PACKET AGGREGATION BASED THROUGHPUT ENHANCEMENT IN WLAN FOR MULTIMEDIA APPLICATIONS

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Abstract- The present multimedia applications need extended throughput to handle the degraded QoS due to queuing delays, transmission delays as well as jitters, especially when the network is infrastructure based 802.11 wireless LAN. The solution such as a proposed packet aggregation scheme for 802.11 will play a significant role. Hence there is a considerable improvement in QoS and the throughput as well as QoE of user is improved.

Keywords- QOS, WLAN, Packet Aggregation, Multimedia.

I. INTRODUCTION

Delay sensitive multimedia applications have increased demand in recent years. These several issues found in the delay sensitive nature of multimedia packets in WLAN such as throughput dependency, latency due to end to end delay and jitter.

Here, we consider the issues related to small sized multimedia packets. In a wireless communication system for proper synchronization overheads of MAC layer and Physical layer are necessary between transmitter and receiver as well as to share wireless medium efficiently. To increase the network efficiency, the ratio of header size to payload size in a packet has to be reduced. The new IEEE WLAN amendment, IEEE 802.11, allows aggregation of packets to increase the payload size. Here a node composes the large packet by aggregation of different applications before it is send to the access point (AP). However, in the case of delay sensitive multimedia applications this method is not applicable.

The original version of the IEEE 802.11 standard was released in 1997. It specified two PHY data rates of 1Mbps and 2Mbps, and three PHY layer technologies i.e. Diffuse Infrared (DIR), Frequency Hopping Spread Spectrum (FHSS) and Direct Sequence Spread Spectrum (DSSS). The FHSS and DSSS PHY layers operate over the Industrial Scientific Medical (ISM) frequency band at 2.4GHz. The other amendment to the original standard released in 1999 is IEEE 802.11a. 802.11a operates in the 5GHz band and uses a 52- subcarrier orthogonal frequency division multiplexing (OFDM) technology at the PHY layer. The maximum raw PHY rate is increased up to 54Mbps. Since the 2.4GHz band is heavily used to the point of being crowded, using the relatively unused 5GHz band potentially offers 802.11a the significant advantage of less interference.

For the applications like VoIP in WLAN there is need of high throughput requirements and jitter free communication strategies. The QoS for VoIP service offered by 802.11 WLAN based on infrastructure network depends on queuing delays, transmission delays, traffic load and jitters.

We have proposed scheme in which we are implementing the packet aggregation which increases throughput and QoS for VoIP Service.

In this paper we consider Voice over IP (VoIP) application to elaborate the need of packet aggregation schemes for multimedia applications and suggest packet aggregation scheme to improve the network efficiency.

II. PROPOSED PACKET AGGREGATION SCHEME

In this section we propose the packet aggregation scheme. The primary responsibility of the WLAN MAC is to control medium access, but it can also provide optional support for roaming, authentication, and power conservation. Modification in AP mechanism for packet aggregation and back to back delivery of bunch of packets continuously to respective nodes. When Bunch of packets are sent back to back continuously it increases throughput which results in enhancement of QoS for VoIP kind of multimedia applications in infrastructure network. If specific VoIP service requirement from all the nodes is considered in the network, then it is possible to achieve enhancement of QoS as compared to existing systems. The packet aggregation scheme implementation can be done as discussed in next methodology section

Figure 1 indicates the time slots in 802.11 MAC frame mechanism. For the sake of implementation of packet aggregation scheme we consider the inter frame spacing in terms of time slots indicated in figure 3. The packet aggregation in infrastructure network can be obtained by increasing the PIFS time slot during which all the packets intended for particular receiver will be gathered together and will be sent back to back when it gets its turn of delivery. It is possible in the polling mechanism of mobile stations which are connected with the access point of 802.11 infrastructure network as indicated in Figure 4 for three nodes A, B and C. The time out for PIFS space can be increased with additional time during which all the upcoming new packets intended for the same, receiver will get more time available and will get aggregated for fast delivery which is expected for VoIP based services.

