Cisco Cooperative Project

Adaptive Threshold, Collisions, Alternative Geometry

Student: Li Li
Advisors: Len Cimini, Chien-Chung Shen

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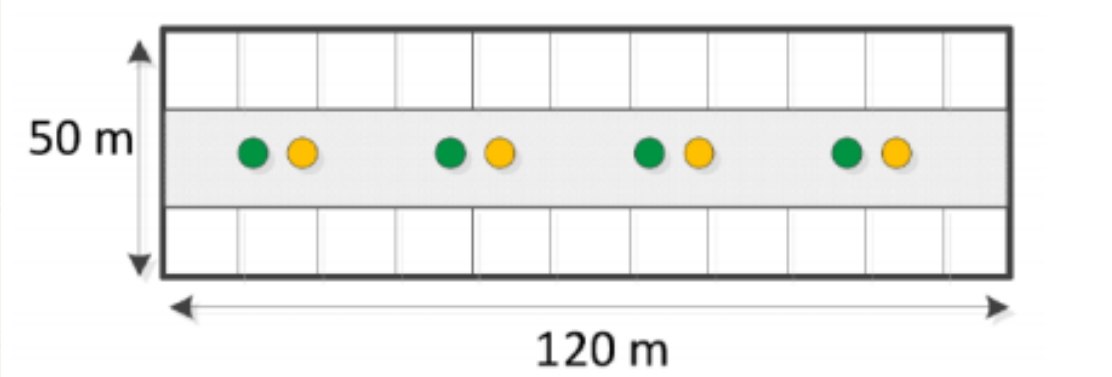
Outline

- Simulation Results
  - ✓Fixed MCS
  - ✓Adaptive MCS
- Adaptive Threshold
- Alternative Geometry

Review

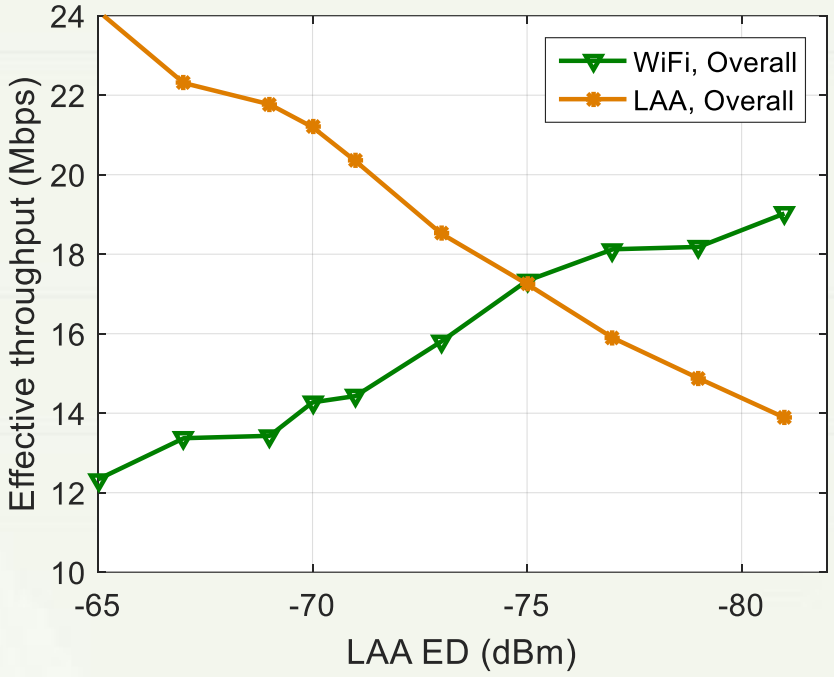
- Simulation Setting
  - ✓ 4 APs, 4 eNBs, and each AP/eNB has five users

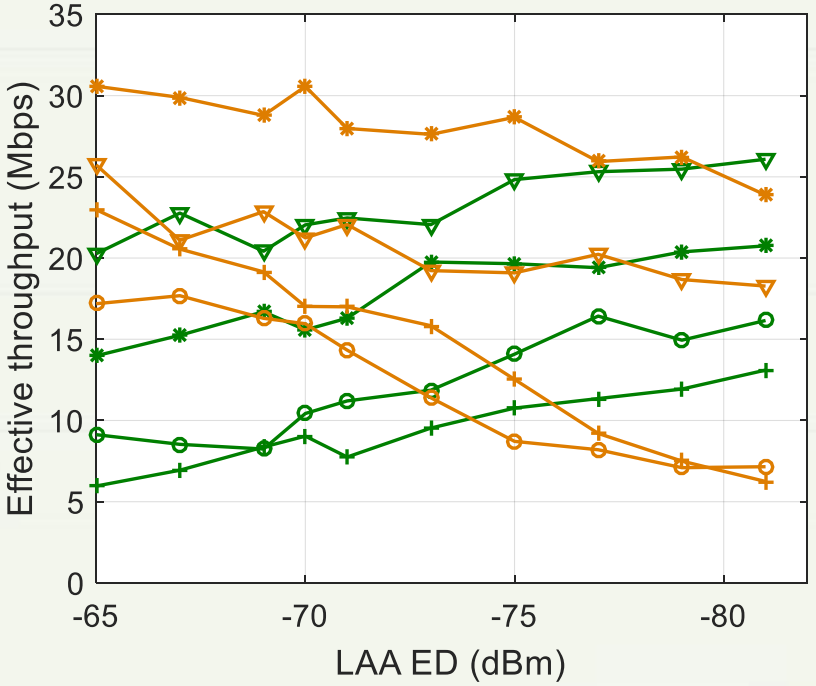


  - ✓ Lambda = 2.5
  - ✓ One LAA eNB serve different UEs one by one.
  - ✓ LAA SNR threshold: 17.5 (75.6 Mbps); WiFi SNR threshold: 20 dB (65 Mbps)

