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Unicast Frame Aggregation with Heterogeneous Destination

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Abstract: The increase in the rate of the data transmission leads to the overhead in the MAC. This overhead must be reduced for the efficient transmission. The overhead is reduced by the frame aggregation i.e. by collaborating various frames in a single transmission, but up to the frames with destination address. This paper introduces a phenomenon to aggregate various frames with different destination addresses. The frame with destination in the path between the source and destination are aggregated here. Simulation is made to verify the optimization of the process.

Keyword: Frame Aggregation, MAC, Overhead, 802.11n

I. INTRODUCTION

The technology is growing day by day and growing technology demands internet at home as well as at coffee shops, hotels etc[1]. That's why now a days, Wi-Fi technology is found useful in mobile phones, notebook computers and also in various other electronic devices. Even though earlier devices are equipped with built-in WLAN [2]. This growing demand of Wi-Fi needs the extension of the technology as constraint of the Wi-Fi technology is increasing. The solution needs the high speed wireless internet connectivity with the existing WLAN hardware. But the data rate with the existing hardware leads to the greater overhead. This overhead can be reduced by aggregating various frames within a single transmission. This phenomenon is known as the frame aggregation.

The frame aggregation reduces the number of transmission as grouping various frames in a single transmission and also reduces the header overhead and several frames are transmitted by using a single header. The 802.11n IEEE standard introduces a frame aggregation that provides high data rate as well as high throughput [3]. The transmission of the data using the 802.11n follows the RTS-CTS-DATA-ACK sequence. The request to send signal followed by clear to send signal are the handshake signals for the data transmission. Each signal is separated by the short inter frame separation time.

II. AGGREGATION IN IEEE 802.11N

Two types of frame aggregation schemes exist i.e. A-MSDU and A-MPDU. A-MSDU is the aggregation of the MAC service data unit while the A-MPDU is the aggregation of the PHY service data unit. The detail of these aggregations with their frame format is given below:

a. A-MSDU

Different Mac service data units are aggregated to form a MAC protocol data unit. The frames consist of one PHY header and PSDU. The PSDU i.e. physical service data unit of the A-MSDU contains the Mac header and the A-MSDU frame along with the frame check sequence i.e. FCS [4]. The A-MSDU consists of various sub-frames and each sub-frame consists of the destination address, source address, length, MSDU and the padding bits. The sub-frames can be of different size and share common MAC header and FCS [5] as shown in figure 1.

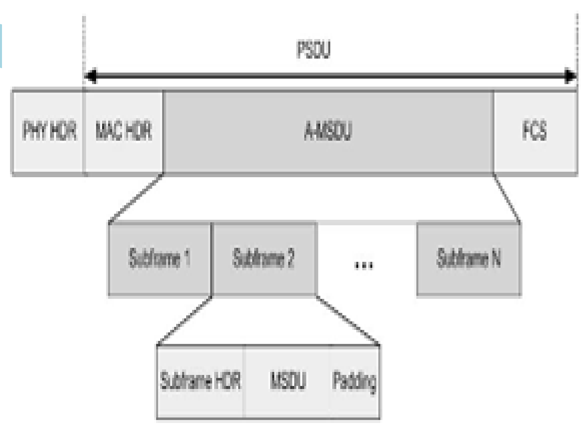

Figure 1: Frame Format of A-MSDU

b. A-MPDU

In this each sub frame is its own MAC header and the FCS. The delimiter is used to separate various subframes [5]. The common PHY header is shared by all frames. The frame format is shown in the figure 2.

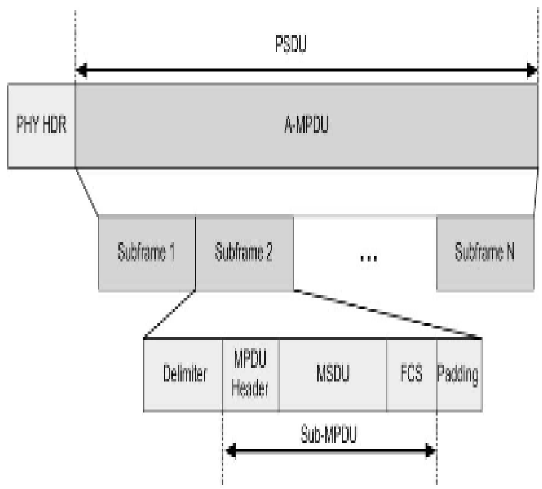

Figure 2: Frame Format of A-MPDU

III. RELATED WORK

Kim et al.[4] proposes a system that aggregates the unicast as well as the broadcast frames. They aggregated the TCP ACK with the TCP data as their system can classify the TCP ACK segments. They implement and validate their system by using a node prototype Hydra. They analyzed the high throughput in the unicast as well as the broadcast aggregation. Lin et al. [6] proposes a frame size adaption algorithm with error-prone channels. Their model is accurate to predict the network throughput. They compared the performance of their algorithm with the fixed size frame aggregation algorithm to validate their algorithm.

