

## Motivation

Wireless LANs are composed of nodes that must contend for the medium in a distributed manner. If two or more contenders attempt transmission at the same time, a collision occurs.

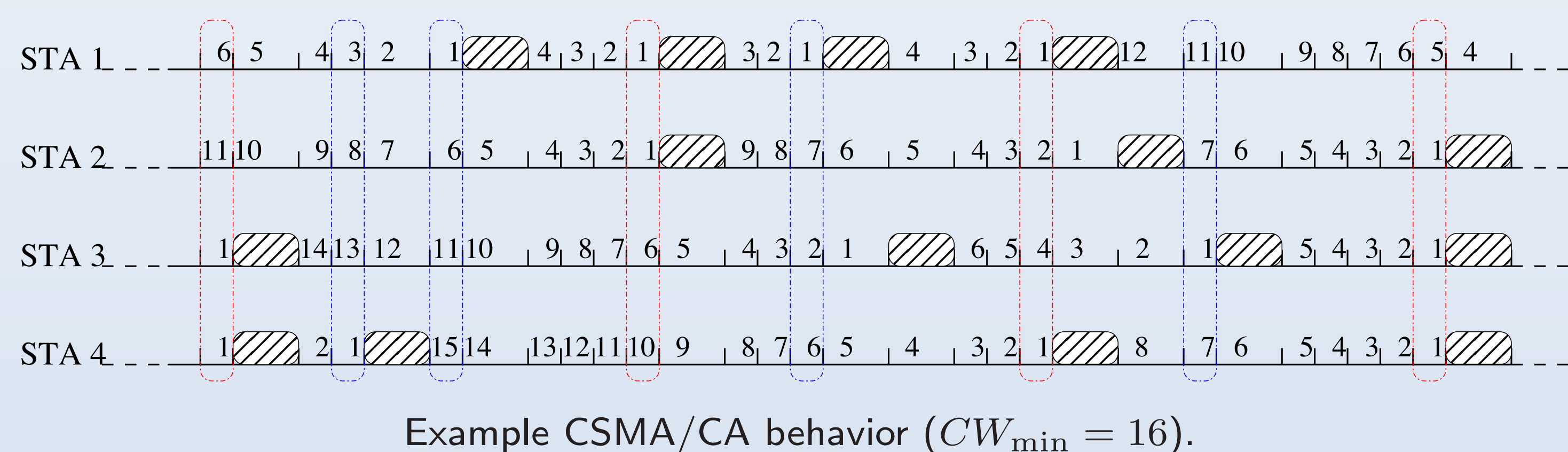
Collisions are the main cause of throughput degradation in Wireless Local Area Networks (WLANs), so by constructing collision-free WLANs one can attain greater levels of throughput.

## 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.

When a node has something to transmit:

- Picks a random backoff counter  $B \in [0, CW(k) - 1]$ , where  $CW(k) = 2^k CW_{\min}$  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 ( $B = 0$ ).
- If there is a collision:
  - Colliding nodes increment the backoff stage ( $k$ ) in one.
- After a successful transmission, the contender resets its backoff stage ( $k = 0$ ).