Results: Fixed MCS

- Same ED for all LAA eNBs

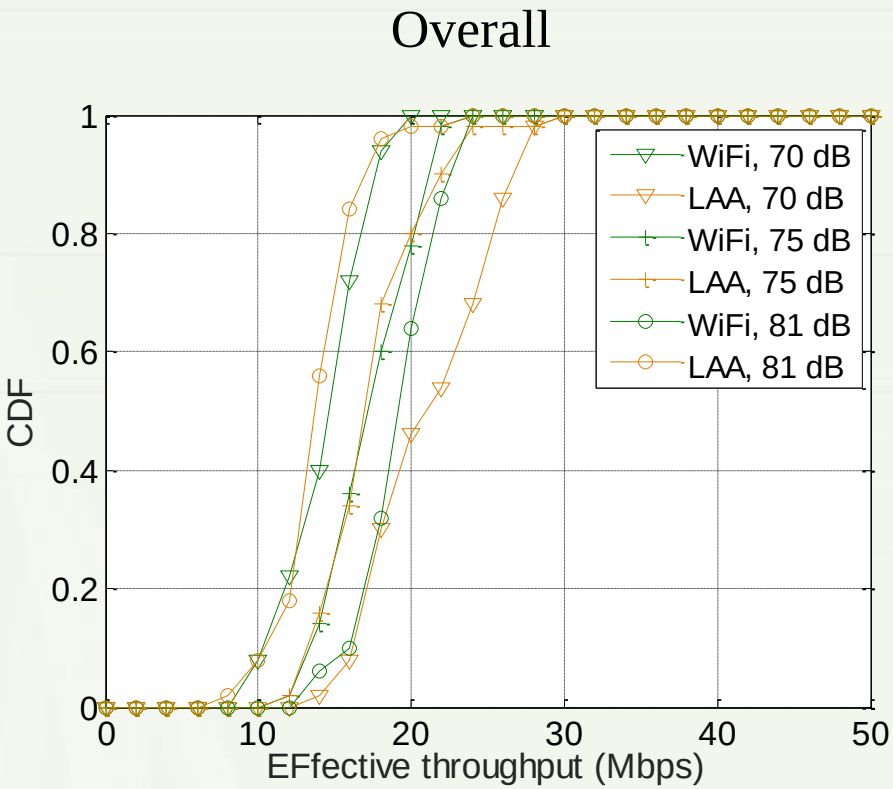


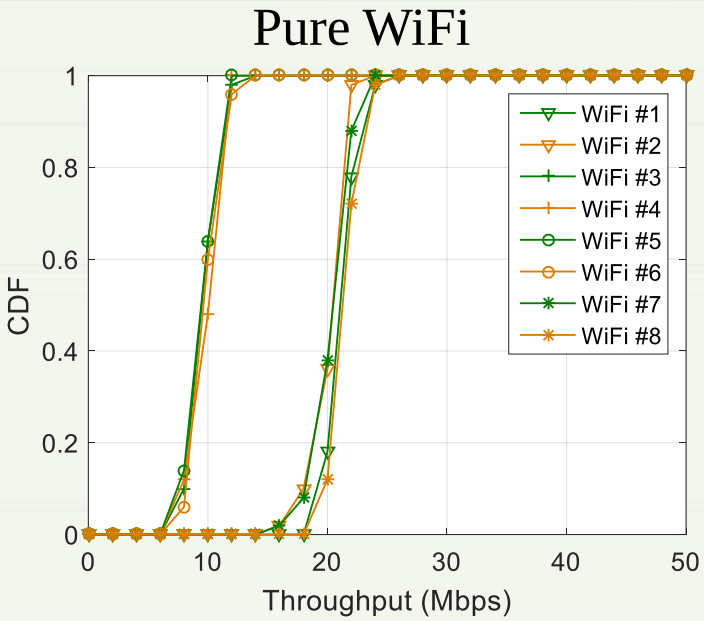


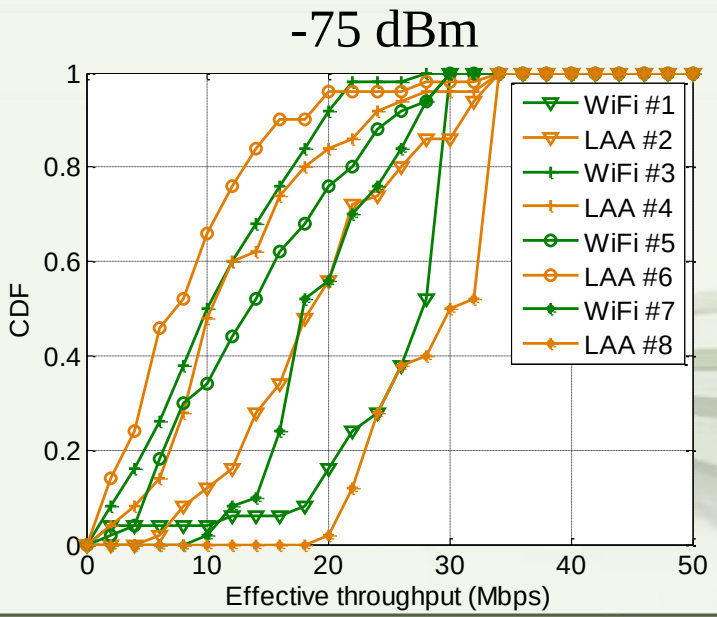
- ✓ For pure WiFi system, WiFi A: 13.84 Mbps, WiFi B: 13.96 Mbps. LAA can provide some performance gain. (LAA has a higher physical rate, and a lower SNR threshold.)

