Cisco Cooperative Project

Adaptive Threshold, Collisions, Alternative Geometry

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April 08, 2016

Outline

- Discussion on Proposal 2016
- Updated Results: Adaptive MCS
- Adaptive Threshold: Collisions

Discussion on Proposal 2016

- Multi-channel and multi-user
- Standalone LAA, the challenge is on the control channel
- Next generation of WiFi: 802.11ax
- …

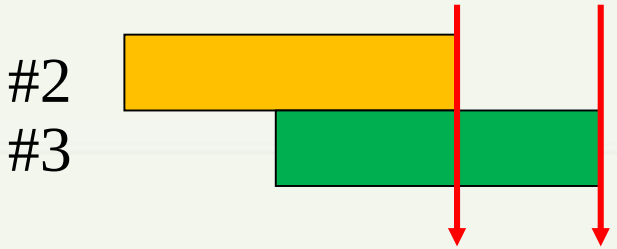
Review: Simulation Setting

- Simulation Setting
  - ✓ 4 APs, 4 eNBs, and each AP/eNB has five users
  - ✓ FTP file size: 0.5 Mbytes, Poisson process: lambda = 2.5
  - ✓ One LAA eNB serve different UEs one by one.
  - ✓ Modulation-coding-scheme

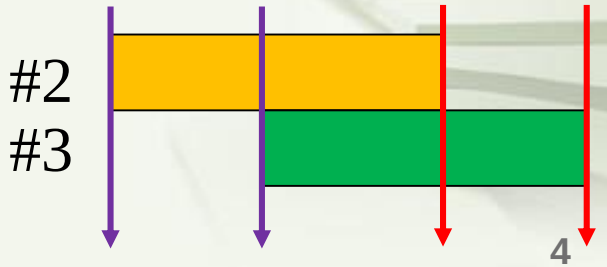
Modulation type	Coding Rate	AC SNR	LTE SNR	AC throughput	LTE throughput
QPSK	1/2	5	2.0	14.4	16.8
QPSK	3/4	9	5.5	21.7	25.2
16-QAM	1/2	11	7.9	28.9	33.6
16-QAM	3/4	15	12.2	43.3	50.4
64-QAM	2/3	18	15.3	57.8	67.2
64-QAM	3/4	20	17.5	65	75.6

Review: Adaptive MCS

- A mistake in previous simulations
  - ✓ SINR is compared with different SNR thresholds at the “end” of each packet, then, a certain MCS is adopted to calculated throughput.
  - ✓ Both #2 and #3 may choose a low MCS.

