Report: multiple instances of CSMA/ECA in a single node

Luis Sanabria-Russo

***Abstract*—This report gathers the progress being made in the implementation of multiple instances of CSMA/CA, CSMA/ECA and CSMA/ECA$_{\text{Hys+FS}}$ into a single node. This effort aims at preparing CSMA/ECA$_{\text{Hys+FS}}$ to provide similar Quality of Service (QoS) services to those offered by the Enhanced Distributed Channel Access (EDCA). Particularly, service priority through multiple queues.**

I. Multiple Queues

The generation of packets has shown to be a bottleneck in our simulator. Nevertheless, I decided to build four different queues, which generate traffic at a user-defined rate.

These queues throw packets to the Channel component, which in turn sends them to the `in_packet` in-port of the stations. When a new packet arrives, it is deposited into a MAC queue matching its Access Category (AC). It is important to highlight that there are as many sources as MAC queues.

II. Contention

Stations start a random backoff for each AC when there is something at either MAC queue.

A. CSMA/CA

After a successful transmission of any AC, the AC's backoff stage is reset and a random backoff for the AC is generated.

If there is a real collision, the backoff stage of that AC is incremented and a random backoff is generated for that AC.

B. CSMA/ECA and Hysteresis

An AC able to transmit successfully chooses a deterministic backoff. Without Hysteresis, the backoff stage for the successful AC is reset and a deterministic backoff is used, $B_d = CW_{\min}/2$. Otherwise, $B_d = 2^k CW_{\min}/2$.

C. Internal Collisions

If a lower priority AC has the same backoff counter as a higher priority AC, an internal collision is eminent (at the expiration of the backoff counter). These are treated as real collisions, that is, augmenting the backoff stage and decrementing the stickiness (for Hysteresis only) for the lower priority AC. The higher priority AC will be sent, whereas the one that suffered the internal collision will be forced to recompute a backoff value.

More than one lower-priority AC may collide internally with the highest priority AC.

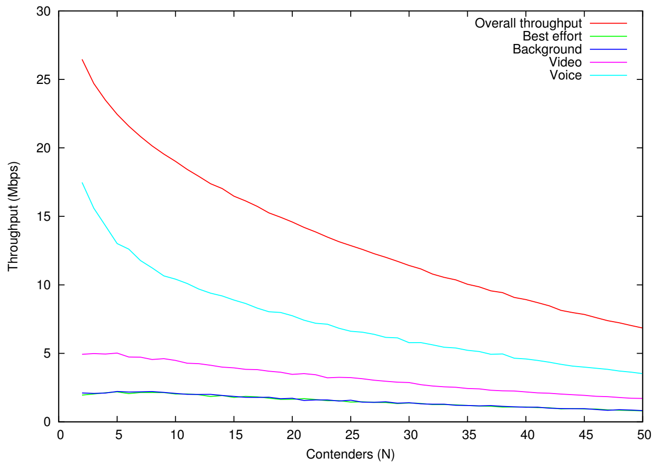

Fig. 1. EDCA: Overall throughput. All ACs in saturation.

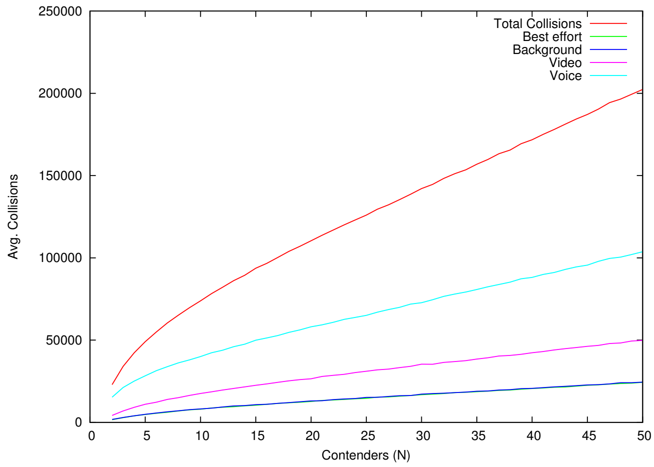

Fig. 2. EDCA: Overall collisions. All ACs in saturation.

III. Simulation Results

All simulations are considered a draft. That is, they are not smooth curves produces by averaging many simulations. Their purpose is to provide insight into the workings of the contention mechanism.

A. EDCA

This implementation seems to work well. That is because the AC receiving the highest throughput is the one with the highest priority. Furthermore, the shape of the throughput and collision curves are the expected ones (Figures 1, 2).