Results: Fixed MCS (cont'd)

- CDF curves

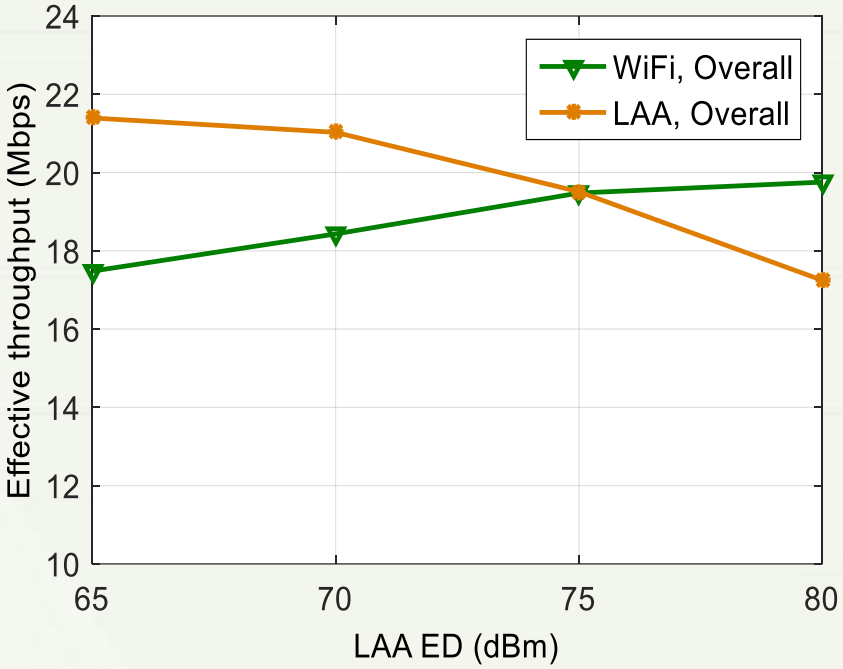


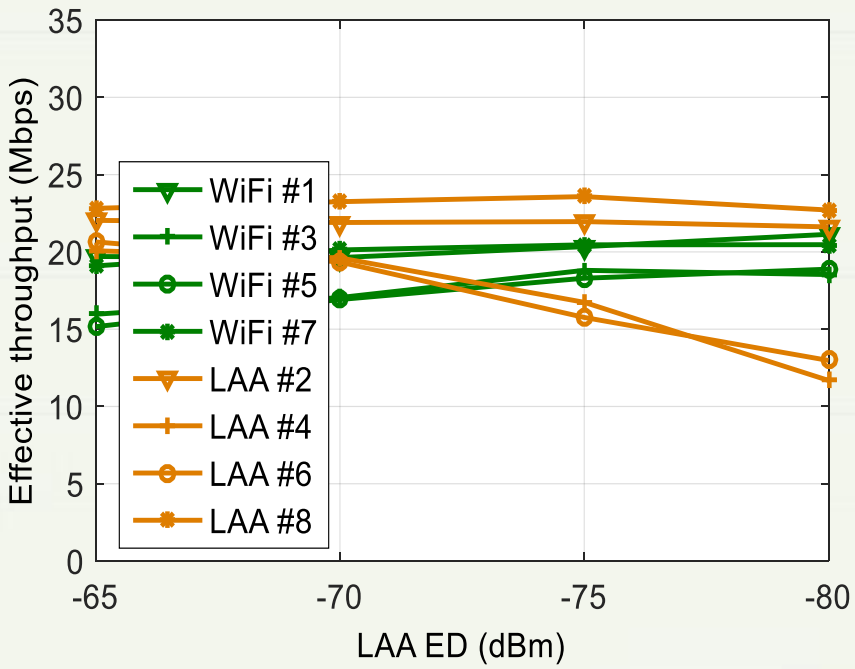




Results: Adaptive MCS

- Same ED for all LAA eNBs



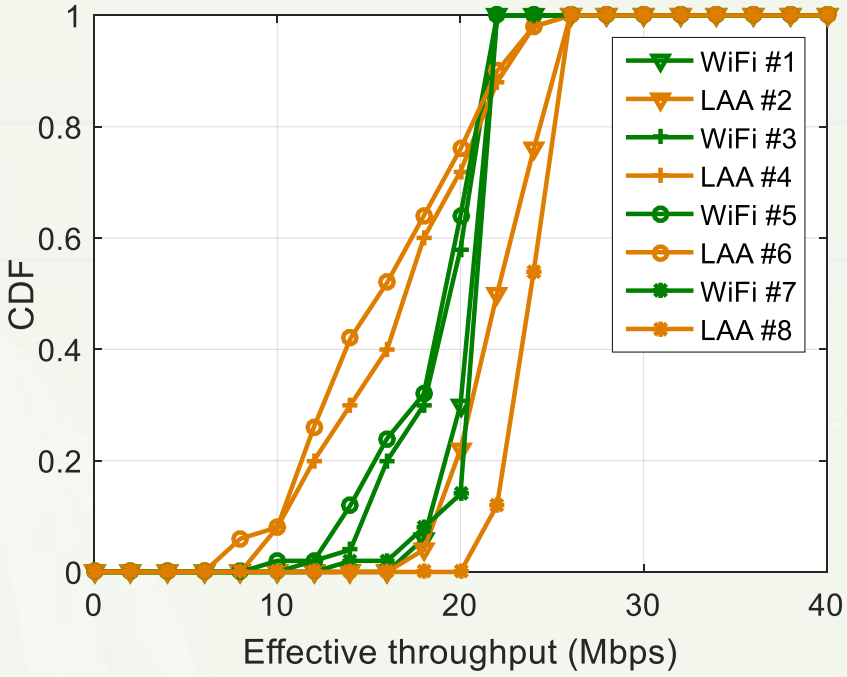


- ✓ With adaptive MCS, the overall performance is better than the case of fixed MCS. Also, the "edge effect" is not so significant.

