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Congestion Minimization through Collision Detection in TDMA and CSMA/CA Scheme in Wireless Mobile Ad-Hoc Network

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ABSTRACT
Mobile ad-hoc network is collection of temporary nodes that are capable of dynamic forming temporary network, self organize, and infrastructure less with nodes contains routing capability. That case we can't predict where the heavy traffic load comes and collision comes and drop actual data packet by the receiver's and intermediate nodes, because all nodes are self governing and self controllable.

In this paper, we identify several network aspects, some of which are unique to mobile ad-hoc networks, that affect congestion, as for example: data rate; data drop causes (via bandwidth, collision) number of MAC retransmissions, Minimum Contention Window etc. before that we study and analyze the result in case of medium access control as (802.11 and TDMA) and we found that 802.11 case collision comes because that approach cannot use RTS/CTS method after that TDMA time we found time division multiple access but packet delivery ratio less as compare to 802.11 after that we apply our CSMA/CA (carrier sense multiple access with collision avoidance mechanism) and we get collision free transmission and enhanced performance as compare to 802.11 and TDMA.

In our approach we use RTS/CTS method for collision avoidance and also apply and enhance CSMA/CA via congestion control through contention window overshooting scheme and jam control technique and analyze our result on the bases of throughput, end-to-end delay, routing overhead, packet delivery ratio etc.

Here we use NS-2.31 simulator for simulation of MANET and take comparative analysis between 802.11, TDMA and CSMA/CA mechanism.

Keywords

TDMA, 802.11, MANET, CSMA/CA

1. INTRODUCTION
Congestion Control through Collision Removal Mechanism with MAC Protocol (802.11, CSMA/CA, TDMA)

Here we describe basic working structure of Network simulator -2, we create number of mobile nodes and set some node as sender and receiver nodes we also generate application relate data like CBR (constant bit rate) ,VBR (variable bit rate) and FTP (File transfer protocol) after that we set lower layer protocol like TCP (Transfer Control protocol) for reliable communication and UDP (User data gram Protocol) for fast transmission but unreliable communication, in inter mediate layer or routing layer we use AODV (Ad-hoc on demand Routing protocol) for ad-hoc routing that provide mobile ad-hoc routing environment, here our main contribution part of Data link layer part, in data link layer we split this part into to group one is LL (logical link) in wired and wireless both cases LL parameter can't change but second group MAC (Media Access Control) layer decide communication is wired or wireless, if wired communication we set Mac 802.3 but case of wireless we use MAC as 802.11 , 802.13 various media Access Technique like CSMA/CA (Carrier Sense multiple Access with collision Avoidance) TDMA (Time division Multiple Access)

In CSMA/CA mechanism a node wishing to transmit data has to first listen to the channel for a predetermined amount of time to determine whether or not another node is transmitting on the channel within the wireless range. If the channel is sensed "idle," then the node is permitted to begin the transmission process. If the channel is sensed as "busy," the node defers its transmission for a random period of time. Once the transmission process begins, it is still possible for the actual transmission of application data to not occur.

Collision avoidance is used to improve CSMA performance by not allowing wireless transmission of a node if another node is transmitting, thus reducing the probability of collision due to the use of a random truncated binary exponential back off time.

CSMA/CA also Send RTS (request to send) and CTS (Clear to send) Message to sender node so that all other node can't use the busy channel that is provide collision free transmission. But 802.11 mechanisms cannot send any RTS and CTS message so that case collision occurs and our throughput is also decreases and packet Drop rate increases in case of 802.11.

In TDMA (Time division Multiple Access) technique sender node sends data according to given time period so that no chance to collision occurs on the network.

In Architecture diagram we so all the MAC layer media access techniques combined manner and functionality steps.

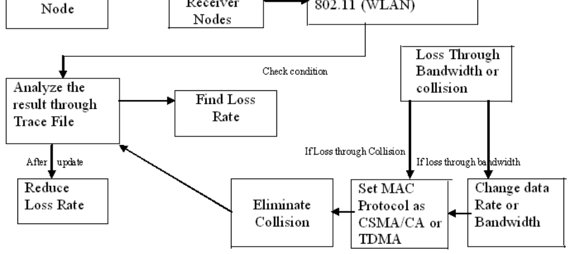

Fig-1 Congestion Control through Collision Removal Mechanism with MAC Protocol

2. MOTIVATION FOR PAPER

This Paper aims to study the problem of congestion in MANETs and identify causes and symptoms strictly related with the philosophy and design of MANETs. The main objective is to examine the behaviour of several network parameters and their impact to congestion in MANETs and address a theoretical framework for congestion control and avoidance that is different from existing traditional schemes that are based on rate control to alleviate congestion. Some other issues are also examined, such as energy consumption and fairness problems and their relation to congestion. The simulation scenarios were implemented and tested with the use of the NS-2 simulator.