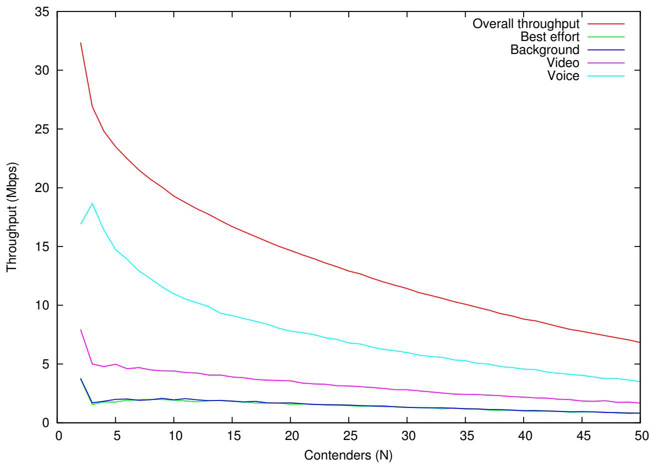

Fig. 3. Basic ECA: Overall throughput. All ACs in saturation.

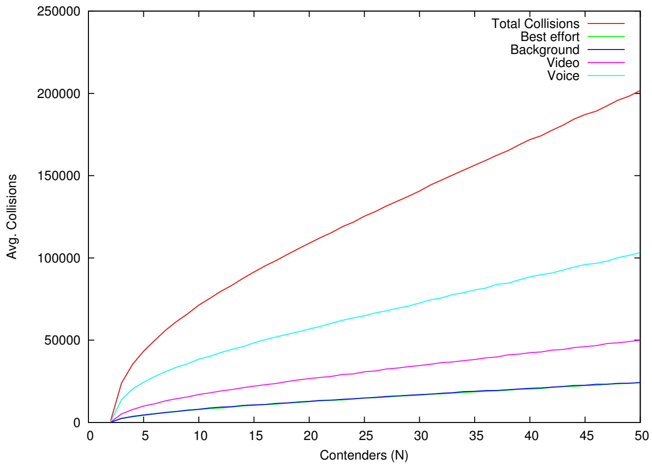

Fig. 4. Basic ECA: Overall collisions. All ACs in saturation.

B. CSMA/ECA (basic ECA)

We see a throughput increase at a low number of contenders. Nevertheless, collisions increase like in EDCA. This effect approximates Basic ECA's throughput to EDCA's (Figures 3, 4).

C. CSMA/ECA$_{Hys}$

We see a throughput increase due to the adaptation of the schedule length provided by Hysteresis. We also see how collisions are *delayed* to around 20 nodes.

It is also interesting to see how the throughput curve changes with the stickiness degree (Figures 5 - 10).

IV. Conclusions

Although there are still a lot of things to implement, like Fair Share and others, this report shines some light over the behavior of multiple instances of CSMA/ECA into a single node. For example, highlighting the importance of the degree of stickiness.

It also originates many questions, like:

1) Is there a *golden stickiness* degree?
2) Is this the better way to treat internal collisions?

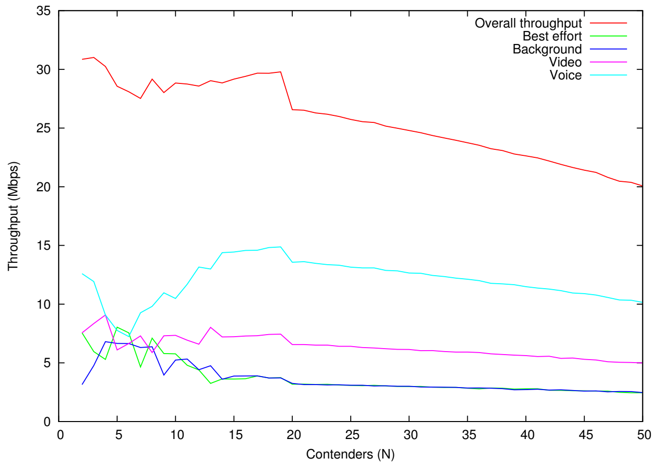

Fig. 5. CSMA/ECA$_{\mathrm{Hys}}$, stickiness = 1: Overall throughput. All ACs in saturation.

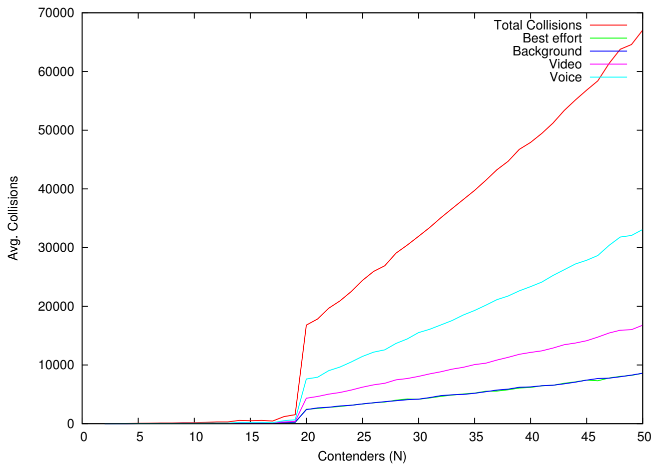

Fig. 6. CSMA/ECA$_{\mathrm{Hys}}$, stickiness = 1: Overall collisions. All ACs in saturation.