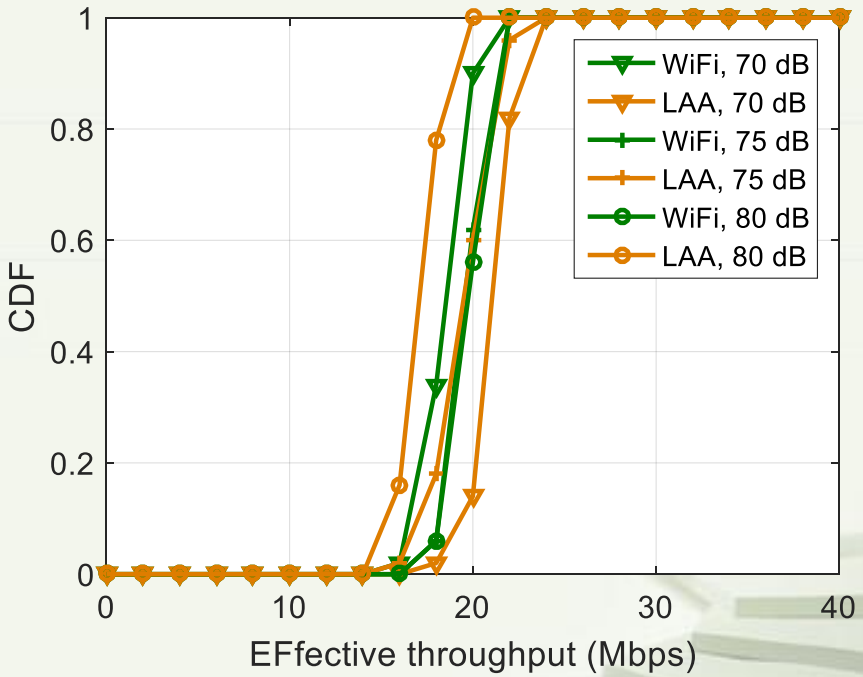
Results: Adaptive MCS (cont'd)

- CDF curves

-75 dBm



Overall

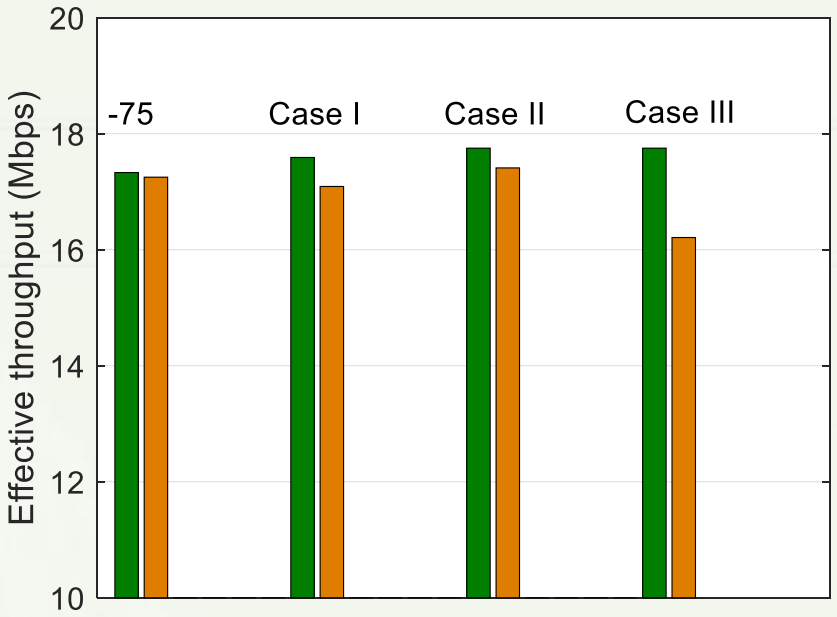


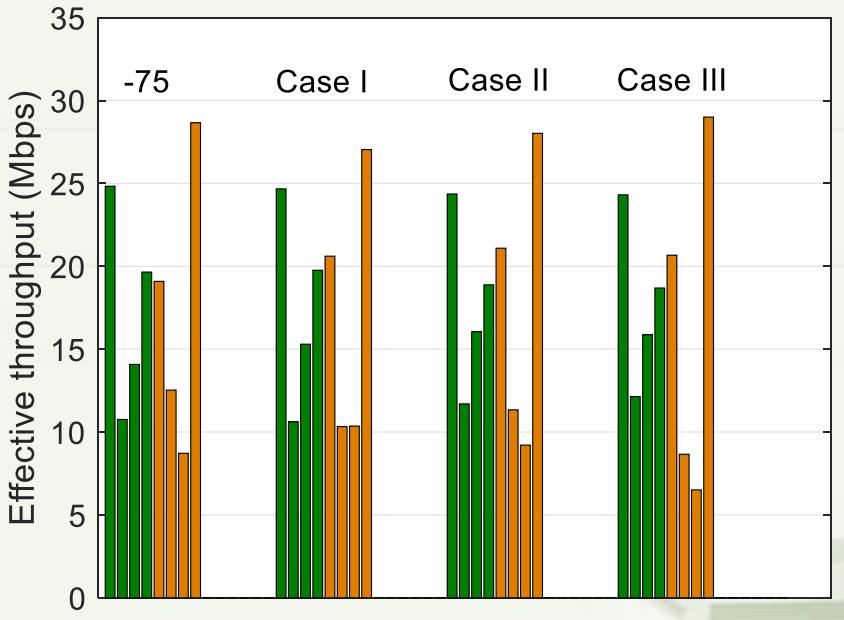
Adaptive Threshold

- According to the measured SINR
  - ✓ During a certain period, if the measured SINR is larger than a threshod, LAAED = LAAED + 1; otherwise, LAAED = LAAED-1. (-82 <= LAAED <= -62)
  - ✓ Check SINR per transmission
- According to the measured interference
  - ✓ During a certain period, if the measured interference is larger than a certain value, LAAED = LAAED - 1; otherwise, LAAED = LAAED + 1. (-82 <= LAAED <= -62)
  - ✓ Check interference level in a certain period

Adaptive Threshold: SINR

- ✓ Case I: Initial LAAED: -75 dBm, threshold: 15 dB;
- ✓ Case II: Initial LAAED: -75 dBm, threshold: 20 dB;
- ✓ Case III: Initial LAAED: -75 dBm, threshold: 25 dB;

