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Performance Enhancement of MAC Layer Protocol of WLAN using TDMA

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***Abstract*– In this paper, simulation and analysis the performance of existing MAC layer protocol and hybrid MAC with TDMA protocol in wireless local Area Network is presented. The demands of WLAN Devices day by day increases exponentially and it operates in the specific narrow spectrum of frequency bands and also increase communication parameters programmed and control over most modern wireless devices. In this simulation, we present a MAC protocol based on IEEE 802.11g standard in the DCF mode and DCF with TDMA mode which are useful to improve packet collision in traditional wireless networks. In this analysis, improved performance with TDMA base MAC layer is compared without TDMA. Here we used simulation through using NS-2 Simulator.**

Index Terms– DCF, MAC and TDMA

I. INTRODUCTION

THE wireless networks build up in infrastructure base or ad-hoc network. In a wireless network Medium Access Control (MAC) is a significant factor. With the help of MAC layer translate raw physical facility into usable network facility, so the option of a MAC protocol significantly impacts on the performance [4].

In a narrow specific spectrum utilized different access technique FDMA, CDMA and TDMA, In TDMA technique time is divided into the number of time slots frames with flat length. A pre-assigned time slots nodes can be transmit. Through this method, interference from neighboring nodes is reduced. So that TDMA protocols is advantageous in performance as compare among arbitrary MAC protocols access. For the reason of that dedicated time slots for each nodes pre-determined.

In this simulation analysis we observe how to improve the performance existing MAC layer protocol and hybrid MAC with TDMA protocol in wireless local Area Network by proposing a above technique based on Binary Exponential Back off Algorithm (BEBA) [5].

II. OVERVIEW OF WLAN MAC

A. MAC Layer Protocol

MAC layer base on Contention free and Contention oriented access. Contention free is a distributed channel access mechanism based on Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). CSMA/CA channel contention mechanism can also used with Request to send / Clear to Send (RTS/CTS) mechanism. The hidden node problem solved using RTS/CTS operation. DCF used different frame space DIFS, IFS, SIFS for transmission a frame. Time space depends on the channel condition (idle or busy). If the channel is busy, it enters a backoff procedure among contention window [7, 10, 11, 12].

In case of distributed mechanism channel utilization is not sufficient, due to this throughput is limited [7, 11, 12].

B. IEEE 802.11g

WLAN is a set of standards for implementing in the different frequency spectrum 2.4G, 3.6G and 5 GHz bands. Stander committee IEEE is maintained WLAN standers. The WLAN family has different modulation and different technique as per series of IEEE standards with same basic protocol. The 802.11b protocol is accepted, which is original standard. Amendments, but this was a first widely accepted, IEEE 802.11g followed by IEEE 802.11b. It works with OFDM modulation technique at Maximum data rate 54 Mbps or about 22 Mbps average throughput. 802.11g Design with 802.11b fully hardware backwards compatible [3, 10].

Improve the efficiency of MAC layer Protocol, various new feature introduced with basic foundation of standards [7, 10].

C. TDMA

In today's hot research area to implements hybrid access technique Medium access control with Time division access technique. In these techniques improve the performance of wireless networks throughputs, end to end delay, minimization collision, energy efficient, high vehicle speed mobility and

long distance [3, 4, 10, 14, 15, 16, 17]. In this technique medium shared (Channel uses several time slots), PHY level and MAC layer level. Same transmission medium to allocate several stations contribute to only a fraction of its channel capacity.

The most important task in scheming a TDMA schedule is to allot time slots depending on the topology and workstation frame generation rates. Minimize to collisions avoidance and latency of every receiver workstation to design appropriate schedule. The larger [10, 13, 18].

TDMA slot time Schedule avoided conflict to same node transmits & receives a same time [5, 13]. In TDMA analysis reduces the collision effects and improvement in BW utilization & collision reduction.

III. MOTIVATION

Our simulation is based on open source simulator on Linux. TDMA model is simulating using open source simulator (NS-2). NS-2 makes available significant support for simulation of OSI and TCP/IP model protocols. We investigated a performance evaluation to compare the loss rate and packet dropped. Binary Exponential Backoff Algorithm (BEBA) is executing which regulate the CW size dynamically in reply to collision probability. Embedded an algorithm in the IEEE 802.11g DCF. TDMA technique by allocated a unique time slots for every station.

IV. SIMULATIONS EXPLANATION

In this Simulation we present 16-node structure show in Fig. 1 Ad-hoc Wireless Network simulation model. In this simulation model consist of 8 source node and 8 receiving nodes. We study 2 scenarios configured using the NS-2. The WLAN 802.11, G-standard scenario with and without TDMA. We observed the performance of the control packets in terms of data throughput and loss rates.