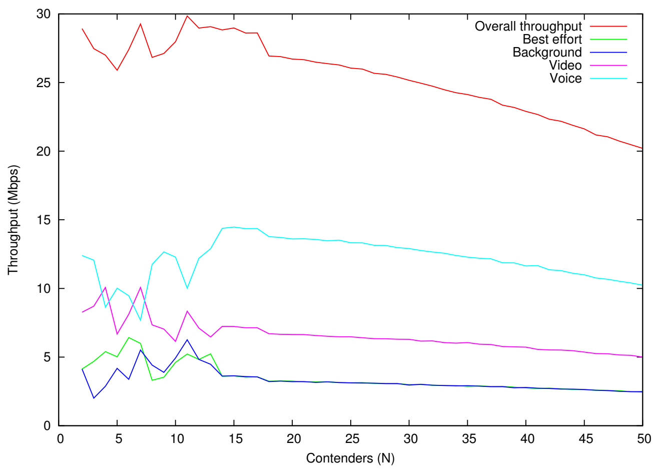

Fig. 7. CSMA/ECA$_{\mathrm{Hys}}$, stickiness = 2: Overall throughput. All ACs in saturation.

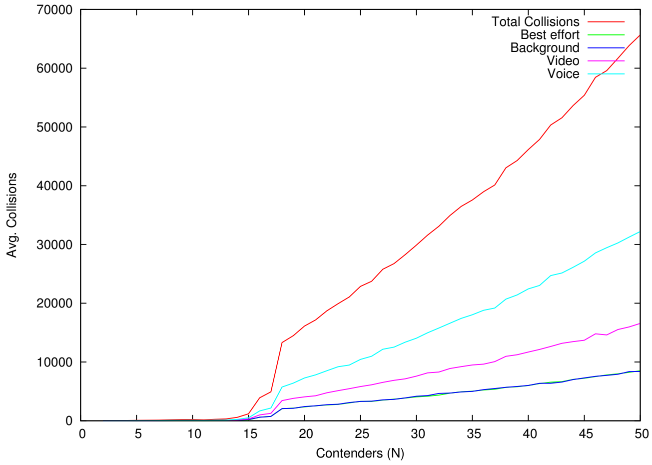

Fig. 8. CSMA/ECA$_{\mathrm{Hys}}$, stickiness = 2: Overall collisions. All ACs in saturation.

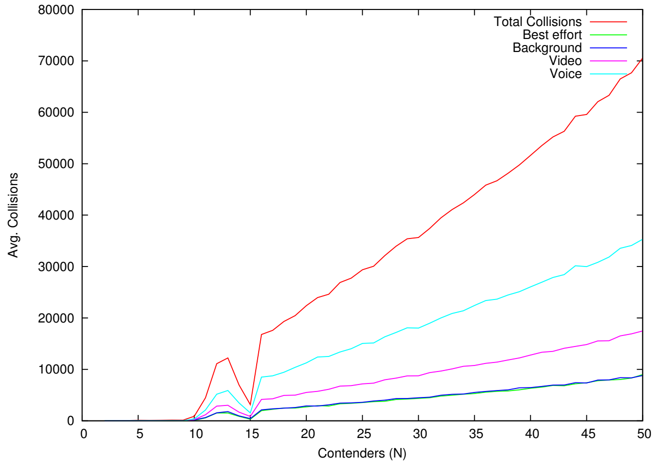

Fig. 10. CSMA/ECA$_{\mathrm{Hys}}$, stickiness = 5: Overall collisions. All ACs in saturation.

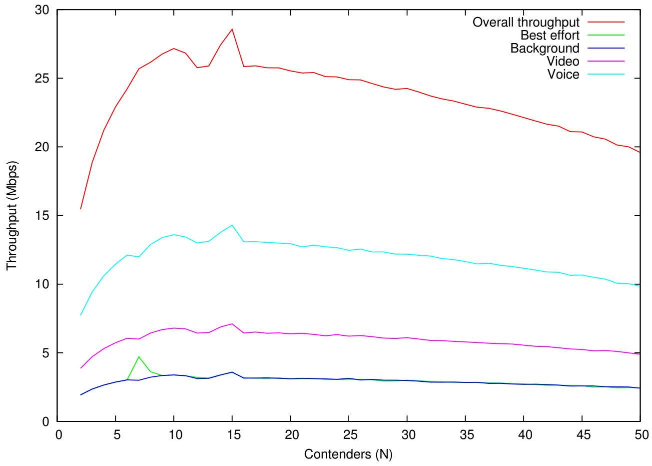

Fig. 9. CSMA/ECA$_{\mathrm{Hys}}$, stickiness = 5: Overall throughput. All ACs in saturation.