BSO based MRMC in WMN

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***Abstract*—** A wireless Mesh network consists of three main components: nodes, gateways, and software. The spatially distributed measurement nodes interface with sensors to monitor assets or their environment. In this research work the optimized MRMC protocol in WMNs is implemented on the basis of BSO optimization scheme. BSO is used to provide a reciprocal path for every link in case of its failure. In this method mutation operator, is used and the new mutation rate is generated by the self-adaptive approach The proposed approach helps to reduce the load and drops in the network, so using the proposed methodology the QOS parameters such as packet delivery ratio, throughput, overheads, average end-to-end delay, average energy consumption are quite improved as shown in the result section. The improvement of 16% is shown between the existing and proposed approach in above defined features.

***Keywords*— WMNs, MRMC, BSO**

I. INTRODUCTION

A wireless mesh network (WMN) is a communications network made up of radio nodes organized in mesh topology. It is also a form of wireless ad hoc network. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways which may, but need not, connect to the Internet. The coverage area of the radio nodes working as a single network is sometimes called a mesh cloud. Access to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network. A mesh network is reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. Wireless mesh networks can self form and self heal. Wireless mesh networks can be implemented with various wireless technology including cellular technologies or combinations of more than one type.

II. CRITICAL DESIGN FACTOR

The critical factors influencing the performance of WMNs are summarized as follows. Radio Techniques Many approaches have been proposed to increase capacity and flexibility of wireless systems in recent years. Typical examples include directional and smart antennas, multiple input multiple output (MIMO) systems, and multi-radio / multi-channel systems. To further improve the performance of a wireless radio and control by higher layer protocols, more advanced radio technologies, such as reconfigurable radios, frequency agile/cognitive radios, and even software radios, have been used for wireless communication. Although these radio technologies are still in their infancy, they are expected to be the future platform for wireless networks due to their dynamic control capability. These advanced wireless radio technologies all require a revolutionary design in higher-layer protocols, especially MAC and routing protocols.

Scalability- Scalability is a critical requirement of WMNs. Without support of this feature, the network performance degrades significantly as the network size increases. For example, routing protocols may not be able to find a reliable routing path, transport protocols may lose connections, and MAC protocols may experience significant throughput reduction. To ensure the scalability in WMNs, all protocols from the MAC layer to the application layer need to be scalable. Mesh Connectivity. Many advantages of WMNs originate from mesh connectivity. To ensure reliable mesh connectivity, network self-organization and topology control algorithms are needed. Topology-aware MAC and routing protocols can significantly improve the performance of WMNs.

Broadband and QoS- Different from classical ad hoc networks, most applications of WMNs are broadband services with heterogeneous QoS requirements.

Security- Although many security schemes have been proposed for wireless LANs in recent years, they are still not fully applicable for WMNs. For instance, there is no centralized trusted authority to distribute a public key in a WMN due to the distributed system architecture. The existing security schemes proposed for ad hoc networks can be adopted for WMNs. However, most of the security solutions for ad hoc networks are still not mature enough to be implemented practically. Moreover, the different network architectures between WMNs and ad hoc networks usually render a solution for ad hoc networks ineffective in WMNs. Ease of Use. Protocols must be designed to enable the network to be as autonomous as possible. In addition, network management tools need to be developed to efficiently maintain the operation, monitor the performance, and configure the parameters of WMNs. These tools, together with the autonomous mechanisms in networking protocols, enable rapid deployment of WMNs.

Compatibility and Inter-operability- In WMNs it is a default requirement to support network access for both conventional and mesh clients. Therefore, WMNs need to be backward compatible with conventional client nodes. This demands that mesh routers need to be capable of integrating heterogeneous wireless networks.

III. RELATED WORK

In this section, we have a tendency to summarize and discuss connected authentication ways employed in follow or projected within the literature to boost positive identification authentication on the net and gift their limits.

