Rate control algorithm using SNR and successful Packet Error Rate

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1 Introduction

The IEEE® 802.11™ standard supports dynamic rate control by adjusting the MCS value of each transmitted packet based on the underlying radio propagation channel. Maximizing link throughput, in a propagation channel that is time varying due to multipath fading or movement of the surrounding objects, requires dynamic variation of MCS. The IEEE 802.11 standard does not define any standardized rate control algorithm (RCA) for dynamically varying the modulation rate. The implementation of RCA is left open to the WLAN device manufacturers. This example uses a closed-loop rate control scheme. A recommended MCS for transmitting a packet is calculated at the receiver and is available at the transmitter without any feedback latency. In a real system this information would be conveyed through a control frame exchange. The MCS is adjusted for each subsequent packet in response to an evolving channel condition with noise power varying over time[1].

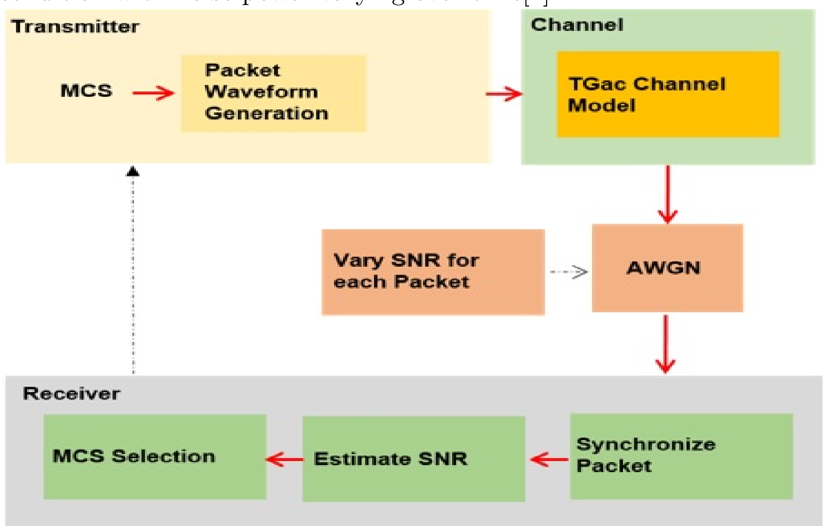

Figure 1: Shows processing of each packet[1].

2 Proposed Algorithm

In the project we have designed our own rate control Algorithm. The algorithm dynamically adjust the MCS value of each transmitted packet on the underlying radio propagation channel by calculating average SNR over channel and number of consecutive successful transmissions.The received signal strength(RSS) is used to calculate the average RSS of the channel by using RSS-avg we are doing Link Adaptation. We are updating RSS-avg using moving average algorithm;
RSS-avg= a*RSS-avg+ (1-a)*SNR-estimated [2]
where 0<a<1
We are calculating number of consecutive successful transmissions.We have classified the rate transition into: Smooth Transition and Fast Transition.
Smooth Transition: It will increase the MCS value sequentially for this particular smooth transition we are using the same logic as explained in the sample example 'TransmitRateControlExample.m'.
Fast Transition:When we observe 5 consecutive successful transmissions we assume that channel quality is constant or shows negligible variations.Now we initialize fast transitions using the look up table of thresholds and their corresponding MCS.
Our Algorithm starts with smooth transition as soon as it observes consecutive successful transmissions it will initiate the fast transition, we might get a better quality so we need to observe the channel for it. The observation is done after few packets to sense the RSS-avg and change the MCS accordingly.
If we observe any bit error rate or request for re-transmission(loss of packet) we will decrements the MCS using smooth transition.It again observes for the number of successful transmissions and uses the same above mentioned logic for

further process.

