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# Back Off Mechanism for Enhancement of Zone Routing Protocol in MANETS

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***Abstract- In mobile ad hoc networks, researchers defines various solutions for MAC aware routing to improve the network performance. In case of contention at MAC layer, the solution which is provided for routing is not feasible so there is need to explore behavior of MAC protocol and compatibility with routing protocols. In this survey paper, we will discuss some contention based solutions those were developed to support the quality of services over ad hoc networks while minimizing the effect of collision and contention at MAC layer.***

***Keywords- Mobile ad hoc networks, Quality of service, hybrid routing***

## I. INTRODUCTION

Ad hoc networks are formed by mobile nodes, don't have any fixed infrastructure and also don't have any central administration. Due to self organizing feature of ad hoc network, there will be a very challenging issue to design an efficient medium access control (MAC) protocol. The majority of ad hoc networks is to implement the network which is based on modified scheme carrier sense multiple access with the collision detection (CSMA/CD) scheme but the CSMA-based approach but it suffers from hidden terminal problem. For better channel utilization lot of methods has been developed by researcher based handshake but channel utilization still suffers from the probability of high packets under heavy load of traffic. Ad hoc networks supports different types of routing protocols and the performance of these routing protocols is affected by the behavior of MAC layer protocols. So there is requirement to develop a cross layer solution which will enhance the performance of routing protocol by minimizing the impact of collision and contention.

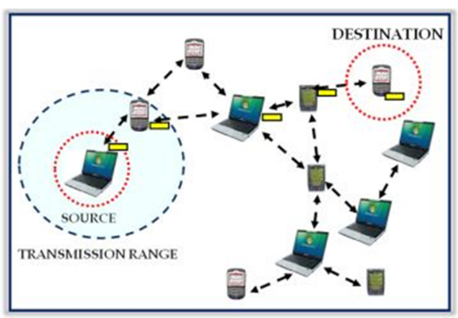


Figure 1.1 Mobile ad hoc network

Medium access control plays a very important role in networks by providing the access for data transmission through the physical medium. Solutions based on MAC are basically of two types i.e. contention-free and contention-based. The solutions for sense the channels or carrier, backoffs algorithms, retry schemes are categorized under contention-based. On the other side, solutions related to synchronization and time division are act under contention-free mechanisms.

Following are the constraints for MAC protocol development for ad hoc networks:

- It should support distributed operations under the QoS constraints
- It should be able to manage Packet Transmission delay
- It should be able to utilize the available bandwidth efficiently

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It should be able to enforce the fair channel allocation scheme for all nodes

It should support the large networks

MAC protocol issues over ad hoc networks-

There is less range for wireless links
In network topology there is uncertainity
Highly mobile environment is there
Bandwidth efficiency
QoS support
Efficiency for synchronization of data
Problem related to hidden nodes and exposed terminal

Features supported by MAC protocols:
MAC protocol is good for work in distributed kind of environment
Efficiency of bandwidth is utilized by MAC layer
The problem related to hidden terminal and exposed node is basically handled by MAC layer.
MAC protocol manages the data rate control adaptively

### *A. IEEE Standards*

IEEE Standards specify the constraints for different types of networks. It subdivided the data link layer in to Logical Link Layer and MAC Layer. LLC deals with the flow & error control whereas MAC Layer deals with channel access control.
Following Table:1 shows the IEEE Standards and their specifications:

| **IEEE Standards** | **Specifications** |
|---|---|
| IEEE802.1 | Network Management |
| IEEE 802.2 | Logical Link Layer |
| IEEE 802.3 | Ethernet |
| IEEE 802.4 | Token bus |
| IEEE 802.5 | Token Ring |
| IEEE 802.6 | MANs |
| IEEE 802.7 | Network Management |
| IEEE 802.8 | Fiber Optic |
| IEEE 802.9 | ISLAN |
| IEEE 802.10 | Interoperable LAN Security |
| IEEE 802.11 | WLAN/Mesh based Network |
| IEEE 802.12 | 100BaseVG |
| IEEE 802.13 | - |
| IEEE 802.14 | Cable modems |
| IEEE 802.15 | Wireless PAN |

