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# Throughput Improved -Adaptive CSMA MAC Protocol Design with Power Optimistic for MANET

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***Abstract - Power conservation and throughput management is a major issue in Mobile Ad Hoc Networks. In the design of wireless ad hoc networks, various techniques are applied to efficiently allocate the scarce resources available for the communication links and the power control. Therefore the throughput management is not related to any particular layer in the layered design communication protocol design. But most of the power control and throughput management mechanisms are working in MAC layer. An adaptive CSMA medium access control (MAC) protocol is proposed to consider a spatial network model in which the nodes are randomly distributed in space, and address the problem of interference, power control, and throughput improvement through CSMA MAC layer design. Power control and throughput improvement is a critical issue to implement Mobile Ad Hoc networks. The proposed method presents a novel power control protocol, and improves the aggregate throughput of the network for its possible application in Mobile Ad Hoc networks.***

***Keyword* - Ad Hoc Networks, Poisson Point Process, MAC Protocols, Outage Probability.**

## I. INTRODUCTION

Wireless ad hoc networks, various techniques are applied to efficiently allocate the scarce resources available for the communication links. Using an appropriate medium access control (MAC) protocol is one such technique. MAC data communication protocol is a sub layer of the data link layer. The sub layer provides addressing and channel access control mechanisms that make it possible for several terminals or network nodes to communicate within a multiple access network that incorporates a shared medium [1]. The channel access control mechanism provided by the MAC layer is also known as a multiple access protocol. The multiple access protocol may detect or avoid data packet collisions when a packet mode contention based channel access method is used, or reserve resources to establish a logical channel. The ALOHA method is the common multiple access protocols that may be used in packet radio wireless networks; it is limited by the large vulnerability period of a packet. By listening before transmitting, stations try to reduce the vulnerability period to one propagation delay. So the proposed MAC Protocol Layer design using contention based CSMA/CD protocol used in Ethernet networks. This mechanism is only utilized within a network collision domain, for example an Ethernet bus network or a hub-based star topology network. An Ethernet network may be divided into several collision domains, interconnected by bridges and switches [2].Carrier Sense Multiple Access with Collision Detection (CSMA/CD) is a one of the MAC carrier sensing scheme. A transmitting data station that detects another signal while transmitting a frame, stops transmitting that frame, transmits a jam signal, and then waits for a random time interval before trying to resend the frame. CSMA/CD is modification of pure carrier sense multiple access (CSMA). CSMA/CD is used to improve CSMA performance by terminating transmission as soon as a collision is detected, thus shortening the time required before a retry can be attempted [3]. In this paper proposes a spatial network model in which nodes are randomly distributed in space, and it addresses the problem of interference through MAC layer design. The CSMA MAC protocol is employed for communication, and the success rate of packet transmissions is investigated. The rest of this paper is organized as follows. In Section II related work of this paper. In Sections III and IV described Methodology and Simulation Setup. In Section V looks Result and discussions. And Finally Section VI presents the conclusion.

## II. RELATED WORK

The performance of the ALOHA and CSMA-MAC protocols are analyzed in spatially distributed wireless networks. Numerous works have been done on fading and its effects in communication networks. In [4],

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Baccelli et.al. Evaluate the outage capacity of ALOHA in a Rayleigh-fading environment. The focus of their work is on optimizing the transmit power and the access probability (which is the product of the number of simultaneously successful transmissions per unit space by the average range of each transmission). In [5], the success probability (*Ps* = 1 – OP) of slotted ALOHA is derived in various fading scenarios, obtaining similar results as the formulas can apply in this analysis. In [6], a new fading model is proposed that combines uncertainties in the transmission distance with small-scale fading. In this model, where TXs are Poisson distributed and fading is assumed to be Rayleigh, it is proven that the effect of fading is a *thinning* in the geographical domain.

Ilow and Hatzinakos [7] consider the impact of random channel effects on the aggregate co-channel interference in an ad hoc network where nodes are distributed according to a PPP. Whereas their focus is on identifying the impact of fading on the parameters of the characteristic function of the interference, concentrate on the MAC layer design and evaluate the OP of various MAC protocols. In [8] and [9], the transmission capacity of slotted ALOHA in an ad hoc network with Poisson distributed node locations is evaluated for a given outage requirement. It is shown that in the absence of CSI, fading can significantly reduce the transmission capacity [9]. Rather than setting a constraint on the OP, the paper evaluating the performance of ad hoc network in terms of OP.

