Aggregating Mesh Network to Increase Throughput in Collision Rate and Reduce Energy Consumption

Nanda P, Dr. Josephine Prem Kumar,
VTU Research Scholar, EPCET, Bangalore, Prof, Dept of ISE, EPCET, Bangalore,

Abstract— A system ought to be exceedingly adaptable i.e. high data rates, high throughput, and low errors. Use of Remote LAN’s utilizing IEEE 802.11n-2009 standard has expanded in the quantity of stations. As the quantity of stations builds the way gets to be congested and will prompt crashes. The IEEE 802.11n-2009 standard gives a high information rate of 100 Mbps at the physical layer yet not that information speed at Macintosh layer. The procedures like the frame aggregation outline increases the effectiveness at Macintosh layer yet none decrease the crash. Consequently collision crash control is much vital to accomplishing high information rates to serve a vast number of stations. And also it increases the energy consumption. WHN (Wireless hybrid Network) technology application has expanded in almost all aspects of life. This is because of their ability and ease of performance of the technologies to solve problems. Although its implementation is very flexible and practical, there are several aspects that need to be investigated, there are several things need to be investigated in the technology development of the wireless Hybrid network, such as lifetime constraints, unreliable and communication and need for self-configuration. We propose Grouping/Gathering plan to decrease the impact rate. Here the stations are assembled and a pioneer is chosen. Just the pioneers of individual gathering contend which diminish the collision. We contrast, our reproduction results and the DCF with frame aggregation and without frame aggregation. We present a protocol, HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. This Clustering reduces the energy consumption and maximizes the throughput.

Keywords - MAC, DCF, Frame aggregation, WMNs, Routing Protocol, Energy consumption.

I. INTRODUCTION

The rapid growth of the wireless local area networks has enlarged the number of the newer stations to the single access point. Interoperability, mobility, flexibility and cost effective deployment of IEEE 802.11n has made it the most accepted wireless network domain [1] [2]. This regularity achieves a very high data rate of 100Mbps and even has configurations up to 600 Mbps at the physical layer and expects the same in the medium access control. But the Medium access control layer was intended for low data rates and thus reducing the efficiency. Frame aggregation [25] were used to enhance the efficiency of the media access control (MAC). But there are no other schemes in this standard to reduce the collision. This collision is directly related to the station count in the wireless network [5] [6]. Hence, it’s much necessary to reduce the collision in order to increase the data rates.

We propose a collision control scheme in the MAC using frame aggregation scheme to increase the efficiency. Here the stations are grouped and leader is elected. Only the leader contends with the access point and the number of stations contending with the access point reduces; thus reducing the collision. Simulation and analytic results were used to evaluate the performance of this frame aggregation grouping scheme. Simulation results show that this provides a good increase in throughput and low collision.

WMN (Wireless Mesh Network) has developed rapidly today, because it’s ease of accomplishment in scalable areas and unkind environment. Grouping scheme for best utilization of available bandwidth and prolonging the network life time. The entire group of nodes participate in election of the leader which is most of the times used for network administration. The grouping scheme depends on the criteria like communication range, hop count, battery power, relative velocity and fairness. Grouping scheme elects the leaders and aggreagates the elected leader as super head using attributes of communication range, hop count, battery power, relative velocity and having maximum battery power. This scheme increase network life time, energy-efficient, scalable and intrusion detection routing or algorithm becomes an open issue to be explored. A various methods have been projected to afford the necessity of the wireless hybrid network, either scalable or network lifetime, which is partial appropriate to limitation of energy source within WMN node.
Based on the way, the means of route selection within the WMN can be open into some routing protocols which are Location-based Protocols, Data-centric Protocols, Hierarchical Protocols, Mobility-based Protocols, Multipath based Protocols, heterogeneity based Protocols and QoS-based Protocols. LEACH (Low Energy Adaptive Clustering Hierarchy) is the earliest Hierarchical routing Protocol effort by dividing various nodes into one cluster to reduce communication cost, thus by select one node as cluster head to aggregate data or communication from another ordinary node before its communicate to a base station. LEACH provides arbitrary rotation means which is used to choose a cluster leader. The subsequently protocol HEED (Hybrid Energy-Efficient Distributed Clustering), which is developed from original LEACH which is using residual energy as a secondary parameter to arbitrarily select CH (Cluster Head) for every cluster created. The difference between LEACH and HEED lies in their bound to choose which node becomes the cluster head. HEED uses residual-energy and intra-cluster communication cost to choose a cluster head supports Multi-Hop transmission, which supports larger area network than the single-hop transmission and RSSI (Receive Signal Strength Indicator) to calculate intra-cluster communication cost.