| | |
|---|---|
| IEEE 802.15.1 | Bluetooth |
| IEEE 802.15.2 | IEEE 802.15 and IEEE 802.11 coexistence |
| IEEE 802.15.3 | Large Range Networks |
| IEEE 802.15.4 | Short Range Networks |
| IEEE 802.15.5 | WPAN Mesh |
| IEEE 802.15.6 | BAN |
| IEEE 802.16 | WiMAX |
| IEEE 802.16.1 | Local Multipoint Distribution Service |
| IEEE 802.17 | Resilient packet ring |
| IEEE 802.18 | Radio Regulatory TAG |
| IEEE 802.19 | Coexistence TAG |
| IEEE 802.20 | Mobile Broadband |
| IEEE 802.21 | Media Independent Handoff |
| IEEE 802.22 | WRAN |
| IEEE 802.23 | Emergency Services Working Group |
| IEEE 802.24 | Smart Grid |
| IEEE 802.25 | OAN |

Table:1 IEEE Standards

### *B. IEEE 802.11 Standards*

IEEE 802.11 Standards deal with Physical layer as well as with MAC layer. It uses different frames for channel access and each frame has different priority. SIFS frame has highest priority among all other frames because it has shortest waiting interval. PIFS has medium priority and falls between SIFS and DIFS frame which has lowest priority. On the basis of frequency and application areas, IEEE 802.11 is further subdivided in to IEEE 802.11a/b/g/n/h etc .

## II. LITERATURE REVIEW

Researchers have developed many algorithms to utilize the shared channel by managing the contention. Now we will explore the various solutions introduced by them. Mui Van Nguyen et al. [3] proposed an optimal cognitive MAC protocol for MHAHNs under opportunistic spectrum access (OSA) approach in which channel contention resolution is done on the basis of interference-dependent random access addressing both social welfare maximization and energy efficiency. It offers contention control at MAC layer, interaction relationship with power control at the physical layer and also congestion control at the transport layer. They proposed an optimal cognitive MAC framework for NP-hard problem. To solve this problem, authors introduced some auxiliary variables which are interpreted as interference weights and develop a distributed solution, which has been proved for global optimum to converge.

Pinyi Ren et al. [4] proposed MAC protocol based CAD (Channel-Aggregation Diversity) technology in which transmission time fairness constraints are introduced which allow to transmit particular number of packets at one time. Two joint power allocation schemes are introduced: First scheme is for high data transmission rate in which optimal allocation policy is used to solve Knapsack

Problem. Dynamic programming is used to solve this. Second scheme is concern with energy optimization which is resolved by fractional programming. Each node pair uses the RTS, CTS and RES for information exchange. If sender observes that channel is free than it send RTS to receiver. At receiver end, RTS is processed and CTS is sent to the sender. Finally, Sender sends RES in acknowledgement and starts the data transmission as per the channel allocation policy. Simulation results sow its performance in terms of energy efficiency and throughput.

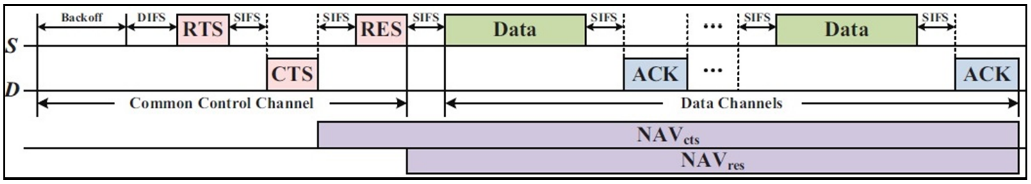


Figure:1 CAD-MAC transmission method

M. Van Nguyen et al. [5] focused on the probabilistic channel contention resolution problem for net revenue maximization in multi-hop wireless ad-hoc networks (MHAHNs) under collision-rate-constrained opportunistic spectrum access (OSA) approach. Specifically, They considered the interference-dependent contention model, in which secondary users (SUs) must coordinate to each other to simultaneously balance between interference and collision, leading a more efficient MAC protocol than the location-dependent one proposed in the literature. By introducing some auxiliary variables and noisy channel estimations, we can then develop a novel heuristic cross-layer cognitive MAC protocol (HCC-MAC) in OSA-based MHAHNs to solve the formulated MAC optimization problem which is shown non-convex and inseparable. Proposed protocol can achieve near-optimal throughput in a distributed manner without control overhead. Analytical analysis show that HCC-MAC can outperform the existing MAC protocols under OSA paradigm. Di Marco et al. [6] introduced the study of routing metrics and interaction of routing with MAC. Concepts of cross layer interactions are introduced. Also the concepts of contention level which can affect the network performance and parameters of MAC layer. Some reliability constraints are used which are efficient to increase the lifetime of network and also used to balance the load in network. Proposed solutions are compared with routing approach based on backpressure mechanism and results show the efficiency of this solution.

