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PhD Research Topic

AP Buffer Sizing for TCP in 802.11 WLANs

- ❑ Still **unhappy** end-users even with the growth of the Internet connections' bandwidth :- (=> **latency due to the excessive buffering!**
- ❑ Latency induced by the **core-routers** vs. **access links!**
 - “Core-routers” issue has already been solved thanks to the [Appenzeller et al., “Sizing router buffers”, Sigcomm’04](#) (multiplexing, de-synchronization,...)
- ❑ IEEE 802.11 as the **main technology** used by the end-users on/adjacent to the access links and probably going to be so (*802.11n, 802.11ac, 802.11ad,...*)

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❑ Example (802.11 Buffer Sizing):

1. A 802.11g-only network
2. A wireless station downloading TCP data from a server just attached to the AP (e.g. 1m away only)
3. TCP payload=1460 bytes, TCP payload + headers=1500 bytes, 1536 bytes incl. MAC and SNAP headers
4. Neglecting *contention* and assuming *no other* downloading/uploading station, with **54 Mbps** rate it takes $322\mu\text{s}$ (DATA_{TCP}) + $106\mu\text{s}$ (ACK_{TCP}) = $428\mu\text{s}$ to transmit and ACK a 1460 bytes payload
5. Having an AP with *Intel* chipset with *wlan0 tx_queue_len*=1000 pkts, being in **full-buffer status**=> **queuing latency=428ms**

Now, assume lower bit-rates, contention, noise, ...



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AP Buffer Sizing for TCP in 802.11 WLANs

- ❑ OK to have hundreds of milliseconds delay on a WLAN with few meters of range?!

Going to fix this!

- ❑ AP downlink queue:

- How large? Static? Dynamic?
- Rate adaptation? Bandwidth changes? RTT changes?
- How many nodes? How many flows?
- Different TCP_CC AIMD behavior? CUBIC? Westwood+? Vegas?
- Fairness issues? Uplink vs. downlink? Mices vs. Elephants?
- ...



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Why am I @ CAIA?

❑ Basically two possible (and *complementary*) approaches to decrease the delay over the Internet:

- ❑ Reduction in buffer sizes across the networks (e.g. core-routers, wired/802.11 access links)
- ❑ Fixing the TCP to not aggressively fill-up any buffer (e.g. delay-based TCPs, Westwood+)

❑ **Delay-gradient TCP (CDG)**: implemented in FreeBSD 9.0

D. A. Hayes and G. Armitage, "Revisiting TCP congestion control using delay gradients", NETWORKING 2011



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