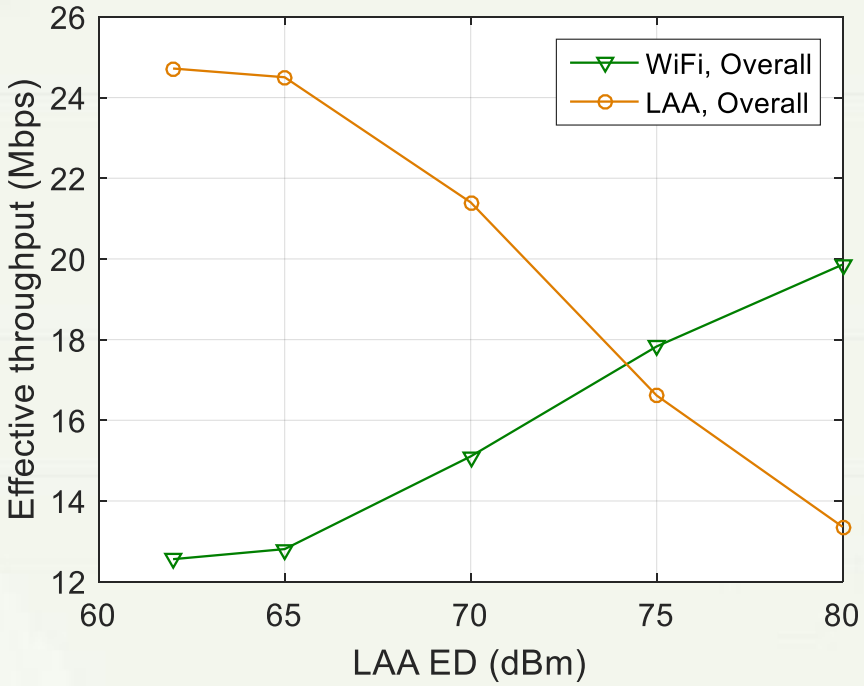


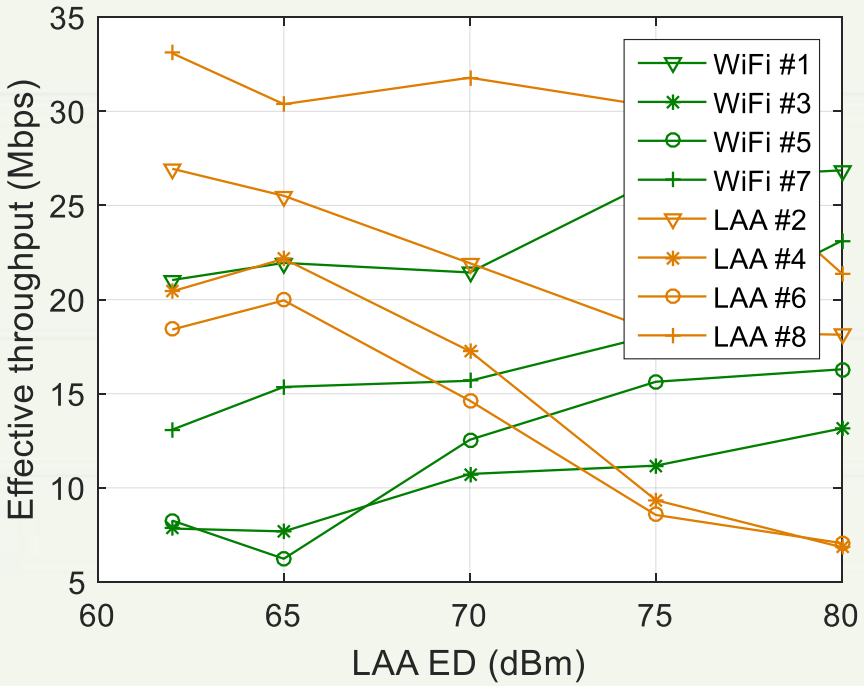
- Correction
  - ✓ SINR is compared with different SNR thresholds at the beginning of each packet to decide MCS; then at the “end” of each packet, the current SINR is used to decide whether collisions happens.
  - ✓ #2 will choose a high MCS, and #3 may choose a low MCS. Collision may happen to #2.