IV. PROPOSED WORK

The existing Frame aggregation scheme aggregates the frame that has the same destination address. This process is not able to increase the throughput but suffers from the overhead problem. The paper increases the throughput by aggregating various frames with different destination. This process needs to change the frame format. The work needs a Frame with unicast data and each unicast data has its own destination address. In this process each node knows its geographic location. The frames are aggregated in terms of distance of the destination i.e. lower distance data will be placed firstly or vice-versa. The routing protocol will route the data from source to the destination in a multi-hop fashion. The destination will be the destination of the last unicast data. The frames have the intermediate nodes as their destination can be aggregated only. This process will enhance the throughput of the system as the data will be travelled at higher rate with less delay. The process can be easily understood by the following algorithm:

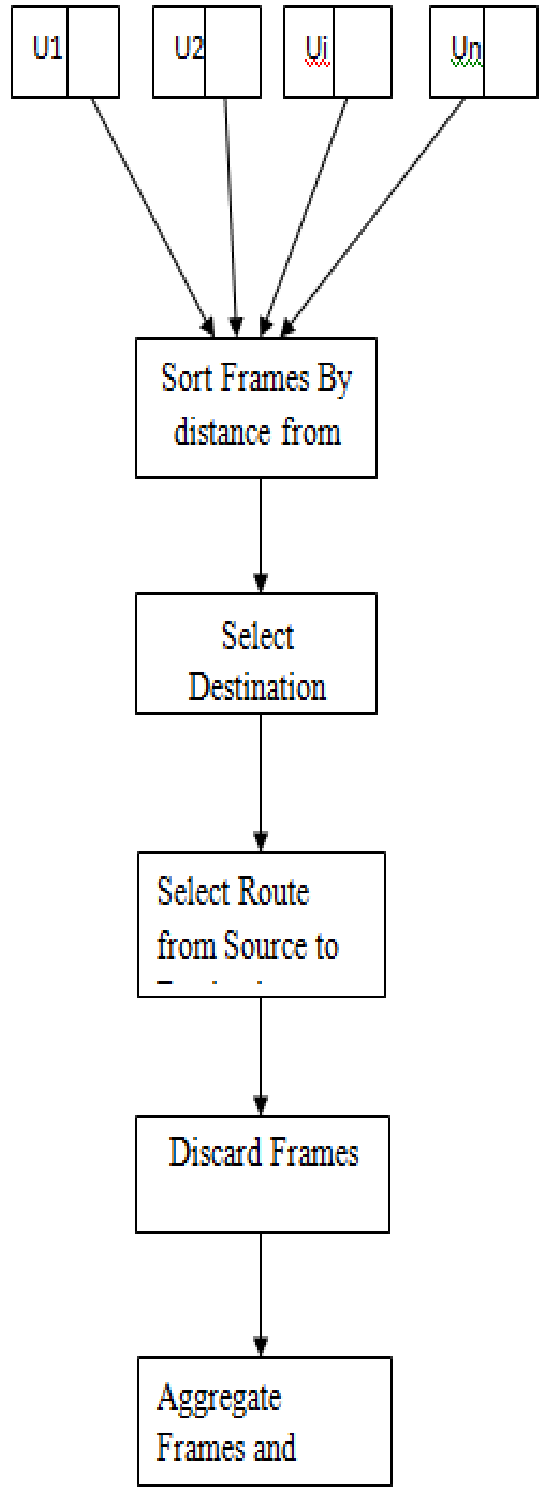

Figure 3: Heterogeneous frame aggregation

Table 1: Comparison of delay and Throughput at different rates

Data rate	Delay		Throughput	
	Homogeneous Frame Aggregation(existing)	Heterogeneous Frame aggregation(Proposed)	Homogeneous Frame Aggregation(existing)	Heterogeneous Frame aggregation(Proposed)
6e3	0.782557	0.767619	541.08	30599.53
6e4	0.782557	0.771418	541.08	30600.46
6e5	0.782557	0.771418	541.08	30602.88
6e6	0.782557	0.772154	541.08	31009.51

The above flowchart shows the aggregation of n frames. Firstly, n frames are sorted according the distance from the destination. The distance between the source and destination can be easily calculated by the distance formulae: $\sqrt{(x1-x2)^2+(y1-y2)^2}$ where x1,y1 are the location coordinates of the source and x2,y2 are coordinates of the destination. These coordinates are known to the sensor node and the nodes know their geographic location. Then the last frame destination is selected as the destination. The routing protocol decides the route from the source to the destination and the routing protocols select the nearest neighbor of transmitting node to transfer the data. The process goes on until destination reaches. The frames that have the destination in the route are kept, and other frames are discarded. The selected frames are aggregated and data is transferred from the source to destination. The intermediate nodes also get the frames of their interest. This process is simulated here by using the NS2 simulator.