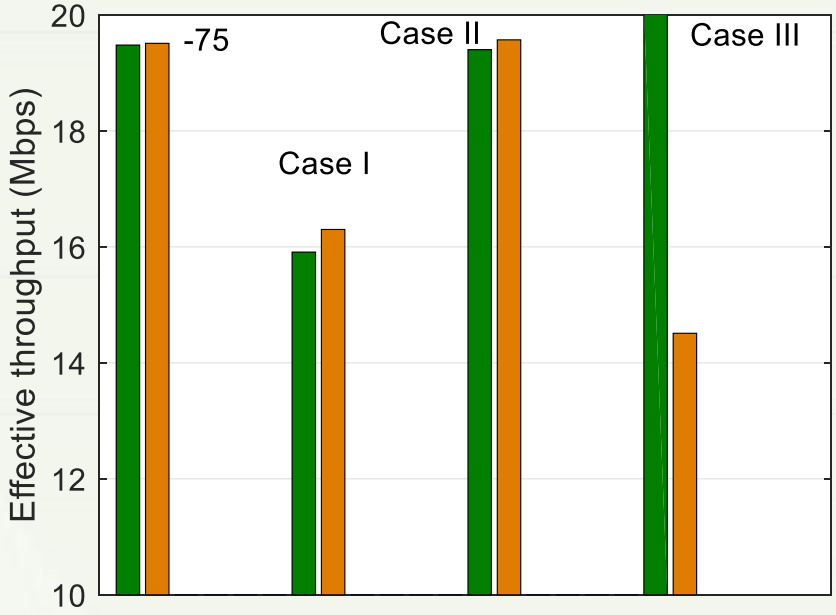


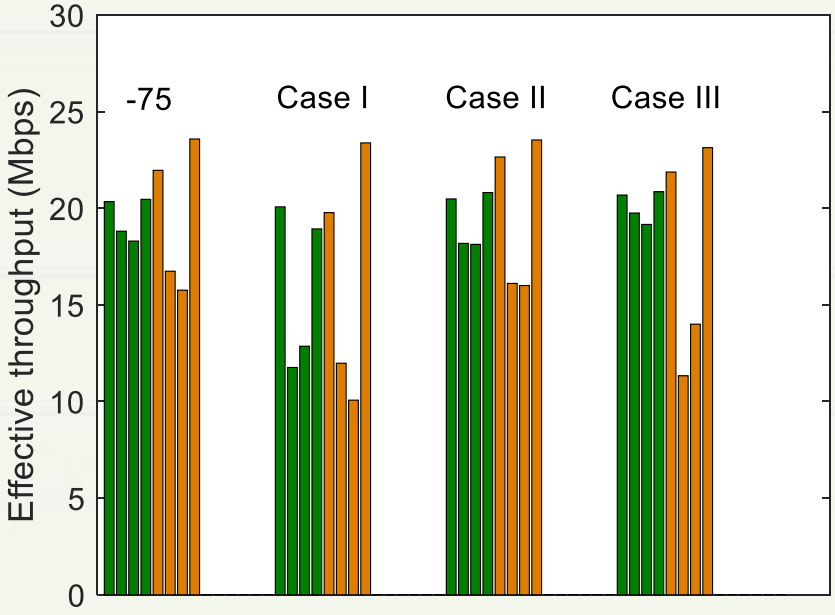


- ✓ The performance is a bit better?

Adaptive Threshold: SINR & A-MCS

- ✓ Same cases as the fixed MCS.

