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Impact of Randomness on MAC Layer Schedulers over High Speed Wireless Campus Network in IEEE802.11e

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ABSTRACT

IEEE802.11e standard provides an EDCA mechanism to ensure the QoS using service differentiation function for IMM traffics through the WCN. In an EDCA mechanism, IMM traffics have been classified into four categories and each category has specific priority. Many EDCA schedulers allow these traffics to access the channel based on assigned priorities. The IMM high priority traffic is high delay sensitive and required high bandwidth to ensure QoS over the networks. Scheduling mechanism is the effective way to satisfy IMM traffic but it cannot give guarantee because of the randomness of some EDCA schedulers or proposed networks. In order to provide the QoS, scheduling mechanism is the challenging issue to transmit IMM traffic through the channel and it is still need to be solved over WCN. This work aims to examine the effect of the randomness on different MAC layer schedulers' performance and evaluates the performance of the proposed schedulers using different performance metrics in WCN.

Keywords: *Scheduling Algorithms, Seed Values, WCN, Multimedia Applications, Back-off Algorithm.*

1. INTRODUCTION

Real time Interactive Multimedia (IMM) that is standard application from Wireless Local Area Networks (WLANs) and includes VoIP, Mobile Video conference and so on from past years have shown tremendous growth and deployment in IEEE802.11 [1-3].The ease of evaluation for high speed Wireless Campus Network (WCN), a interconnection of multiple WLANs (in a single wireless subnet) has been made much easier by the contribution and advancement of IMM applications [4]. Due to the heterogeneities and constraints like- the requirements of severe Quality of Service (QoS), limited bandwidth and the different standards etc, the transmission of IMM applications over the WCN is a challenging issue. Among IMM applications , some major services include voice, video conferencing, animation, graphics and so on over the WCN and for optimal performance ,these applications require minimum data loss , high throughput , least delay and many other such factors [5].One of the effective way to enhance the performance of the IMM traffics through the WCN in IEEE802.11 is a technique known as Frame scheduling [6].Besides , there has been some enhancements made in the IEEE802.11e standard with respect to QoS for IMM applications over the networks [7]. The service differentiation based on assigning priorities is the effective way to guarantee QoS which provides IEEE802.11e standard EDCA protocol. Figure 1 shows the access mechanism of the different categories of IMM traffics in EDCA protocol.

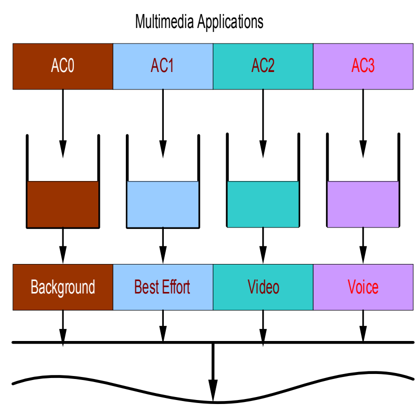

Fig. 1. Access Mechanism of multimedia traffic in IEEE802.11e based on priority

An EDCA protocol is a contention based Medium Access Control (MAC) layer protocol which differentiates the IMM traffics based on various Arbitration Intra-Frame Space Numbers (AIFSNs) and assigns the Transmission Opportunity (TXOP) limit for high priorities traffics to occupy the channel without other traffics interruption. Table I displays the default parameters of an EDCA protocol. These parameters values ensure to occupy the wireless channel for a specific duration of time for transmission without interruption over the network. After that, an EDCA mechanism cannot guarantee to deliver IMM traffics with the least delay through the network due to the randomness of some MAC layer schedulers and mechanism of the proposed network.

Table 1: EDCA Default Parameters Set

Fig. 1. **ACs**	Fig. 2. **AIFSN**	Fig. 3. ***TXOPlimit***
Fig. 4. AC3(Voice)	Fig. 5. 2	Fig. 6. 3.008msec
Fig. 7. AC(Video)	Fig. 8. 2	Fig. 9. 6.016msec
Fig. 10. AC(Best Effort)	Fig. 11. 3	Fig. 12. 0
Fig. 13. AC(Background)	Fig. 14. 7	Fig. 15. 0

Many researchers have worked to reduce the randomness from the network because it could be degraded the network performance unluckily but it is still unresolved problem over the networks. This work aims to examine the effect of the randomness on different MAC layer schedulers' performance and evaluates the performance of the proposed schedulers using different performance metrics in WCN.