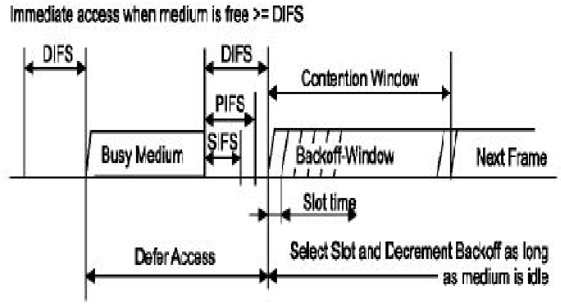

Fig. 1: Medium Access and Frame Spacing [7]

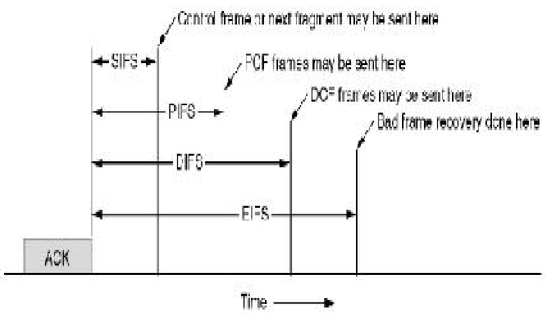

Fig. 2: Interframe Time Spacing [7]

III. METHODOLOGY

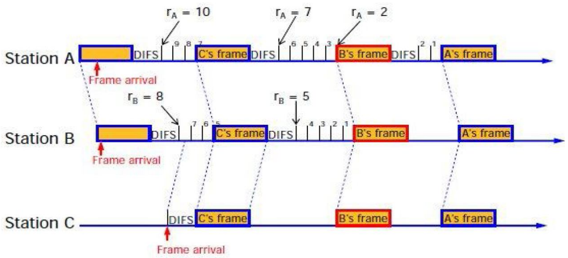

Fig. 3: Channel Sharing Mechanism [7]

$$T(P) = \sum_{t=t1}^{t2} \mathrm{Pt} \qquad \ldots(1)$$

Where, t1 to t2 is time slot available for communication. Equation (1) represents total number of packets to be delivered to the node in time slot t1 to t2. We modify equation (1) to equation (2) with increment of time slot by 'Γ' for packet aggregation.

$$T(P) = \sum_{t=t1}^{t2+\Gamma} \mathrm{Pt} \qquad \ldots(2)$$

The time out for PIFS space can be increased with additional time during which all the upcoming new packets intended for the same, receiver will get more time available for fast delivery for enhancing QoS in VoIP based service.

$$\text{Timeout} = \text{PIFS} + t \qquad \ldots(3)$$

Where,

PIFS is time slot of station obtained from polling, t is additional time allotted for packets aggregation.

IV. SIMULATED RESULTS

The analysis has been done based on implementation of different time slots in different network scenarios with varied number of nodes in the network.

Steps taken for implementation in NS-2:

1. Implementation of PCF support in 802.11 MAC code by using Anders Lindgren patch.
2. Writing TCL script for generating topology of Infrastructure network.
3. Changing CFP period and recompiling the back end of ns2.
4. Running simulation by using tcl script.
5. Analysing performance by using trace file.
6. Repeat steps 3 to 5 for several observations.
7. Tabulate different results and observe the performance by plotting them.

The results are indicated in terms of graphical views. The comparative analysis indicates satisfactory results after modifying the protocol.

Table 1: Throughput 20 nodes Network

0	78.329998
105	78.329998
200	78.329998
500	78.32998
800	76.259998
1200	80.769998
1400	78.119998
2500	79.909998
2750	79.909998
2800	95.859997
3000	95.859997
5000	76.719998

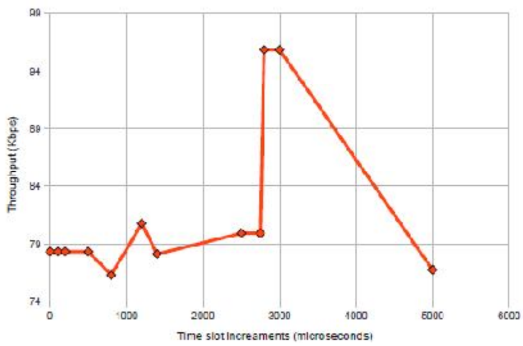

Fig. 4: Throughput analysis for 20 nodes

Table 2: 32 nodes Network

0	147.529987
105	147.779987
200	147.779987
500	147.779987
800	147.719987
1200	153.969986
1400	169.069985
2500	190.269983
2750	190.269983
2800	143.839987
3000	143.839987
5000	166.769985

