Cisco/UDel Meeting Minutes
October 30, 2015

Attendees: Jim Seymour, Len Cimini, Chien-Chung Shen, Li Li
Minutes Taken By: Li Li

Slides #5, #6, #7 - If different WiFi pairs transmit data simultaneously (have data to send and have the same random), whether a collision happens depends on the location of the clients.

- Jim: What's the traffic model in your simulation? If it is Poisson, collisions will happen only when their data arrive at exactly the same time and they also have the same random backoff.
- Li: Yes, it is true. But for "high load rate" case, all pairs almost have data to transmit all the time. For example, we assume there are three pairs, #1, #2 and #3, and they all have data to transmit. If #1 is transmitting first, both #2 and #3 will backoff. When #1 finishes its transmission, both #2 and #3 will try to occupy the channel, if they happen to have the same random backoff, collisions will happen in this case.

Slides #8, #9, #10 – Collisions may happen among WiFi and LAA pairs, even though they do not transmit data simultaneously. For example, if LAA #2 transmit first, WiFi #3 cannot detect its transmission. Then, WiFi #3 will also begin to transmit data; this may lead to a collision. So, collision probability among WiFi and LAA pairs will be much larger than that among pure WiFi pairs.

- Jim: In your current simulation, do you consider the location of the users?
- Li: I did not consider the actual location of the users. In simulations for different cases now, I assume the users are located as in Scenario 1, 2 and 4.

Slides #11, #12 – Case II: only collision to LAA.

- Jim: What happens when you do get a collision?
- Li: If a collision happens, I will double the contention window size, generate a new random backoff, and try to retransmit at a later time.
- Jim: I still try to get understand why WiFi's performance may go down by decreasing the LAA threshold.
- Li: I will firstly explain why LAA's performance decrease so quickly. At -70 dBm, only LAA #2 and WiFi #3 is asymmetric, and LAA #2 has no idea that it will be corrupted by WiFi #3's transmission at a later time, so LAA #2's performance degrades a lot; at -75 dBm, LAA #2 and WiFi #3, and LAA #1 and #4 are both asymmetric, so LAA #2 and #4's performance also degrades a lot.
- Len: If a problem depends on the geometric locations, it may disappear if we increase the number of pairs.
- Li: Yes. I also did some simulations with a large number of pairs, and similar behaviors can be observed, but not so obvious. Since there are other reasons, I will explain later.
- Li: One reason for the decreasing of WiFi's performance: at -70 dBm, LAA #2's performance degrades a lot, then, WiFi #1 can take this advantage, since they

are only 5 meters away. Since WiFi #1's performance improves at -70 dBm, it may block WiFi #3's transmission; this means WiFi #3's performance may decrease in this case. I did one more simulation, assuming that LAA #2 is totally gone, then WiFi #3's performance is still worse than WiFi #1 and LAA #4.

Slides #13, #14 – Case IV: Not a collision to WiFi and LAA.

- Li: The other reason for the decreasing of WiFi's performance: From -65 to -70 dBm, the number of collisions for WiFi pairs increases, this leads to a decreasing in the number of successful transmissions. For example, we assume #1, #2 and #3 all have data to transmit. At -65 dBm, if #3 is transmitting first, #2 can also transmit and #1 have to wait; at -70 dBm, if #3 is transmitting first, both #1 and #2 have to wait, then this may lead to a collision. Also, a collision means doubling the contention window size, which further decrease the opportunity to access the channel.
- Chien-Chung: At -70 dBm, if #3 is transmitting first, both #1 and #2 have to wait. If they have different random backoff, one of them can transmit first without collision.
- Li: Yes, this could or could not happen, and the collision probability is 1/16.
- Jim: Besides including the location of users, you can also do some analyses on the probability of each case, and then see what the performance will be.

Slides #17, #18 – Performance for 8 pairs: similar trend, but more interactions.

- Jim: We can assume a client is at different locations and then do an average. We can also include multiple clients, some are in Case I, some are in Case II, and so on.
- Jim: The goal here is to see whether there is an optimal threshold for the coexistence of WiFi and LAA. But now, it looks that it is impossible, decreasing LAA threshold will degrades LAA's performance a lot, but not improve WiFi's performance so much.

Slides #19 – Next steps.

- Len: We may need to get some theoretical things for Li's Ph.D research. Is this work suitable for a conference?
- Jim & Len: To get a paper accepted, we may need to add some theoretical analysis, like formulas; or we can include some statistics, and show the average results; or we can come up with an algorithm to adaptively change the threshold to optimize the performance. We may need to follow a plan for a paper, and for Li's Ph.D proposal.

Actions Items:

- **Simulate the delay performance;**
- **Consider clients at different locations or do some statistical analysis.**

Next meeting: Thursday November 12 4:00 - 5:00pm (EDT)