A. Simulations Settings

We generated the traffic of 1000 bytes based on CBR generator within the application layer, and a time interval of 0.008s

Source bit-rate: 1000*8/0.008=1.0 Mbps

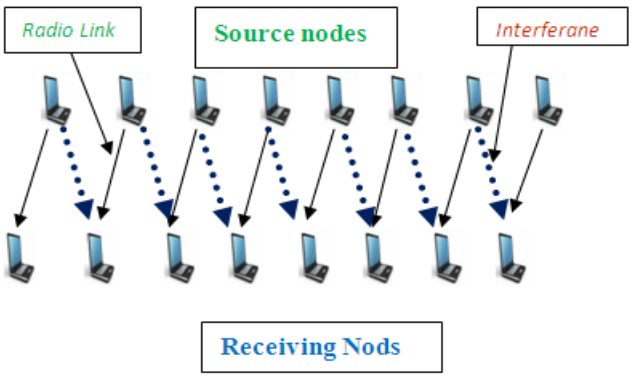

Fig. 1: Simulation Model: Ad-hoc WLAN

Table 1 shows the MAC layer parameters values used in the simulation.

Table 1: MAC Layer Parameter

Parameter	Value
Slot time_	9us
CCA time_	3us
SIFS_	16us
DIFS_	28us
Preamble Length_	96 bits
PLCP Header Length_	40 bits
PLCP Data Rate_	6 Mbps
Max Propagation Delay_	5us
Short Retry Limit_	7
Long Retry Limit_	4
Header Duration__	40us
Symbol Duration_	8us
RTS Threshold_	2346
CW Min_	15
CW Max_	1023
Rx Tx Turnaround Time_	2us

B. Performance Evaluation

As per our design simulation model 0, 2, 4, 6…….14 are source nodes and 1, 3, 5…15 receiving nodes. The application CBR source rate 1 Mbps. Our simulation model an Ad-hoc Network, we intended to better performance improve through puts and minimization loss data. These all are limited by size of network and link capacity.

In this simulation application layer CBR packets forward to lower layer UDP, UDP forward packets to MAC layer. MAC layer protocol work with or without TDMA to send the packet physical layer and NULL detector at receiver end. NS-2 simulator work with discrete time simulation, our simulation discrete time .0625 sec and total time 20 sec. Simulation parameters records in the form of receive bytes, received packet, loss packets during discrete time and find the performance as throughputs and loss data rate as following:

$$\text{Average throughputs} = \frac{\text{total bytes received} * 8}{\text{Simulation Stop time} - \text{simulation start time}}$$

$$\text{Average loss rate} = \frac{\text{total bytes loss} * 8}{\text{Simulation Stop time} - \text{simulation start time}}$$

In MAC layer Protocol with TDMA technique by allocated a unique time slots for every station. Fig. 2 show TDMA nodes time slots Structure. Time slots time depends upon the no of nodes in the ad-hoc Network, our simulation time slots time is .0625 sec.

C. Comparative Analysis WLAN basic Standard and 802.11g

The simulation analysis is shown in Table 2 and graphs (Fig. 3 and Fig. 4). Standard and 802.11g Scenario show assessment among by numbers of sources nodes and receiving nodes of the Receive_ data_rate (throughput) and loss_data_rate.

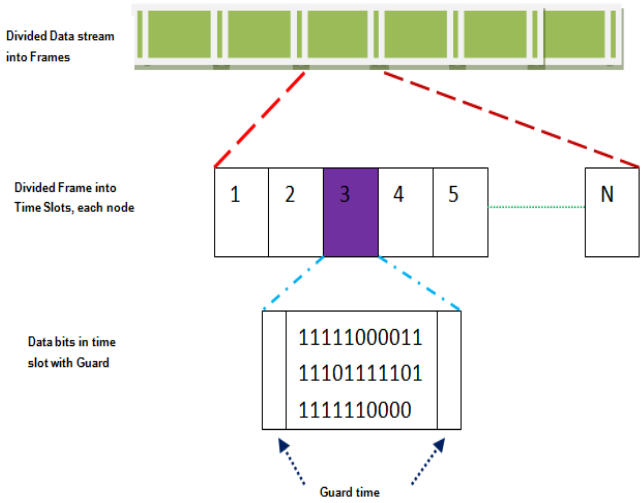

Fig. 2: TDMA nodes time slots Structure

TABLE 2
STANDARD_____802.11g

	Standard _MAC_802.11		EXT_MAC_802.11g	
NODES	Received _Data _Rate (Kbps)	Loss_Data_Rate (bps)	Received _Data _Rate (Kbps)	Loss_Data_ Rate (bps)
0-1	93.8400000000000	281.60000	457.776000000	0.8000000
2-3	153.4079999999	764.0	1013.064	0.0
4-5	57.52799999999	1637.59999	758.47199999	1961.2
6-7	138.72	1486.8	1020.408	0.0
8-9	145.24799999999	714.799999	954.31200000	1731.2
10-11	108.93600000000	1340.40000	1006.53599999	0.80000000
12-13	0.0	0.0	960.840000000	1848.8
14-15	105.672	1421.2	1004.496	0.8000000

