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Improving Wifi Coverage Using Mesh Network

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Abstract
The current digital age has made good internet access via wireless internet a prerequisite in residential homes, offices, learning institutions and in the streets. Most of the traditional Wi-Fi networks are known to have limited coverage, poor signal strength, and dead zones especially in the large or multi-storey buildings due to their use of single router or access point. These problems are also enhanced by physical barriers, interference of the signal, and the emergence of more users with connections, thus making the sustainability of the connectivity a challenge.The given project is going to enhance the functionality of wireless networks by deploying a Wi-Fi mesh network infrastructure. A Wi-Fi mesh network is a network comprised of several connected wireless nodes working as one network altogether. In contrast to traditional Wi-Fi networks, mesh networks can help in multi-hop communication and dynamic routing so that the data could be relayed by more than one of the existing paths. This will increase network reliability, fault tolerance, and be able to self-heal, so that even in the event of a node failure, it will not interrupt the connectivity.Mesh nodes in the proposed system are spacially placed throughout the coverage area to remove the dead zones and give a consistent signal strength. The intelligent routing systems keep a constant watch on the network conditions including signal quality and load to choose the best data transmission routes. Performance analysis indicates that mesh network is much better in terms of coverage area, throughput, stability and latency compared to single-router Wi-Fi system. In general, the given Wi-Fi mesh network has the potential to be a scalable, reliable, and efficient solution that can be applicable to the contemporary homes, offices, campuses, and large residential areas. It is responsive towards new wireless needs in terms of longer durability and greater flexibility.

Keywords: Wireless Internet Access, Network Coverage, Signal Strength, Multi-hop, Dynamic Routing, Self-healing Network, Fault tolerance, Network performance, throughput, Latency, Scalability.

1.Introduction
Wireless communication has a significant role in our day to day lives as it is used in homes, offices, schools and in the streets to give internet connectivity. Wi-Fi is a very popular as it is relatively inexpensive and simple to implement. Nevertheless, in most cases, conventional Wi-Fi networks which are dependent on a single router have limited coverage, poor signal strength, and dead zones, particularly in high-rise or multi-storey buildings. These issues are also exacerbated by the physical obstacles, interference with signals and the presence of many connected users.In solving these constraints, Wi-Fi mesh network has become a helpful solution. A wireless mesh network is made up of two or more wireless nodes that cooperate with each other to extend their coverage and offer a more reliable coverage. In comparison with the traditional Wi-Fi protocol, mesh networks have multi-hop communication and dynamic routing capabilities, so that when one node goes dead, other nodes still remain connected. Wi-Fi mesh networks can be used in the environment that has to maintain the stability and consistency of the wireless connection because of their scalability and self-healing properties.

2.Review of literature
In **2020, I. F. Akyildiz, X. Wang and W**. Wang came up with a comprehensive survey of wireless mesh networks and here they pointed out the drawbacks of the traditional single router Wi-Fi networks. They also noted that mesh networks offer prolonged coverage, fault tolerance and enhanced reliability through network communications that are multi-hop and decentralized.
In **2021, Joshua Robinson and Edward W**. Knightly discussed a range of deployment strategies of wireless mesh networks. Their study showed that systematic node deployment is a very good way of enhancing uniformity

of cover as well as network throughput. The conclusion of the authors was that adequate positioning of mesh nodes is important in reducing dead zones and improving the performance of the Wi-Fi system.

In **2022, Zhansarik Nurlan, A. N. Bazarbayev** and others discussed the application of a mesh network architecture in wireless sensor networks. In the course of their research, they discovered that mesh-based systems provide scalable and self-healing communication, and they can be used in large-scale applications, including smart buildings and Internet of Things. Some issues concerning energy efficiency and routing complexity were also discussed by the authors.

In **2023,Subramanian et al**. concentrated on the topic of routing protocols in multi-radio networks of wireless mesh routers. They suggested interference-conscious routing schemes whereby they dynamically choose the best paths depending on the network conditions. The experimental outcomes showed a better throughput and lower latency over the traditional routing metrics particularly in congested environments.

In **2025,Karamchand** determined that mesh networking can be used to improve connectivity within cities and rural regions. The study highlighted the cost-effectiveness, scalability as well as the resilience of mesh networks. Their possible application in intelligent cities, educational institutions, and the large residential complexes were also noted in the research.

3.Existing System

The current system offers internet connectivity with a conventional Wi-Fi network that is based on one router or access point. This configuration is easy to install and has various drawbacks as far as coverage and performance is concerned. The further one is to the router the weaker the signal strength is and poor connectivity is experienced as well as dead zones are created.Physical barriers like walls and floors and interference with other wireless devices are additional physical obstacles to the performance of the existing system. The single- router methodology does not deliver a consistent coverage of buildings that are large or have more than one storey. Also, with several users being connected at the same time the network becomes congested, slow and has lost connectivity.The other significant weakness of the current system is that it lacks fault tolerance. In case the router fails or has a problem, then the whole network goes dead. The conventional Wi-Fi system is incapable of supporting the increasing needs of the current wireless communication networks because of doubts on scalability, self-healing capacity, and uneven signal strength.

4.Proposed System

The suggested system has an architecture of Wi-Fi mesh network that can help the wireless coverage and performance of the network to a great degree. Under such a strategy, a group of mesh nodes are strategically spread over the coverage range so as to create one and integrated wireless network. In contrast to the traditional Wi-Fi system, the mesh nodes are able to exchange the data with the neighbor nodes and provide the efficient data forwarding via several potential routes.