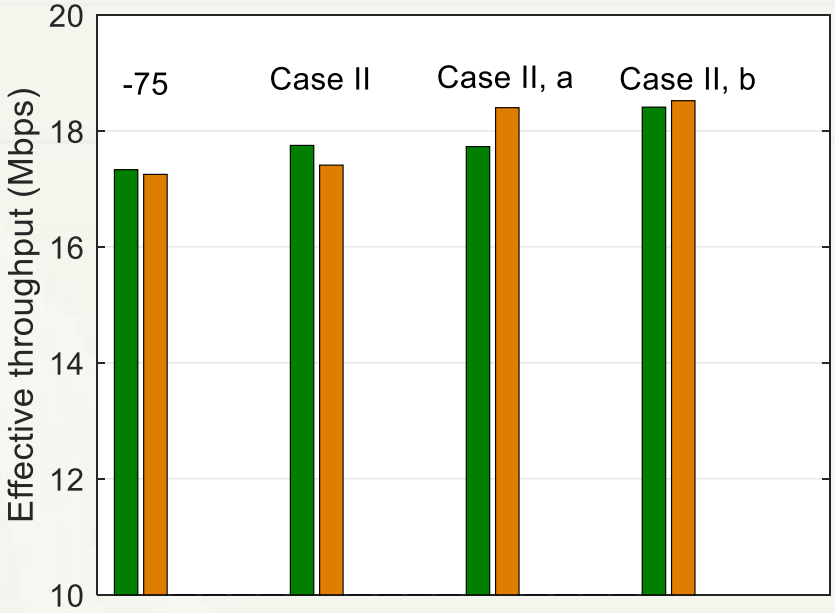


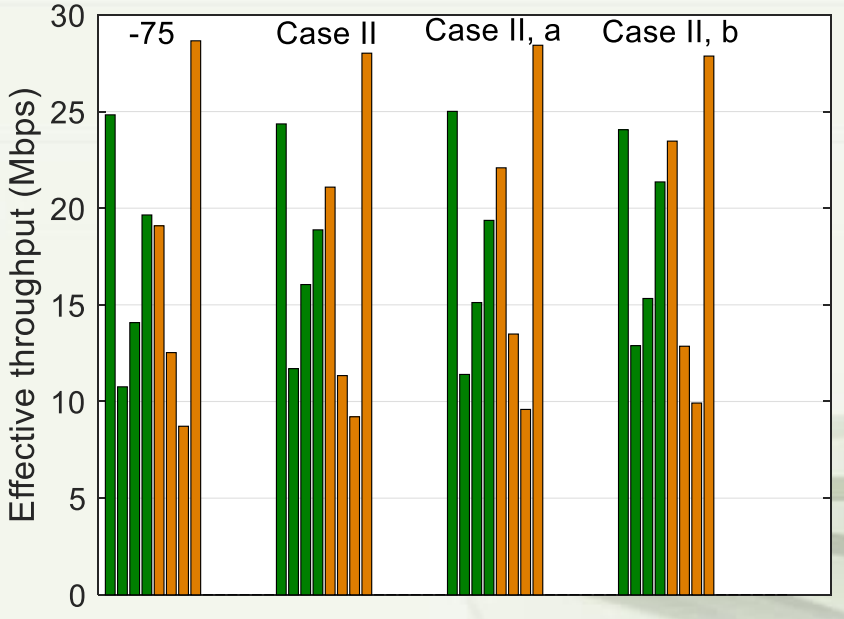


- ✓ Choosing a certain threshold is not a good choice with adaptive MCS?

Adaptive Threshold: SINR & Collision Avoidance

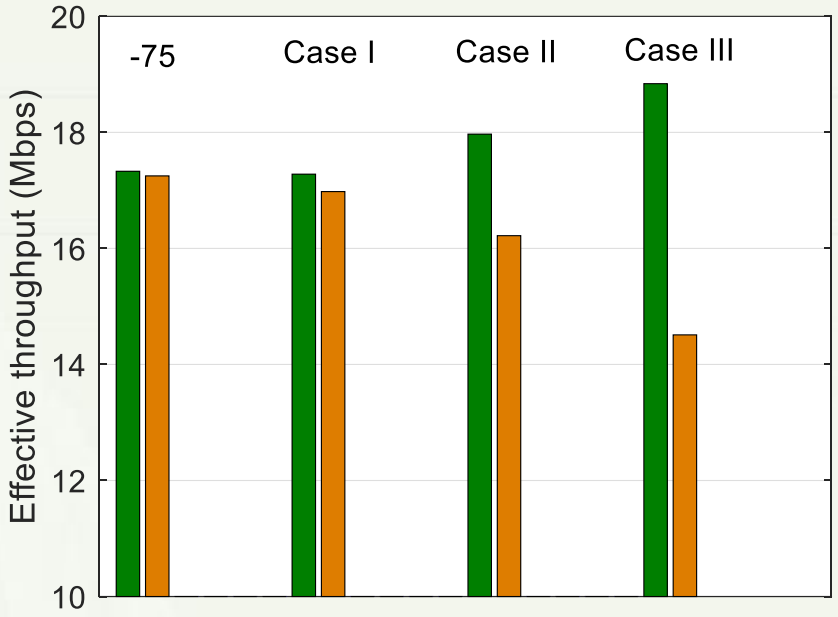
- ✓ With different LAAED for different LAA eNBs, collisions may happen among them due to the asymmetric setting.
- ✓ Case II: Initial LAAED: -75 dBm, threshold: 20 dB;
- ✓ Case II, a: LAA will avoid collisions
- ✓ Case II, b: Both LAA and WiFi will avoid collisions (RTS/CTS)

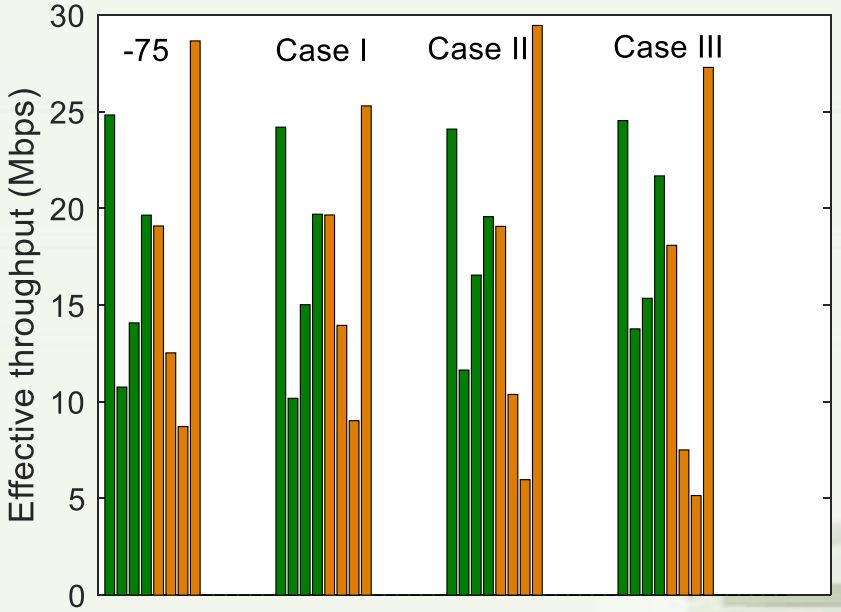




Adaptive Threshold: Interference

- ✓ Case I: Initial LAAED: -75 dBm, threshold: -55 dBm;
- ✓ Case II: Initial LAAED: -75 dBm, threshold: -60 dBm;
- ✓ Case III: Initial LAAED: -75 dBm, threshold: -65 dBm;



