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Multi Rate Multicast Routing in Fixed Gateway Multi Channel and Multi Radio Wireless Mesh Network

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Abstract: ***WMN is the wireless mesh network is having real type of application in the current time for the multicasting type of networking. Where one sender and there is a group of people who receives the message. But the bandwidth constraints will make the network to be on the slower side because the lowest speed channel will be allotted to the receiver automatically. The proposed algorithm with fixed gateway position with multichannel and multi radio wireless mesh network can create efficiency into the network. The proposed algorithm is having ability to get maximum throughput with the balancing of the different gateways with multichannel and multi radio wireless mesh network. The proposed algorithm has been tested in node count of 15 and 30 with variable channel and with variable number of receivers. The performance of the network is enhanced compared to the MGMR with variable number of gateway. Optimization based technique if applied for the identification of the optimal node. The simulated results are optimal in all the scenarios.***

Keywords: Genetic, WMN, Mesh, Gateway, Channel, Multi radio.

I. INTRODUCTION

Wireless mesh network is the optimal type of network with different types of applications in the current environment. There are different applications which are possible for the network with the requirements to have single sender and multiple receivers. In all the cases there are different types of constraints. Covering those constraints will make multicasting based WMN as the most suitable type of network. There are different applications which are having utilities of this type of network. Because it provides the cost effective way of transfer the data using multiple free channels to multiple users at a same time. It is the versatility of the network to have this type of utility because this type of network is easy to install and also easy to setup. Since it gives the cost effective method for trading the information between single source and multiple receivers, it can results in to be a characteristic decision for various application zones. In this type of network various nodes are connected together using wireless links. This type of network provides the utility for the network to have sender to connect the receiver through various intermediate devices as relay nodes.

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These intermediate nodes are routers, gateways. Through routers the path is established for transferring the traffic to the gateway for the connection of the mesh network to the internet. This means whole traffic from the mesh network through the router will be transferred to the gateway forwarding to the internet. In same way on the receiving side message from the router will be forwarded to the gateway and will be multi casted to the set of receivers (Akyildiz IF, 2005).

Multicasting is the basic requirements of the saving the resources or efficient utilization of the bandwidth. Same requirements are for the different applications like video conferencing and online games. These applications are very resource oriented. They require different types of algorithms for enhancing the system resources utilization.

In WMN type of network, performance is downgraded with various types of interferences in the connecting lines. These noises will make the network to be vulnerable for the multicasting type of applications. But with various new technologies the network performance can be enhanced. Different techniques like multi channel, multi Radio are being employed for the network performance enhancement (Alicherry M, 2006).

In previous times a sender sends the message to the multiple receivers at the single data speed. Due to the diversity of the network the receivers receives the data at the slowest speed. As sender will sends the data to the receiver with single rate of transmission. But there should be a technique to transfer the data to the destination with the variable speed. In this technique sender will send the data to the all the receivers with the variable speed. The receiver with the higher speed network availability is not dependent on the slower speed receiver. Multi casting with multi rate employed by various applications to make the efficiency of the network. So in different networks multi casting with multiple rate of the transmissions is the efficient way of transmission to the destination. (Amaldi E, 2008)

In the WMN the whole network traffic is transmitted through the network gateway. The network with the multi gateway technique is used for the t transmission efficiency. This will build the base of MGMR multiple gateway and multiple router for the network. The network efficiency is achieved using multiple gateways. While selecting the path the nearest gateway will be selected so that the network traffic can have minimum traffic on the route. But the selection of the gateway is based on the local information available.

The performance of the network is enhanced using selection of the gateway using multi channel and multiple radios. This will help in identifying the best gateway for the network traffic transfers. (Ancillotti E, 2010) This paper focuses on four issues like multi channel, multi gateway, multi routing and multi radio for achieving the efficiency of the system. In multiple gateways the positions of the gateway is fixed. The path identification is based on the selection of the most suitable type of network which has minimum distant gateway. This will reduces the network traffic on the route.

II. RELATED WORK

Liu and Liao (2010): author in this paper has focused on the multi channel and multi routing based Mac layer technique. This technique is focus on efficient utilization of the resources. Most important Resource is bandwidth, because bandwidth is used for transmitting the maximum traffic.

Ruiz and Gomez-Skarmeta (2005): Authors in this paper has emphasized on MAC layer for efficiency point of view. The technique used is based on multi channel and multi routing based scheme. Where the multiple channels are used for the multicasting based transmission for WMNs. The objective is to minimum utilization of the available band width.

Wang et al. (2010): Author in this paper has proposed a WMNs routing scheme for the network with the availability of the wired network. The proposed technique is based on single channel and single routing based scheme or called as uni-casting based scheme. The objective is of efficient utilization of the network resources.