Algorithm for contention period, jam period and data send method

// The MAC calls this Channel contention () to enter contention period

```
void Channel::contention(Packet* p, Handler* h)
 {
        Scheduler& s = Scheduler::instance();
        double now = s.clock();
        if (now > cwstop_) {
                cwstop_ = now + delay_;
                numtx_ = 0;
        }
        numtx_++;
        s.schedule(h, p, cwstop_ - now);
 }
```

Jam the channel for a period txtime

```
int Channel::jam(double txtime)
 {
        // without collision, return 0
        double now = Scheduler::instance().clock();
        if (txstop_ > now) {
                txstop_ = max(txstop_, now + txtime);
                return 1;
        }
        txstop_ = now + txtime;
        return (now < cwstop_);
 }
```

Data send through Send method

```
int Channel::send(Packet* p, double txtime)
{
  double drop_ ;
        // without collision, return 0
        Scheduler& s = Scheduler::instance();
        double now = s.clock();
        // busy = time when the channel are still busy with
earlier tx
        double busy = max(txstop_, cwstop_);

        if (now < busy) {
        // if still transmit earlier packet, pkt_, then corrupt it
                if (pkt_ && pkt_->time_ > now) {
                        hdr_cmn::access(pkt_)->error()
|= EF_COLLISION;
                        if (drop_) {
                                s.cancel(pkt_);
                                pkt_ = 0;
                        }
                }

                if (drop_) {
                        return 1;
                }
        }
        pkt_ = p;
        trace_ ? trace_->recv(p, 0) : recv(p, 0);
        return 0;
    }
```

3. SIMULATION PARAMETER

We get Simulator Parameter like Number of nodes, Dimension, Routing protocol, traffic etc. According to below table 1 we simulate our network.

Table 1. Simulation parameter

Number of nodes	30
Dimension of simulated area	800×600
Routing Protocol	AODV
Simulation time (seconds)	25
Mac Layer property	802.11 , TDMA,CSMA/CA
Traffic type	CBR ,FTP
Transport Layer Protocol	TCP ,UDP
Packet size (bytes)	1000
Number of traffic connections	16
Maximum Speed (m/s)	25

4. RESULT AND ANALYSIS

TDMA (Time Division Multiple Access) Mechanism Case TCP Flow Analysis

Here we show the result of TCP (Transfer Control Protocol) packet flow analysis, in our simulation we take 30 mobile node with MAC as TDMA with three TCP connection, time division access case all the sender node send data according timely manner that case no any collision occurs on the network but heavy traffic case end to end delay has increases, in that diagram tcp0 , tcp1 and tcp3 packet transmitted through the genuine sender to intended receivers, and according to resultant graph our simulation maximum time is 25 sec. graph shows all tcp data start sends nearby 5th sec. tcp2 and tcp1 maximum data send in time within time 10th sec. to 18th sec. but tcp0 flow start at the time nearby 8th sec. ant maximum data send at the time of 20 to 25th sec. that case data send in timely manner so our flow start different time units.

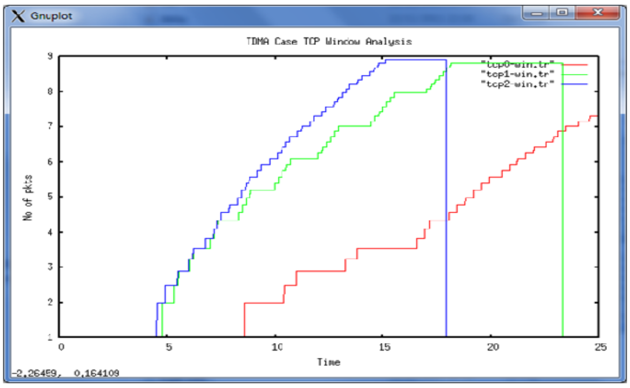

FIG.2 TDMA CASE IN TCP ANALYSIS

TDMA (Time Division Multiple Access) Mechanism Case UDP Flow Analysis

Here we show result graph for UDP (user datagram protocol) analysis in case of time division media access technique result shows nearby 3700 packet transmitted, 3550 packet lost and nearby 150 packet received that means receiving percentage only 4% and 96% udp packet loss, according to result we conclude our huge number of packet loss in TDMA case but all packet loss are occur due two region first for bandwidth and another for out of coverage area for mobile nodes. In TDMA scheme provide collision free transmission but slow data transmission

