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Comparative analysis of MH-TRACE and IEEE 802.11 protocols for the load distribution in the MANET network

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***Abstract*— MANET is basically infrastructureless and wireless in nature. With the evolve in application and increasing number of nodes the load on the network increases. Hence their will be increase in bandwidth usage, energy consumption, and delay. Coordinated MAC protocol i.e. MH-TRACE is well suited in the heavily loaded network and do not support non-uniform load distribution. In uncoordinated MAC protocol i.e. IEEE 802.11, nodes contend with each other to share common radio access channel and is bandwidth efficient for low network loads. In this paper dynamic channel allocation based on spectrum sensing and cooperative load balancing algorithms are applied over MH-TRACE protocol overcome the problem of non-uniform load distribution to increase the throughput and share of bandwidth. With the help of simulations we show that above two algorithms applied over MH-TRACE increases throughput and bandwidth compared to IEEE 802.11 which do not support these mechanisms.**

***Index Terms*— Dynamic channel allocation (DCA), cooperative load balancing (CLB), IEEE.802.11, MH-TRACE.**

I. INTRODUCTION

MANET is considered to be the most important part for the communication. It is an infrastructureless in nature, which has the dynamic network topology and nodes are in mobility. With the evolution in the application and the increasing number of nodes the load over the network increases due to which their is an increase in need for the bandwidth efficiency and energy consumption and also their is an increase in delay and jitter. So it becomes difficult for the MAC protocol of the Manet to adapt for such environment. Basically MAC protocol in MANET is classified into two types: Coordinated MAC protocol and Uncoordinated MAC protocol [1]. Coordinated medium access control protocol is basically used for the heavily loaded network and it supports uniform load distribution. The major problem of the MAC protocol is it does not support the maximization of bandwidth efficiency when load on network increases, non-uniform load distribution and multicasting.

In order to overcome these problem, two algorithms called dynamic channel algorithm and cooperative load balancing algorithms are used over the MH-TRACE MAC protocol [2] which increases share of bandwidth, service rate as well as throughput in Manet. The architecture is given in fig.1. In uncoordinated MAC protocol IEEE 802.11, nodes contend with each other to share common radio access channel and is bandwidth efficient for low

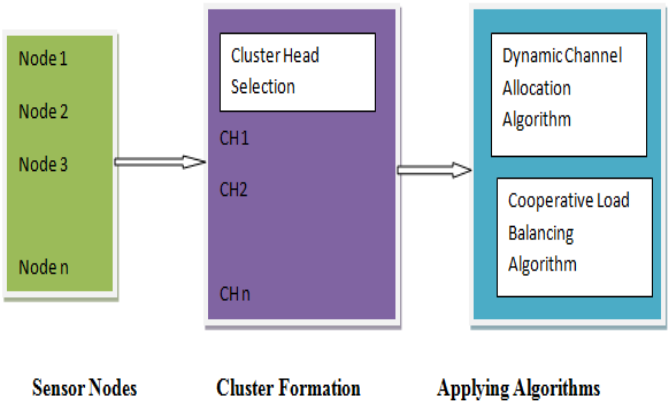

Fig.1. Architecture for channel allocation and load balancing

network loads. Also protocols are not energy efficient due to idle listening. In order to distribute the load to its destination two methods are used in this paper: Localized load distribution and Random load distribution. In localized load distribution only localized nodes of single cluster and only one cluster head is involved to distribute the load towards its destination. In random load distribution more than one cluster heads are involved to distribute the load to its destination, due to which their will be increase in throughput as compared to localized load distribution. Both of these methods follow single path routing technique using AODV protocol (multi-hop network). In this paper we are making a comparison between the MH-TRACE protocol over which the two algorithms namely dynamic channel allocation algorithm and cooperative load balancing algorithm to overcome the problem of non-uniform load distribution and IEEE 802.11 protocol which do not support the dynamic channel allocation and load balancing mechanisms for the localized and random load distribution using multi-hop network. We are also showing that MH-TRACE which supports both the algorithms increases throughput as compared to IEEE 802.11.

II. RELATED WORK

The main purpose of MAC protocol is to coordinate the access of nodes over shared channel and reduce interference between the nodes. When number of nodes access over the shared channel in a burst mode than conflicts occurs between the nodes. So in order to sense the existence of previous transmission the technique called CSMA [3] is used. Sometimes the condition exists in which the nodes are out of range or hidden from each other which results in the hidden terminal problem. This problem is over come by RTS/CTS [4] packet exchange mechanism before data transmission in order to increase the bandwidth efficiency. 802.11 distributed coordination function uses similar mechanism. But these are not efficient for heavily loaded network due to the exposed terminal problem. Various RTS/CTS mechanisms are applied to overcome the problem [5][6]. All these approaches try to solve the channel assignment problem when there is only one destination. It does not support group communication.