Roy et al. (2008): author in this paper has proposed a scheme for the multi channel and multiple routing based contention based protocol. The proposed technique is based on identifying the path based on selecting the route which will be most efficient route from the set of identified routes. The objective is to maximize the throughput of the network.

Zeng et al. (2010): Author in this paper has proposed a scheme based on multi channel and multiple routing based scheme. Here the aim is to identify the route based on identifying the channel which has maximum speed and has minimum noise. The proposed technique helps in selection of the channel which is having least traffic and also has minimum interference. Results in lowering down the delay for the data transmitted.

III. NETWORK MODEL

The proposed model is represented with the graph having 'V' is the set of the vertex, and 'E' is the edges connected to the these vertex. Each link has the transmission capacity of C(u,v). it is the capacity of transmission or called as bandwidth between the node u and node v. All the nodes has same transmission range and also the same interference range. Transmission range is represented as 'R_t' and 'R_i'. 'N' is the total number of neighbor nodes of vertex 'V'. The node which is lying with the transmission range of 'R_t' or below the node will be considered to itself. There are fixed position gateway nodes. All the nodes have multiple channels and multiple radio. There are multiple routers in the network. Each node V identifies the gateways in its neighbor. Select the shortest distance gateway. Allocate the free channel for the connection to the gateway for the data transmission. While WMN network connects itself to the receiver with the selected channel and selected bandwidth. (Benyamina D, 2011)

IV. OPTIMAL MODEL

The optimal model is for the optimization of the selection of the gateway, channel and router. The node in the network is selected with the optimized configuration node as the relay node.

Gateway selection

Gateway is required for the routing of the message from source node to the destination. Gateway is required for the optimal channel selection for the receiver node. This channel is the channel which is available as the optimal channel.

Step 1 G is the set of the gateways in the network. Each gateway has different position in the network area.

Step2 identify the gateway in the network. Selected gateway will be added to the selection list (G1).

Step3 Add the selected gateway g to the G1.

Step4 if g' <g then add the new gateway to the list and remove previous. Else keep older gateway. g represents the gateway

Step5 Finalize the gateway list.

Loop Avoidance

For the gateway selection we need not to create a loop between the source node and gateway.

Step1 The selected gateway has to the removed from the gateway list.

Step2 Updated gateway will be updated in the list. The visited gateway needs not to visited again.

V. RATE ALLOCATION CONSTRAINT

For the multicasting network multiple receivers requires variable rates for the efficient utilization of the bandwidth. The allotted channel will be based on the selection of the optimal channel which is available for the receiver. Multiple rates will be selected for the multiple receivers. Receivers with fast channel availability will be selected and for receiving the data, if some slow channel is available then the same will be allotted. With variable speed of multiple channels, there is better utilization compared to allotting the channel with the lowest rate in the network available for the receiver.

$$r_{\min} \leq \sum_{(u,v) \in E} r_{uv} \quad \forall v \in R \qquad \ldots\ldots\ldots\ldots \text{(i)}$$

$$r_{uv} \le bigMl_{uv} \quad \forall (u,v) \in E \qquad \text{..... (ii)}$$

$$\sum_{k=1}^{K} f_{uv}^{k} = r_{uv} \quad \forall (u,v) \in E \qquad \text{..... (iii)}$$

i. Flowchart Of The MGMR Technique

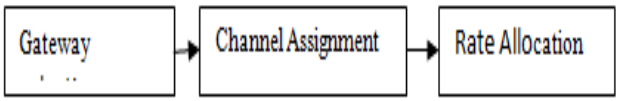

Fig. 1 Flowchart

MGMR technique is used for the Gateway selection. In the first step gateway is selected. The selected gateway will identifies the channel for the receiver node. In the last on the selected channel specific rate for the transmission will be selected. This selected rate will be from the set of the given rates. Which is suitable given channel.

ii. Algorithm

Let there is a graph G=(V,E) and link(u,v).

Step1 identify the channel out of set of the available channels at each receiver. The channel count will be equals to the total number of channel allotted. The allotted channel should have maximum transmission speed and having minimum interference. This is the vertex 'u'.

Step2 identify the channel for the receiver which has minimum interference and has minimum receiving frequency.

While 'V' become empty

Identify the neighbor from the list of nodes.

Add the element to the selected list and set vertex flag to the 1

Set the selected frequency to 1 for the nodes set u,v.

Take next element from the vertex list.

End loop.

End algorithm.