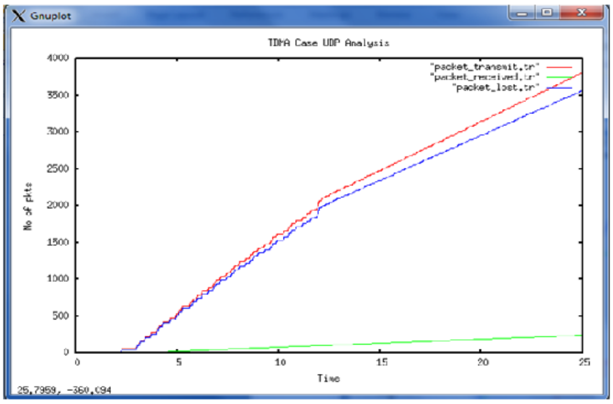

Fig.3 Tdma Case In Udp Analysis

802.11 Mechanism Case TCP Flow Analysis

Here we analyze the TCP result through using Mac as 802.11 mechanism, that time data loss through three different region namely via bandwidth, out of radio range and last and important through collision. We increase out put result via increasing bandwidth and network in denser mode but collision packet not avoid in case of 802.11. Because 802.11 can't send any RTS (request to send) and CTS (clear to send) message so collision comes to our network.

In figure we same tcp flow uses tcp0, tcp1 and tcp2, result shows our tcp0 maximum data send at the all time till the simulation end and two other tcp flow send data less as compare to tcp0 because tcp0 sender node are near y receiver node or within the radio range and other tcp flow belong far distance from sender two destination so our data sending is minimum in tcp1 and tcp2 cases

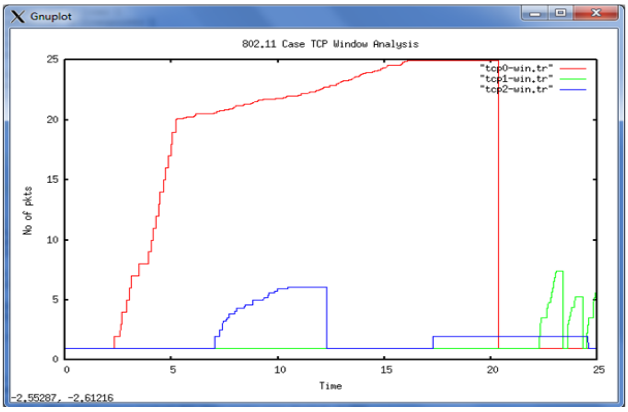

Fig 4.802.11 TCP flow Analysis

802.11 Case UDP Flow Analysis

Here we show result through gnu plot in case of 802.11 mechanisms, according to 802.11 mechanism constraint packet loss through three different cases we define in 4.4. Result produce udp packet analysis here total udp packet transmitted nearby 3050 packet and we receives 1750 packet and drop nearby 1300 packet that means 58% data receives and 42% loss so we conclude our result best as compare to TDMA technique.

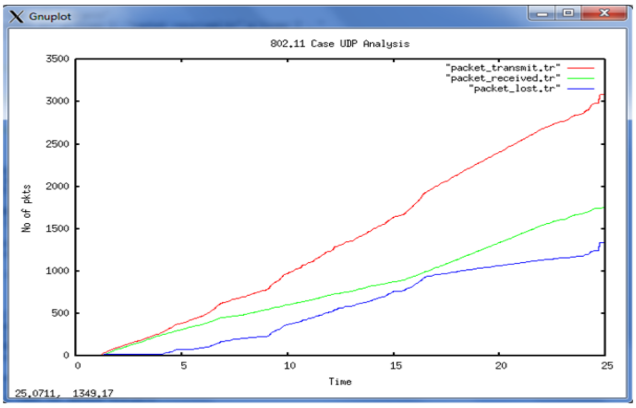

Fig.5 802.11 UDP flow analysis

802.11 time Data drop analysis

In figure we show the result of data drop. Basically 802.11 case data drop through collision comes and through bandwidth limitation, we can't eliminate collision drop rate because 802.11 mechanisms cannot use RTS and CTS scheme but we reduce drop in case of bandwidth. Result conclude in collision case nearby 2600 packet drop and 1400 packets drop that means 65% data drop through collision and 35% through bandwidth.