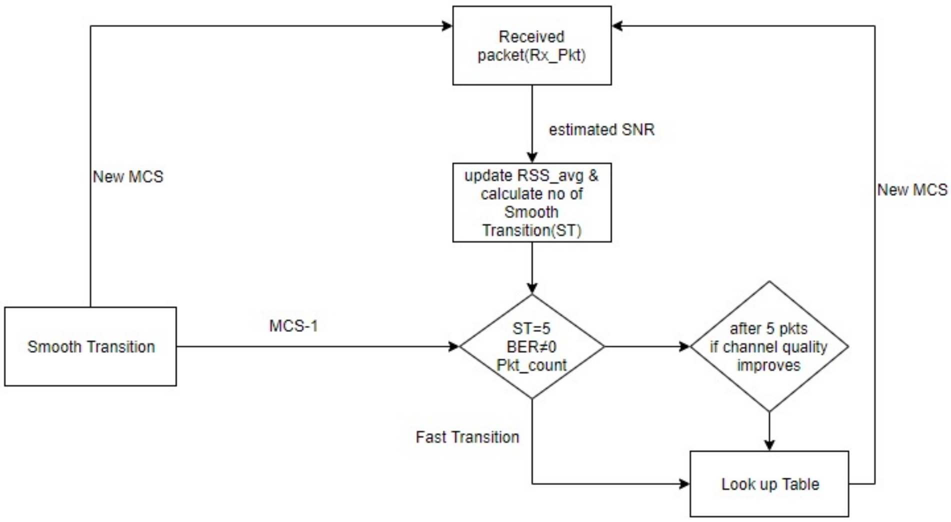

Figure 2: Proposed Rate Control Algorithm.

3 Results and Observation

We investigated the performance of the algorithm using 1x3 transmitter and receiver antennas.By increasing the no of receiver antenna we will get a better SNR. At the receiver end we are equal gain combining diversity technique.We observed potential increase in data rate even though we got erratic results in Packet error rate.The reason for increase in data rate could be because of fast transition and improved SNR obtained due to link adaptation and diversity.

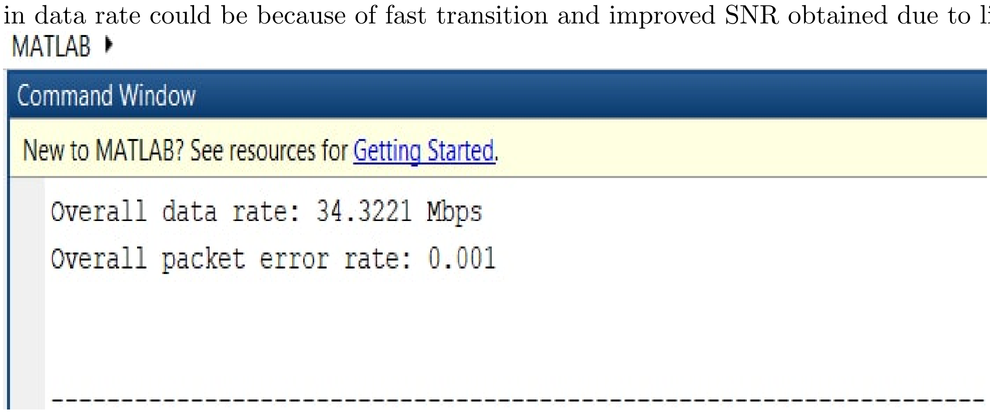

Figure 3: Data Rate and Packet Error for 2000 packets with Channel Bandwidth=40 MHz

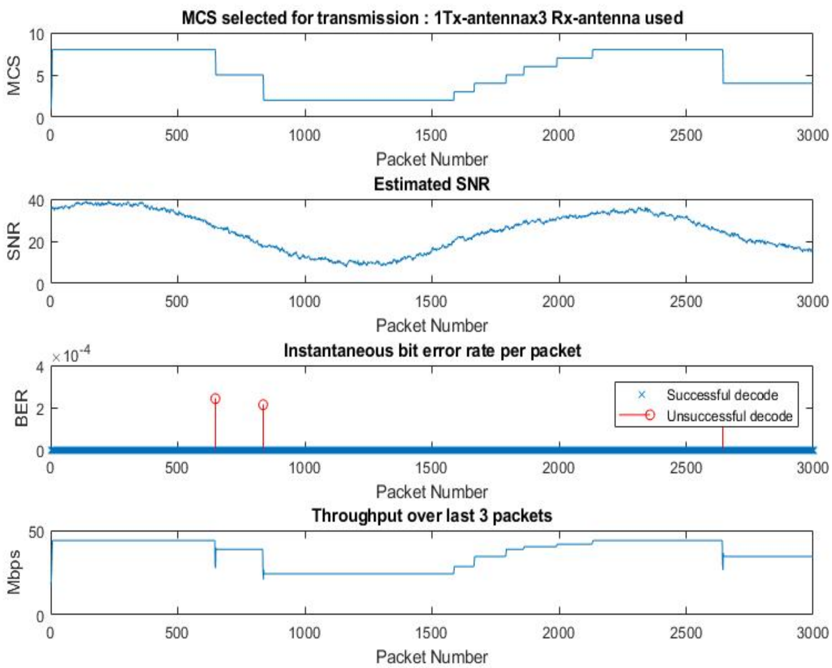

Figure 4: Plot of MCS,SNR, BER, Throughput with channel bandwidth=40MHz.

