Cisco/UDel Meeting Minutes
August 14, 2015

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

NOTE: Slides will be provided at least two days before the next meeting. They will be available on a UDel website (the link will be provided). The audio for the meetings is now being recorded. Jim sent the link to the recording in an email after the meeting.

Vikram will be joining our discussions starting with the next meeting.

A. Proposal
    - Jim: They are doing this later than last year. Will reach out to Megan.

B. We first reviewed the minutes from the previous meeting on July 30, 2015.
    - Jim:
        o   On Slide #15, he will look at #3 again and have an answer by early next week.

C. Then, we started a detailed review (Li presenting) of the slides on Channel Selection for LAA with 802.11ac, including the simulation that was performed and next steps.

Slide #2 – Parameters for WiFi and LAA. For WiFi the contention window q=32 and for LAA it was fixed at 16.
Slides #3, #4, and #5 – Simulation Results → LAA is a bit less aggressive when the number of pairs increases. They coexist better when only two pairs because the rate is available and they can always get what they want. As the number of pairs increases to more than 8, LAA can be worse than WiFi. When q=32, WiFi performs better.
    -   Jim:
        o   What is dominating is the q=16 used for LAA. So, the results make sense because there is less backoff. → *Li will try updating the contention window.*
        o   When q=32 for both, how do we explain what happens from 4 to 8 pairs? → *needs explanation*
        o   The results are very dependent on the assumptions for LAA. We need to make LAA as close to CAT4 as possible. Vikram can help here and provide the parameters that are actually being used.
Slide #6 – Channel Selection – Review Scenarios
Slide #7 – Channel Selection – Qualcomm & Ericsson (May 28 Workshop) → (1) choose the cleanest channel. (2) Avoid primary channels of WiFi. (3) Avoid channels occupied by other or same LTE-U operators.
    -   Li:
        o   Didn't find anything else in his search. Jim concurs.
Slide #8 – % of time occupation for 802.11ac (averaged results). Uses 80 MHz, 40 MHz, 20 MHz, or Fails (means ac cannot work). There are a variable number of LAA nodes (1

to 8). Each LAA is 20 MHz and can have 1 to 4 channels. → The % for WiFi goes down very rapidly.

- Jim:
    - o What does it really mean to fail? This might not be the best measure.
- Li:
    - o "Fail" means 802.11ac cannot work *at that time* because LAA is using the WiFi primary channel. That is, it is random each time, and no attempt is made to avoid the primary. And, all the pairs are in the same location.
- Jim:
    - o ***We need to consider the traffic model and load. Look at 3GPP and consider light, medium, and heavy loads (Jim can provide this to us).***

Slide #9 – Effective Bandwidth → Only one ac node. LAA increases.

- Jim:
    - o If more LAA nodes (e.g., 8) and only 1 ac node, we should expect 8/9 more bandwidth to LAA.
- Chien-Chung:
    - o We should increase the number of ac nodes
- Jim:
    - o We also need to spread out the nodes in space (with distance attenuation)

Slides #10 and #11 – % of time occupation (#10) and effective bandwidth (#11), but now LAA only uses channels #2 to #4 (#1 is primary for 802.11ac). → Of course, there are no "fails" now since ac can always use its primary channel.

Slide #12 - Comparison

- Jim:
    - o Qualcomm and Ericsson don't always want to avoid the primary. They only "try" to avoid it. But, if congested, they can still use it.
    - o ***We need to be a little more realistic → far from what actually deployed.***

Slide #13 – Channel Bonding for LAA → one WiFi, one LAA in 80/40/20 using carrier aggregation (can be noncontiguous) or channel bonding (same as WiFi)

Slide #14 – Effective Bandwidth versus density of 802.11 → Three scenarios: (1) one ac node (2) one ac and one LAA node using CA (3) one ac node and one LAA node using CB

- Jim:
    - o What do you mean by channel bonding for LAA?
- Li:
    - o Grow from 20 to 40 to 80 contiguous. Didn't simulate 80+80.
- Chien-Chung:
    - o Why are you adding "a" and "n" nodes?
- Li:
    - o Because there are "a" and "n" nodes operating at 5 GHz
- Jim:
    - o They are all 20 MHz, right? Yes.

- o But we should think about looking at this by increasing the # of clients rather than nodes all in the same location. This would be a better way to increase load.
  - o Why, in Scenario II, is LAA not affected by adding more "a" and "n" nodes?
- Li:
  - o It depends on the load → if the load is not very high, LAA with CA can always find 4 idle channels
- Jim:
  - o There is something between CA and CB
  - o In LAA, primary is in the licensed band.

Slide #15 – Next Steps: Different locations, more efficient channel selection algorithms, LAA with CA or CB or something in between, multiuser BF, …
- Jim:
  - o *Change offered load and consider different clients in different locations*
  - o *Realistic traffic model*

Actions Items:
- **Continue Matlab simulation study, include more details**
- **Realistic traffic loads**
- **Distance attenuation**

Next meeting: Thursday September 3 4:00 pm – 5:30 pm (EDT)