Dynamics of Contention Free Period Reservation in IEEE 1901 Networks

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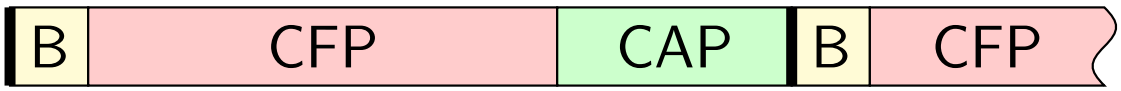
Overview

- IEEE 1901, broadband, in-home.
- Options for contention-based and contention-free access.
- Contention part looks like WiFi.
- Contention free arises from previous work[1][2]
- Good for traffic with QoS requirements?

[1] H. Hrasnica and R. Lehnert, Reservation Domains in MAC Protocols for Broadband PLC Networks, ISPLC 2005.

[2] Y.-J. Lin, H. A. Latchman, J. C. L. Liu, and R. Newman, Periodic Contention-Free Multiple Access for Broadband Multimedia Powerline Communication Networks, ISPLC 2005.

Contention Free Access



For each flow wanting to use CFP:

- Station must make request to BSS manager in CAP.
- BSS manager must update CFP schedule.
- Schedule is announced by BSS manager in beacons.
- Station begins use of CFP, until reservation is canceled.

Schedules are transmitted with a lifetime; to expire a schedule you must wait for the lifetime CSCD ($= M$ frames) and transmit a preview of the new schedule.

Sources Reservation of Delay

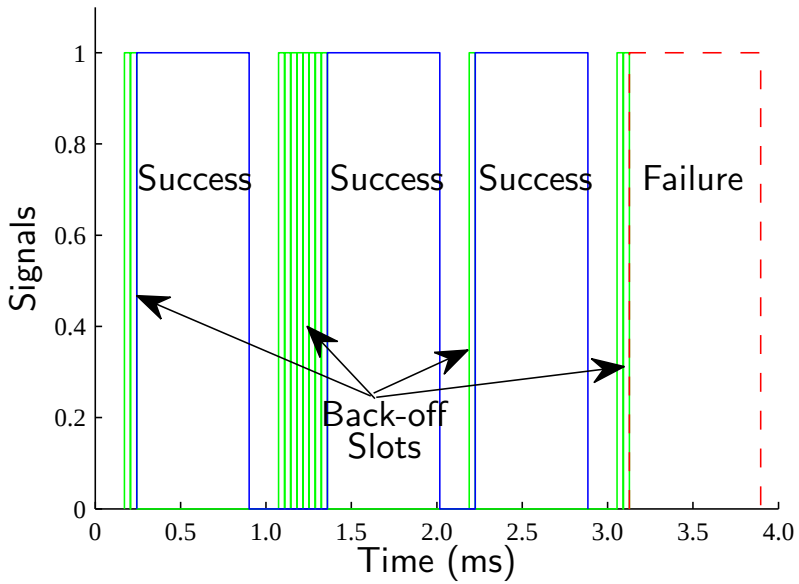
- Contending for access (backoff, collisions, ACKs, etc.).
- Waiting for preview schedule to become current.
- Waiting for modification to current schedule.

Has to be repeated if reservation is canceled.

