Supporting First Person Shooter Games with Competing Traffic in 802.11e MAC

Hanghang Qi, David Malone, Ashwin Murali and Dmitri Botvich

Hamilton Institute, National University of Ireland Maynooth. TSSG, Waterford Institute of Technology, Ireland.

Competing Traffic and 802.11

- Game traffic is often timing sensitive.
- 802.11 (WiFi) can have relatively limited resources.
- Previously considered game server/client resource allocation for WiFi.
- Now interested in split between game and other traffic.

Aim: Want to prioritise time-sensitive game traffic over other traffic, while retaining good performance for other traffic.

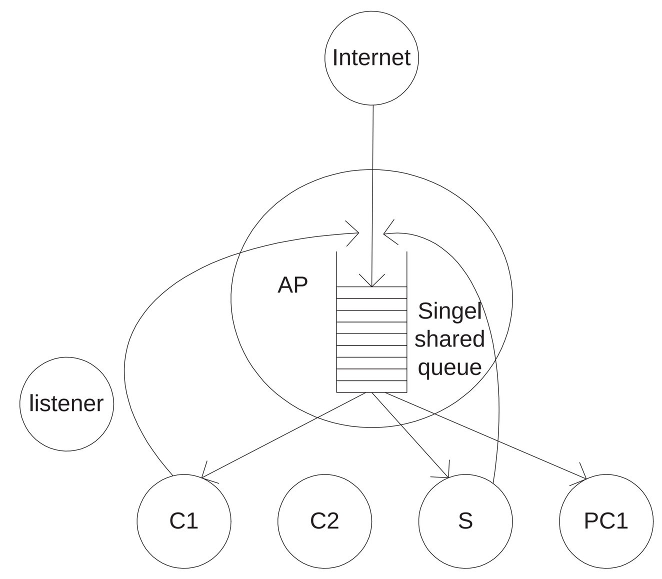
Observation: two types of congestion in WiFi — internal and external.

- Internal congestion arises from shared buffering.
- External congestion because medium is shared and MAC regulates access.
- 802.11e provides useful tools: multiple queues and tuneable MAC.
- 802.11e features we require are included in WME/WMM and 802.11n.
- Interstation traffic usually through access point.

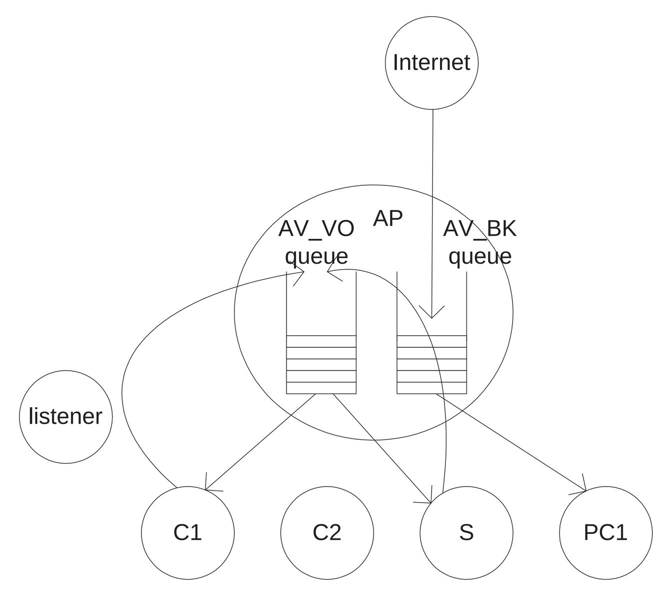
ADRA Scheme

The Application Divided Resource Allocation (ADRA) scheme:

- Deal with internal congestion by using separate 11e queues.
- Deal with external congestion by assigning MAC parameters.
- Can do this at all devices, including access point.
- Classify packets into queues (e.g. packet size).



Before



After

Bianchi Models

802.11 MAC is randomised: concurrent transmissions are possible.

- Need to choose 802.11e parameters: CW_{min_i}, CW_{max_i}, $AIFS_i$ and $TXOP_i$.
- Use Bianchi-like model, extended to 11e.

$$\tau_i = \frac{2(1-2p_i)}{w_i(1-p_i-p_i(2p_i)^{m_i}) + 2(1-p_i)(1-2p_i)/q_i} \quad (1)$$

$$1-p_1 = (1-\tau_1)^{n_1-1}(p_h + (1-p_h)(1-\tau_2)^{n_2}) \quad (2)$$

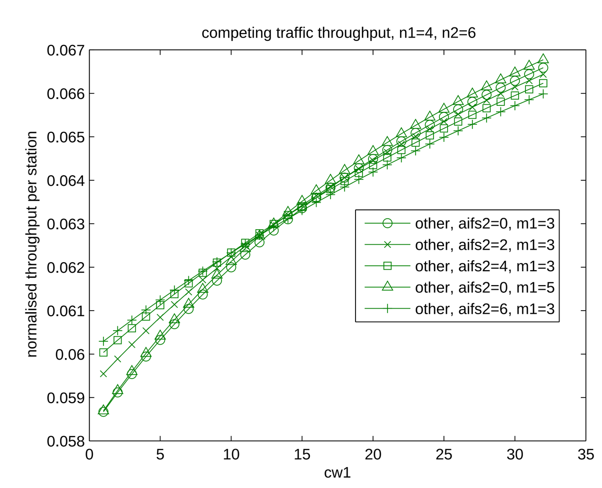
$$1-p_2 = (1-\tau_1)^{n_1}(1-\tau_2)^{n_2-1} \quad (3)$$

$$p_h = \frac{(1-(1-\tau_1)^{n_1}(1-\tau_2)^{n_2})\sum_{i=1}^{k} p_{s1}}{1+(1-(1-\tau_1)^{n_1}(1-\tau_2)^{n_2})\sum_{i=1}^{k} p_{s1}} \quad (4)$$