Sujatha Kolipaka et al [1] "Performance Analysis of AODV with Multi-Radio in Hybrid Wireless Mesh Network" Wireless Mesh Network (WMN) is a promising wireless technology for several emerging and commercially interesting applications. It is a multi-hop wireless access network where nodes can act both as a host as well as a router. The proposed work focuses on architecture of hybrid mesh network such that gateway routers are used for accessing the internal or external network. The mesh router has been divided into two parts that is, backbone mesh router and border mesh router (BMR). With the recent 802.11e quality-of-service (QOS) extension real-time applications such as voice over IP and video streaming are finding their way to be running over WLANs. This paper proposes twin adaptation of hybrid mesh network architecture at physical layer and 802.11e MAC layer considering a network model, which is an enhancement of AODV-MR routing protocol. Based on simulation results, we show that there is a significant improvement on standard AODV in terms of key performance metrics such as Throughput, delay, packet delivery ratio and normalized routing overhead

Wei Liu et al [2] "A novel gateway selection method to maximize the system throughput of Wireless Mesh Network deployed in disaster areas" In this paper, we suppose a wireless mesh network which consists of wireless mesh routers and a base station directly connected to external networks. The base station is located at the center of the wireless mesh network chooses a certain number of wireless mesh routers as gateways, and establishes a connection with each of them. Our goal is to easily and quickly find the candidate gateways that maximize the system throughput without solving a complex optimization problem which includes a large number of parameters and involves heavy computation load. The performance of the proposed scheme is evaluated by numerical analysis, and demonstrated through computer simulations. The results show that our proposed scheme can determine the appropriate candidate gateway with high accuracy when there is a certain variance in the amount of traffic generated by users at each wireless mesh route.

Gaur, N et al [3] "Load-aware routing for non-persistent small-world wireless mesh networks" In this paper, we propose a Load-aware Non-Persistent small-world long link Routing (LNPR) algorithm for small-world wireless mesh networks to achieve lower average transmission path length for data transfer sessions among a set of source-node and destination-node pairs in the network. LNPR uses load balancing strategy to better distribute the network traffic among the normal-links and the non-persistent long-links in the small-world wireless mesh networks for efficient use of long-links which are precious data transmission paths in the network. LNPR provides 58% to 95% improvement in call blocking probability and 23% to 70% in maximum load reduction with increment ranging from only 0.7% to 9% increase in average transmission path length. Small-world wireless mesh networks find numerous applications in rural and community networks for cost-effective communication.

Zhong Hui et al [4] "Implementation of Wireless Mesh Network Protocol Research Platform" Study of the wireless mesh network protocol, it be constructed that embedded Linux operating system platform which dedicated to the wireless mesh network protocols. The performance parameters and indexes of OLSR protocol can be experimental in different environment. Using of NET4526 embedded development board, build Linux operating system and various service needed for OLSR environment, transplant Midwife wireless drivers and OLSR services as well as routing protocols of OLSR, edit and compile the program of OLSR to achieve running wireless mesh network protocol research platform. Experimental results achieve the wireless mesh network as well as configure it for web. Multiple wireless mesh network protocol debugging platforms can be created. The use of more than 486 desktop configured to run the built Linux operating system instead of simulated experimental platform to compensate for the deficiencies caused by the deficiencies in the number of embedded platform for routing protocol.

Alrayes, M.M et al [5] "Enhancement of route maintenance in AODV over hybrid wireless mesh network" Wireless mesh network has been considering as promising technology for next generation that provides a better services and guarantee to different internet applications. AODV routing protocol is being considered as routing protocol in hybrid wireless mesh network. Route breaks in mobile mesh client is one of the research issues in hybrid wireless mesh network, especially if the traffic comes from internet to mobile mesh clients. To ensure the robustness of the network a link breaks in routing protocol should be able to repair as fast as possible. In this paper, we have proposed a novel mechanism for the enhancement of route maintenance features of AODV in hybrid wireless mesh networks. The proposal mechanism uses the capability of mesh router backbone in terms of minimal mobility and no constraint in power consumption. Where border mesh routers that involves in route path between the internet gateway and mobile mesh clients can finds a new route when the route breaks if a local repair is fail between mobile mesh clients. Simulation results show that the proposed approach outperforms the standard AODV under routing overhead, end to end delay, throughput, number of packet delivery ratio in hybrid Wireless mesh networks.

