Cisco Cooperative Project

Adaptive LAAED & Different Layout

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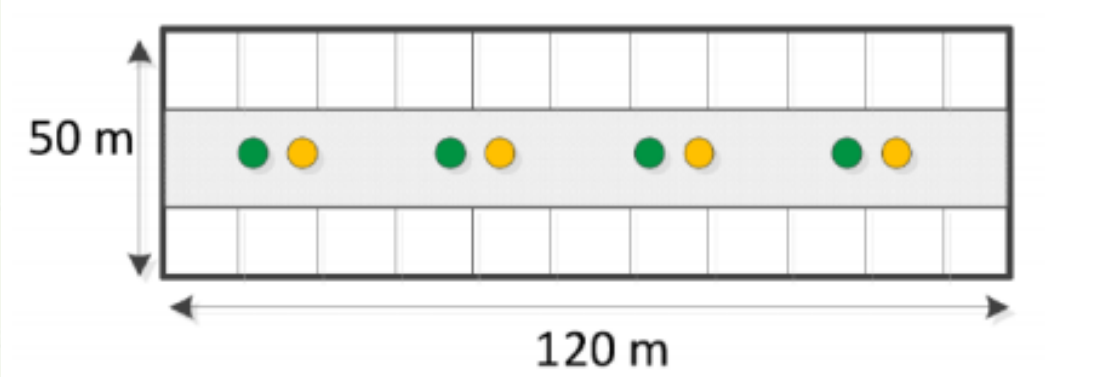
Outline

- Review& Results for multiple users
- Adaptive Approaches & Analytical Questions
- Alternative Geometry

Review

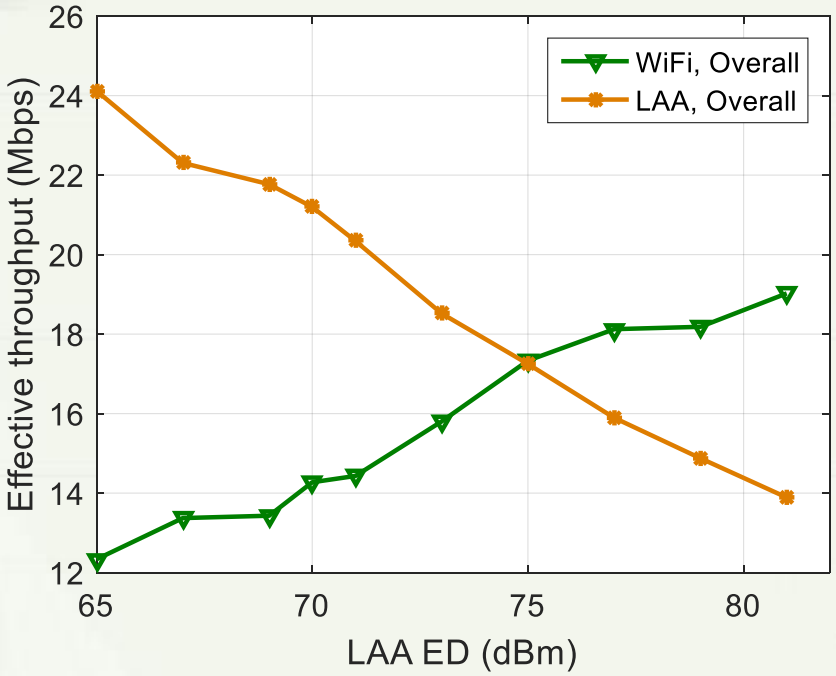
- Simulation Setting
  - ✓ 4 APs, 4 eNBs, and each AP/eNB has five users