II. RELATED WORK

The IEEE 802.11 PHY layer plays out a concurrent employment of focusing on the remote transmission and evaluating the condition of the remote medium and overhauling the state to the MAC layer. Because of the quick increment in the client’s interest for fast remote system and expansion in the quantity of clients; there has been a change in the PHY layer, i.e. the present 802.11 n Wireless Network has an information rate of 100Mbps at the PHY by utilizing the Multi-information Multi-yield (MIMO). Disregarding the strategies the throughput at the MAC layer has been low, prompting the low information rate. [7]

Macintosh layer is an interface between the Sensible Connection Control (LLC) and the PHY. Macintosh broadly utilizes the Conveyed Coordination Work generally utilizing CSMA/CA. Be that as it may, it was found that the this DCF strategy couldn't give the highest information rate as the physical layer of 100 Mbps rather could just give an information rate which is just half of the physical information rate i.e. around 25Mbps [8]. The standard uses the Block ACK which totals the ACK outlines which are to be sent to the beneficiary. There are two sorts of Block ACK. The Immediate Block ACK outline sends a number of data frames followed by the Block ACK request frame followed by the reply from the recipient after SIFS duration. Delayed Block ACK the quantity of information casings to be gotten for the affirmation is indicated. In the wake of accepting the specific number of edges the beneficiary answers with the affirmation after TXOP. The transmission should likewise be possible in both ways utilizing the opposite heading convention.

A number of protocols have been proposed to reduce useful energy consumption. These protocols can be classified into three classes. Protocols in the first class control the transmission power level at each node to increase network capacity while keeping the network connected [3], [4]. Protocols in the second class make routing decisions based on power optimization goals [8]. Protocols in the third class control the network topology by determining which nodes should participate in the network operation (be awake) and which should not (remain asleep) [9], [11]. Nodes in this case, however, require knowledge of their locations via GPS-capable antenna or via message exchange.

Hierarchical (clustering) techniques can aid in reducing useful energy consumption [8]. Clustering is particularly useful for applications that require scalability to hundreds or thousands of nodes. Scalability in this context implies the need for load balancing, efficient resource utilization, and data aggregation.

Routing protocols utilize clustering [12]. Clustering exceedingly efficient in one-to many, many-to-one, one-to-any, or one-to-all broadcast contact.

Clustering protocols have been investigated in the framework of routing protocols [3], [8], or autonomous of routing [16], [18], [19]. In this work, we present a genus disseminated clustering move towards a hybrid of energy and communication cost HEED (Hybrid, Energy-Efficient, Distributed) clustering protocol. HEED has four primary objectives [21]: (i) prolonging network lifetime by distributing energy consumption, (ii) terminating the clustering process within a constant number of iterations, (iii) minimizing control overhead (to be linear in the number of nodes), and (iv) producing well-distributed cluster heads. Our clustering approach does not make assumptions about the distribution of nodes, or about node capabilities, e.g., location-awareness.

The approach only assumes that the Super leader node can control their transmission power level. In classical distributed systems, a node can either be a server or a source, but not both. A fixed number of servers are known to every source in the system, and a server is always available for processing and every node can act as both a source and a server (cluster head), which motivates the need for efficient algorithms to select servers according to the system goals outlined. A node only knows about the servers that are within its reachable range, which implies that achieving global goals cannot always be guaranteed but can be approximated through intelligent local decisions. Finally, a node may fail if its energy resource is
depleted, which motivates the need for rotating the server role among all nodes for load balancing.

III. OVERVIEW OF THE PROPOSED SOLUTION

3.1 Grouping of Stations

WMNs have a substantial number of stations associated with a solitary access point. These stations are gathered and care is taken so that no hidden nodes are available. At the point when another hub goes into the system, it first gauges the separation from it to the pioneer for a specific timeframe. The hub joins the gathering which is at a separation of D/2 where D is the corresponding separation. In the event that there are a few leaders present inside the separation of D/2 then the hub chooses the closest gathering. Later new hub sends a solicitation to the entrance point demonstrating the name of the gathering it needs to join. The entrance point, then sends the affirmation for its solicitation to join the gathering.