In our next approach CSMA/CA technique we reduce the data drop rate through elimination of collision packets.

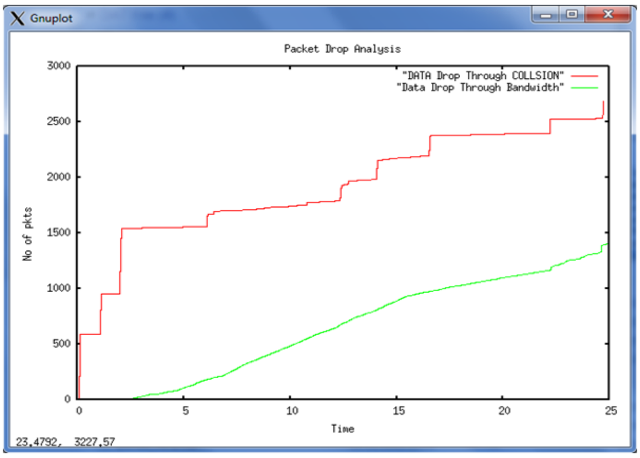

Fig.6 802.11 time Data drop analysis

CSMA/CA (carrier sense multiple access with collision avoidance) Mechanism Case UDP Flow Analysis.

CSMA/CA technique provides collision free data transmission, here result shows 100% data receiving graph. In CSMA/CA mechanism use RTS and CTS message scheme and avoid collision occurrence in network. Result also concludes CSMA/CA best as compare two both above mechanism 802.11 and TDMA. All the result in case of UDP (user data gram protocol) time. UDP protocol provides unreliable communication but fast transmission.

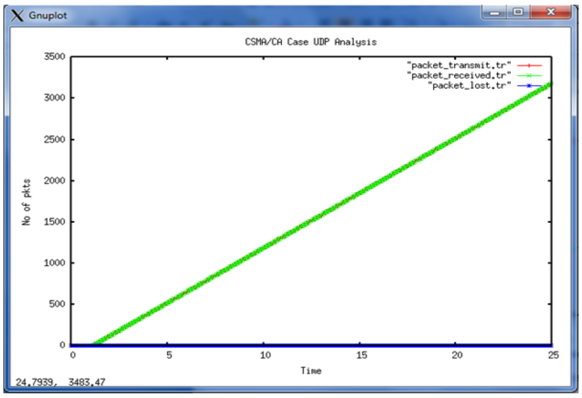

Fig 7. Csma/ca UDP flow analysis

CSMA/CA (carrier sense multiple access with collision avoidance) Mechanism Case TCP Flow Analysis

Here we produce result through gnu plot with thirty mobile node cases. in our simulation we crate three tcp transmitter and three tcp receiver node and send data packet through reliable communication, here we simulate only 25 sec. and produce given result with CSMA/CA technique here shows tcp0 and tcp1 transmission flows maximum data till the end but tcp0 flow is very low, according to given result we conclude our CSMA/CA mechanism gives best result as compare to 802.11 and TDMA technique.

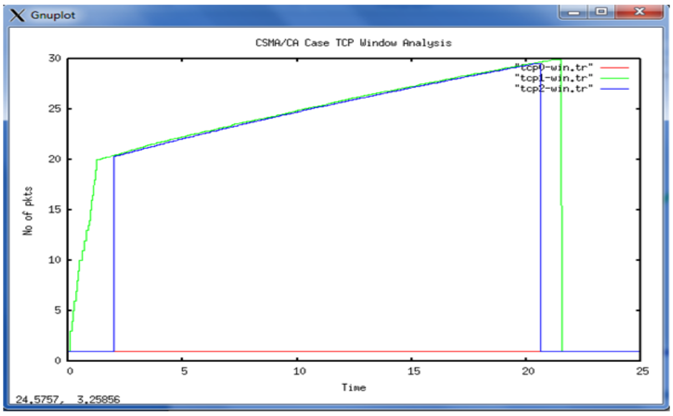

Fig 8. Csma/ca TCP flow analysis

TCP analysis routing load analysis in 802.11, TDMA and CSMA/CA time.