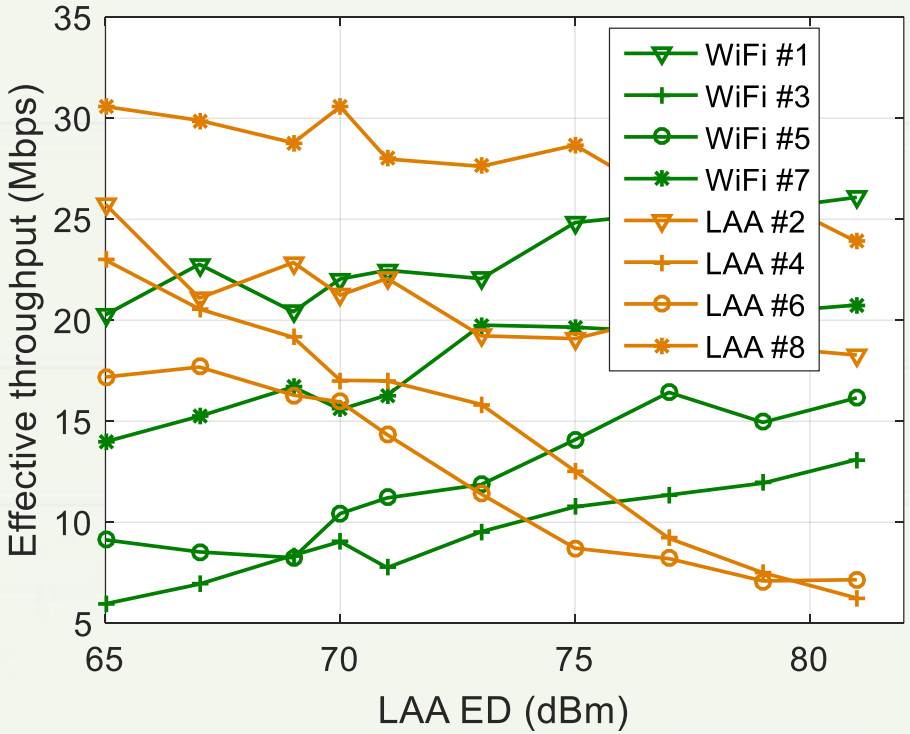


  - ✓ Load ratio: 0.8
  - ✓ One LAA eNB serve different UEs one by one.
  - ✓ LAA SNR threshold: 17.5 (75.6 Mbps); WiFi SNR threshold: 20 dB (65 Mbps)