Farooq M.O et al. [7] presented a bandwidth estimation-based admission control and routing protocol, called BEAR for IEEE 802.15.4 - based networks. The purpose of BEAR is to support real-time multimedia flows in IEEE 802.15.4 - based networks by satisfying their end-to-end bandwidth requirements. It combines a bandwidth estimation approach, admission control, and routing. It uses a measurement-based bandwidth estimation algorithm that combines nodes' transmission rate, and actual MAC layer overhead to estimate the available bandwidth. The available bandwidth information is used as input to the admission control protocol, and It supports algorithms to estimate a flow's contention, intra-flow contention, and additional MAC layer overhead with an increased data load inside a network. Available bandwidth information can be used as a routing metric to select forwarding path(s) that can offer better end-to-end available bandwidth. Proposed framework can be used to support real-time multimedia applications for IEEE 802.155.4 - based networks.

Jackson.C.A et al. [8] proposed a hierarchical and heterogeneous multichannel ad hoc network. The channels employed by this network are non overlapping, and each channel differs significantly in its characteristics, such as achievable data rate, communication range, and traffic load. Every terminal is connected with frequency-agile radio which can change its transmission rate and carrier frequency. These radios communicate using contention-based access and are permitted to utilize multiple channels. A subset of the terminals form a backbone network, and are equipped with a second radio tuned to a traffic channel employing schedule-based access. They considered various hierarchical and heterogeneous multichannel ad hoc network topologies and investigated the backbone networks that increase network-layer performance over scenarios in which too few or too many terminals are selected to form the backbone network.

Zheng Li et al. [9] proposed a novel multiple-recipient based on cooperative MAC layer protocol for wireless adhoc networks. The sender selects a recipient among multiple candidate recipients. Candidate helpers employ a preliminary helper contention scheme and an optimal helper contention scheme to select the optimal helper according to their cooperation gain. Besides, the sender can send data packet at the highest data rate that it can support according to the busy tones in the preliminary helper contention process, guaranteeing both the channel utilization and the link reliability.

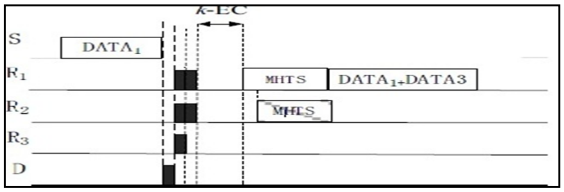


Figure:2 Contention Stage for Optimal Helper

Once the recipient receives the sender's data packet through the optimal helper, it can also send its data packet to the sender through the same optimal helper. Furthermore, the optimal helper can piggyback its data packet to the sender or the recipient, reducing the reservation overhead and the possibility of collisions during channel reservation.

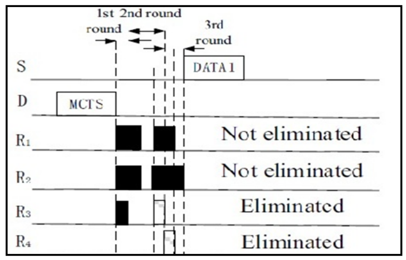


Figure:3 Contention Stage at Preliminary Helper

Figure show the contention stages at Preliminary/Optimal Helper Simulation results show the performance of proposed protocol compared with CoopMACA and 2rcMAC using different parameters such as throughput and average packet delay.