This evaluation is performed for both the ALOHA and CSMA protocols. For this analysis, apply some of the techniques that were proposed in [10] and developed further in [11] and [12]. Due to the absence of fading in these works, outage could be directly translated into a distance problem. That is, lower bounds to the OP were derived by only considering the closest interferer to the node under observation. In the presence of fading, however, as is the case in this work, the closest interferer does not necessarily cause outage for packet. It is now the dominant interferer (i.e., the one with the largest received interference power when its link is affected by fading) that should be considered.

## III. METHODOLOGY

The modules which are to be implemented in this project are given below.

### *A. Cooperative Diversity in Wireless Ad Hoc Network*

Reliability of a communication link is very important in wireless ad hoc networks, because they are often deployed as a temporary network in noisy and unstable environments. A link breakage at one hop of a multihop route, caused by fluctuating communication environment, interference or node mobility, would bring some of overhead: The intermediate node experiencing the link breakage needs to report this event (route unavailability) to the original source of the data packets. In Cooperative diversity, each node proactively selects one partner device for its cooperative communication. It exploits cooperative diversity via DSTC to overcome the link breakage problem due to unreliable, fluctuating communication environment [13].

### *B. Implementation Of MAC (CSMA) Protocol*

The use of multiple channels may provide some performance advantages in reducing collisions and enabling more concurrent transmissions and thus better bandwidth usage even with the same aggregate capacity. The poor performance of unslotted ALOHA is improved greatly by introducing channel sensing and the ability to back off from transmissions is also increased. Multichannel protocols allow a number of nodes in the same neighborhood to transmit concurrently on different channels without interfering with one another. Carrier sensing can be coupled with an efficient channel selection mechanism to pick the clearest channel for transmission.

Carrier sensing can be coupled with an efficient channel selection mechanism to pick the clearest channel for transmission. If multiple channels are formed on the basis of multiple CDMA codes, a receiver may also receive multiple signals from different sources at the same time. Due to these advantages, a number of multichannel MAC protocols have been explored for multihop wireless networks. Moreover, several modifications were proposed in order to overcome the inherent hidden and exposed node problems of CSMA. By allowing some kind of communication between the TX and its RX, throughput improvement was achieved along with the work to consider point-to-point wireless ad hoc networks and enables us to evaluate the OP performance of CSMA.In this design, a packet is backed off if the measured or estimated (depending on whether the RX or TX are sensing) SINR is below the sensing threshold, $\beta sens$, at the beginning of its transmission .Maximum of $M$ times the packet waits .At random received in error at its RX, the packet is retransmitted. This is repeated $N$ times before the packet is dropped [14].

### *C. Outage Probability of CSMA*

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By introducing sensing of the channel prior to transmission, the CSMA protocol improves the performance of ALOHA considerably. In this protocol, when a new packet is formed, the channel is sensed (by the TX in CSMATX, by the RX in CSMARX, and by both TX and RX in CSMATXRX), and a decision is made on whether or not the packet transmission should be initiated. If the measured SINR at the start of the packet is above $\beta$, then the packet is sent immediately. Otherwise, the transmission is backed off. Since no retransmissions are allowed, a back off is equivalent to dropping the packet. Consequently, each back off must necessarily be counted as outage. The total OP of CSMA may be expressed as $P_{out(CSMA)}=P_b^M+(1-P_b^M)P_{rt1}P_{rt}^N$ and the density of packets attempting to access the channel is

$$\lambda_{csma}(P_b, P_{rt1}, P_{rt}) = \lambda\left[\frac{1-P_b^M}{1-P_b} + (1-P_b^M)P_{rt1}\frac{1-P_{rt}^N}{1-P_{rt}}\right]$$

Where $Prt1$ is the probability that an activated packet is received erroneously at its first transmission attempt and must be retransmitted, and $Prt$ is the probability of error in the retransmission attempts.

Due to the back off property of CSMA, and since packets tagged for retransmission do not perform new channel sensing, multiply $\lambda csma$ by $(1 - Pb)$ to find the density of active packets:

$$\lambda_{active}(P_b, P_{rt1}, P_{rt}) = \lambda(1 - P_b^M + (1-P_b^M)P_{rt1}\frac{1-P_{rt}^N}{1-P_{rt}})$$

*CSMA with Transmitter Sensing*

In the conventional CSMA protocol, which is employed in many of today's network standards, such as IEEE 802.11 and 802.16, the TX is the back off decision maker. That is, when a new packet arrives, the TX immediately measures the aggregate interference power. If this is greater it$\left(\frac{\rho R^{-\alpha}}{\beta} - \right)$, backs off, otherwise, it starts transmitting $P_b \approx \bar{P}_b$is the backoff probability, and is found as the solution to,

$$\bar{P}_b = 1 - e^{-\lambda\left(1-\bar{P}_b^M+(1-\bar{P}_b^M)\bar{P}_{rt1}\frac{1-\bar{P}_{rt}^N}{1-\bar{P}_{rt}}\right)}$$