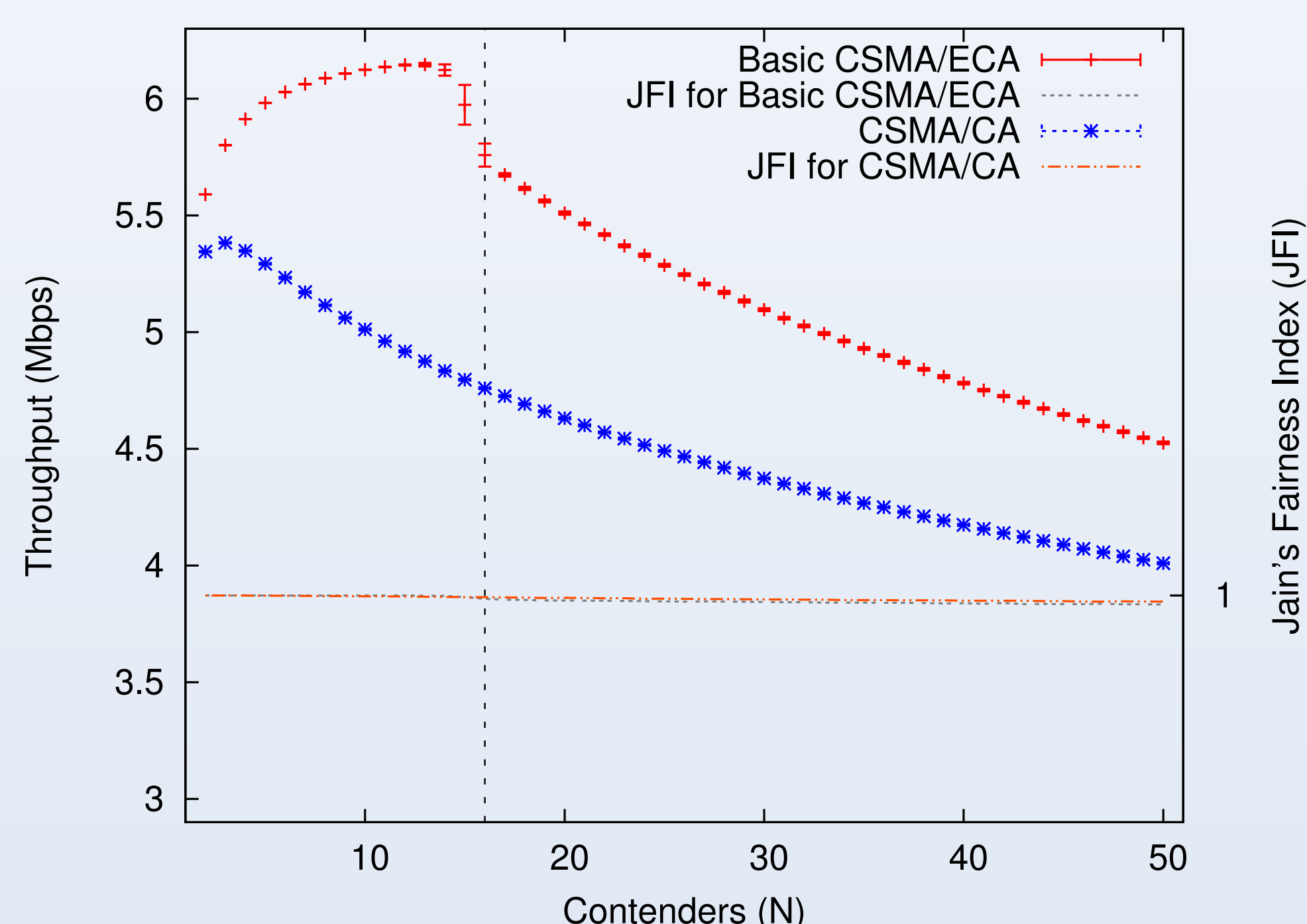


## Basic CSMA/ECA

CSMA/CA relies in a random backoff counter ( $B$ ) which by its nature generates collisions. Furthermore, CSMA/CA instructs nodes to reset the backoff stage ( $k$ ) after a successful transmission: increasing the collision probability.

Carrier Sense Multiple Access with Enhanced Collision Avoidance [1] (Basic CSMA/ECA):

- Picks a deterministic backoff counter  $B_d = CW_{\min}/2$  after successful transmissions.
- Achieves a collision-free state.
- Basic CSMA/ECA's throughput goes beyond CSMA/CA's.



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 repercussions in the attained throughput, approximating Basic CSMA/ECA's to CSMA/CA's.