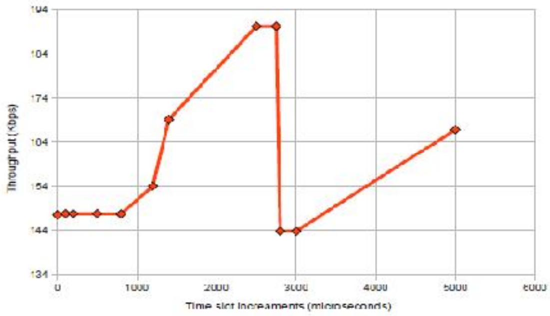

Fig. 5: Throughput analysis for 32 nodes

Table 3: Throughput for 70 nodes network

0	386.41993
105	385.519931
200	385.519931
500	376.789932
800	376.789932
1200	543.379902
1400	261.349953
2500	637.429885
2750	648.199883
2800	659.259881
3000	659.259881
5000	639.489885

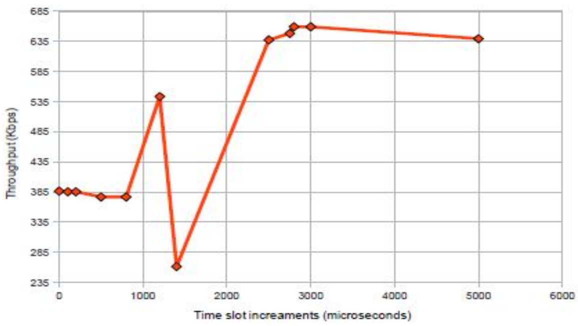

Fig. 6: Throughput analysis for 70 nodes

Table 4: PDR for 20 nodes network

0	16.046275
105	16.051181
200	16.051181
1400	15.866841
2500	15.387215
2750	15.378095
2800	18.493489
3000	18.493489

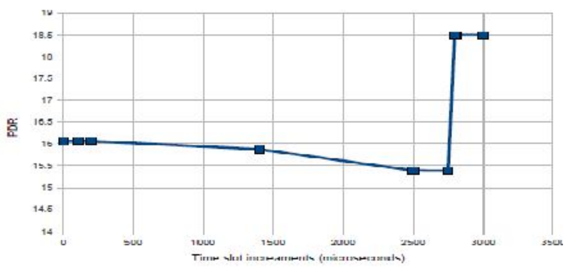

Fig. 7: PDR analysis for 20 nodes

Table 5: PDR for 20 nodes network

0	14.269948
105	16.051181
200	14.256196
1400	12.576658
2500	16.085128
2750	16.085128
2800	14.864653
3000	14.864653

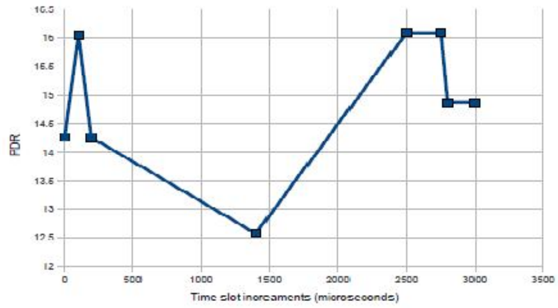

Fig. 8: PDR analysis for 32 nodes

Table 6: PDR for 70 nodes network

0	23.349274
105	23.289585
200	23.281722
1400	27.218566
2500	14.352869
2750	14.094587
2800	14.845463
3000	14.845463

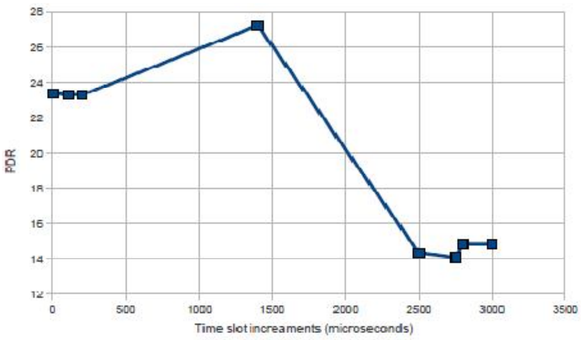

Fig. 9: PDR analysis for 70 nodes

ANNOTATIONS:

1. We have analysed throughput performance and PDR for different network load scenarios. For 20 nodes scenario to 70 nodes scenario we observed the throughput changes due to increment in time slot.
2. Throughput in the network with maximum traffic gets affected due to increment in time slot. Particular increment in allotted time slot for communicating each node in the network gives

more throughput as compared to time slot with no increment.

3. PDR of the network also increases with rise in contention free period increment.
4. Increment in contention free period time slot increases both throughput and PDR but upto some limit hence forth it decreases the performance of the network.

CONCLUSION

Based on our simulated experimentation we conclude that increment in contention free time slot increases the network performance in terms of throughput and packet delivery ratio.

We also conclude from observations that, as traffic due to increment in number of nodes in the network increases the network performance decreases but it can be made adequate when time slot for contention free period is increased.

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