Shu-qiang Huang et al [6] "Research of capacity optimizing model on wireless mesh networks" the paper proposes a hierarchy optimization model from bottom to up and a series of optimization ways based on programming theory. The main content in this paper includes: (1) Optimizing link-channel scheduling strategy, studying the wireless Mesh network channel allocation algorithm, and an interference-based model and linear programming channel allocation and routing joint algorithm is proposed; (2) research of network scalability, taking into account the network coverage and performance at the same time, the paper presents a mixed integer nonlinear

programming algorithm for the deployment of the AP; (3) research of gateway deploying strategy, a linear programming based heuristic algorithm gateway deployment is proposed. Research on these issues of network capacity optimization will improve the performance of networks and promote the development of wireless mesh networks; it also has certain significance in the engineering practice.

IV. EXISTING SCHEME

Wireless Mesh Network is a branch of networking that deals with multi hop wireless access network. In this network the nodes available act as host as well as router for transmission of data. In the WMN gateway routers have been utilized for accessing internal or external network. Hybrid Mesh network has been used for both voice & video streaming between mesh routers & mesh clients, Mesh routers & clients are of two types of nodes that are used to forward the data & can communicate with each other. The main problem in the mesh network due to number of packets is increasing. This issue degrades the performance of WMN & Packet loss is much due to over head on mesh clients.

1. To design Wireless Mesh Network using Mesh Client & Mesh Router Properties.
2. To transmit the data from gateway by using Radio Channel Frequency.
3. To modifies the AODV For multi radio Connectivity in Hybrid Wireless Mesh Network.
4. To analyze various parameters Packet Delivery Ratio, Packet Loss, Throughput, Routing overhead for performance Evaluation.

V. PROPOSED WORK

Implementation of proposed MR-MC in WMNs protocol is done by simulation or designing of WSN using software MATLAB. For designing and simulation process 100 nodes are taken against 3000 number of rounds. In this research the scalability of the proposed protocol is tested by implementing the approach on various number of nodes i.e. 20, 40, 60, 80, 100. To find out the results of various metrics, the average value of every metrics in every set of nodes is calculated and plotted in graph. For eg, to calculate the delay along with the scalability of this approach in various set of nodes as defined above, the resultant graph of 20 nodes is generated and then the average value of that graph is calculated and plot on the 20 nodes for delay. To perform algorithms the values of initial energy is taken as 0.5J and value of energy dissipation for transmission an reception of packet is 50*0.000000001J and 50*0.000000001J. If there is a need of amplification of signal then there is a dissipation of 0.0013*0.000000000001J amount of energy. In last the energy dissipation for aggregation of data packets is 5*0.000000001J. Using the proposed approach the energy dissipation is less due to the optimization scheme. With the help of optimization scheme an alternative path is formed so that the packets can always have a route from which it can reach destination. Using this process the packet drop will be reduced. Due to it there will be fewer packets in the network so low congestion and low load will be in the network. Due to the low congestion time taken for a packet from source to destination will be less, results in low delay. In this fashion all the metrics for all set of nodes are calculated as shown in the graphs below.

VI. SIMULATION ENVIRONMENT

During preliminary study it has been studied that, there are a number of parameters that are to be assumed before the simulation like Frame Duration, frequency Bandwidth, Mode of transmission, network size etc. The area taken into consideration is 100*100m. For the implementation of coverage techniques in WSN, simulation parameters used are shown in Table 4.1.