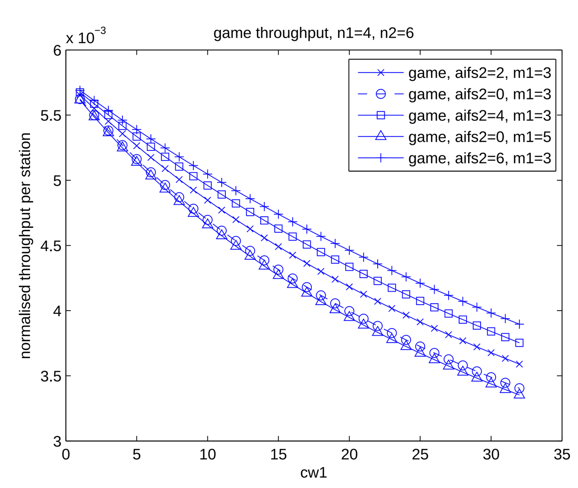
- τ_i is transmission prob,
- p_i is collision prob,
- w_i is CW_{min_i},
- m is number of backoff doublings between CW_{min_i} and CW_{max_i},
- q_i is arrival prob (related to load),
- p_h is hold prob.

Choosing Parameters

Throughput for game flow/competing flow when game traffic is Quake IV and competing traffic is saturated:



competing traffic



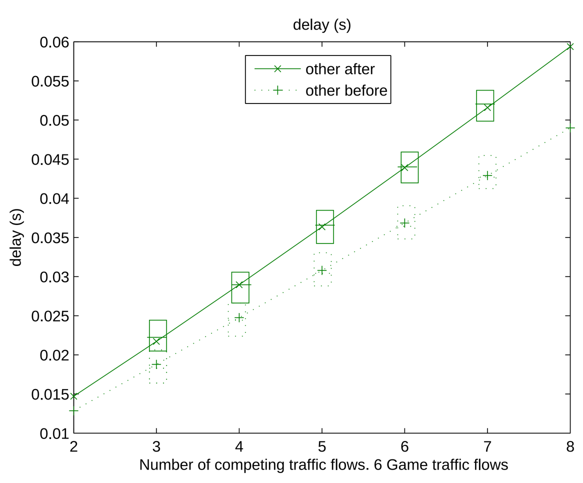
game traffic

Can predict for a range of numbers of stations in each class. Model predicts small CW values good, but we increase CW_{max} for extra robustness.

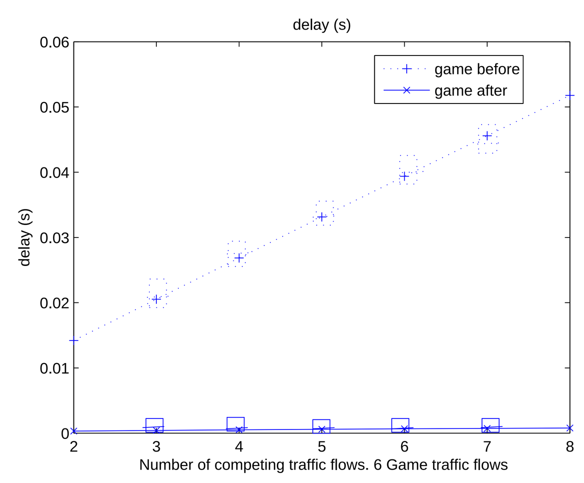
AC	CW_{min}	CW_{max}	AIFSN	TXOP(ms)
competing traffic	32	1024	6	0
game traffic	1	8	0	2.2

Testbed Results

Implemented in testbed with 6 game flows and variable numbers of competing flows:



delay for competing traffic



delay for game traffic

Even bigger improvements for downloads with shared queueing.

- In practice the game experience with the ADRA scheme is better.
- Without ADRA, gameplay unpleasant particularly when players meet.

Conclusions, Future and Related Work

- Two types of contention important.
- Use mix of queueing/MAC parameters necessary.
- Would like to generalise to other games.
- Would like to use better classification.
- Considering buffer tuning.

References

[1] M. Claypool and K. Claypool, "Latency and player actions in online games," *Commun. ACM*, vol. 49, 2006.

[2] A. F. Wattimena, R. E. Kooij, J. M. van Vugt, and O. K. Ahmed, "Predicting the perceived quality of a first person shooter: the Quake IV G-model," in *NetGames '06*, NY, USA, ACM.

[3] B. Carrig, D. Denieffe, and J. Murphy, "Supporting first person shooter games in wireless local area networks," in *Personal, Indoor and Mobile Radio Communications, 2007. IEEE 18th International Symposium on*, Sept.

[4] T. Nguyen and G. Armitage, "Quantitative assessment of IP service quality in 802.11b and DOCSIS networks," in *Proceedings of the Australian Network and Telecommunications Conference 2004*.

[5] Y. E. Liu, J. Wang, M. Kwak, J. Diamon, and M. Toulouse, "Capability of IEEE 802.11g networks in supporting multi-player online games," in *Consumer Communications and Networking Conference, 2006. 3rd IEEE*, vol. 2, pp. 1193–1198.