## CSMA/ECA + hysteresis and fair share

CSMA/ECA is totally distributed, that means that the number of nodes is unknown to all contenders. So, to make it possible to achieve a collision-free state with more than  $CW_{\min}/2$  contenders, CSMA/ECA:

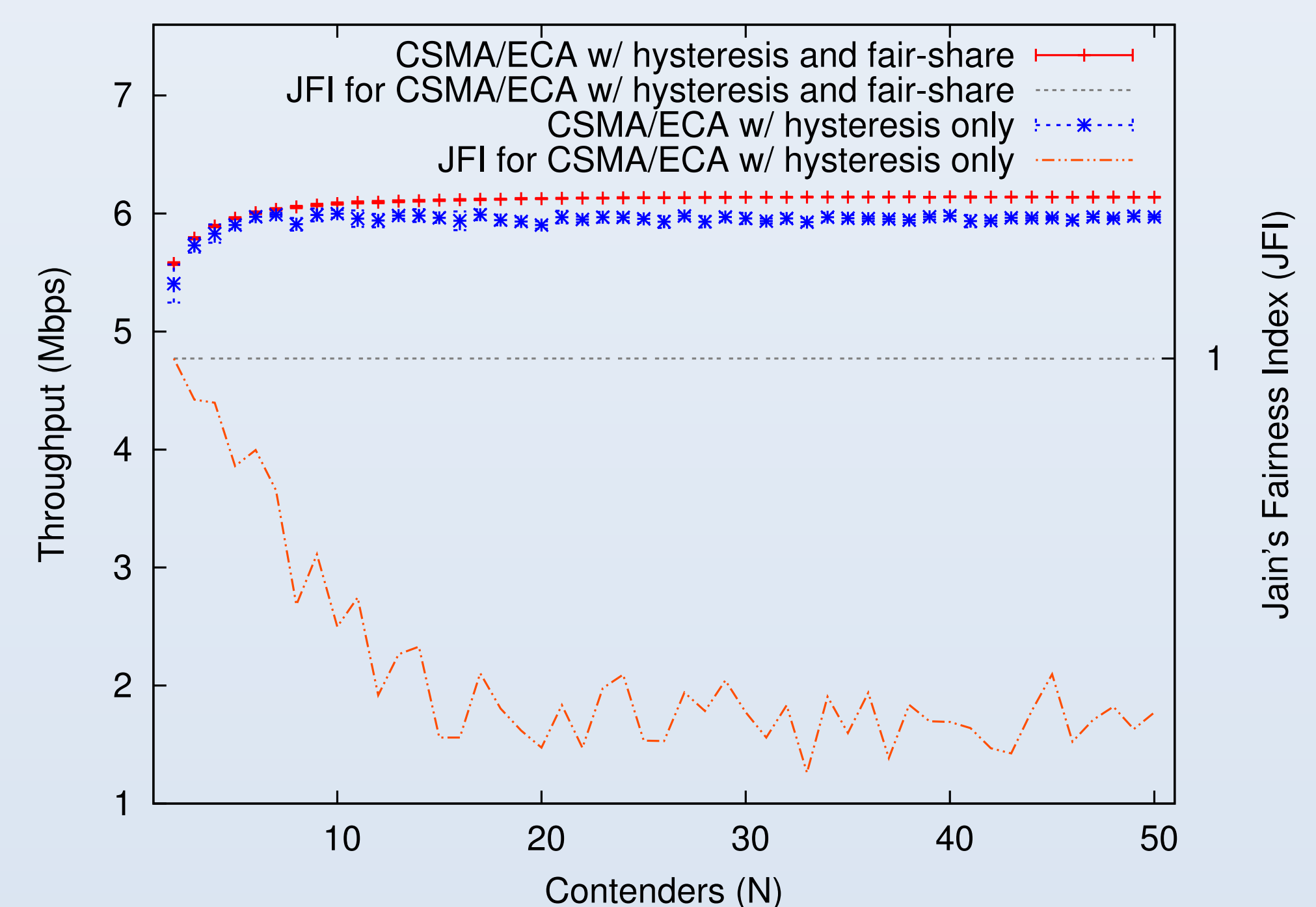
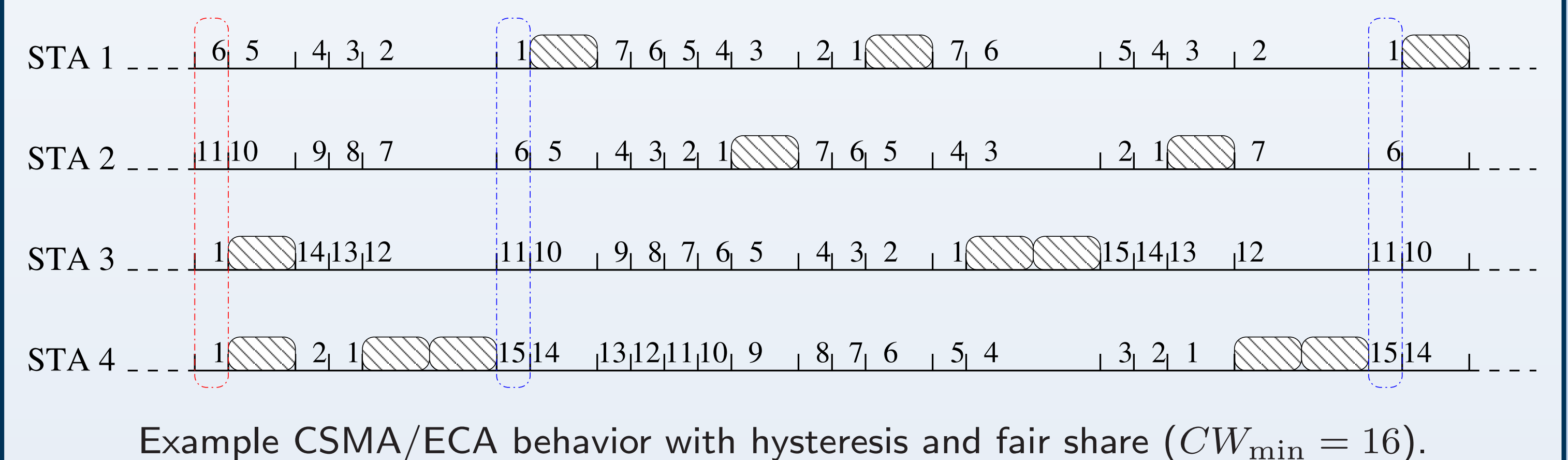
- Instructs nodes **not** to reset their backoff stage after successful transmissions.
- Picks a new deterministic backoff  $B_d = CW(k)/2$ .