Results: Adaptive MCS

- Same ED for all LAA eNBs

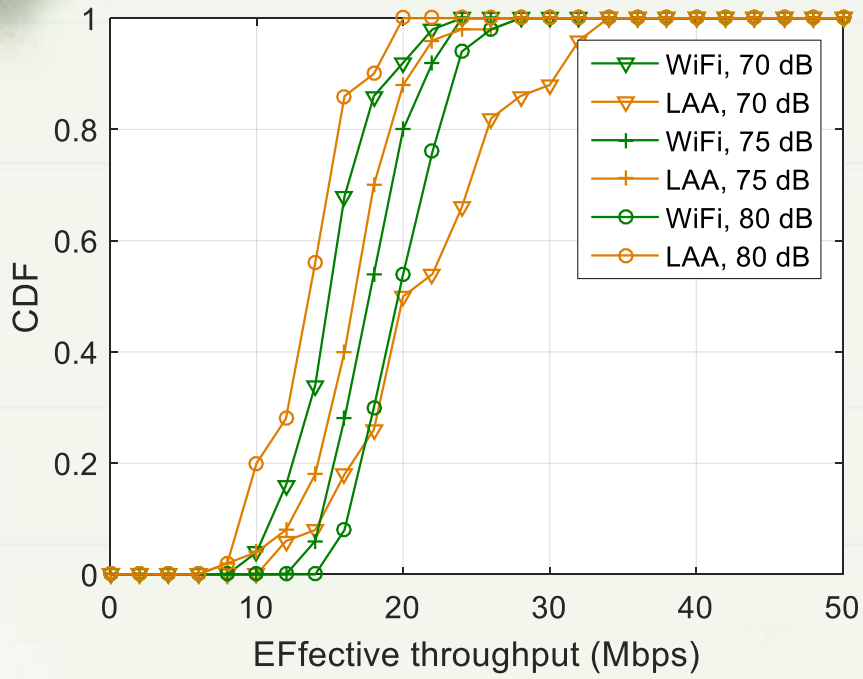


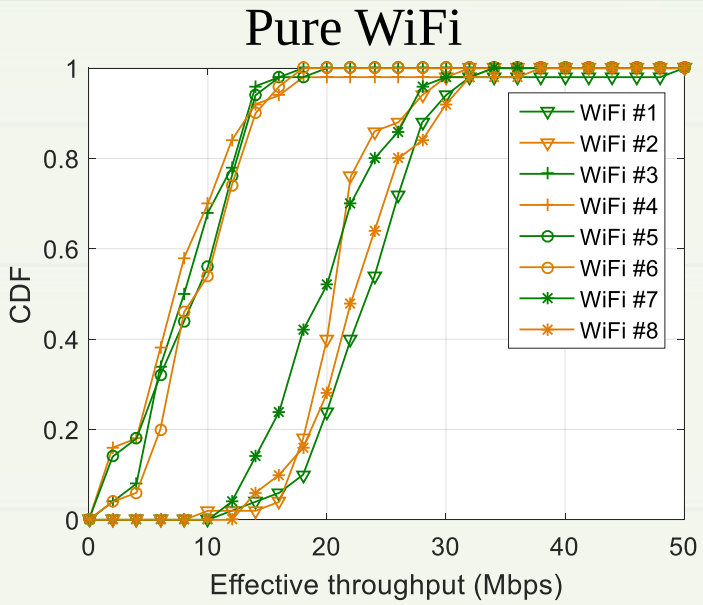


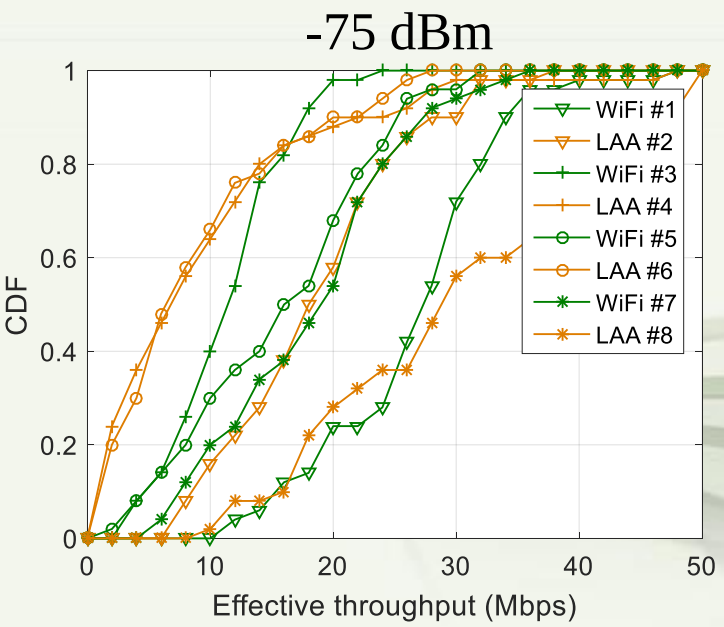
- ✓ For pure WiFi system, WiFi A: 14.97 Mbps, WiFi B: 15.05 Mbps. LAA can provide some performance gain.
- ✓ The difference between a fixed MCS and adaptive MCS is not so large.