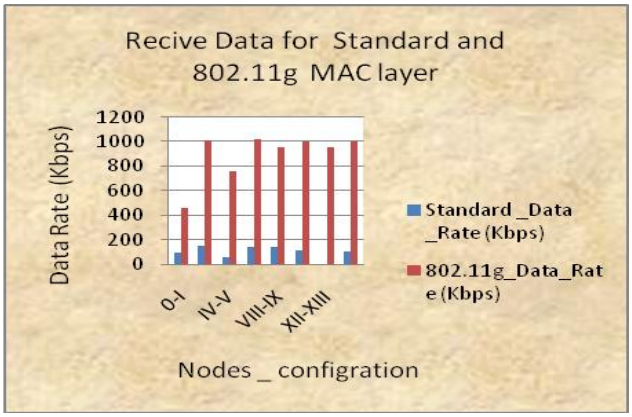

Fig. 3: Comparison between Standard and 802.11g Scenario

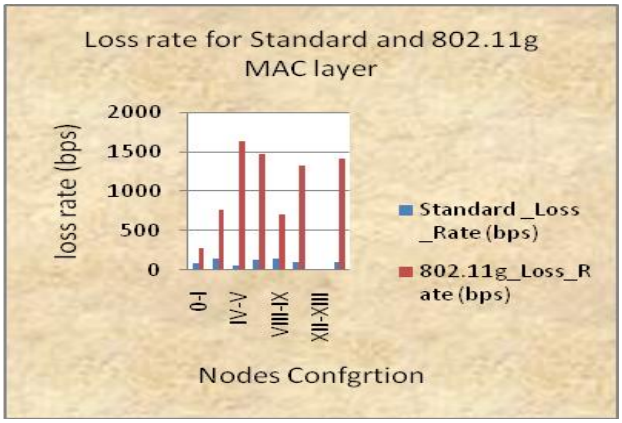

Fig. 4: Comparison between Standard Scenario and 802.11g

D. Comparative Analysis WLAN 802.11g and 802.11 TDMA

Simulation analysis is shown in Table and graphs. 802.11g and 802.11 TDMA Scenario show assessment among by numbers of sources nodes and receiving nodes of the Receive_ data_rate (throughput) and loss_data_ rate. As shown in Fig. 5, Fig. 6 and Table 3:

TABLE 3
802.11g_____802.11-TDMA

	EXT_MAC_802.11g		TDMA _MAC_802.11	
NODES	Received _Data _Rate (Kbps)	Loss_Data _Rate (bps)	Received _Data _Rate (Kbps)	Loss_Data_ Rate (bps)
0-1	457.776000000000 1	0.8000000 0000	515.711999999999 9	329.6000000 00000
2-3	1013.064	0.0	760.511999999999 4	329.6000000 00000
4-5	758.471999999999 8	1961.2	763.775999999999 5	262.3999999 99999
6-7	1020.408	0.0	979.200000000000 5	179.1999999 99999
8-9	954.312000000000 1	1731.2	962.88	44.7999999 99999
10-11	1006.53599999999	0.8000000 00000	979.200000000000 5	0.0
12-13	960.840000000000 3	1848.8	858.432000000000 2	166.4000000 00000
14-15	1004.496	0.800000	727.871999	118.4000000