V. RESULTS AND DISCUSSION

The paper simulates the heterogeneous frame aggregation and compares the delay and the throughput with the existing homogeneous frame aggregation. The comparison is made at different data rates. Table 1 shows the results of the comparison of the delay and the throughput at different data rates of the existing homogeneous and proposed heterogeneous frame aggregation.

This comparison can be analyzed graphically as shown in Figures 4 and 5.

The graphical comparison shows that the throughput of the heterogeneous frame aggregation is far better than the existing homogeneous frame aggregation while the delay is reduced minutely. The increase in the throughput shows that the output in the given time gets increased.

CONCLUSION

This paper discusses the frame aggregation with different values of destination to decrease the load. The simulation results show the effectiveness of the concept by comparing the throughput and the delay with the existing homogenous frame aggregation. The delay is reduced minutely but the throughput gets enhanced. The large enhancement is throughput increases the effectiveness of the concept. In future the delay can be reduced in the heterogeneous frame aggregation.

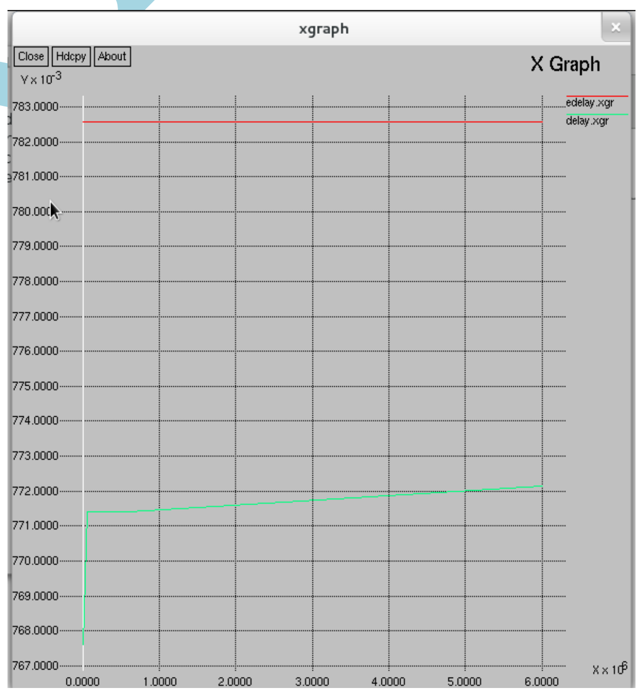

Figure 4: Comparison of delay data

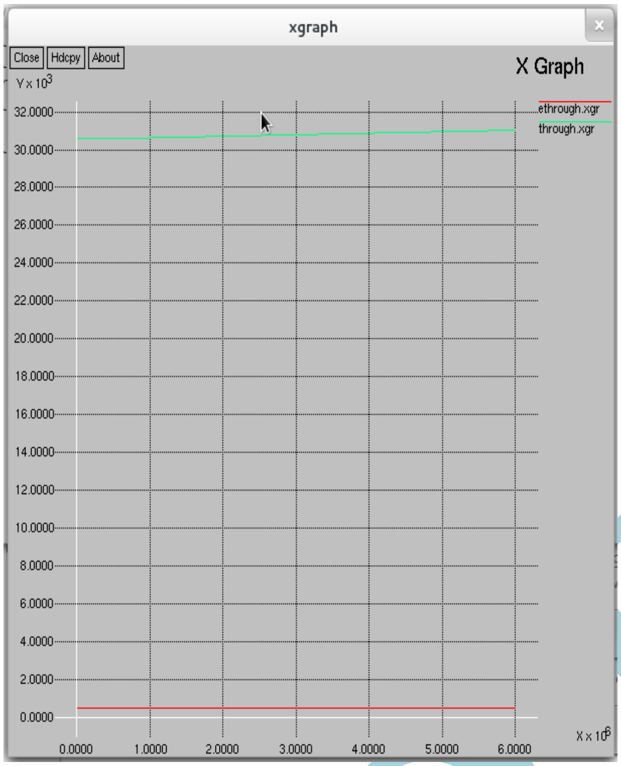

Figure 5: Comparison of Throughput results

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