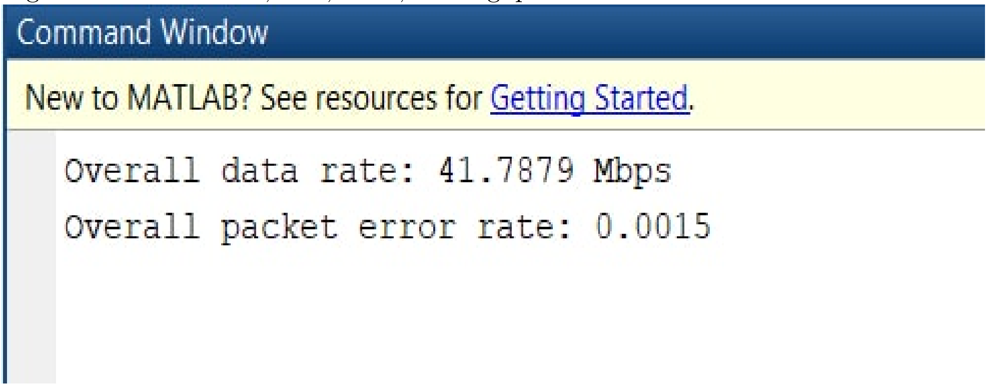

Figure 5: Data Rate and Packet Error for 2000 packets with Channel Bandwidth=80 MHz

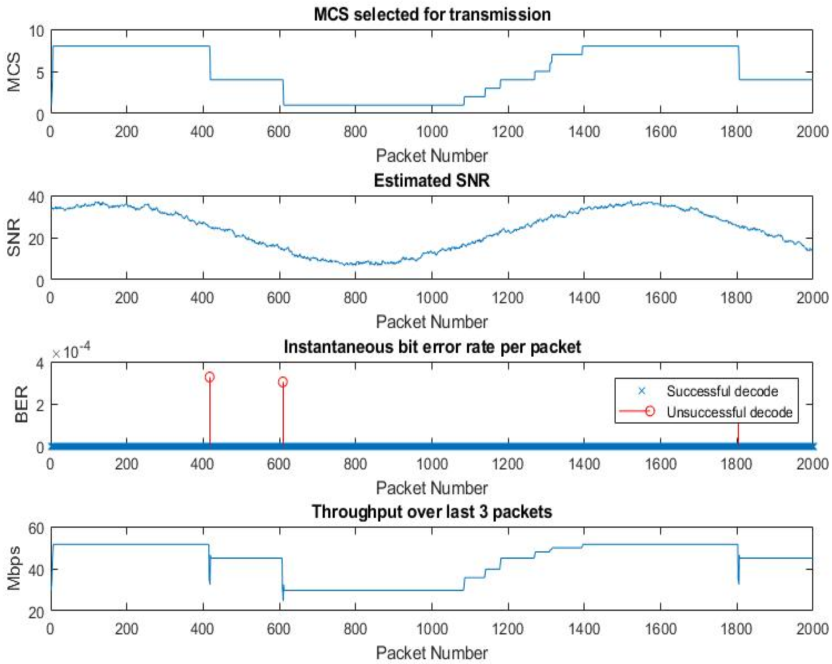

Figure 6: Plot of MCS,SNR, BER, Throughput with channel bandwidth=80MHz.

4 References

1) https://nl.mathworks.com/help/wlan/examples/802-11-dynamic-rate-control-simulation.html
2) J. P. Pavon and Sunghyun Choi, "Link adaptation strategy for IEEE 802.11 WLAN via received signal strength measurement," Communications, 2003. ICC '03. IEEE International Conference on, Anchorage, AK, 2003, pp. 1108-1113 vol.2. doi: 10.1109/ICC.2003.1204534
3) Q. Xia and M. Hamdi, "Smart sender: a practical rate adaptation algorithm for multirate IEEE 802.11 WLANs," in IEEE Transactions on Wireless Communications, vol. 7, no. 5, pp. 1764-1775, May 2008. doi: 10.1109/TWC.2008.061047