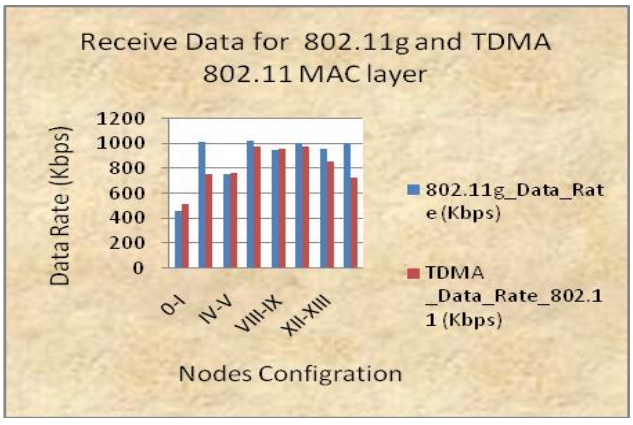

Fig. 5: Comparison between 802.11g and 802.11 TDMA Scenarios

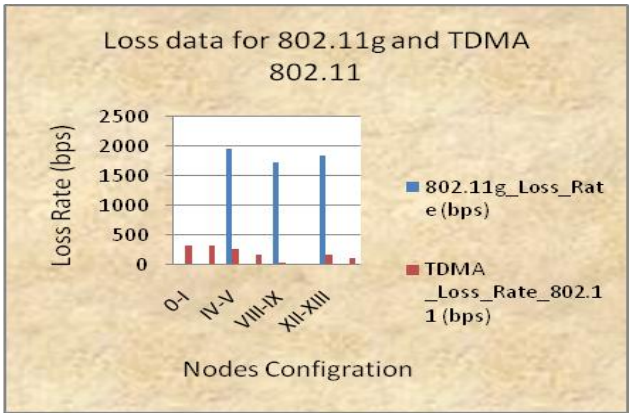

Fig. 6: Comparison between 802.11g and 802.11 TDMA Scenarios

E. Comparative Analysis 802.11 TDMA and 802.11g TDMA

Simulation analysis is shown in Table and graphs. 802.11 TDMA and 802.11g TDMA Scenario show assessment among by numbers of sources nodes and receiving nodes of the Receive_ data_rate (throughput) and loss_data_ rate. As shown in Fig. 7, Fig. 8 and Table 4:

TABLE 4
802.11-TDMA_____802.11g-TDMA

	TDMA _MAC_802.11		TDMA_EXT_MAC_802.11 g	
NODES	Received _Data _Rate (Kbps)	Loss_Data_ Rate (bps)	Received _Data _Rate (Kbps)	Loss_Data _Rate (bps)
0-1	515.71199999999999	329.60000000000002	1070.5920000000001	0.0
2-3	760.51199999999994	329.60000000000002	1034.6880000000001	0.0
4-5	763.77599999999995	262.39999999999998	1037.952	0.0
6-7	979.20000000000005	179.19999999999999	1073.856	0.0
8-9	962.88	44.799999999999997	1054.2719999999999	0.0
10-11	979.20000000000005	0.0	1064.0640000000001	0.0
12-13	858.43200000000002	166.40000000000001	1044.48	0.0
14-15	727.87199999999996	118.40000000000001	1028.1600000000001	0.0

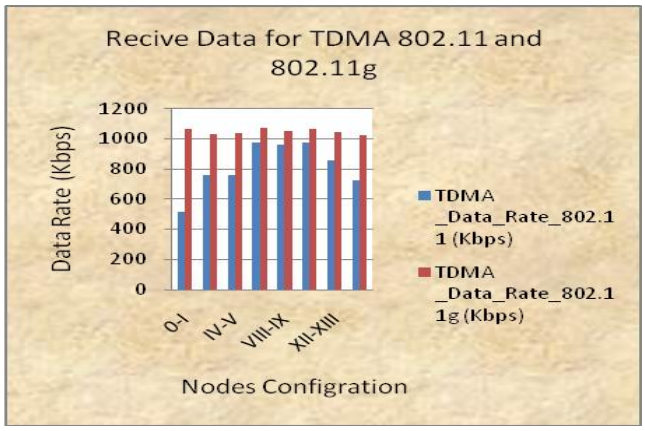

Fig. 7: Comparison between 802.11 TDMA &802.11g TDMA Scenario

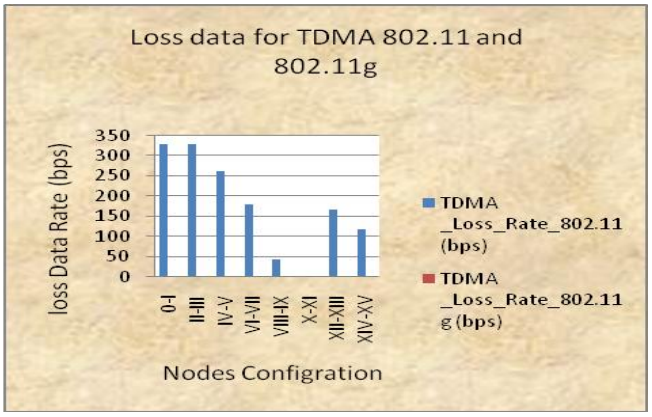

Fig. 8: Comparison between 802.11 TDMA & 802.11g TDMA

F. Analysis of results

We have observed the simulation results in the form of numerical value in the tables and graphs. Our simulation results show data loss decreased using TDMA technique.

V. CONCLUSION

Paper simulation study based on the Wireless Standards (802.11, 802.11g) MAC layer with and without TDMA transmission and reception as per our design simulation model. In this simulation analysis the performance in the form of throughputs and loss rate parameters. The performance MAC layer with TDMA is better as comparative MAC layer without TDMA as per our simulation results.

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