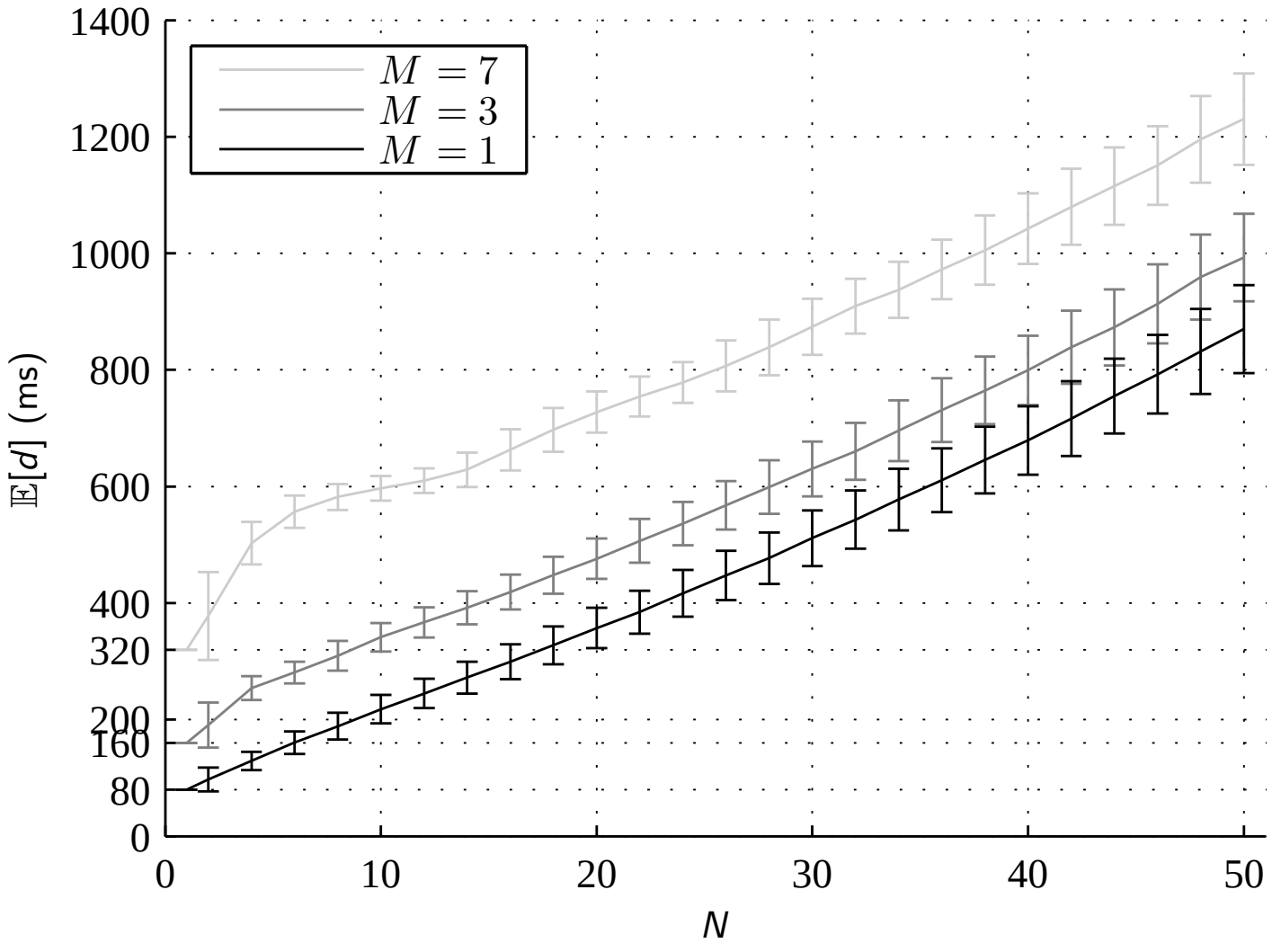
- BSS manager can cancel the reservation.
- The station can request the cancellation.
- There is an inactivity limit (T_{il}).

