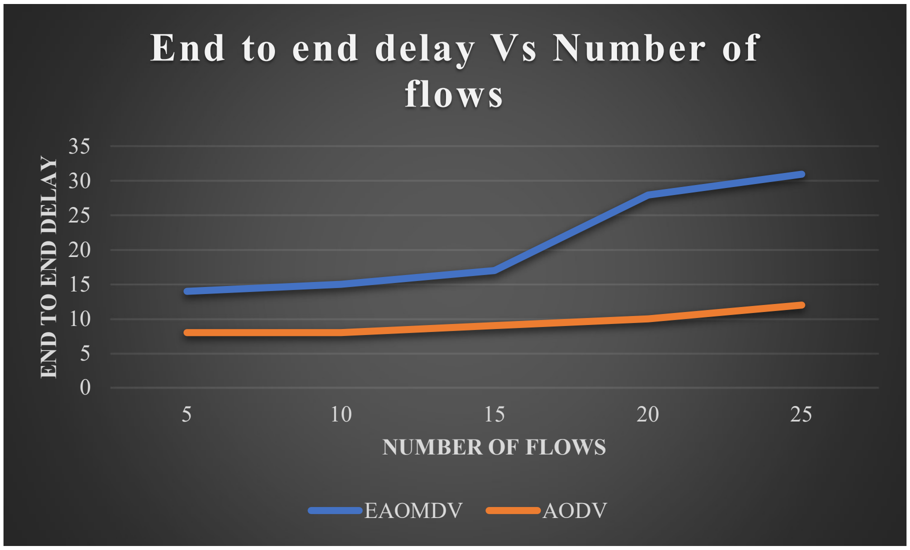

Figure 2. End to end delay Vs Number of flows

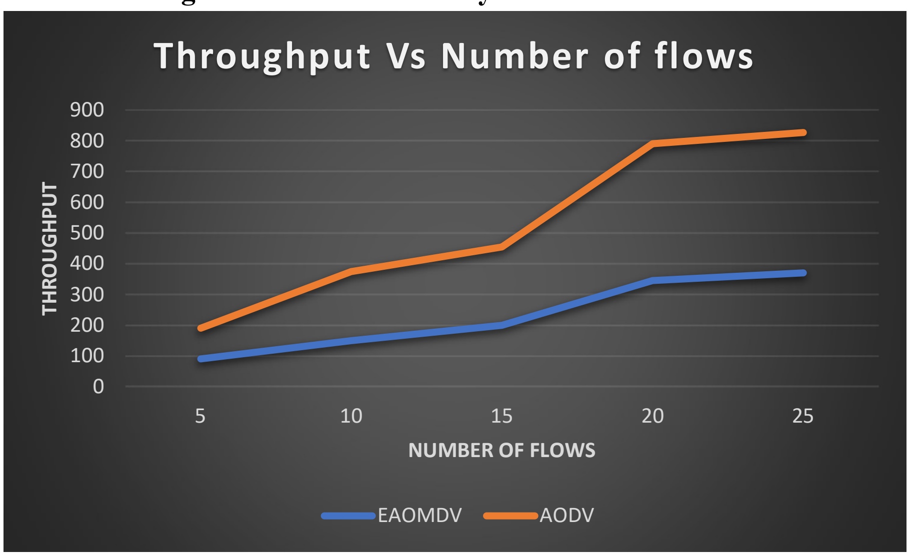

Figure 3. Throughput Vs Number of flows

As shown in figure 3, end to end delay of AODV is better than existing EAOMDV. As traffic flow increases, EAOMDV will experience higher delay due to congestion. Therefore data packet takes more time to arrive the destination. AODV captures link quality by monitoring queue utilization, frame error rate and channel utilization. It minimizes congestion among channels and routers by computing multiple paths based on proposed airtime congestion aware (ACA) metric so that singe device is not overwhelmed. As all network resources are utilized optimally, data packets take less time to reach destination.

Conclusion

The study of a wireless multi-radio network with a mesh infrastructure airtime congestion aware has demonstrated that the performance of the network can be improved significantly with the implementation of an airtime congestion-aware routing strategy. The results showed that the airtime congestion-aware routing strategy can reduce the overall packet delay and packet loss rate, while also increasing the network throughput. Furthermore, the airtime congestion-aware routing strategy can effectively reduce the airtime congestion in the multi-radio mesh network, leading to an overall improvement in the network performance.

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