Results for multiple users

- Same ED for all LAA eNBs

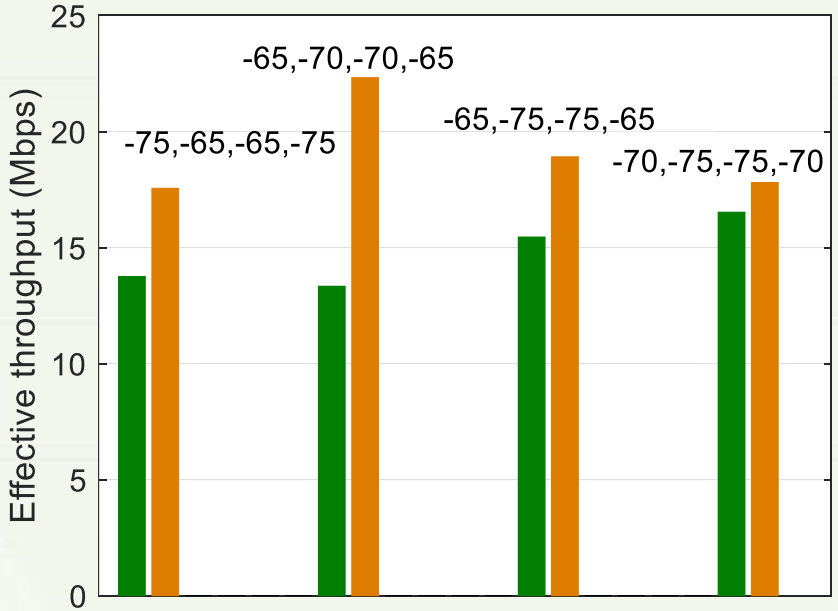


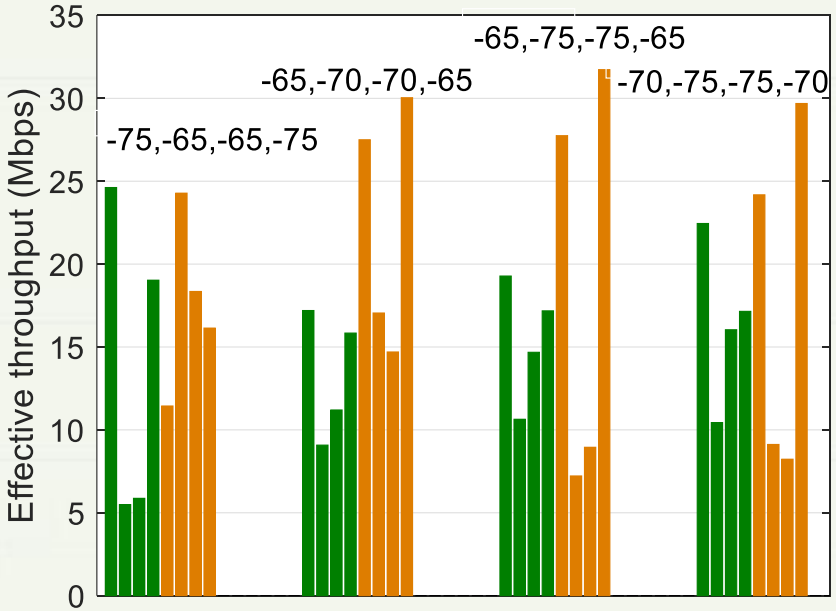


- ✓ In this specific layout, WiFi and LAA achieve similar performance at -75 dBm.
- ✓ For pure WiFi system, WiFi A: 13.84 Mbps, WiFi B: 13.96 Mbps. LAA can provide some performance gain. (LAA has a higher physical rate, and a lower SNR threshold.)

Results for multiple users

- Different ED



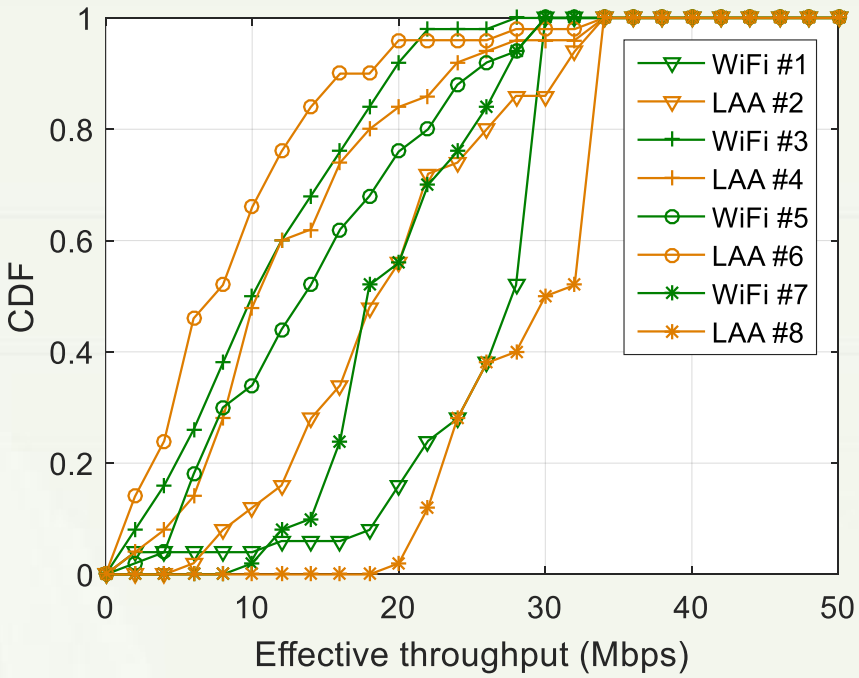


- ✓ In the four combinations above, there is not significant performance gain.
- ✓ At the combination of '-75,-65,-65,-75', LAA nodes in the middle even have better performance than that in the margin. Then, WiFi nodes in the middle will suffer a lot.