VI. RESULTS AND ANALYSIS

WMN based on MGMR with three perspectives for the efficient utilization of the bandwidth resources. There are multiple gateways with fixed position, multiple routers, multiple channels and multiple rate transmission. Multicasting network for the efficient utilization of the resources the variable rate is fixed for each receiver. Because rather than setting the network based on slowest rate, variable rate will transmit the data with available channel with highest rate to the receiver. The performance of the multiple gateways with unknown position and the multiple gateways with the fixed position is to be identified.

a) Throughput comparison of variable Gateways and the fixed gateways under 15 nodes

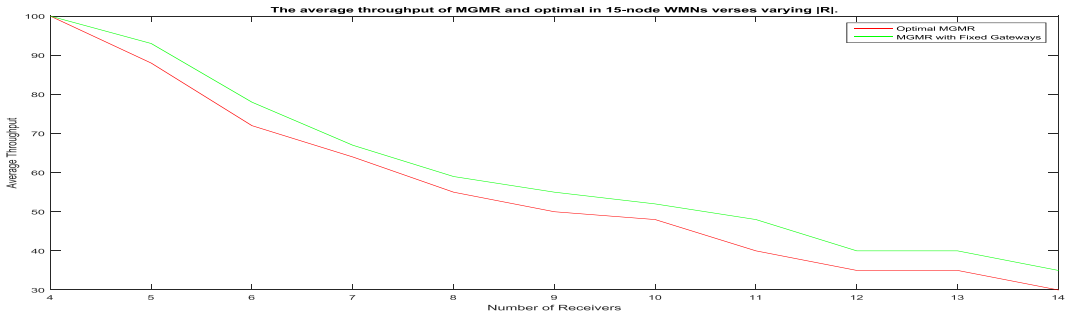

Fig. 2 Average throughput with 15 nodes

Table 1 Comparison of throughput with 15 nodes network

Average Throughput with base	**100**	**88**	**72**	**64**	**55**	**50**	**48**	**40**	**35**	**35**	**30**
Average Throughput with proposed	100	93	78	67	59	55	52	48	40	40	35

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Fig. 2 shows the average throughput comparison for the fixed gateway and the variable gateway. The performance has improved over the variable position of the gateway. Less time will be taken for the identifying the gateway for the shortest distance.

b) Throughput comparison of variable Gateways and the fixed gateways with 30 nodes.

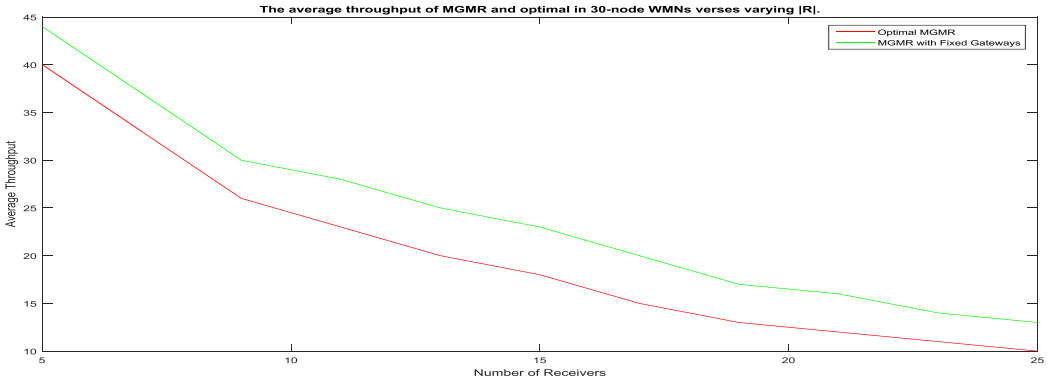

Fig. 3 Average throughput with 30 nodes

The comparison of the existing and the proposed with variable and fixed gateway has been compared. The proposed technique with the fixed gateway has shown the improvement in the network of 30 nodes. The WMN with fixed gateway is having better throughput, less time will be taken for the path establishment. Multiple channel and multiple rate of the transmission will be set for the transmission purpose.

Table 2 Comparison of throughput with 30 nodes network

Average Throughput with base	**40**	**33**	**26**	**23**	**20**	**18**	**15**	**13**	**12**	**11**	**10**
Average Throughput with proposed	44	37	30	28	25	23	20	17	16	14	13

c) Throughput comparison of variable Gateways and the fixed gateways with 15 nodes with different number of channels