Table 4.1: Simulation Parameters for MRMC Protocol

Simulation parameters	Value
Frame duration	1ms
Frequency bandwidth	25MHZ
Mode of transmission	TDD
Packet size	5kb
Simulation grid size	100m*100m
Rounds	3000
Initial Energy	0.5J
Energy for transmission	50*0.000000001J
Energy for reception	50*0.000000001J
Energy for Amplification	0.0013*0.000000000001J
Energy for Data Aggregation	5*0.000000001J

Performance Metrics

Performance metrics are the parameters on the basis of which we analyze the performance of the network. The performance metrics that are to be used are packet delivery ratio, average end-to-end delay, overheads, throughput, average energy consumption which are discussed below.

Packet Delivery Ratio: The first metric is PDR, which is defined as the number of packets successfully received Prx, to the number of packets transmitted Ptx. As shown in equation 1.

$$PDR = Prx/Ptx \quad (1)$$

Where Prx is packets received and Ptx is packets transmitted

Average End-to-end Delay: It is the average time between a packet being created and being delivered to the sink. The average delay in a TDMA multi-hop based protocol depends greatly on the order of the allocated time slots of the forwarding nodes.

Overhead: Overhead is a major factor in designing routing protocols for mobile sensor networks since more no. of packets can cause congestion, which will limit the throughput of data. There are generally two types of overhead; packet overhead and control overhead. Packet overhead is the ratio of non-data bits to data bits in a data packet. Control overhead is the ratio of bits in control packets to bits in data packets. Control packets are often used to negotiate channel access, discover routes or share topology information.

Throughput: Throughput is defined as the number of data bits successfully delivered to the sink in predefined time.

Average Energy Consumption: It is the energy consumed in transmitting and receiving the message packets in a mobile wireless sensor network.

VII. RESULTS

In this section with the help of comparative study, we can draw all the pros and cons of the above defined scheduling schemes. In this scenario a comparison is made between hybrid routing schemes by taking 25 subscriber stations which is shown below.

Load: Load may be defined as the total number of packets in a network at a time t.

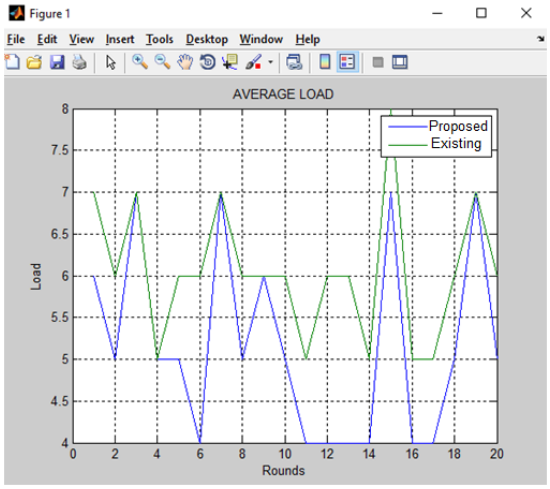

Fig 1: Average load

Load: The load in two MANET protocols called existing and proposed in 25 nodes. From the above graph it is shown that the load in proposed approach is less than that of existing approach. From the figure 5.1 it is cleared that the average load in the proposed technique is approx 5 Kb/s where as in case of existing scheme it is approx 6.5 Kbps.

Delay: Network delay is an important design and performance characteristic of a computer network or telecommunications network. The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds. Delay may differ slightly, depending on the location of the specific pair of communicating nodes. Although users only care about the total delay of a network, engineers need to perform precise measurements.

