# Fairness in Collision-Free WLANs

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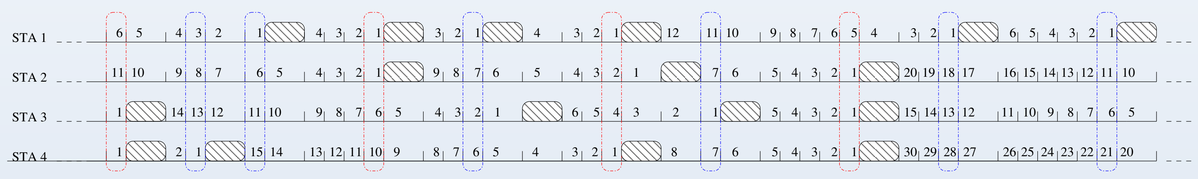
## Motivation

Wireless networks are composed of nodes that must contend for the medium in a distributed manner. If it two or more contenders attempt transmission at the same time, a collision occurs.
Collisions are the main cause of throughput degradation in wireless local area networks (WLANs), so by constructing collision-free WLANs one can attain greater levels of throughput.

## CSMA/CA

Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) is the most widely used protocol for medium access control (MAC) in WLANs. CSMA/CA's job is to coordinate access to the medium for each contender.

Time in WLANs is slotted, so CSMA/CA divides it into empty, collision and successful transmission time slots. When a node has something to transmit, it picks a random backoff counter $B \in [0, CW(k) - 1]$, where $k \in [0, \ldots, m]$ is the *backoff stage* and $CW(k) = 2^k CW_{\min}$ is the contention window, with $CW_{\min}$ its minimum value. Each passing empty slot decrements $B$ by one. Contenders attempt transmission when the counter expires ($B = 0$).



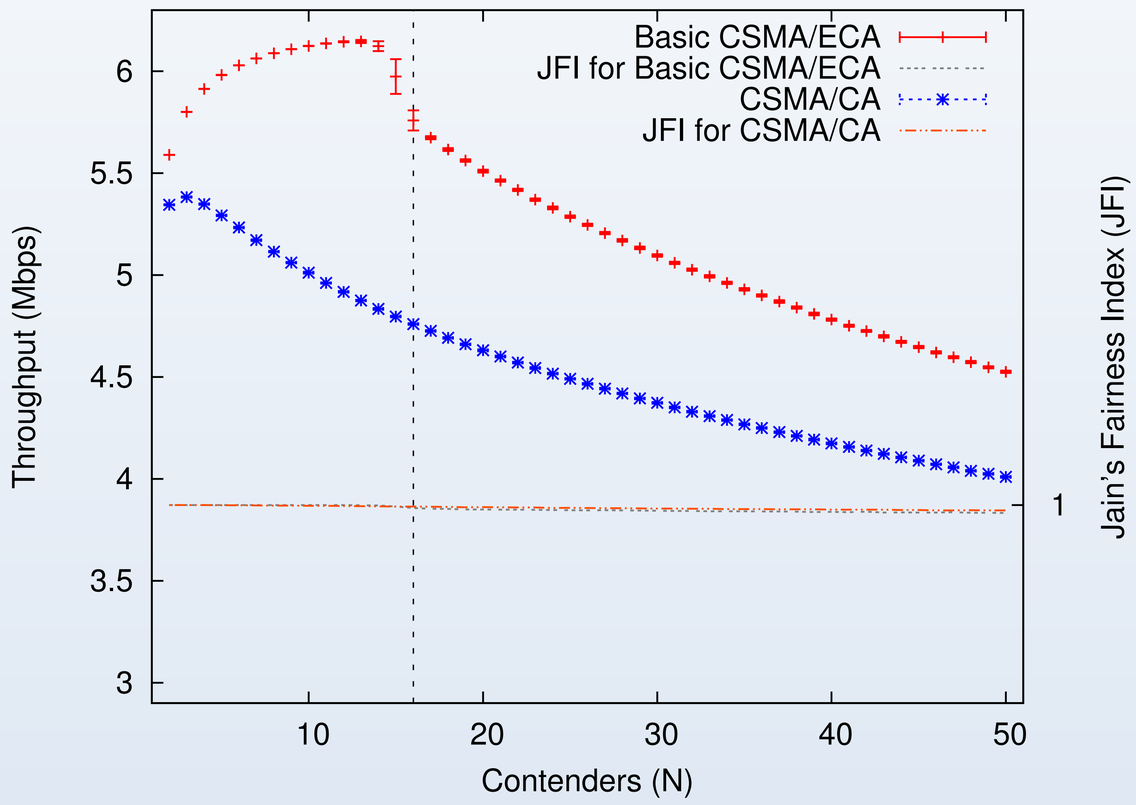

Example CSMA/CA behavior.

If a contender collides, it doubles the range of possible values whence it draws $B$ by incrementing the backoff stage ($k$) in one. This measure effectively reduces the collision probability. After a successful transmission, the contender resets is backoff stage ($k = 0$).

## Basic ECA

CSMA/CA relies in a random backoff counter ($B$) that by its nature generates collisions. Furthermore, it instructs nodes to reset the backoff stage ($k$) after a successful transmission: increasing the collision probability. Basic Carrier Sense Multiple Access with Enhanced Collision Avoidance [1] (Basic ECA) achieves a collision-free state by picking a deterministic backoff counter $B_d = CW_{\min}/2$ after successful transmissions. This choice makes it possible for CSMA/ECA to fairly coexist with CSMA/CA.

By picking a deterministic backoff counter and achieving a collision-free state, Basic ECA is capable of throughput levels beyond those attained with CSMA/CA.