Results: Fixed MCS (cont'd)

- CDF curves







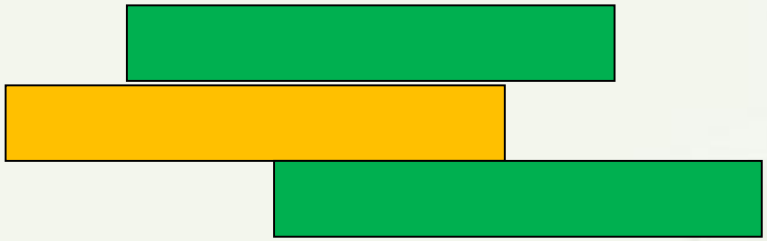
- ✓ LAA has a higher physical rate;
- ✓ LAA has a lower SNR threshold under the same MCS;
- ✓ For pure WiFi, only CCACS (-82 dBm) is adopted: less transmitting opportunities.

Adaptive Threshold: Collisions

- According to collisions
  - ✓ All LAA eNBs begin with a high ED (-62 dBm)
  - ✓ If collision happens, certain LAA eNBs decrease their ED by 1
  - ✓ Every time when a eNB is transmitting data to a different user, its ED goes back to -62 dBm.

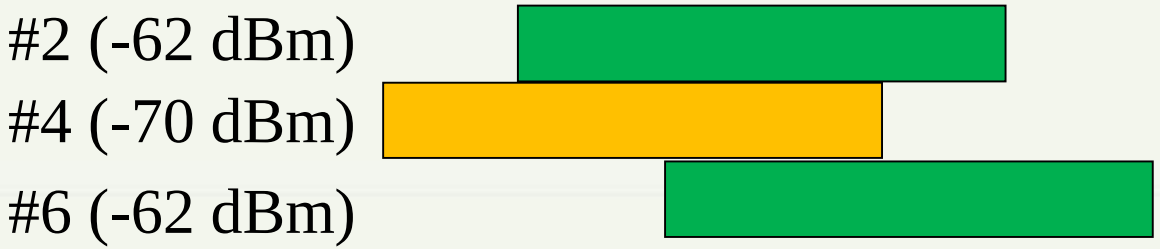
- Case I: LAA adopts “RTS/CTS” to avoid collisions. (For comparison)
- Case II: certain eNBs: those who cause collisions (#2 and #6 in the example).

#2 (-62 dBm)
#4 (-70 dBm)
#6 (-62 dBm)