Load balancing plays the major role in the heterogeneous network. When the load on the network increases, it can be offloaded to other network using gateway nodes. In case of loosely coupled network i.e. cellular/WLAN integrated network for resource management, a load balancing policies are designed to efficiently utilize the pooled resources of the network [7]. Dynamic channel allocation and channel handoff has been studied extensively with respect to the cellular network, and has not been studied with respect to Manet where bandwidth efficiency and load balancing are studied at network layer [8][9]. In order to deduce the status of the network and to optimize routes based on bandwidth efficiency and stability [9] extend AODV protocol to include distributed system.

III. PROBLEM STATEMENT

Manet network plays a major role for the communication and is infrastructureless in nature. With evolve in application and increasing number of nodes the load on the network increases. Due to dynamic network topology and node mobility the load in this case is non-uniformly distributed. It becomes difficult for the MAC protocol of the Manet to adapt to such dynamic condition. Coordinated MAC protocol MH-TRACE is well suited for heavily loaded network and support the uniform load distribution. The major problem of the MAC protocol is it does not support the maximization of bandwidth efficiency when load on network increases, non-uniform load distribution and multicasting. In uncoordinated MAC protocol IEEE 802.11, nodes contend with each other to share common radio access channel and is bandwidth efficient for low network loads. Also protocols are not energy efficient due to idle listening.

IV. PROPOSED SYSTEM

In order to support the non-uniform load distribution in Manet, the two algorithms called Dynamic channel allocation algorithm using spectrum sensing and cooperative load balancing algorithm is applied over the MH-TRACE MAC protocol. In MH-TRACE the channel access is monitored by the cluster head. Two methods are involved in the load distribution: Localised load distribution and Random load distribution. In localised load distribution only localised nodes of single cluster and only one cluster head is involved to distribute the load towards its destination. In random load distribution more than one cluster heads are involved to distribute the load to its destination, due to which their will be increase in throughput as compared to localised load distribution. Both of these methods follow single path routing technique using AODV protocol (multi-hop network).

A. Dynamic channel allocation using spectrum sensing:

In dynamic channel allocation algorithm the channel coordinators continuously monitors all the channels available in the network and rate the availability of the channel in descending order. If the load on the channel coordinator increases and the available power is low then the channel coordinator start using the additional channel from the other neighboring channel coordinator. When the channel coordinator start using the additional channel its transmission increases the power level of that channel and makes it available to the other channel coordinators. This increases the share of bandwidth. Dynamic channel allocation mechanism reacts to the increasing network load and increases the share of bandwidth between the channel coordinators. This reactive response increases the interference in the whole system.

B. Cooperative load balancing algorithm:

In order to overcome the problem of interference in dynamic channel allocation algorithm, cooperative load balancing is being proposed. In this the active nodes continuously monitor the power level of all the channel coordinators. When the load on channel coordinator is high, then the active nodes switch from the heavily loaded channel coordinator to the one with the available resources. The resources vacated by the nodes that switch from heavily loaded channel coordinator to the low loaded channel coordinator is made available to the other nodes that do not have channel access to any other channel coordinator. Hence this will increase the total number of nodes that access to the channel, increases the service rate and the throughput. The scenario for the cooperative load balancing is shown in fig.2. As shown in the fig.2. Nodes A to G are the source nodes and try to contend for the channel access from one of the cluster heads (CHs). Each CH has the fixed number of the channels. If the accessibility for the channel goes in the alphabetical order, then node G would demand and mark for the CH1 and later nodes F and so on. CH1 makes the availability of the channel based on the nodes demand. As the load on the CH1 increases it start using the additional channel from CH2. The situation comes in which the nodes surrounding CH2 may also try to access the channel from CH2 and hence the interference occurs. Therefore cooperative load balancing algorithm is applied in which the active nodes continuously monitor the load of the cluster head and try to switch from heavily loaded CH to the one with the available resources.

