Cisco/UDel Meeting Minutes
September 17, 2015

Attendees: Jim Seymour, Len Cimini, Chien-Chung Shen, Li Li
Minutes taken by: Li Li, Chien-Chung Shen

A. Proposal status
- Jim: Approved, congratulations!

B. A detailed review of Li's slides on the coexistence of LAA and 802.11ac.

Slide #2, – In general, there is no random backoff for initial transmission in WiFi.
Slides #3, #4, - In Enhanced Distributed Channel Access (EDCA), the contention window size depends on the specific traffic. Voice packets have the highest priority (3-7), video packets are in the second tier (7-15), best effort data follows (15-1023), and the one with the least priority is background data, such as file downloads, and print jobs (15-1023).

- Len: Voice packets have the highest priority, why?
- Jim: Giving the voice packets the highest priority will make VoIP to incur the minimum latency.
- Chien-Chung: Although voice packets have the highest priority, they will only occupy the channel for a very short time due to its small packet size.

Slide #5, - In simulation, the contention window size of WiFi is from 16 to 1024 (q_WiFi), and that of LAA is from 16 to 32 (q_LAA).

- Jim & Len: Why do you choose 32 for LAA?
- Li: I followed a paper by Ericsson, and they choose LAA to be [4,32].
- Jim: These parameters are not decided yet, so you may want to make LAA as similar to WiFi as possible.
- Len: Yes, from the research perspective, we may also want to simulate the performance with different parameters to get insights.

Slide # 6, - Simulation results with different contention window size are provided.

- Chien-Chung & Li: There is only one type of traffic in the current simulation, either pure FTP or pure Voice.
- Jim: We may want to consider mixed types of traffics. Pure voice is kind of a theoretic thing, and it would not happen in the real world.

Slide # 7, - Discussion: to better coexist with WiFi, does LAA need to change contention window size according to the type of traffic in WiFi?

- Jim: First, we will try to have the same range of the contention window size for both LAA and WiFi.

Slide # 8, - Update the simulation for different locations.

- Jim: This is a good problem. For WiFi, the preamble decoding threshold is -82 dBm, and the energy detection threshold is -62 dBm. In contrast, there is only energy detection for LAA. So, we may need to propose an algorithm to adaptively change the LAA threshold to better coexist with WiFi.

- Chien-Chung: What's the cost of preamble decoding? Because, for example, if we want to optimize the performance, we have to know the cost or some constraints.
- Jim: The first cost is that we do not have the WiFi preamble in LTE, that's not an easy thing given the structure of WiFi and LTE.

Slide # 10 - Simulation results for different load rates with LAA CCAED of -68 dBm.

- Jim: The LAA nodes in the middle have almost the same performance as the LAA nodes in the margin, but the WiFi nodes in the middle would suffer performance loss. When we decrease the LAA CCAED, LAA nodes may have similar performance as WiFi.
- Chien-Chung: Do you mean if there exists a service provider that can control both WiFi and LAA, then it can change their detection threshold to make them to coexist well?
- Jim: No, WiFi is there, and one cannot change its decoding or energy detection threshold. But one can do something to LAA.
- Chien-Chung: Right. So, if one operator owns both WiFi and LAA in one area, will it expect one player to be stronger than the other?
- Jim: It may be possible that one operator owns both WiFi and LAA. However, we are considering the unlicensed band, so you cannot make one of them to be too aggressive.

Slide # 11 - Discussion: all LAA eNBs will be assisted by LTE licensed part. So, with ideal scheduling, there will be no competition among LAA eNBs?

- For the unlicensed band, we still tend to consider the case where there exists competition among LAA eNBs. They will be very local, so fair sharing may be still required.

Slides # 13, # 14, - Review multi-carrier LBT. Option 1: multiple LBT CAT4; Option 2: WiFi like LBT.

- Li: Current LTE is limited to aggregate a maximum of 5 component carriers, which means it can aggregate 4 carriers in the unlicensed band.
- Jim: Right, in Release 12, LTE supports 5 carriers, but they are extending it to 32 in the future releases.

Slides # 15, # 16, - Review simulation results for multi-carrier LBT by Ericsson.

- Li: According to their results, both options coexist with WiFi very well, and Option 2 is a bit better than Option 1 in terms of throughput.

Slide # 17, - Review the power sharing problem. Operators in the 5GHz band is subject to a total transmit power and per MHz PSD constraint on the entire bandwidth. This is different from the current LTE.

- Len: I think LTE also has a constraint in the total power, 1) FCC will not allow you to broadcast on a 1GHz bandwidth; 2) there are also constraints in implementation.
- Jim: I think LTE has a constraint in per MHz PSD constraint. For example, if one LTE occupies 20 MHz and use power P, and the power can be doubled if it is extended to 40 MHz. But you cannot double the power in unlicensed band if P is already the maximum allowed power.

Slide # 18, - Three options. Fixed or dynamic power allocation.

- Jim: What are you thinking to do based on these references?

- Li: 1) I am also trying to do some simulations for multi-carrier LBT, but did not finish yet. 2) Develop mathematical models to solve the channel selection problem.
- Chien-chung: we may also study the dynamic detection threshold mentioned by Jim.

Actions Items:

- **Continue Matlab simulation for multi-carrier LBT, and study algorithms for detection and channel selection.**

Next meeting: Friday October 2 10:00 am – 11:00 am (EDT)