$P_{rt} \approx \bar{P}_b + (1-\bar{P}_b)\bar{P}_{during}^{TX}$is the probability that an activated packet is received erroneously in a retransmission attempt, with$\tilde{P}_{during}$being the probability that the error occurs at some $t\in (0, T)$,

$$\bar{P}_{during}^{TX} = 1 - e^{-\int_{s-R}^{s}\lambda_{csma}\left[2\pi - 2\cos^{-1}\left(\frac{r^2+R^2+s^2}{2Rr}\right)\right]r\,dr}$$

$P_{rt1} \approx \bar{P}_{rx}/transmit + (1-\bar{P}_{rx}/transmit)\bar{P}_{during}^{TX}$is the probability that an activated packet is received erroneously at the first transmission attempt, $\tilde{P}_{rx|transmit}$with being the probability that the RX is in outage upon the packet arrival, given its TX decides to transmit,

$$\bar{P}_{rx}/transmit = \bar{P}_b\left[1 - \frac{1}{\pi s^2}\left(2s^2\cos^{-1}\left(\frac{R}{2s}\right) - Rs\sqrt{1-\frac{R^2}{4s^2}}\right)\right]$$

***CSMA with Receiver Sensing***

With the objective of improving the performance of CSMA, introduce a novel protocol, termed CSMARX. In this protocol, the RX senses the channel and subsequently determines whether or not the packet transmission should be initiated. The communication between the TX and RX is assumed to occur over a separate 1 bit control channel, and the delay introduced by the feedback is assumed to be small and insignificant compared to the packet length.

$P_b \approx \bar{P}_b$is the backoff probability and $P_{rt} \approx \bar{P}_b + (1-\bar{P}_b)\bar{P}_{during}^{R\bar{X}}$ is the probability that an activated packet is received erroneously some time during its transmission and must thus be retransmitted [15].

$$\bar{P}_{during}^{RX} = 1 - e\left(-\int_{s-R}^{s}\int_{v(r)}^{2\pi-v(r)}\lambda_{CSMA}\,P(active/r,\phi)r\,d\phi\,dr\right)$$

$$P(active/r,\phi) = 1 - \frac{1}{\pi}\cos^{-1}\left(\frac{r^2+2R^2-s^2-2Rr\cos\phi}{2R\sqrt{r^2+R^2-2Rr\cos\phi}}\right)$$

$$v(r) = \cos^{-1}\left(\frac{r^2+2Rs-s^2}{2Rr}\right)$$

***D. Performance Analysis***

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Extensive simulation results of the proposed CSMA-MAC protocol along with ALOHA. In the simulations, the source nodes always have data packets to send and the following performance metrics are evaluated.

– Throughput
– Energy efficiency

Finally, CSMA-MAC can significantly improve the performance of throughput and energy efficiency compared to ALOHA.

### *E. Data Flow Diagram*

The data flow diagram of the ad-hoc Node model and the adaptive CSMA MAC module is give below.

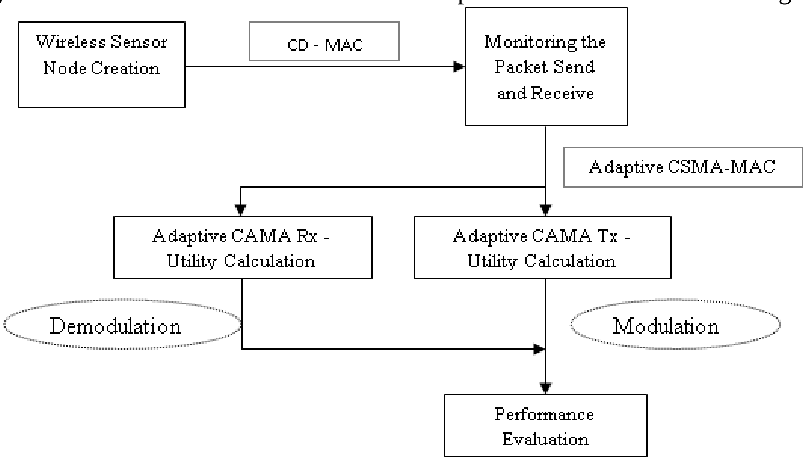


**Fig.1. Dataflow Diagram**

## IV. SIMULATION SETUP

A network simulator is a software program that imitates the working of a computer network. The simulator can be used for traffic modeling of telecommunication networks, protocol modeling, modeling queuing networks, modeling multiprocessors and other distributed hardware systems, validating hardware architectures, evaluating performance aspects of complex software systems. NS2 needs the fixed parameter setup, they given below