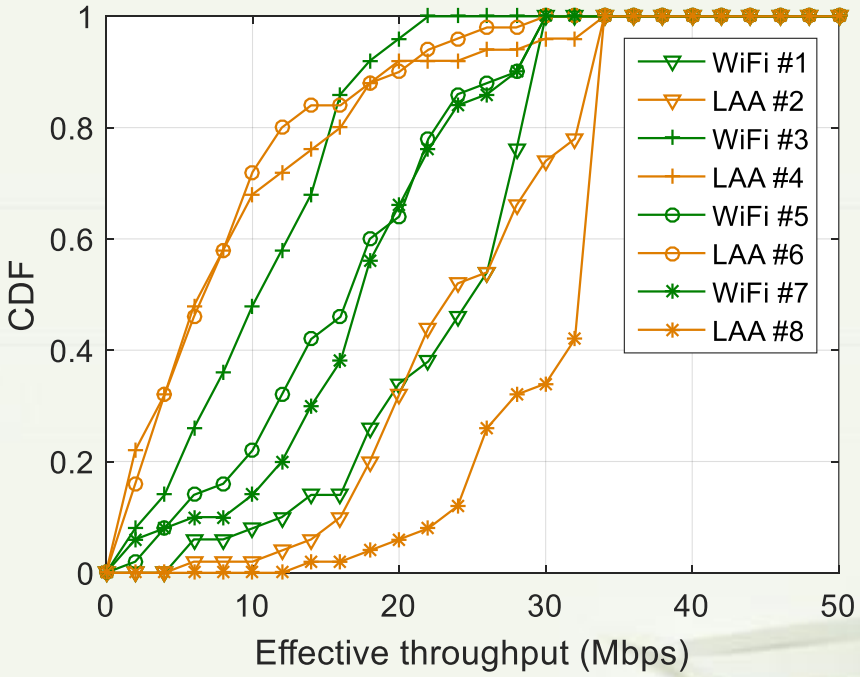
Results for multiple users

- CDF curves

-75 dBm



-70, -75, -75, -70



Adaptive Approaches

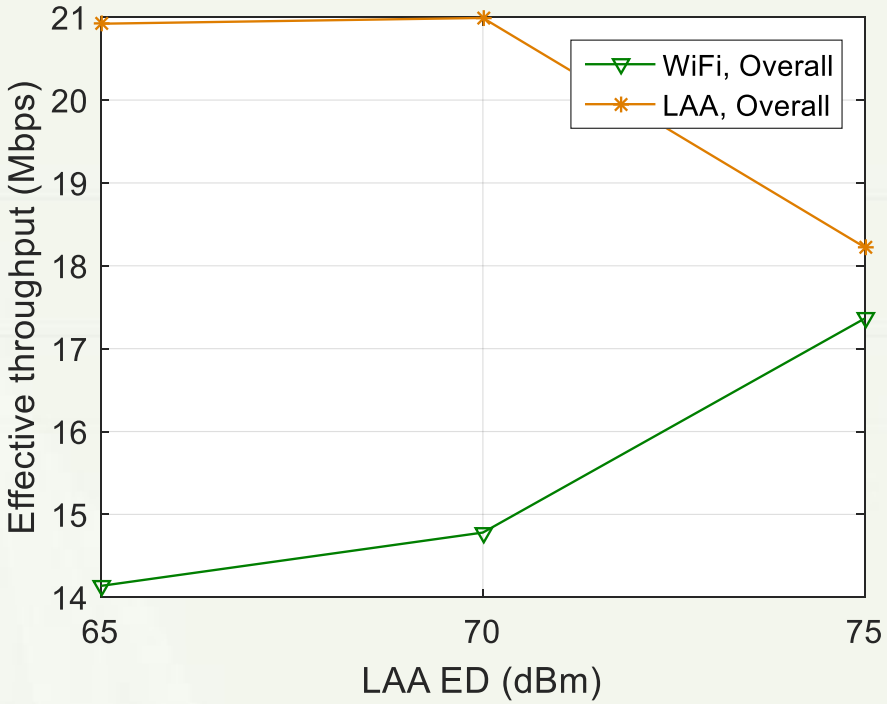
- According to the measured SINR
  - ✓ During a certain period, if the measured SINR is larger than a threshold, increase LAAED; otherwise, decrease LAAED.
  - ✓ In unlicensed band, maybe it is also a good choice to let one eNB serve UEs one by one. In this case, can we have a different LAAED for different UEs?
  - ✓ However, the current simulation results do not show performance improvements. (The period for the measurement should be long enough.) For example, with an initial ED of -72 dBm, and SNR threshold of 10 dB, WiFi: 18.88 Mbps, LAA: 14.58 Mbps.
- According to the number of collisions? (Similar results)
- Different ED based on the locations of UEs, or even different transmit power?