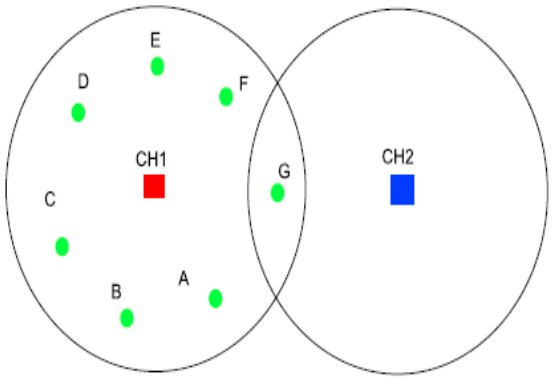

Fig.2. Scenario for cooperative load balancing

C. Single path routing AODV protocol:

Single path routing mainly indicates the routing of data packet using the multi-hop network with single path. In order to route the protocol in a single path the protocol used is Adhoc On-Demand Distance Vector routing protocol. Here each node maintains one routing table. Each table consists of: Active neighbor list, Destination address, Next-hop address toward that destination, Number of hops to destination, Sequence number, Lifetime. When the node wants to communicate with the destination node, then the source node broadcasts the RREQ (Route Request message) to all its neighbouring nodes. As RREQ propagates over the network then the intermediate nodes update their routing tables. RREQ contains more recent sequence number for the destination. A sequence number should be at least as great as that contained in RREQ for valid destination route. When the RREQ reaches the destination node, then the destination route is made available by unicasting the RREP (Route Reply) to source node. When RREP propagate back to source then the intermediate nodes must update their routing tables. The fig.3 shows route discovery phase of AODV. RRER (Route Error) is broadcasted when link breaks. Later Hello message is used for broadcasting connectivity information. Hello message is used by the node only when it is part of active nodes.

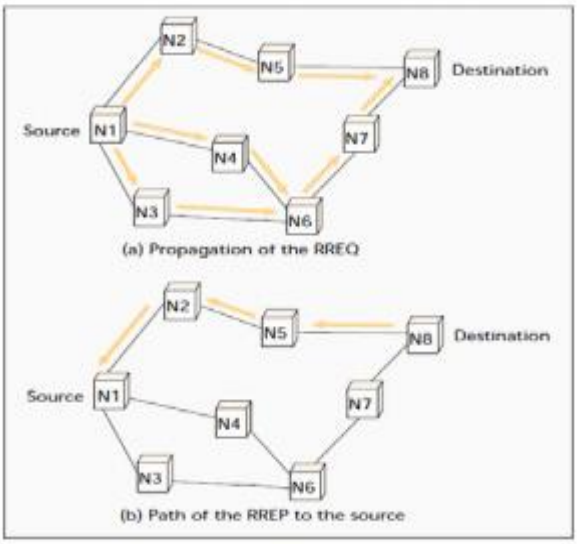

Fig.3. AODV route discovery process

V. SIMULATION RESULTS

In the simulation results comparison is made between the MH-TRACE coordinated MAC protocol which use or support the dynamic channel allocation algorithm using spectrum sensing and cooperative load balancing algorithm and IEEE 802.11 uncoordinated MAC protocol which do not support both the algorithms for the non-uniform load distribution in Manet network using Localised and Random load distribution. Here the proposed system i.e. MH-TRACE supporting both the algorithms transmits and receives the highest data packets with respect to time period as compared to the IEEE 802.11 that does not support the above two mechanisms in case of both localised shown in fig.4 and fig.5 and random load distribution shown in fig.6 and fig.7. The red line in the figures shows the proposed system i.e. MH-TRACE over which DCA and CLB algorithms are applied and green line shows IEEE 802.11 protocol which do not support the above two algorithms. X-axis in the figure indicates the time period and Y-axis indicates the data transmission or reception.