The rest of this paper is organized as follows: section II deals with the background studies of different randomness characteristics schemes, the proposed scheme of this paper introduces in section III, section IV employs the simulation results and discussion and this paper is concluded with the last part.

2. BACKGROUND STUDIES

In this section, we review some related to random number or position selection schemes and MAC layer scheduling schemes that are very commonly used in any wireless mobile network. Moreover, we discuss about the importance of seed values. By using these seed values we can generate different random numbers or positions that are very important to analysis the network performance.

2.1 Back-off Window (BW) mechanism

Providing the QoS the EDCA protocol employed the back-off window mechanism but it cannot provide guarantee strictly due the randomness of the back-off window algorithm. The back-off procedure indicates the current channel status is idle or busy by sitting the random back-off timer whose value is selected uniformly in the [0,CWmin] interval. If the current medium becomes busy during the back-off process then the node pauses it back-off timer and waits until the channel is idle again. When the back-off time will be expired then the next transmission will be attempted. If the collision occurs the back-off window mechanism increases the contention window size exponentially to reduce the other collision. During the first transmission attempt the contention window is set the minimum contention window size after every unsuccessful transmission it increases exponentially until the contention window maximum [8]. Table II highlights the different minimum and maximum contention window sizes based on various priority traffics in EDCA MAC layer protocol.

Table 2: Contention Window (CW) Sizes Based on Different Traffic Priorities

Access categories (ACs)	**Contention Window (CW) sizes**	
	CWmin	***CWmax***
AC3	7	15
AC2	15	31
AC1	31	1023
AC0	31	1023

2.2 Random Waypoint (RW) mobility model

The great impact of mobility models is observed in any wireless mobile communication networks. The mobility models are considered for simulation of any wireless mobile network systems in order to justify the user mobility on different distinctiveness of these systems [9]. There is lots of mobility models exist in modern wireless technology [10], [11]. These models are employed in different wireless networks. For instance, the random waypoint mobility model is commonly used in any wireless mobile networks [12]. In this model, every mobile node of the wireless network selects the destination randomly for moving during simulation. Let assumes the mobile nodes are placed in the wireless network. During the simulation these nodes move from one place to another place randomly using the random waypoint mobility model. When these nodes move and reach one destination point after that these remain for static pause time and then start to move again according to the same mobility rule [13].

2.3 Random Number Generators

The random number generators determine the outcome of any randomness schemes in any gaming devices or networks. Typically, the random number generator is used in many electronics gaming devices. It generates the random numbers based on seed value (i.e., the outcome of the random generator). The seed value can be any numeric numbers even it can be represent by numeric date and time.

Any random number generator algorithms are used the seed values as an input of the algorithms that produce different random numbers [14].

2.4 Seed Value

The importance of seed value is quick growth to analysis the performance of the wireless mobile network and any gaming devices that use random number generators. In any random number generator algorithms can only generate the static random numbers. They cannot change those numbers. Using different seed value can be change the random numbers of any random algorithm [15]. The wireless network is used some random number or destination selection mechanisms. The performance analysis of this network used to change the random number or position in any random mechanism which is done by using various seed values.

2.5 Strict Priority Scheduler (SPS)

The SPS schedule the different categories of traffic based on assigned priority. Arriving traffics in the SPS buffer are classified in highest to lowest priority discipline manner in the output queue. It provides service differentiation facility according to assigned priorities to satisfy the QoS through the networks. When the different categories of traffics in the input link first assign the priorities on these then transmit them to the medium according to the priority levels. The highest priority traffics transmit through the medium before serving the lowest priority traffics but if the lowest priority traffics transmission ongoing over the channel and on that time if the highest priority traffics arrive in the scheduler input buffer then the highest priority traffics have to wait until completed the current lowest priority traffic served [16]. The main limitation of SPS the lowest priority traffics may receive little attention during the transmission of the highest priority traffic streams.

2.6 First in First out (FIFO)

FIFO scheduling discipline specifies the traffics for transmission over the channel in the same order in which they reached at the output queue. In particular, people are waiting to maintain a queue to get the bus in the bus stop. Who comes first in queue he will get serve first to enter the bus. Moreover, like customers join in the back of the single waiting line and serve from front of the waiting line [17]. Many researchers work on FIFO algorithm and they have proved that the FIFO scheduler leads to a feasible real time constraints schedule which minimizes the energy consumption and gives the optimal schedule considering shortest path problem with the minimal voltage and speed changes[16]. Although, FIFO provides the mentionable facilities over the networks but it cannot differentiate the traffic categories into different priority classes. Moreover, it cannot identify the ill-behaved traffic flow from the other flows. Thus, the FIFO increases the end-to-end delay, jitter and packets loss over the network.