Haitao Zhao et al. [10] proposed a capacity-aware statistical QoS routing scheme which is used to realize statistical Quality of service guarantees for IEEE standard 802.11 wireless network under a particular medium or for high traffic load. This proposed scheme estimates the probability of packet collision through MAC layer retransmission and the statistical traffic load dynamically, thereby achieving the capacity prediction of wireless channel based on statistics probability and service process. Furthermore, a cross layering design approach is used, in which proposed scheme offers a stochastic QoS route optimization and the traffic flow admission control in terms of capacity-aware criteria and the location-based route discovery to obtain effective resource utilization and packet forwarding. Simulation results shows that this scheme can detect the state of wire less link well. Also, it decreases end-to-end delay and improves successful packet delivery percentage without increasing routing overhead over multi-hop wireless networks. Simulation shows the effectiveness of the proposed scheme over the existing location-based QoS optimization delivery algorithm in terms of retransmission count, successful delivery rate and end to end delay on the condition of time-varying multi-hop wireless links.

Alessandro Delfino et al. [11] presented the opinion for design and implementation of medium access control in which they use ECMA-392 standard. They basically focused on centralized cognitive network, in which network is considered which uses out-of-band cognitive control channel (CCC). This CCC is used to manage different types of operations of network. Proposed work shows that the capability of network should be reconstructed or reconfigured when CCC is jammed by any primary user. They designed a prototype for average network reconfiguration delay which is used to operate in 375-445 MHz frequency bands for public safety ad hoc networks.

Ze Li et al. [12] proposed the enhancement in hybrid approach by using Quality of Service support capability. This new protocol named as QoS Oriented Distributed Routing Protocol (QOD) which used the advantages of anycast and fewer transmission hops. There are five algorithms for QOD- First algorithm is for QoS guranteed neighbor selection which is used to overcome transmission delay requirement. Second algorithm is to reduce transmission delay is distributed packet scheduling algorithm. Third algorithm is to reduce time of transmission is mobility based segment resizing algorithm which can adjusts its segment size according to the mobility of node. Fourth algorithm is used to increase throughput is traffic redundant elimination algorithm and Fifth algorithm is used to remove the redundancy in data is Data Redundancy elimination-based transmission algorithm. Simulation results shows the performance of QOD which can achieve more scalability, reduce the contention and high mobility-resilience.

K.H. Almotairi et.al [12] presented a MAC protocol based on distributed multi-channel that can utilize hopping sequences with multiple radio interfaces for transmission and reception. They proposed an analytical model and simulation results validate this model and show the performance in terms of Throughput.

Bourdelles, M et.al [13] proposed a CPU resources control module to be included in a real-time embedded system, and using platform resources tuning capabilities such as Dynamic Voltage and Frequency Scaling (DVFS). This control module has been designed to be generic enough to be adapted to any system, but precise enough to take into account real-time constraints of such systems. The solution proposed does not need any knowledge and pre-execution of the business code of the active components of the system to be monitored. The solution is demonstrated on the Medium Access Control (MAC) of a radio protocol implemented on a Freescale IMX6 board with power gains of more than 40% with frequency scale variations from 800MHz to 400MHz.

## III. PROBLEM DEFINATION

Due to the excessive node movement in the network, it becomes unstable and puts extra control over head over entire network and results in route failures due to the dynamic topology of network and packet loss or drop due to the Medium Access Control (MAC) contention and interference, and also by random channel bit errors. With this Performance of routing protocol significantly lower down in ad hoc networks because wireless connections in those networks can influenced by various factors like high bit error rates, frequent route changes, and by partitions. Dynamic topology is a major issue for ad hoc routing. Both table driven and on demand routing protocols suffer from this factor. Hybrid routing protocol such as ZRP, combines the advantages of the table-driven and on-demand methods of routing by maintaining up-to-date topology map of the zone centered on each node in the network. Inside the zone, routes are available immediately because of the presence of route tables. For destinations which lies outside the zone, it uses route discovery mechanisms, which make the benefit as compared to the local routing information of the zones but still it faces challenges related to the MAC contentions and interference etc. because nodes can enter in to any zone and can claim the channel for transmission which may lead to MAC contention and interference and finally puts the extra control overhead over entire network. So there is need to develop a mechanism which can adopt the dynamic topology and can also control the MAC contentions and interference while maintaining the different Quality of service parameters such as delay, routing load and packet delivery ratio etc.