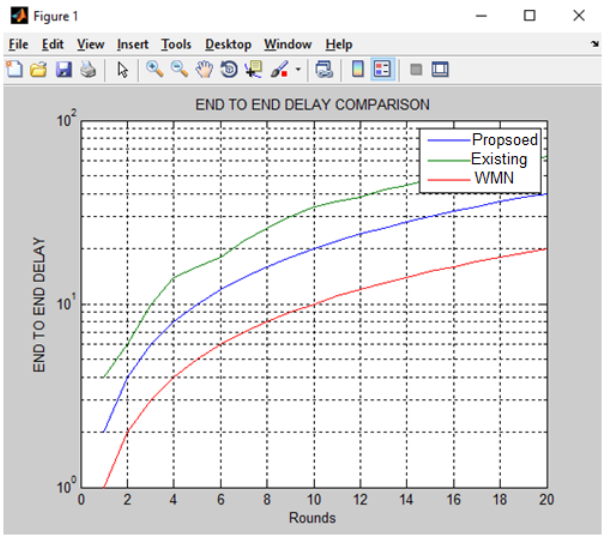

Fig 2: Delay

Delay: Delay in existing and proposed approach in MANET in 25 nodes. From the graph it can easily depicted that the delay in proposed algorithm is less than that of existing protocol. As depicted from the figure 5.2 it may be defined that the delay in the existing approach is approx 80ms where as in case of proposed approach it is 65ms.

Throughput: Throughput is the maximum rate of production or the maximum rate at which something can be processed. When used in the context of communication networks, such as Ethernet or packet radio, throughput or network throughput is the rate of successful message delivery over a communication channel. The data these messages belong to may be delivered over a physical or logical link, or it can pass through a certain network node. Throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second (p/s or pps) or data packets per time slot.

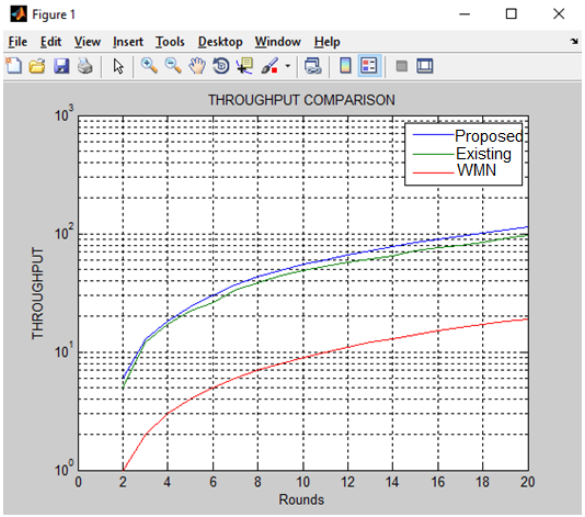

Fig 3: Throughput

Throughput: Throughput in proposed and existing algorithm in MANET in 25 nodes. From the graph it can easily depicted that the throughput in proposed is less than that of existing protocol. Throughput in case of proposed case is

approx 110 packets and in existing case it is approx 100 packets.

Jitter: Jitter is simply the difference in packet delay. In other words, jitter is measuring time difference in packet inter-arrival time. It is a specific phenomenon that normally exists in bigger packet switched networks. As a time shift phenomenon it usually does not cause any communication problems. Actually, TCP/IP is responsible for dealing with the jitter impact on communication.

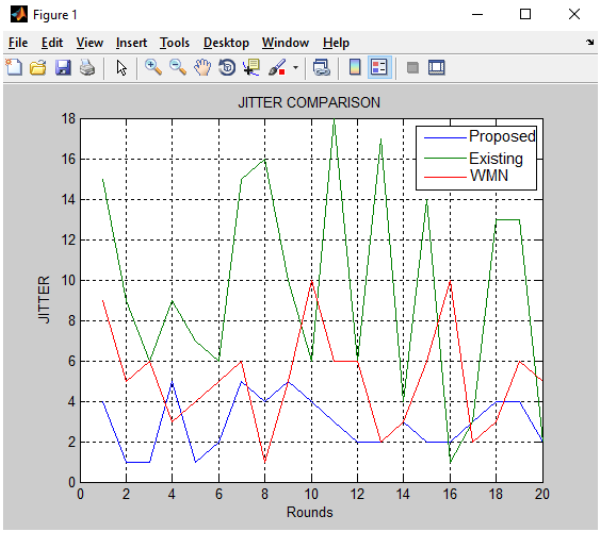

Fig 4: Jitter

Jitter: Jitter in proposed and existing protocol in MANET in 25 nodes. From the graph it can easily depicted that the jitter in proposed is less than that of existing protocol. Jitter in case of proposed case is approx 3.5 sec and in existing case it is approx 7 sec.