2.7 Random Early Detection Scheduler (RED)

The RED scheduling mechanism is well known for an active queue management and it is also known as random early drop and random early discard algorithm. This is employed to control the network congestion. It plays a vital role over the network by the way of not allow to admit full queues for further processing. As a result, it reduces the frame delay and loss. According to the statistical probabilities, the RED monitors the average size of queue and the number of dropped packets' queues. It maintains the threshold based queuing manner. Statistically, the RED drops the packets from the dropped packet flows until reaching its threshold value. Hence, it maintains a good packets queue for situations where per-session state tracking's complexity is needed. Many researchers have employed to control the congestion, resource management and so on in [18]. However, the higher maximum threshold value increases the delay and the minimum maximum threshold value decreases the throughput over the networks.

2.8 Weighted Random Early Detection (WRED) scheduler

WRED scheduling mechanism is the update version of RED scheduler. Both mechanism control the congestion over the network but WRED can avoid congestion more effectively and improve the gateway's queue when it is too full for its buffer. The RED scheduler avoids congestion by dropping the packets with the dropping probability. When the average queue size is less than minimum threshold and maximum threshold then the packets dropped. However, the RED scheduler router has no any bias against the bursty traffics hence, avoids the global synchronization which reduces the congestion window of many connections at the same time. The RED is very easy to configure but it will not justifiably for the processing resource of gateway. As a result, The RED cannot ensure to provide optimal QoS for real time sensitive applications to the end users. The WRED develops the congestion avoidance mechanism for QoS sensitive applications. It selects the packets for dropping based on either Resource Reservation Protocol (RSVP) or Internet Protocol (IP) precedence because the number of different types packets flows are classified by WRED but it is very limited that is why still a better mechanism for congestion avoidance is required [19].

3. PROPOSED SCHEME

In this section we proposed three MAC layer schedulers to analyze the randomness of the performance according to different seed values because two schedulers named RED and WRED mark the high dropping probability packets randomly. Due to the randomness, the selection can be good or bad. That is why, in the proposed paper, modifying the seed values we can get the dissimilar random values or positions. In this paper we analyze the randomness of the performance of high speed WCN based on various seed values for achieving different end to end delay, and throughput of the multimedia applications because every specific seed value generates different specific random numbers or locations. In the sub-sections we state the proposed system model and simulation parameters.

3.1 Proposed System Model

In the proposed mechanism, We consider strict priority scheduling mechanism for network layer for assigning the priority on different ACs and three different MAC layer scheduling schemes (FIFO, RED, WRED) to analyze the randomness of the performance of WCN according to different seed values. We set the beacon interval default 100ms which is fixed configured in Access Point (AP). AODV routing protocol is employed to select the best path to transfer the IMM traffic over the network. The random waypoint mobility model is used to move the mobile nodes as the real scenarios. Evaluating the effect of randomness on different schemes of the proposed network has been performed by modifying seed values. The packet size 1560Bytes, and the traffic loads keep constant for analyzing the randomness of the proposed network. Figure 2 shows the simulation animated veiw.

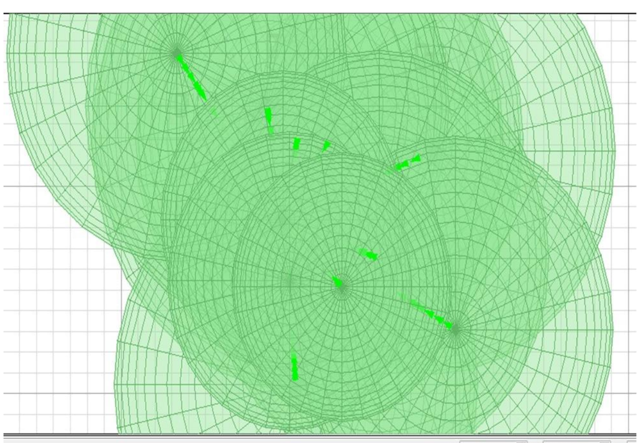

Fig. 2. The simulation scenario of the proposed network using Qualnet simulator

3.2 Simulation Setup

The proposed work has been simulated by Qualnet 5.1 simulation tool. This simulation software provides scalable simulation of different wireless networks. Qualnet offers enormous simulation tools for comprehensive simulation of wired and wireless networks. Using this software we can simulate and emulate the networks to predict the networks behavior, operation and management [20]. Table III shows the different simulation parameters of the proposed scheme.