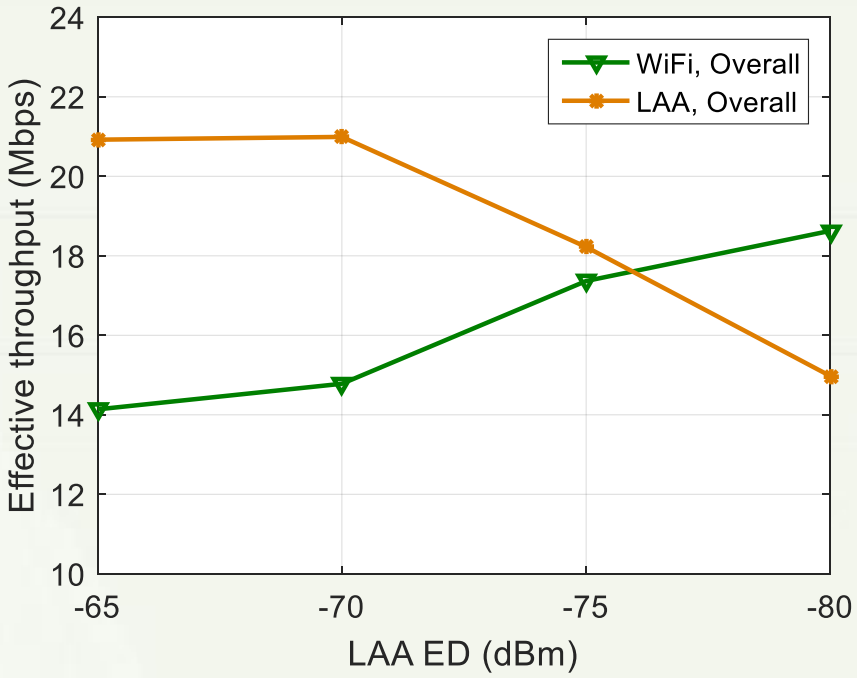


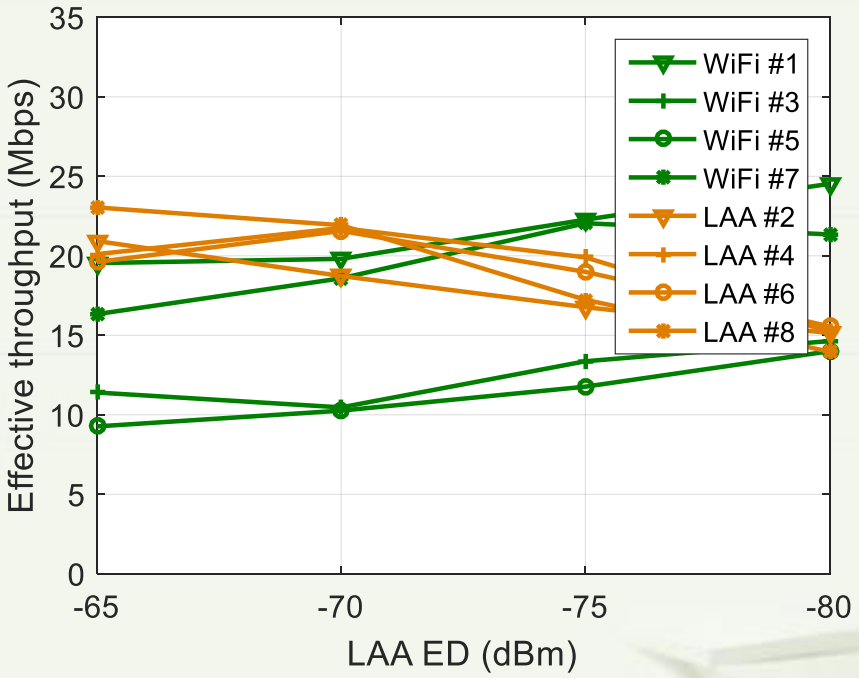
Discussion

- ✓ Choosing a fixed threshold to update LAAED may be not a good choice.
- ✓ Having different LAAED for different eNBs may provide some benefits, however, it may also cause more collisions.
- ✓ There are a lot of competitions with high traffic loads, can we get a significant performance gain without scheduling?

Alternative Geometry #1

- 4 eNBs are randomly located, and 4 APs are arranged in a line as in 3GPP layout