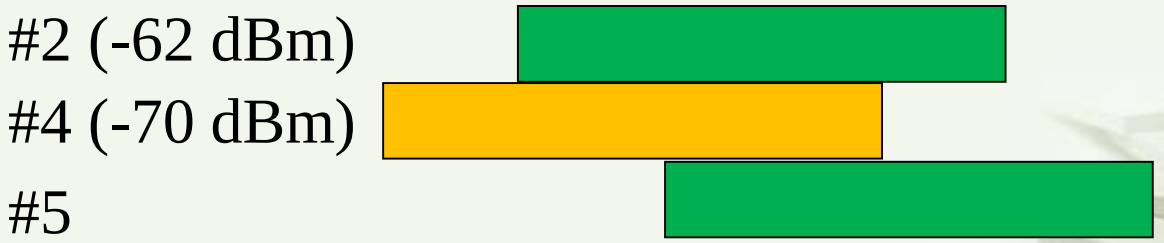


Adaptive Threshold: Collisions

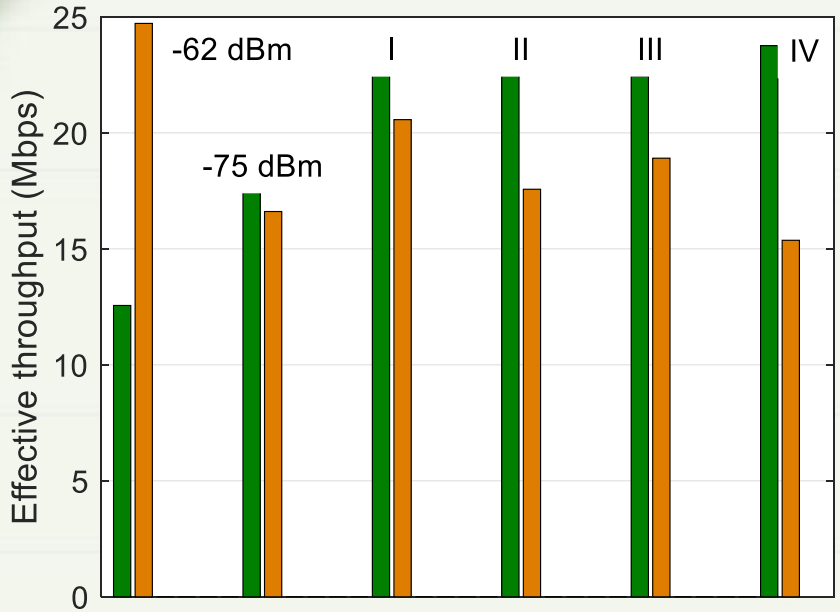
- Case III: certain eNBs: the one who suffer from collision (#4 in this example).

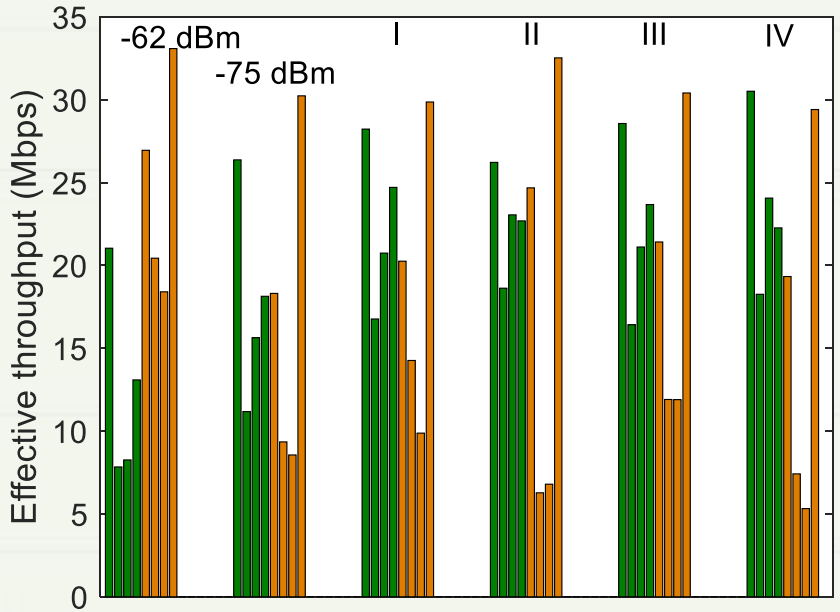


- Case IV: certain eNBs: neighbor eNBs (#2 and #6 in the example).



Adaptive Threshold: Collisions





- ✓ "RTS/CTS" (Case I) achieves the best performance.
- ✓ Case II and Case III have similar performance. There are also collisions between WiFi and LAA, case II cannot deal with this?
- ✓ "Decreasing by 1" is too much for LAA. (In case III, decreasing by 1 with more than three collisions: WiFi: 20.46 Mbps, LAA: 21.51 Mbps.)

Adaptive Threshold: Collisions

❖ Number of collisions

	WiFi 1	WiFi 3	WiFi 5	WiFi 7	LAA 2	LAA 4	LAA 6	LAA 8
-62 dBm	7242	6275	10944	9771	15770	35044	33178	15975
-75 dBm	7183	8564	11894	7615	8468	7971	7989	7769
Case I	2244	2756	3179	1062	2711	4022	2806	2043
Case II	1622	3330	2607	1446	5219	2561	2494	2543
Case III	2031	3358	3119	2193	4249	3756	3587	2540

- ✓ There are a lot of collision at -62 dBm;
- ✓ The number of collisions is decreased a lot by adaptively changing the threshold.