Power Left: Energy left or power left may be defined as the energy or power residual at a time t in network nodes. Energy is consumed in the network by the packet transmission, packet reception, amplification and by fading. So energy left or power left may be defined as the total power – power consumed.

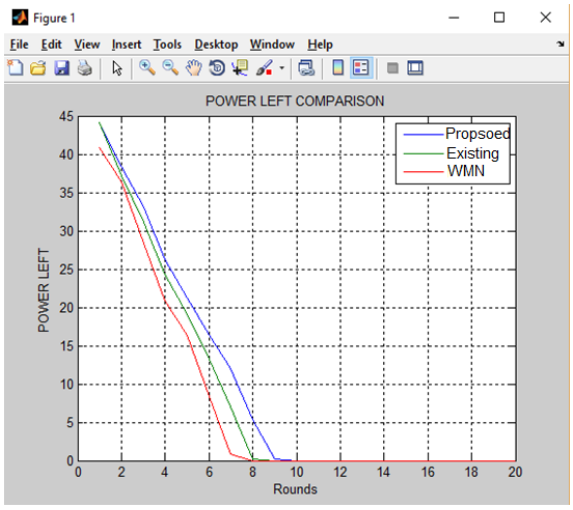

Fig 5: Power Left

Power Left: Power Residual in proposed algorithm and existing algorithm in MANET in 25 nodes. From the graph it can easily depicted that the residual power in proposed is more than that of existing protocol. Residual power in case of proposed case is retained upto approx 10 rounds and in existing case it is approx 8 rounds.

Power Consumption: Power Consumption may be defined as the energy released by a node during various network operations. Energy is consumed in the network by the packet transmission, packet reception, amplification and by fading.

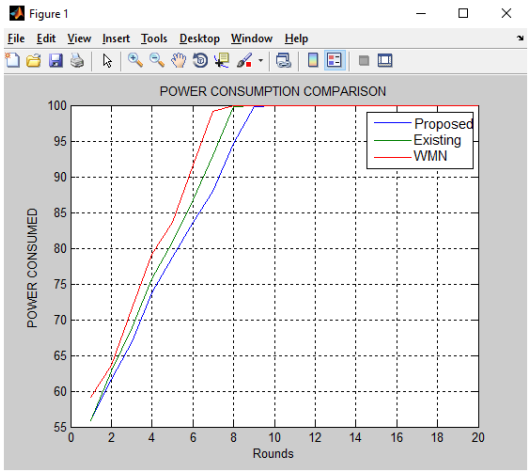

Fig 6: Power Consumption

Power Consumption: Power Consumption in proposed and existing protocol in WMN in 25 nodes. From the graph it can easily depicted that the residual power in proposed is more than that of existing protocol. Residual power in case of proposed case is retained upto approx 10 rounds and in existing case it is approx 8 rounds

Table 5.1 Comparative study of various parameters for both algorithms

Algorithm / Parameters	Existing	Proposed
Delay(sec)	80	60
Throughput(packets)	100	110
Residual power	8 rounds	10 rounds
Jitter(sec)	7	3.5
Average Load(bits/sec)	7000	6000
Power Consumption	8 Rounds	10 rounds
Data Privacy	95.7	98.7
Encryption Overheads	2.5	1.6

VIII. CONCLUSION

A wireless Mesh network consists of three main components: nodes, gateways, and software. The spatially distributed measurement nodes interface with sensors to monitor assets or their environment. In this research work the optimized MRMC protocol in WMNs is implemented on the basis of BSO optimization scheme. The proposed approach helps to reduce the load and drops in the network, so using the proposed methodology the QOS parameters such as packet delivery ratio, throughput, overheads, average end-to-end delay, average energy consumption are quite improved as shown in the result section. The improvement of 14% is shown between the existing and proposed approach in above defined features.

In the future scope the scalability of the approach can be improved so that quality parameters cannot be reduced. Any other algorithm can also be used in order to improve the QoS parameters if it shows better results than this proposed work.

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