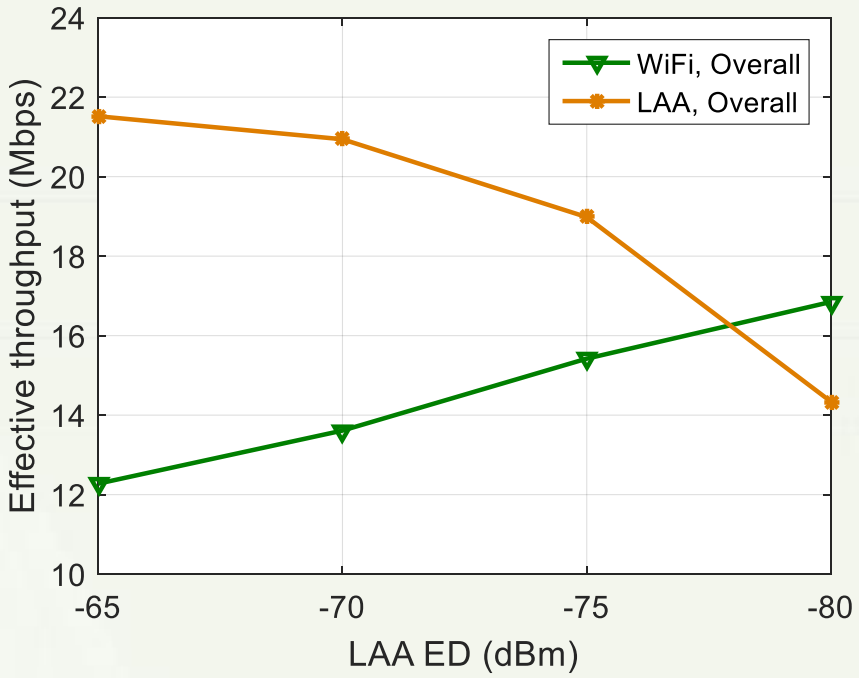


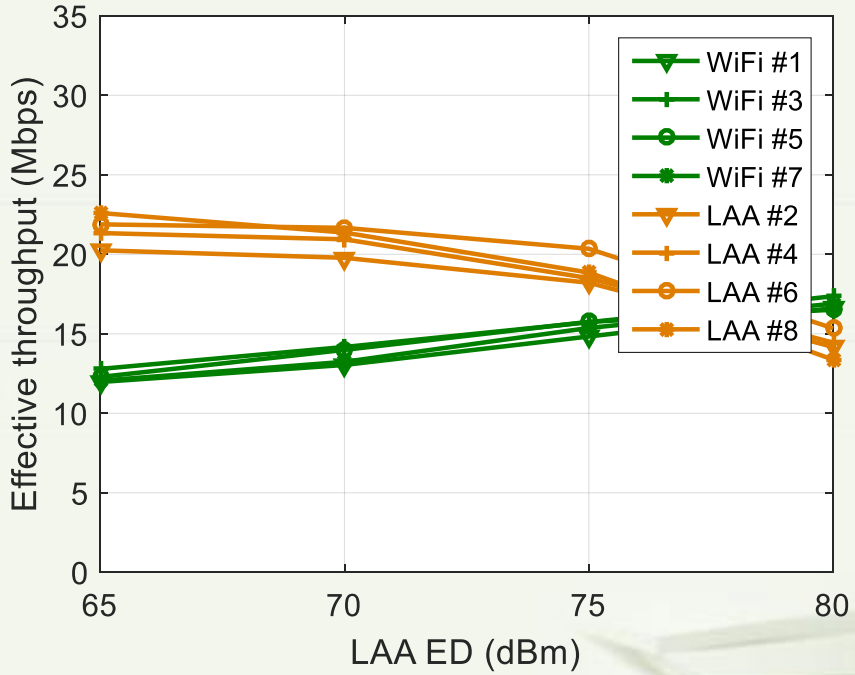


- ✓ There will be no “edge effects” for LAA in this case.

Alternative Geometry #2

- Both eNBs and APs are randomly located, but eNBs and APs are co-located.

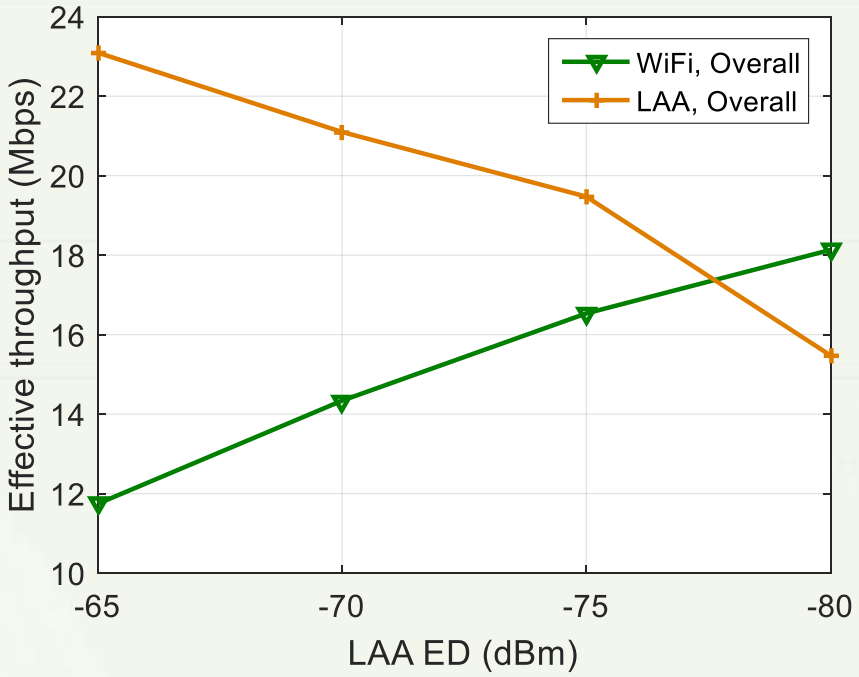


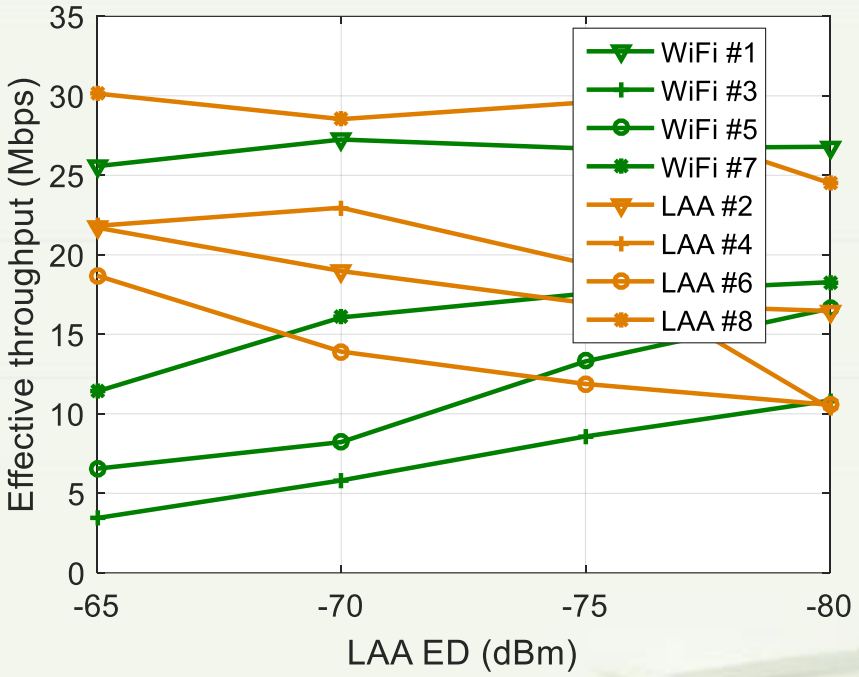


- ✓ There will be no “edge effects” for LAA and WiFi in this case.
- ✓ LAA’s performance is becoming better with random locations?

Alternative Geometry #3

- eNBs and APs are equally spaced in a line.





- ✓ This is not the best case: each transmitter is only 15 meters away