Table 3: The Simulation Parameters

Simulator Used	QualNET 5.1
Simulation Area	1000 X 1000
Simulation Time	100second
Total number of nodes	30
Propagation model	Two-ray pathloss
Shadowing model	Constant
MAC protocol	IEEE802.11e
Radio Type	IEEE802.11b
PHY data rate	11Mbps
Routing protocol	AODV
Mobility model	Random Waypoint
Application	CBR

3.3 Performance Metrics

The performance evaluation of the proposed network has been done by the different performance metric over IEEE802.11e. These are throughput and end-to-end delay.

- **Throughput (bits/sec)** - the calculation of total number of successful delivery packets divide by the total amount of session between the first packet sending start time and the last packet received time.

- **End-to-End Delay (sec)** - represents the combination of whole (source to destination) travelling delay of packet.

4. SIMULATION RESULTS AND DISCUSSION

In this section, we have simulated our proposed scheme through WCN based on different seed value by qualnet 5.1 simulation tool. In this approach we measure the performance of the proposed network through various (End-to-End Delay and Throughput) performance metrics. Following the sub-sections are analyses the simulation result of the proposed scheme over WCN.

4.1 Average End to End Delay and Throughput Analysis

Figures 3 and 4 show the average end-to-end delay where, the packet size and traffic load are constant always over the network. After that, the proposed schedulers are having different amount of average end-to-end delay and throughput with respect to different seed values. The FIFO scheduler is having the highest end-to-end delay because there is no additional function to discard some packets from the queue. In contrast, the RED and WRED can remove the packets from the queue that packets are marked randomly as dropping probability. Due to these achieve low end-to-end delay. On the other hand, the FIFO scheduler achieves better throughput compared to others due to the least packets loss. Both Fig 3 and Fig 4 attain different average end-to-end delay and throughput with respect to various seed values because the randomness of the proposed schedulers and networks. Finally, according to this analysis we can say that, the effect of randomness on the network might be good or bad, it depends on the seed values and there is no guarantee to ensure QoS over the network for IMM high priority traffics.

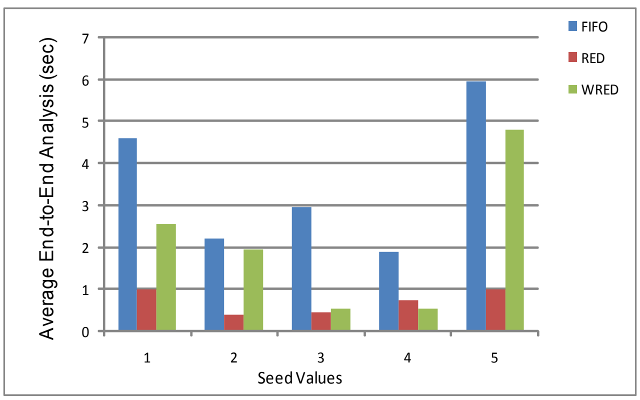

Fig. 3. Average End-to-End Delay Analysis

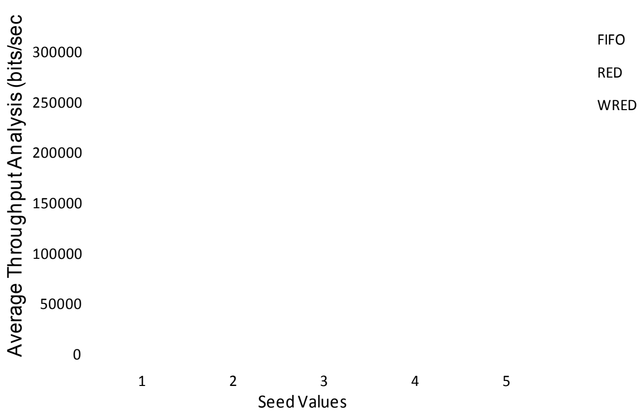

Fig. 4. Average Throughput Analysis

6. CONCLUSION

In this paper we analyze the randomness of the performance of the proposed scheme based on different seed values to justify the effect of the mentionable parameter (seed value) on the proposed network performance. After finished the simulation for every seed value of the proposed scheme, we have proved that a great change of the performance of our proposed scheme cause of the randomness exist in the proposed network and the variation of seed values. Thus, we can conclude that analyzing the effect of randomness on the networks, seed value is the very effective parameter. Evaluating the effect of randomness of the proposed network on jitter and packets delivery ratio will be analyzed in the future work.