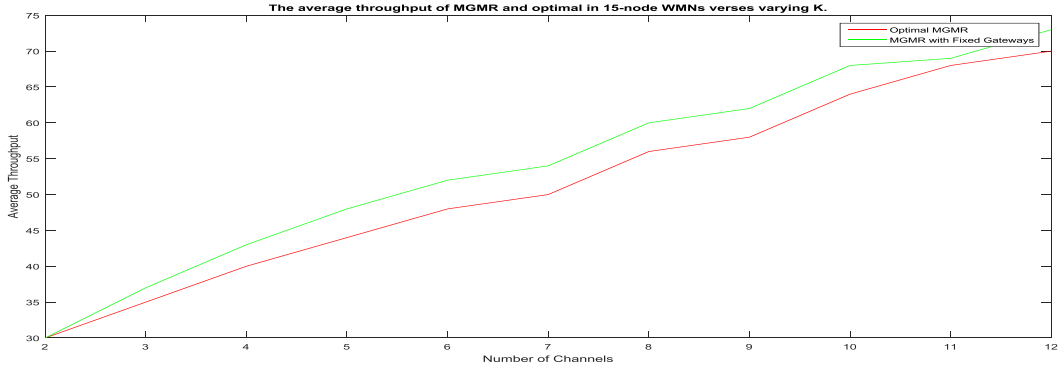

Fig. 4 Comparison of the average throughput with variable channels

Fig. 4 shows the comparison of the average throughput for the WMN with the variable channels count. The path will be established based on the selection of the channel which is highest rate. Allocating the variable channel with the highest rate will be efficient process.

Table 3 Comparison of the Average throughput with variable channels under 15 nodes WMN

Average Throughput with base	30	35	40	44	48	50	56	58	64	68	70
Average Throughput with proposed	30	37	43	48	52	54	60	62	68	69	73

d) Throughput comparison of variable Gateways and the fixed gateways with 30 nodes with different number of channels

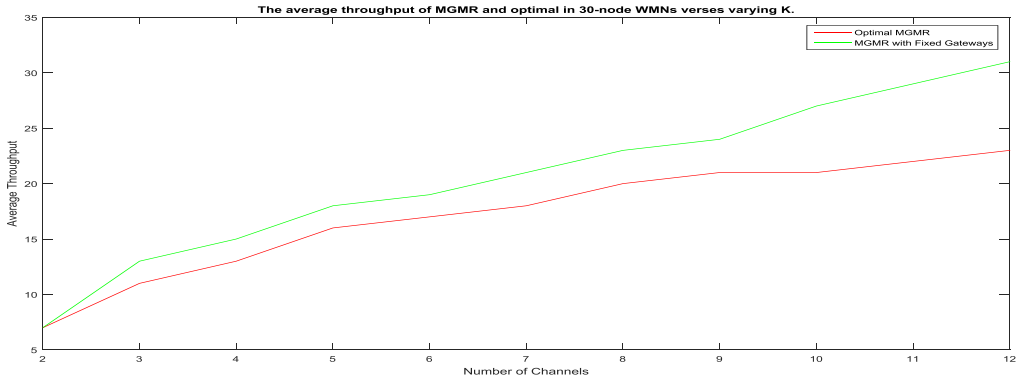

Fig. 5 Comparison of the average throughput with variable channels with variable channels

Fig. 5 shows the network with 30 nodes and the variable channels are set from 1 to 12. Under the variable scenario the average throughput has performed better in comparison to when there are variable number of gateways with variable gateway position.

Table 4 comparison table for the average throughput with variable channel under 30 nodes WMN.

Average Throughput with base	7	11	13	16	17	18	20	21	21	22	23
Average Throughput with proposed	7	13	15	18	19	21	23	24	27	29	31

VII. CONCLUSION

Multicasting based WMN is the efficient way of utilizing the bandwidth of the network. But there are different issues that can be there for the multicasting type of communication. The proposed technique is based multi channel, multi rates, multiple routers and fixed gateways. It is used for the efficient WMN communication with multicasting. Each time sending the data from the sender the receiver available channelsis checked. For the multiple users there are multiple channels with the multiple rates. So rather than sending the data with the slowest rate, variable rates are chosen for sending the data based on the available rate for the available channel. Different scenarios are established for the checking the throughput of the proposed technique over to the based technique.

Technique with fixed Gateway has been testing with variable no. of nodes and with variable number of channels. The WMN is applied for the nodes 15 and 30. The variable no. of channels are changed from 1 to 12. In all the aspects the scenario for the proposed technique has shown the improvement.

VIII. FUTURE WORK

WMN is used for the different applications. These applications are mostly based on multicasting based techniques. Here the most important aspect is the efficient utilization of the resources. Multiple gateways, multiple routers, multiple channels, and multiple rates are used for the system efficiency. Various other perspectives can be considered which can reduce the evaluation time. Future Expectations will be Hybrid Technologies like WMN MRMC performance evaluated with the help of VANETs, IoT etc.

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