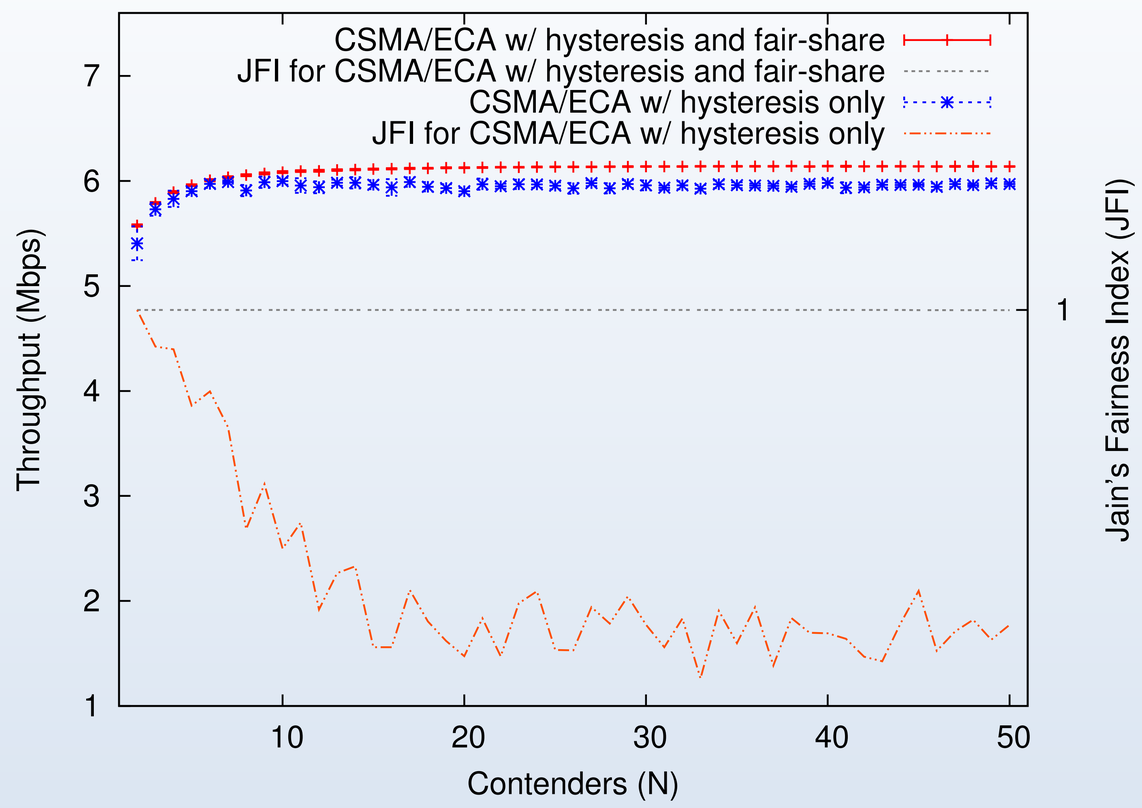



Throughput and fairness in CSMA/CA and Basic CSMA/ECA.

Nevertheless, when the number of contenders surpasses $CW_{\min}/2$, the system incurs in a mixed behavior; some nodes pick a random and others a deterministic backoff counter. This setup has undesired repercussion in the attained throughput, approximating Basic ECA's to CSMA/CA's.

## CSMA/ECA + hysteresis and fair share

Explanation on how the hysteresis allows us to support many more contenders in a collision-free fashion. And also how fair share corrects the unfairness issue associated with hysteresis.

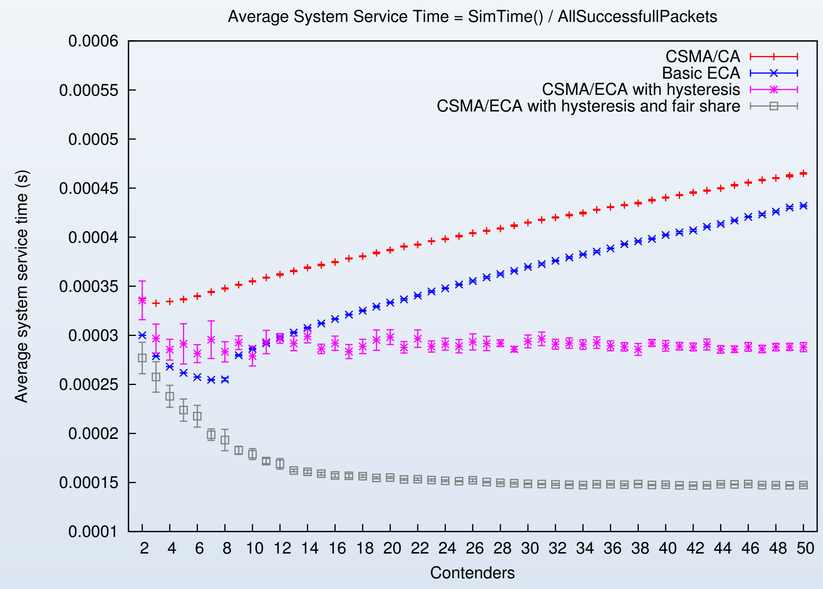



An STB establishes active (used) and inactive (unused) SIP sessions.

## Future plans

Some of the future directions of the project:

- Unsaturated scenarios.
- To implement IEEE 802.11e EDCA.
- Wireless MAC Processors.
- Implementation in RFID networks.




Average system service time.

## References


# References

[1] J. Barcelo, A. Toledo, C. Cano, and M. Oliver, "Fairness and Convergence of CSMA with Enhanced Collision Avoidance (ECA)," in *2010 IEEE International Conference on Communications (ICC)*, may 2010, pp. 1 –6.