3.2 Association frame

The gathering pioneer decodes this association frame whenever it gets an access to the channel and interprets this affiliation outline and appoints a rank to the station. Next the gathering pioneer transmits the planning outline showing the positioning and Macintosh location of the new station.

On the off chance that the new station finds that there are no gathering leaders inside separation of D/2 then it allots a gathering ID - 1 showing in the affiliation demand outline that there are no gatherings to join. The entrance point, then appoints another gathering ID to the hub showing that the new hub begins its own particular gathering advertisement gets to be its leader.

3.3 Dispensation of Association frame

The leader assigns the schedule for each node in its group and this schedule is stored in the scheduling frame. At the point when the pioneer gets its swing to transmit the information it totals its planning outline in A-MPDU to the information outline. The stations then transmit the information in a steady progression with a SIFS length hole between them. Here since there are no shrouded hubs in the system, there is no requirement for RTS/CTS trade.

3.4 Clustering in LEACH protocol

The Existing Approach, In LEACH, a node elects to become a cluster head randomly according to a target number of cluster heads in the network and its own residual energy. Clustering starts by computing the optimal number of clusters in the network. When clustering is triggered, certain nodes broadcast their willingness to become cluster heads, and regular nodes unite clusters according to cluster head proximity. Each cluster head, then creates a TDMA plan for its nodes and broadcasts it. Every node sends its data to its cluster head, according to the precise TDMA schedule.

3.5 Clustering With HEEDs

HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. First, we define the parameters used in the clustering process. Second, we present the protocol design and pseudo-code. Finally, we prove that the protocol meets its requirements.

3.5.1 Clustering Parameters

The overarching purpose of our approach is to prolong the network lifetime. Cluster head selection is primarily based on the residual energy of each node. Measuring this residual energy is not necessary, since the energy consumed per bit for sensing, processing, and communication is typically known, and hence residual energy can be estimated. To increase energy efficiency and further prolong network lifetime, we reflect on intra-cluster “communication cost” as a secondary clustering parameter. For example, the cost can be a function of neighbor proximity or cluster density. We use the primary clustering parameter to probabilistically select an initial set of cluster heads,
and the secondary parameter to “break ties” among them. A tie in this context means that a node falls within the “range” of more than one cluster head. To understand what “range” denotes in this case, observe that a node typically has a number of discrete transmission power levels. Thus, the cluster range or radius is determined by the transmission power level used for intra-cluster announcements and during clustering. We refer to this level as the cluster power level. The cluster power level should be set to one of the lowest power levels of a node, to increase spatial reuse, and reserve higher power levels for inter-cluster communication. These higher power levels should cover at least two or more cluster diameters to guarantee that the resulting inter-cluster overlay will be connected. If this condition cannot be satisfied, then our approach for clustering in conjunction with power level selection is inapplicable.

Our approach can be used for constructing energy-efficient hierarchies for routing protocols, in which higher tier nodes should have more residual energy, efficient data aggregation and prolonged network lifetime, such as environmental monitoring applications.