Setup

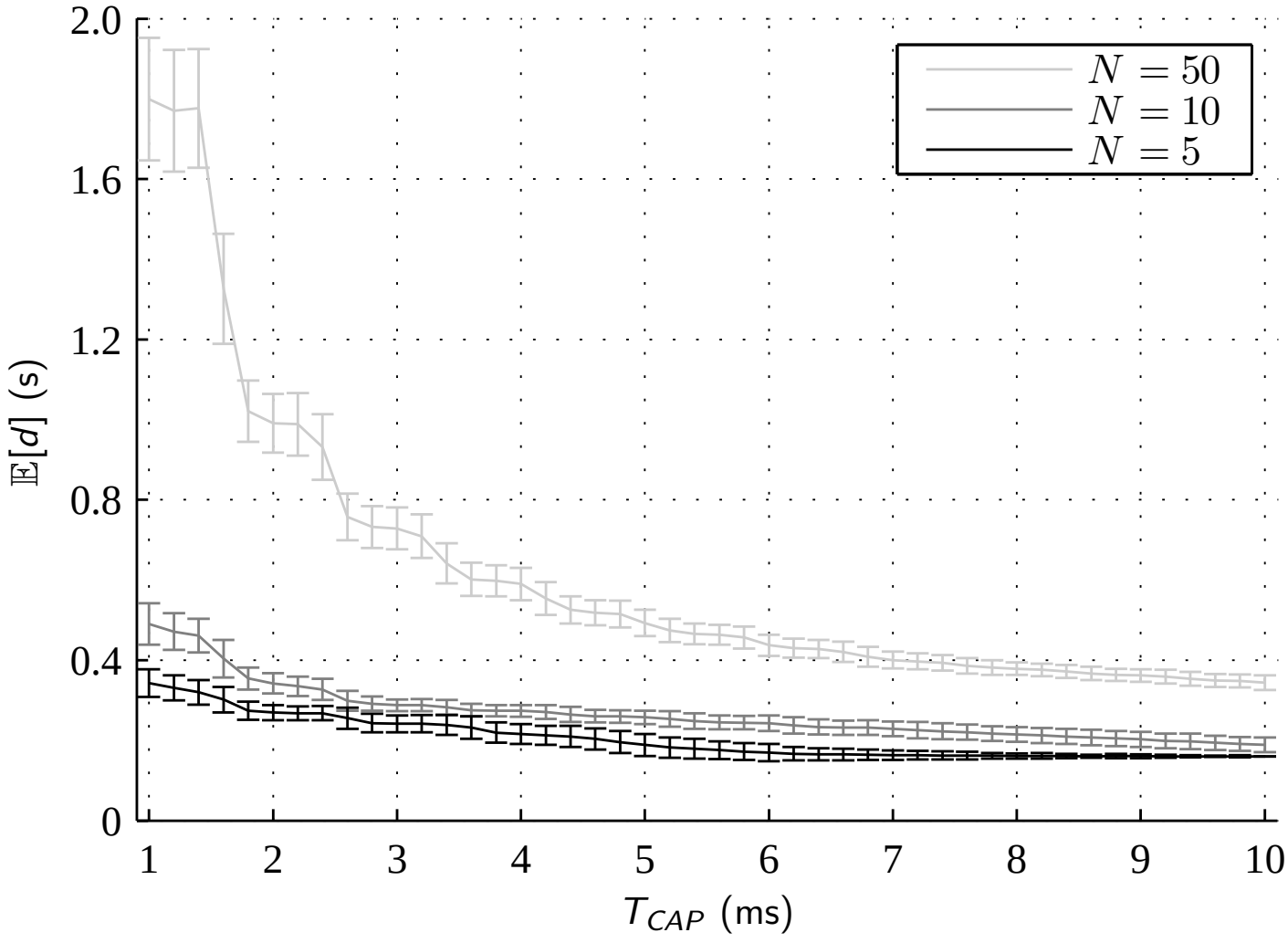
- Focus on reservation delay.
- Simulate with discrete event simulator.
- N stations making reservations.
- Run with beacon interval of 40ms for 80s (2000 intervals).
- Start with defaults of $T_{CAP} = 4$ms and $M = 3$.



Saturated Traffic



How big should CAP be?

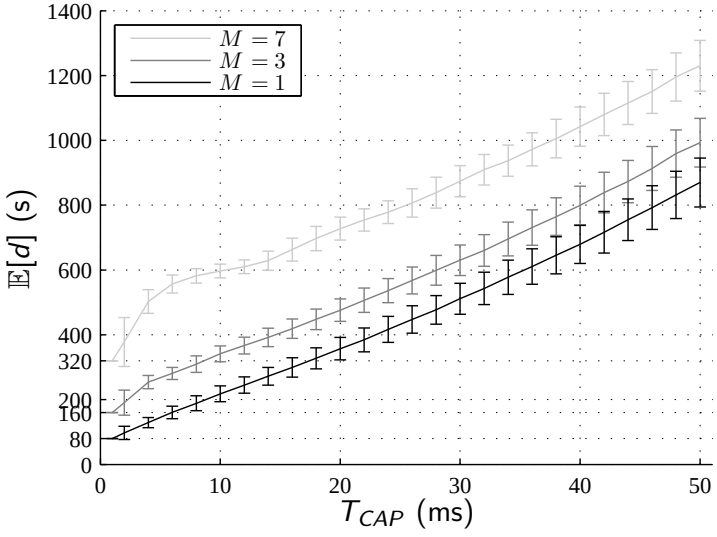


How about voice?