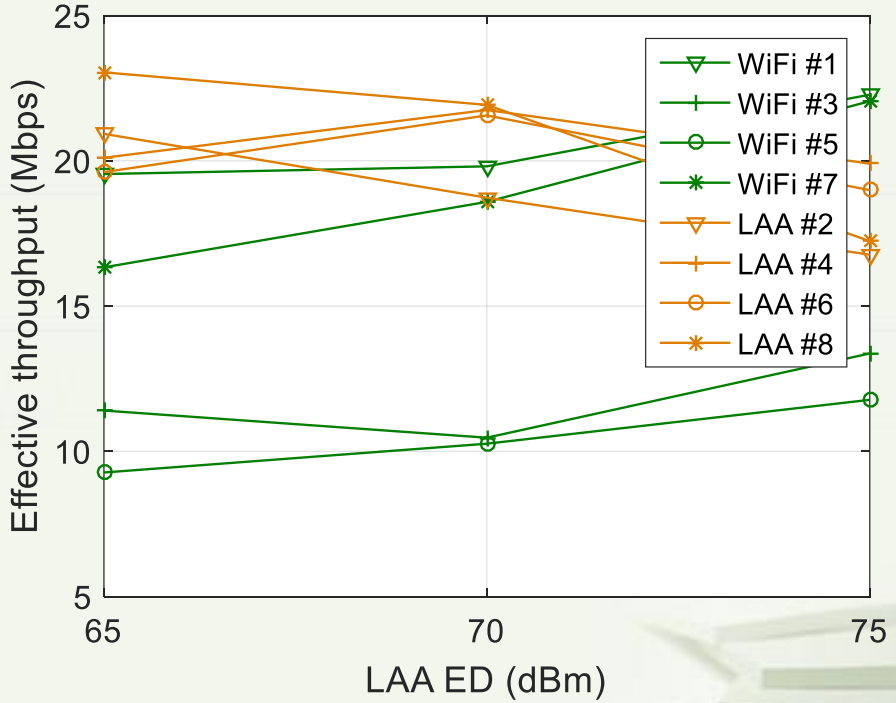
Analytical Questions

- Objective: maximize LAA's overall throughput?
  - ✓ The impact of introducing a LAA should be not larger than introducing a WiFi. How to define this except by simulations?
  - ✓ In the 3GPP layout, how to guarantee the performance of the nodes in the middle?
  - ✓ LBT-CAT4 and CSMA/CA are quite similar, and simulation results also show that LAA and WiFi have similar performance under same simulation setting. Can we remove CSMA/LBT, and assume they have a certain probability to access the channel?