### IV. SYSTEM IMPLEMENTATION

#### 4.1 HEED Pseudo code

```
I. Initialize
1. \( S_{ch} \leftarrow \{v : v \ is \ a \ cluster \ head\} \)
2. Compute broadcast cost to \( e \in S_{ch} \)
3. \( CH_{init} \leftarrow \max (C_{cost} \times \frac{E_{res}}{E_{trans}}) \)
4. \( ch_{final} \leftarrow \text{FALSE} \)

II. Repeat
1. If \( (S_{ch} \setminus \{v : v \ is \ a \ cluster \ head\}) \neq \phi \)
2. \( my\_cluster\_head \leftarrow \text{least}\_cost(S_{ch}) \)
3. If \( my\_cluster\_head = \text{NodeID} \)
4. \( C(CH_{init}) = 1 \)
5. \( \text{Cluster}\_head\_msg(\text{NodeID}, \text{final}\_CH, \text{cost}) \)
6. \( ch_{final}\_CH \leftarrow \text{TRUE} \)
7. Else
8. \( \text{Cluster}\_head\_msg(\text{NodeID}, \text{tentative}\_CH, \text{cost}) \)
9. Else if \( C(CH_{init}) = 1 \)
10. \( \text{Cluster}\_head\_msg(\text{NodeID}, \text{final}\_CH, \text{cost}) \)
11. \( ch_{final}\_CH \leftarrow \text{TRUE} \)
12. Else if Random(0, 1) \leq C(CH_{init})
13. \( \text{Cluster}\_head\_msg(\text{NodeID}, \text{tentative}\_CH, \text{cost}) \)
14. \( CH_{init} \leftarrow \min (CH_{init} \times 2, 1) \)

Until \( CH_{init} = 1 \)

III. Finalize
1. If \( ch_{final}\_CH \leftarrow \text{FALSE} \)
2. If \( (S_{ch} \setminus \{v : v \ is \ a \ cluster \ head\}) \neq \phi \)
3. my\_cluster\_head \leftarrow \text{least}\_cost(S_{ch})
4. join\_cluster(cluster\_head\_ID, NodeID)
5. Else Cluster\_head\_msg(NodeID, final\_CH, cost)
6. Else Cluster\_head\_msg(NodeID, final\_CH, cost)
```

### V. PERFORMANCE ANALYSIS

We demonstrate the advantage of grouping of the stations in lessening the likelihood of collision. The analysis compares the throughput with our scheme grouping and normal MAC scheme using DCF.

Let \( n \) stations fight utilizing DCF after some time duration \( D \) and \( d \) data frames information outlines. At that point \( s (n, d, D) \) gives the quantity of effective transmissions.

In our plan, consider \( n \) stations and are partitioned into \( g \) rise to groups. Each station transmits \( d \) information outlines on access. As the quantity of competing station is \( g \) the quantity of information data frames transmitted after every dispute is \( (n/g).d \). The performance gain analyzed over DCF is

\[
p = s (g (n/g, d, T)/s (n, 1, T)
\]

The regular DCF schemes time utilization [10] is given by

\[
C = P_s \cdot P_r \cdot \frac{TPayload}{((1-P_r)S+P_rF+T_r+S+P_r(1-P_r)T_c)}
\]

In this condition the \( P_r \) is the likelihood that the station transmits and \( P_s \) is the likelihood of effective transmission, \( T_s \) is the ideal opportunity for successful transmission, \( T_c \) is the ideal opportunity for collision event and \( S \) is the ideal opportunity for back off opening.
The expression of Pr and Ps is given by

\[ Pr = 1 - (1 - r)^n \]
\[ Ps = n \cdot \frac{r(1-r)(n-1)}{Pr} \]
\[ r = \frac{2(1-p)}{(1-2p)(CW\text{min}+1) + p \cdot CW\text{min}(1-2p)^n} \]

**VI. RESULTS**

**6.1 Simulation Results**

The results explain about the collision, Throughput rate in both standard MAC and aggregated MAC is in Figure 3 and 4 graphs the existing shows with the Mach 802.11 in red and Proposed by Group Mac in green.

![Figure 3: Graph of Throughput.](image)

The Performance Graph Explains about the energy consumption here in the graph which is in Figure 5 the existing shows with the LEACH clustering in red and Proposed with the HEED Clustering in blue.

![Figure 4: Graph of Energy Consumption.](image)

![Figure 4: Collision Data rates with 60, 70, 80 clients.](image)

**VII. CONCLUSION AND ENHANCEMENT**

The typical MAC plan had a high collision rate with the increased demand of WMNs prompting foremost to increase in number of approaching stations. The aggregating of stations leads to the demise in the impact/conflict rate henceforth increasing the throughput at the MAC layer. It was found that the impact rate was considerably less when contrasted with typical MAC which utilizes a DCF plan. An Augmentation in the quantity of hubs did not diminish the throughput of grouping plan than typical.

Analysis of previous routing protocol (LEACH) compares to its (HEED), based on the scenario that has been done, it shows successfully reduced wasteful energy consumption while is clustering process by the adaptive path selection and increases the network lifetime. We can extend the technique by adding the authority entity for detecting the cluster head intruder among the nodes by providing security against misbehaving aggregate head.

**REFERENCES**