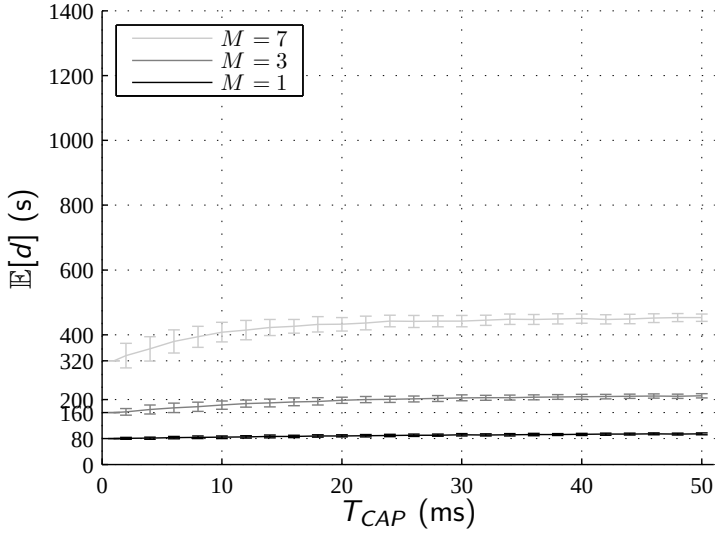
- Saturated traffic won't time out, delay is one off.
- Saturated traffic usually not too delay sensitive.
- How about voice?
- Simple model, 64kbps, on-off exponential mean 1.5 with talk clamped below at 240ms[3].
- Note, delay budget on the order of a few frames.

[3] A. P. Markopoulou, F. A. Tobagi, and M. J. Karam, Assessing the quality of voice communications over internet backbones, IEEE/ACM ToN, vol. 11, no. 5, 2003.