References

[1] IEEE 802.11b Supplement to 802.11-1999, . Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifica-tions: Higher speed Physical Layer (PHY) extension in the 2.4 GHz band, 1999.

[2] IEEE 802.11a, Supplement to IEEE 802.11-1999. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: High-Speed Physical Layer in the 5 GHz Band, 1999.

[3] Md. Khorshed Alam, Suhaimi Abdul Latif, Mosharrof H. Masud, Farhat Anwar, " A Review on Scheduling Schemes of High Speed Wireless Campus Network for Interactive Multimedia Transmission", IEEE 11th Malaysia International Conference on Communications (MICC), 2013.

[4] M. K. Alam, S. Abd Latif, M. H. Masud, M. Akter, F. Anwar, J. S. Yalli, " An Analysis of Scheduling Scheme for QoS Guaranteed Interactive Multimedia over High Speed Wireless Campus Networks ", 1st International Conference on Artificial Intelligence, Modelling and Simulation (AIMS), 2013.

[5] R. Dondera, C. Jia, V. Popescu, C. Nita-Rotaru, M. Dark, and C. S. York, “Virtual classroom extension for effective distance education.,” IEEE computer graphics and applications, vol. 28, no. 1, pp. 64–74, 2008.

[6] K. Nisar, A. Amphawan, S. Hassan, and N. I. Sarkar, “A comprehensive survey on scheduler for VoIP over WLAN,” Journal of Network and Computer Applications, vol. 36, no. 2, pp. 933–948, Mar. 2013.

[7] IEEE, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 8: Medium Access Control MAC) Quality of Service Enhancements November 2005.

[8] Bello, Lucia Lo, Emanuele Toscano, and Salvatore Vittorio. "A perspective on the IEEE 802.11 e Protocol for the Factory Floor." (2010).

[9] Rojas, Andres, Philip Branch, and Grenville Armitage. "Experimental validation of the random waypoint mobility model through a real world mobility trace for large geographical areas." In Proceedings of the 8th ACM international symposium on Modeling, analysis and

simulation of wireless and mobile systems, pp. 174-177. ACM, 2005.

[10] C. Bettstetter, “Mobility Modeling in Wireless Networks: Categor-ization, Smooth Movement, and Border Effects,” ACM MobileComp. and Comm. Rev.,vol. 5, no. 3, 2001.

[11] T. Camp, J. Boleng, and V. Davies, “A Survey of Mobility Models forAdHocNetworkResearch,” Wireless Comm. & Mobile Computing (WCMC),vol. 2, no. 5, pp. 483-502, 2002.

[12] M. Musolesi,S. Hailes,and C. Mascolo. An ad hoc mobility model founded on social network theory. In Proceedings of the 7th ACM International Symposium on Modeling, Analysis and Simulation of Wireless and Mobile Systems. ACM Press,October 2004.

[13] Bettstetter, Christian, Giovanni Resta, and Paolo Santi. "The node distribution of the random waypoint mobility model for wireless ad hoc networks." Mobile Computing, IEEE Transactions on 2, no. 3 (2003): 257-269.

[14] Weber, Reid M., and Michael M. Oberberger. "Gaming system and method enabling player participation in selection of seed for random number generator." U.S. Patent Application 13/957,019, filed August 1, 2013.

[15] Kelly, John R., and Bruce McLoughlin. "Random number generator seeding method and apparatus." U.S. Patent 6,728,740, issued April 27, 2004.

[16] S.Rajeswari and Dr.Y.Venkataramani "Congestion Control and QOS Improvement for AEERG protocol in MANET ", International Journal on AdHoc Networking Systems (IJANS) Vol. 2, No. 1, January 2012.

[17] James F. Kurose, Keith W. Ross " Computer Networking : A top down approach (5th edition)", http://engineering.free-book.biz/Computer-Networking-A-Top-Down-Approach-5th-Edition-ID208.pdf, 2010.

[18] Hamadneh, Nabhan, David Murray, Michael Dixon, and Peter Cole. "Dynamic Weight Parameter for the Random Early Detection (RED) in TCP Networks." International Journal of New Computer Architectures & their Applications 2, no. 2 (2012).

[19] Amara, Satish Kumar, and Michael Freed. "Policy-based weighted random early detection method for avoiding congestion in internet traffic." U.S. Patent 6,996,062, issued February 7, 2006.

[20] Scalable Network Technologies, Qualnet User Manual v 4.0., Culver City CA, www.qualnet.com,2010.