**Table 1: Simulation Parameters**

| PARAMETER | VALUES |
|---|---|
| Mobile nodes | 50 Nodes over 300m x 1500m |
| Reflection model | Two-ray ground reflection model |
| Data rate | 2Mbps |
| Environment noise level | -83 or -90 dBm |
| Traffic model | UDP based CBR traffic |
| Routing protocol | Ad hoc On demand Distance Vector (AODV) |
| Physical layer protocol | PHY 802.11 |
| Packet size | 512 bytes |
| Simulation time | 900 sec |

## V. RESULT AND DISCUSSION

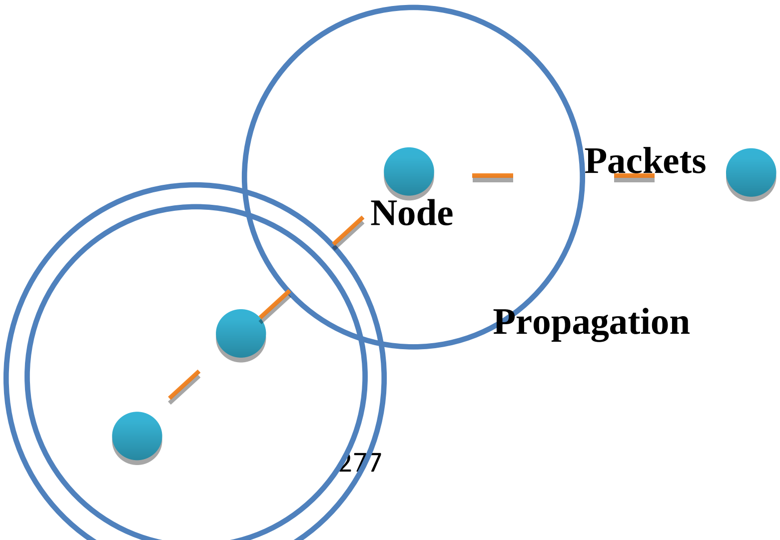

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**Fig 2: CSMA Node method**

The existing slotted aloha method transmits the data without propagation which may lead to data drop. The simulation results of proposed CSMA shows that all nodes are properly receiving every frames from sender without any failure due to propagated transmission. The graph shows the throughput of both methodologies. The result shows that, the proposed CSMA reduces much packet drop as well as the outage probability, so that the throughput is automatically increased.

The ratio of the OP of unslotted ALOHA and CSMA over that of slotted ALOHA as a function of $\beta sens = \beta req = \beta$, for $(M,) = (2, 1)$ and a high density of $\lambda = 0.2$. For low values of $\beta$, CSMARX yields up to 10% lower OP compared to unslotted ALOHA, while CSMATX yields 32% higher OP.

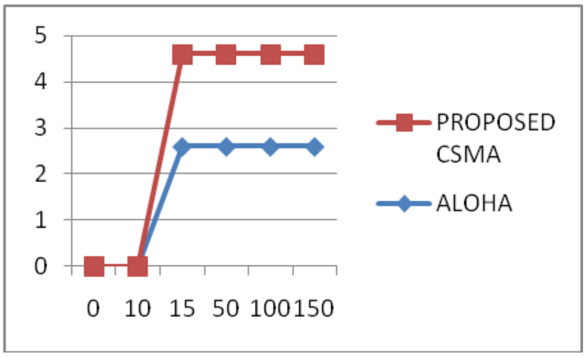


**Fig 3 : Graph for both ALOHA and CSMA**

However, as $\beta$ increases (i.e., for $\beta > -6$ dB), making both the sensing zone and the communication zone grow, the OP of CSMATX decreases below that of unslotted ALOHA. This is because the ratio of the area within which the arrival of an interferer causes outage in CSMATX over that in ALOHA (i.e., (RX0, $s$)) decreases with $\beta$. More interestingly, for even higher values of $\beta$ (i.e., for $\beta > 8$ dB), both CSMA protocols actually perform better than slotted ALOHA.

## VI. CONCLUSION

Mobile Ad Hoc networks find its applications in many areas and are useful in many cases. But it faces some problems due to limited battery power of the mobile nodes. Since all mobile nodes are battery powered, power has to be used efficiently. In this proposed work, consider a stable network environment for Wireless MAC design. Mobility of the nodes is not consideration.

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