The mesh network uses dynamic and intelligent routing protocols that identify the best route to use in transmitting the data according to the conditions of the network like the signal strength and also the traffic load. This will also guarantee that internet connectivity is smooth without interruption even in the event of failure of one or even more nodes. The network automatically routes the data via the alternative paths, and it gives it a fault tolerant and self healing architecture.

The Benefits of the Proposed System:

1.Offers long-range and consistent Wi-Fi services over big and multi-storey spaces.

2.Removes the dead spots and poor signal areas successfully.

3.Ensures self-healing ability, which keeps one connected always.

4.Enhances network speed, stability and throughput.

All in all, the proposed Wi-Fi mesh network provides the robust, scalable, and high-performance solution that can rise above the constraints of the traditional Wi-Fi systems and address the requirements of a modern wireless communication environment.

5.Methodology

The proposed system methodology is based on the development and implementation of a Wi-Fi mesh network to enhance the performance of the network and the coverage of wireless. To determine coverage dead zones and gaps, the limitations of the current traditional Wi-Fi system are analyzed first. On the basis of this analysis, appropriate points are used to install mesh nodes in order to have uniform and widespread coverages.

Thereafter, strategic placing of mesh nodes on the target area is done to create a single wireless mesh network. The nodes are set to communicate with their neighbors and this provides the capability to transmit data at multi-hop distance. Intelligent and dynamic routing protocols are used so as to dynamically monitor the network conditions like signal strength and load in the network.

When transmitting data, the network automatically chooses the best route that is to be used to pass data. The system bypasses the failed node or the disruption of links, which is why the data is redirected to the other routes, and their connection remains intact. Lastly, the proposed mesh network is analyzed in terms of coverage area, signal strength, latency, and throughput among other parameters, and the analysis is compared with the traditional Wi-Fi system.

6.Result and Discussion

The suggested Wi-Fi mesh was experimented and compared to a traditional single-router Wi-Fi network. The findings make it clear that the mesh network offers better coverage to the whole area of wireless network. The problem of dead zones that were experienced with the traditional system was avoidable in the mesh network system.

There was more steady and better connectivity in terms of signal strength measurements because of the strategic location of mesh nodes. The dynamic routing mechanism has been effective to select efficient transmission paths leading to undergoing latency and an augmentation of throughput. The mesh network also held minimal degradation and remained consistent even when the network had its maximum users.

The self-healing ability of the mesh network was one of the most important observations. In case a mesh node had been deliberately disconnected, the network had automatically diverted traffic using alternative routes, without affecting the internet connection. This shows how the proposed system is fault tolerant when compared to the traditional Wi-Fi networks.

7.Conclusion

The current project managed to demonstrate the fact that Wi-Fi mesh network can be efficient to increase the range of the wireless network and improve the network performance. The lack of dead zones and the availability of uniform coverage also characterizes the mesh network as compared to the traditional single- router Wi-Fi networks, which have limited cover and are easily affected by a few storeys. The use of a series of mesh nodes and dynamic routing also render data flow to its destination efficient as well as enable the internet to continue operating.

The results show that the proposed system has improved the signal strength, reduced latency and improved throughput. Another enhancement on the reliability of the network is the fault-tolerant and self-healing self of the mesh network that automatically redirects the traffic to the other node when the node is downed. Overall, the proposed Wi-Fi mesh network is an expansionable, powerful, and high-performance wireless communication device that can be deployed in the modern homes, offices, and educational institutions.

8.Future Enhancements

The suggested Wi-Fi mesh network system can be improved in the future through the incorporation of more sophisticated routing algorithms relying on artificial intelligence and machine learning to make decisions regarding the path selection that is optimized dynamically. The use of power-efficient mesh nodes can be implemented to achieve better sustainability and consumption of less energy. Besides, the system can also be extended to accommodate Internet of Things (IoT) applications to facilitate easy connection of smart devices. The addition of real-time performance monitoring and cloud based network management tools can be also added

to enhance scalability, security, and fault detection. Such improvements would render the mesh network more dynamic, intelligent as well as appropriate in the next generation wireless communication space.

9.References

1.I. F. Akyildiz, X. Wang, and W. Wang, “Wireless Mesh Networks: A Survey,” Computer Networks, vol. 47, no. 4, pp. 445
2.J. Robinson and E. W. Knightly, “A Performance Study of Deployment Factors in Wireless Mesh Networks,” IEEE INFOCOM, 2007.
3.A.P. Subramanian, H. Gupta, and S.R. Das, “Interference Aware Routing in Multi-Radio Wireless Mesh Networks,” IEEE Workshop on Wireless Mesh Networks, 2008.
4.Z. Nurlan, et al. "Wireless Sensor Network as a Mesh: Vision and Challenges," Sensors (MDPI) 22, no. 5, 2022.
5.P. Arya & D.F. Priambodo, "Wi-Fi Optimization with Wireless Mesh Network," Journal of Informatics & Telecommunication Engineering, 2024.
6.IEEE Standards Association, “IEEE Standard for Information Technology—Telecommunications and Information Exchange between Systems—Local and Metropolitan Area Networks—Specific Requirements—Part 11: Wireless LAN Mesh Networking (IEEE 802.11s).”
7.G. K. Karamchand, “Mesh Networking for Enhanced Connectivity in Urban and Rural Areas,” Journal of Computing and Informatics, 2024.