Saturated vs. Voice with long timeout



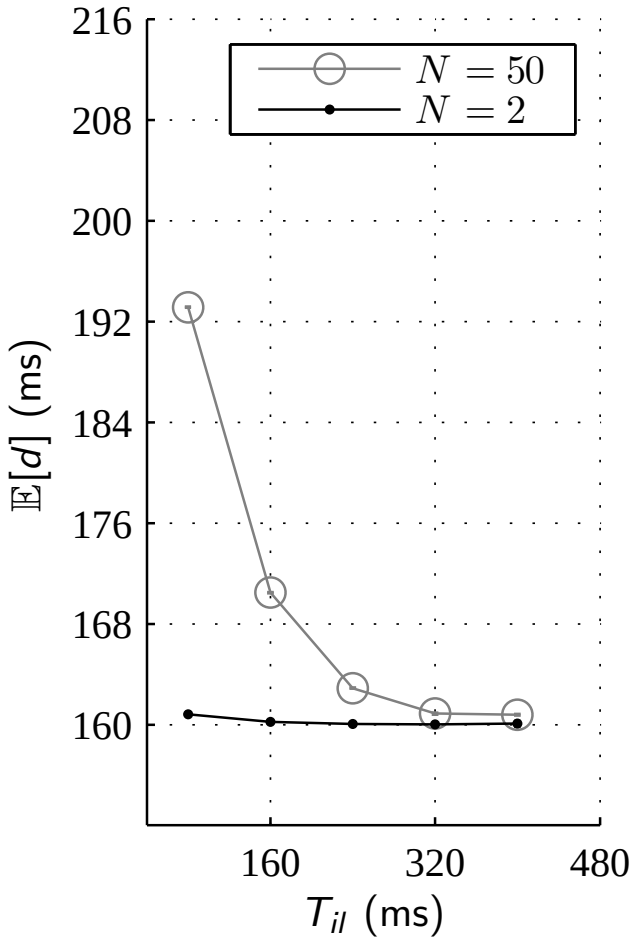
Saturated



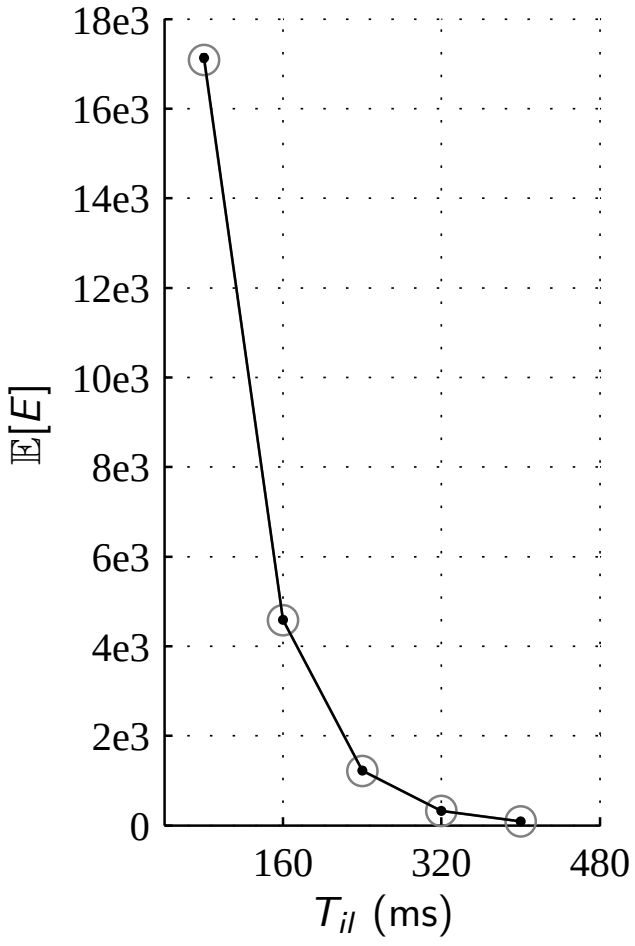
Voice

Really measuring setup. How about with more realistic timeouts?

How big should T_{il} be?



Delay

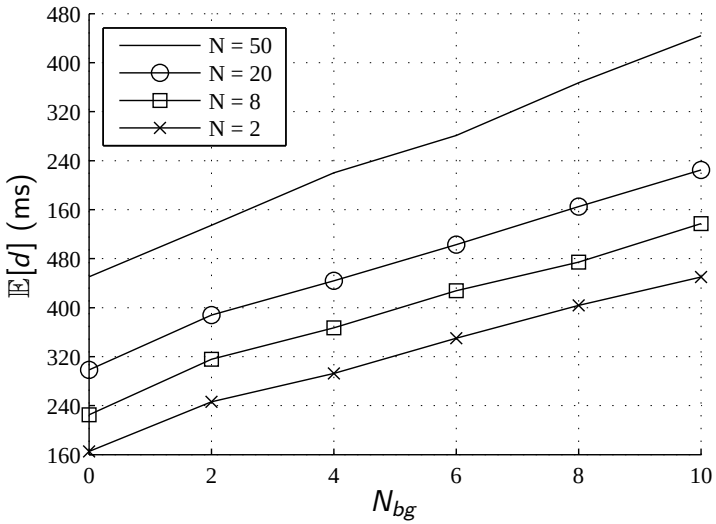


Timeouts

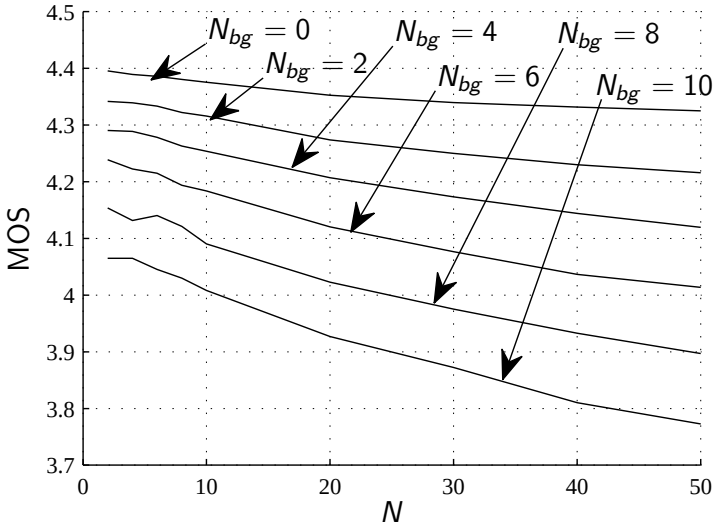
$M = 3,\ T_{CAP} = 40$ ms

Mixed Saturated and Voice

Saturated would usually live in contention period.



Delay



E-Model MOS

MOS: 4.34 Very satisfied; 4.03 Satisfied; 3.60 Some users dissatisfied.

Conclusion

- Contention-free access looks useful.
- Reservation delays can be significant.
- Use small M if possible.
- Use long T_{il} if possible.
- Careful use of prioritisation may help.
- Matching application may help.