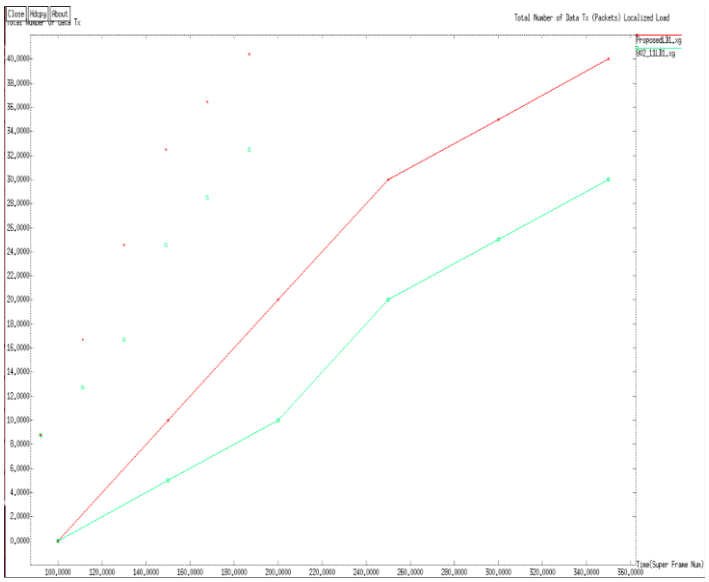

Fig.4. Data transmission for the localised load distribution

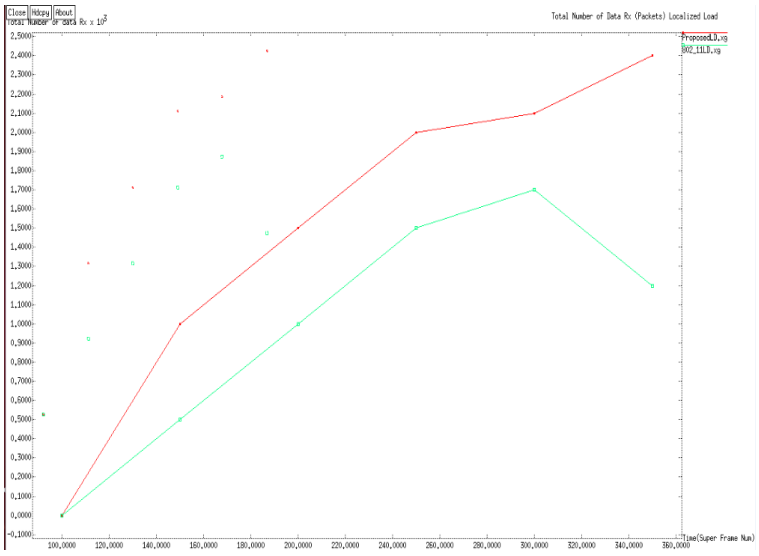

Fig.5. Data reception for the localised load distribution

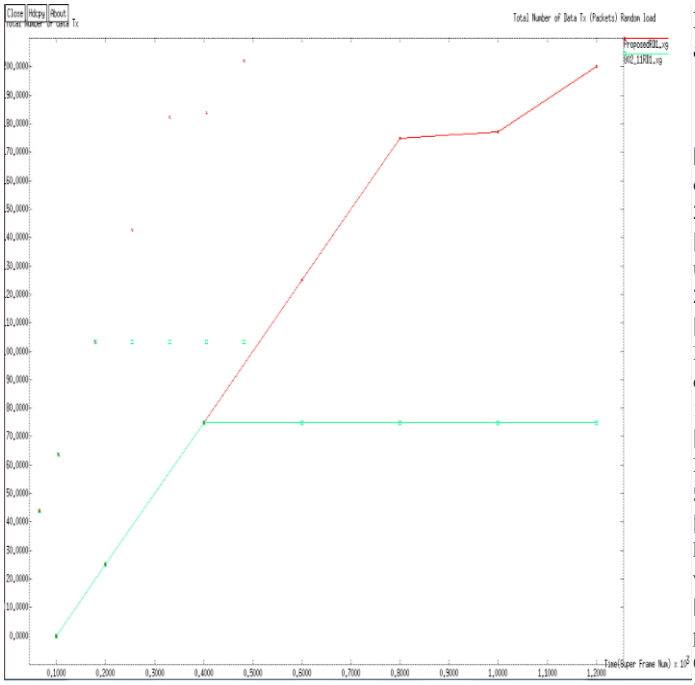

Fig.6. Data transmission for the random load distribution

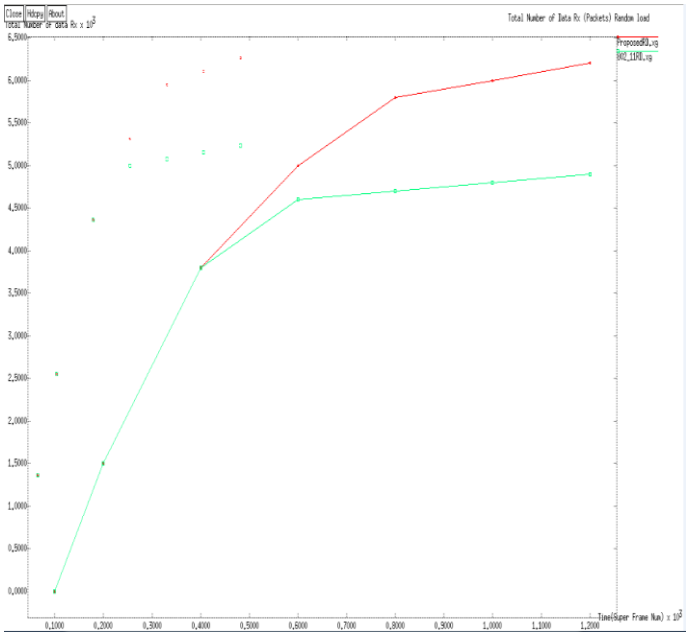

Fig.7. Data reception for the random load distribution

VI. CONCLUSION

Dynamic channel allocation using spectrum sensing and cooperative load balancing algorithm is applied over the MH-TRACE MAC protocol to overcome the problem of non-uniform load distribution in MANET for single path routing using AODV. These two algorithms increases the share of bandwidth, service rate and throughput. This will also decrease the energy consumption. Comparison of MH-TRACE after application of two above algorithms is made with the IEEE 802.11 protocol which do not support these algorithms, in load distribution using two methods i.e. random and localized load distribution. MH-TRACE is considered to be more efficient in load transmission and reception as compared the IEEE 802.11.

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