Routing load that means total number of routing packet sends by the sender node to destination through different intermediate mobile node. If routing packet is increases that means routing overhead is maximum and actual data sending percentage is lower, here result show all three cases routing overhead graph in 802.11 time nearby 850 routing packet sends, in TDMA time routing packet send only first five sec. and total routing packets 500 send that means no routing overhead after fifth second and CSMA/CA time routing overhead nearby 550 at the time of 12.5 second after 12.5 second no any routing packet send by the sender node.

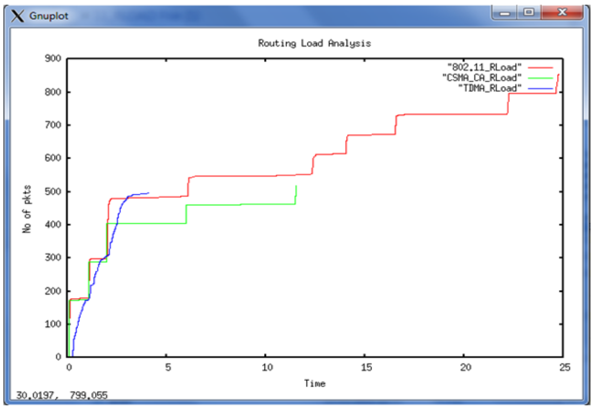

Fig 9. TCP analysis routing load in 802.11,TDMA,CSMA/CA analysis

PDF (Packet delivery fraction) analysis in 802.11, TDMA and CSMA/CA time

Packet delivery fraction means total number of packet receives by the intended receiver out of total number of packets send by the sender node. According to definition if PDF (packet deliver ratio) maximum that means our reception percentage is maximum. Here result shows 100% PDF in case of CSMA/CA, nearby 58% PDF in case of 802.11 but case of TDMA 11% PDF that conclude CSMA/CA mechanism is best at the time of 30 mobile nodes with random deployment with random motion case.

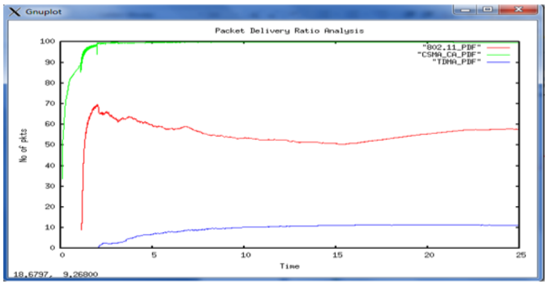

Fig 10 PDF analysis in 802.11, TDMA and CSMA/CA time

5. CONCLUSION

The Paper addresses the Congestion Problem and Congestion Control in MANET. It first identifies the several network aspects, some of which are unique to mobile ad-hoc networks that affect congestion, study congestion symptoms for different Wireless mobile ad-hoc Network Congestion Types and more over .In our simulation we analyze our result on the bases of packet delivery ratio, throughput, routing load, TCP flow analysis and collision analysis in Media Access control as (802.11 , TDMA and CSMA/CA) mechanism. And we conclude following points.

1) Our approach (CSMA/CA) gives better packet delivery ratio as compare to 802.11 and TDMA. CSMA/CA gives 99.9% , 802.11 gives nearly 58% and TDMA Nearly 11%.
2) Our Scheme also minimizes routing overhead as compare to 802.11 and TDMA mechanism that improve the network performance.
3) Enhanced CSMA/CA and TDMA both provide Collision Free data delivery but Enhanced CSMA/CA better performance through other factors, we also get result in case of 802.11 case but that not provide collision free environment.
4) Finally conclude our Enhanced CSMA/CA approach gives better data delivery with minimum data drop rate if actual TCP and UDP packet flow on the network

6. FUTURE WORK

Early results given by the simulations and tests of the Paper are very promising and encourage us to investigate toward the hybrid framework even further. This can include the following:

Full development of the hybrid framework in NS-2. Formal analysis and evaluation of the on-line hybrid framework Extension to large scale (larger MANET

Extension to large scale (larger MANET scenarios)

In future we also apply our technique in Wi-Max and Bluetooth scheme and analyze the results.

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