Alternative Geometry #1

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

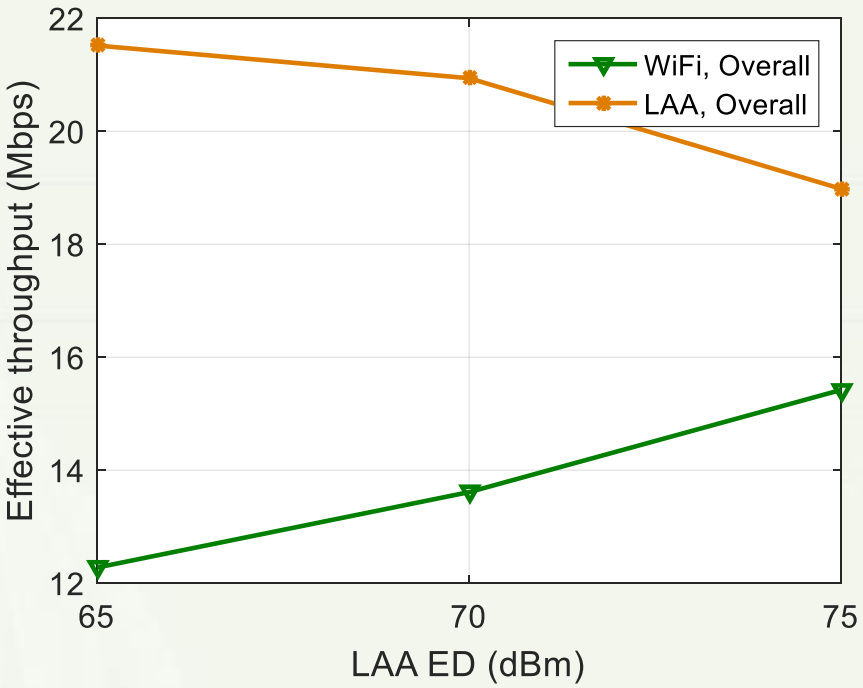


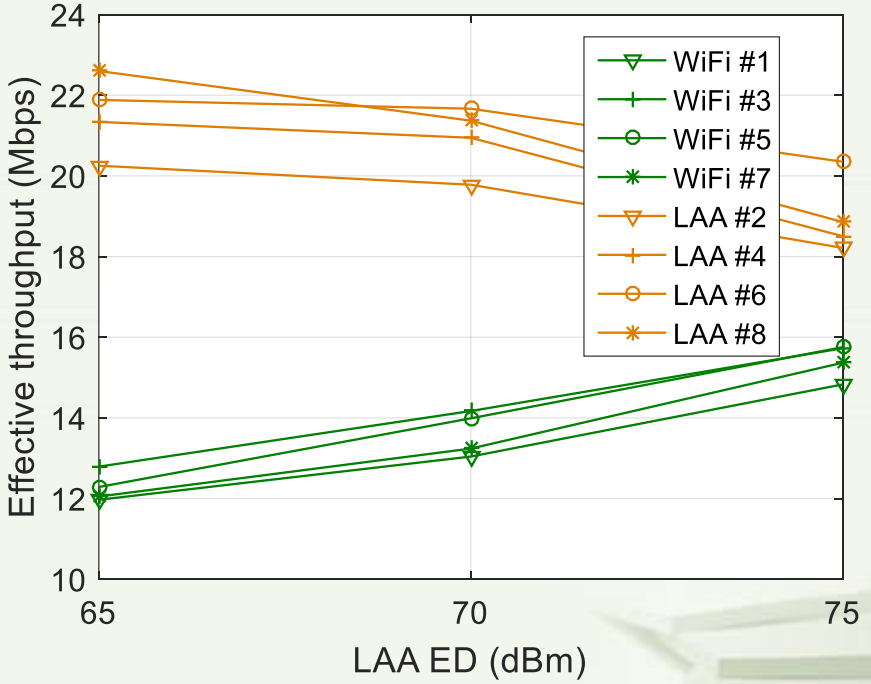


- ✓ There will be no “edge effects” for LAA in this case.

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?