We called this measure *hysteresis*.

With hysteresis some nodes may have larger  $B_d$  than others. This unfairness issue is averted by:

- Allowing nodes at backoff stage  $k$  to send  $2^k$  packets.

This is called *fair share* [2].



## Conclusions and Future plans

Hysteresis allows CSMA/ECA to allocate any number of contenders in a collision-free state, while fair share compensates the unfairness issue; allowing CSMA/ECA to attain greater throughput than CSMA/CA under most typical conditions.

As future work, we plan to:

- Test CSMA/ECA under non-saturated scenarios.
- Implement IEEE 802.11e EDCA quality of service measures.
- Implement CSMA/ECA in cheap commodity hardware [3].

## References

- Barcelo, J. and Toledo, A.L. and Cano, C. and Oliver, M. Fairness and Convergence of CSMA with Enhanced Collision Avoidance (ECA). *2010 IEEE International Conference on Communications (ICC)*, may 2010, pp 1–6.
- Sanabria-Russo, L. and Barcelo, J. and Bellalta, B. Fairness in Collision-Free WLANs. *INFOCOM, 2013 Student Poster Abstract and ArXiv e-print*, February 2013.
- Tinnirello, I. and Bianchi, G. and Gallo, P. and Garlisi, D. and Giuliano, F. and Gringoli, F. Wireless MAC processors: Programming MAC protocols on commodity Hardware. *INFOCOM, 2012 Proceedings IEEE*, march 2012, pp 1269–1277.