## IV. CONCLUSION

In this survey paper, we discussed the importance of MAC protocol and the various solutions developed by the researches for Qos enabled communication support over Ad hoc networks by enhancing the existing functionality of the MAC protocol. They explored the different channel allocation schemes, capacity & energy awareness methods, contention based QoS control methods, cross-layer approaches to optimize the effect of collusions over different layers and bandwidth utilization etc. As per this survey, we can conclude the role of MAC layer and proposed solutions those are sufficient to maintain the different Quality of service parameters such as delay, routing load and packet delivery ratio etc.

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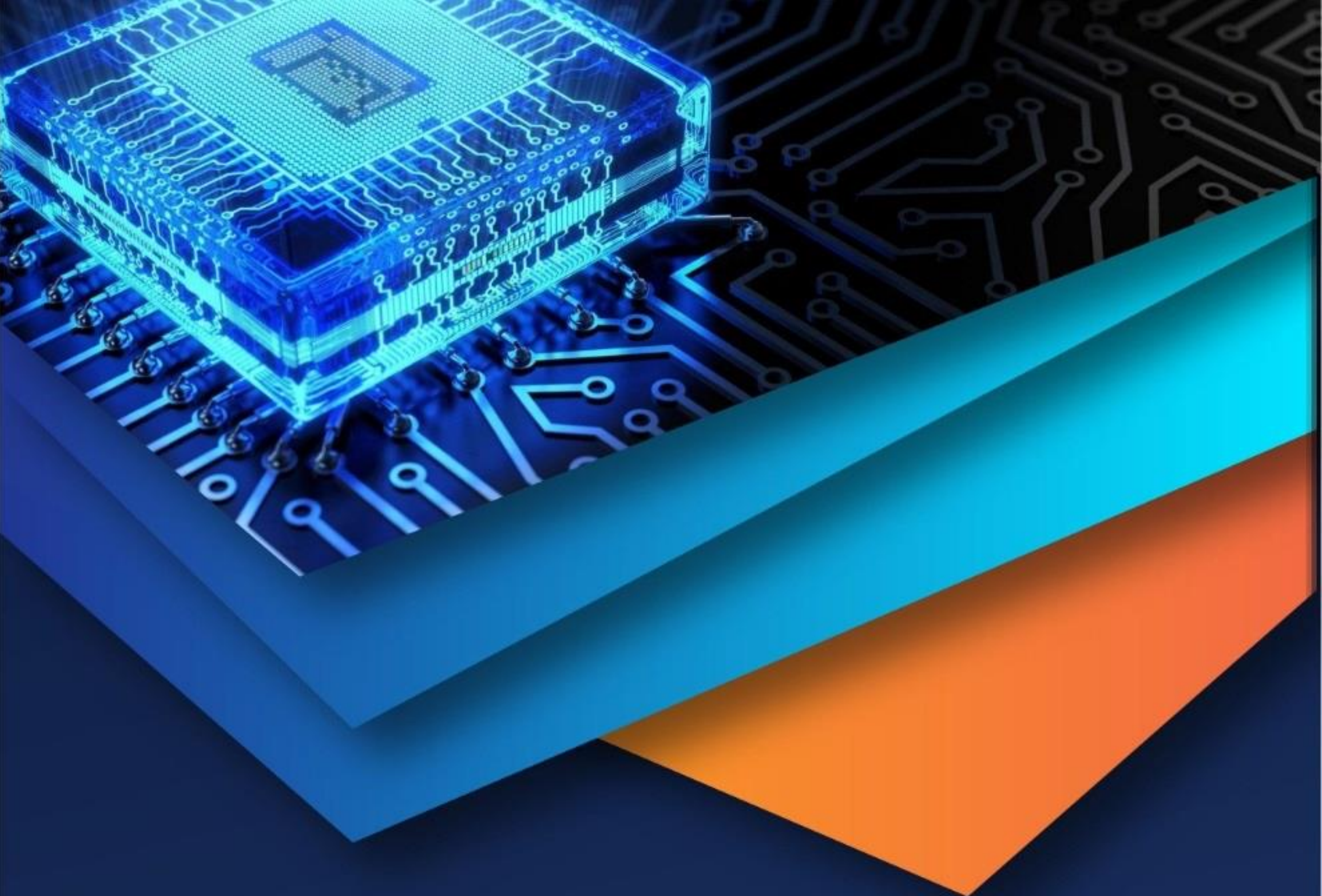

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