Making WiFi Great Again

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COMPUTER SCIENCE
DATAVETENSKAP

Outline

- **A History of Bloat Fixes in Linux**
- Problems With WiFi
- Making WiFi Great Again
- Going Forward

What is Bufferbloat?

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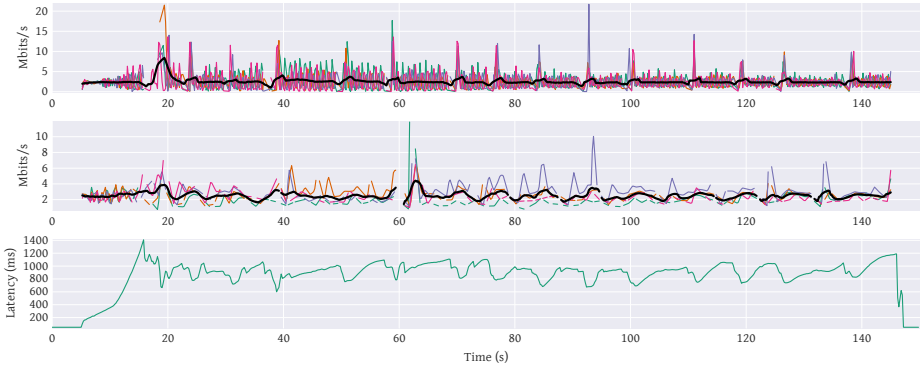

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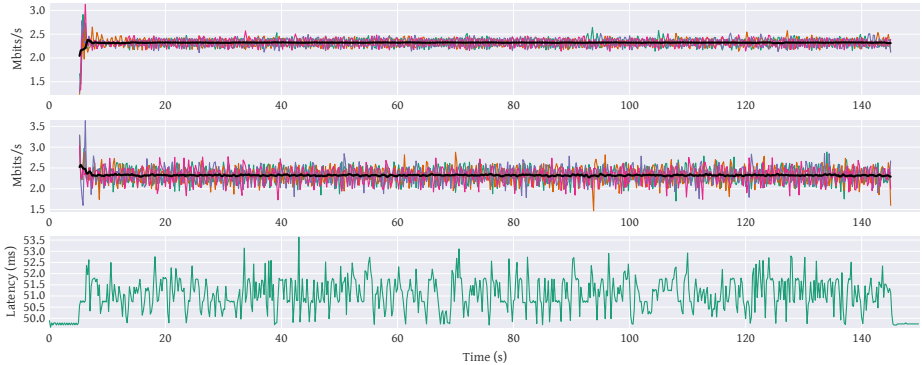

A history of Bloat Fixes in Linux

	Mainline	OpenWrt / LEDE
Byte Queue Limits	Linux 3.3	Dec 2012
FQ-CoDel qdisc	Linux 3.5	Apr 2013
TCP small queues	Linux 3.6	
`sqm-scripts`		Oct 2014
Package pacing (`fq` qdisc)	Linux 3.12	
`cake` qdisc		May 2016
BBR congestion control	Linux 4.9	

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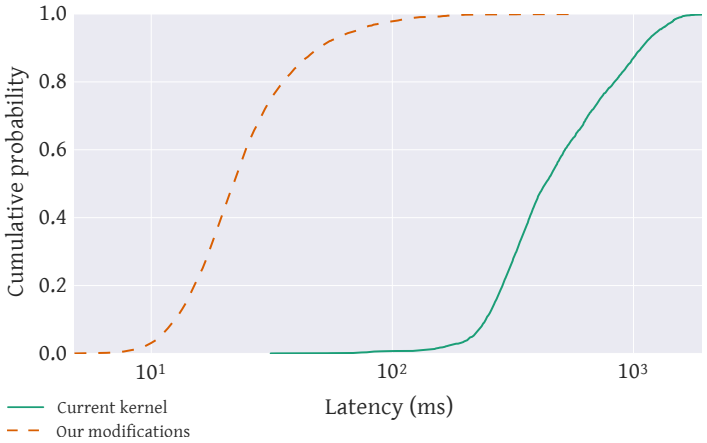
Problems With WiFi 1: Bufferbloat



Problems With WiFi 2: Airtime fairness

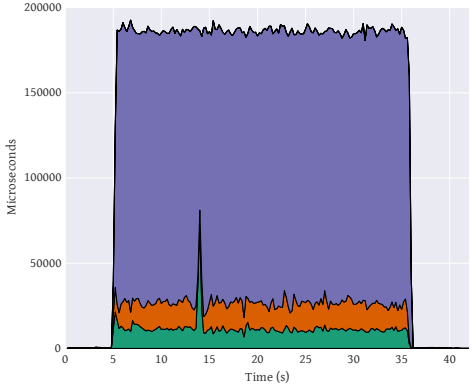
For station $i \in I$ transmitting A-MPDU aggregates of size s_i at PHY rate r_i:

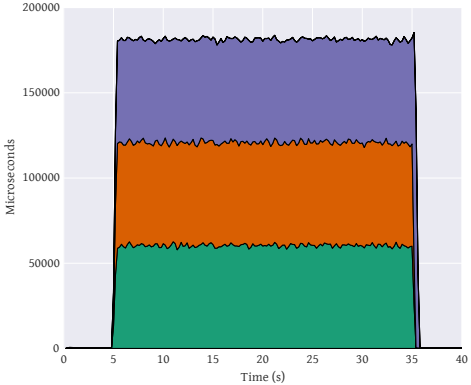
$$T(i) = \begin{cases} \frac{1}{|I|} & \text{with fairness} \\ \frac{T_{data}(s_i,r_i)}{\sum_{j \in I} T_{data}(s_j,r_j)} & \text{otherwise} \end{cases} \quad (1)$$

$$R(i) = T(i)R(s_i, r_i) \quad (2)$$

where $R(s_i, r_i) = \frac{s_i}{T_{data}(s_i,r_i)+T_{oh}}$ is the effective station rate with no collisions.

Problems With WiFi 2: Airtime fairness





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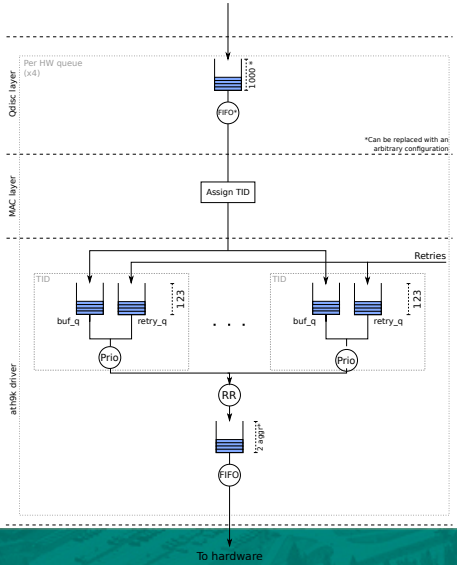
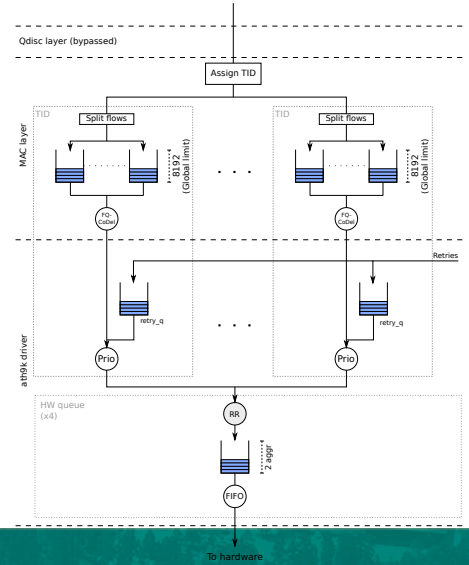


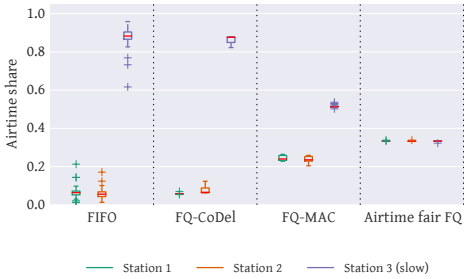


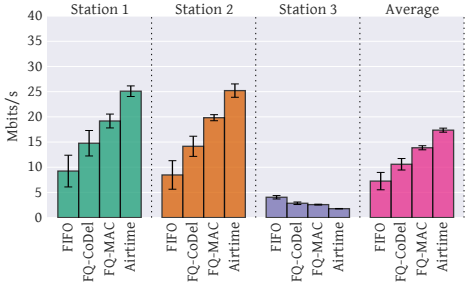
Airtime Scheduler (ath9k only)

```
function on_tx(pkt)
    station = get_station(pkt)
    station.deficit -= pkt.duration
function on_rx(pkt)
    station = get_station(pkt)
    station.deficit -= calc_dur(pkt)
```

```
function schedule(hwq)
    if full(hwq) then return
begin:
    station = list_head(station_list)
    if station.deficit <= 0 then
        station.deficit += quantum
        list_move_end(station, station_list)
        goto begin
    if !station.queue then
        list_del(station)
        goto begin
    queue_aggregate(station)
```

It Works!





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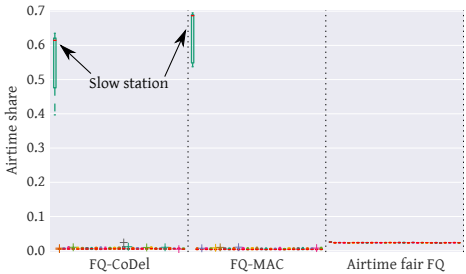
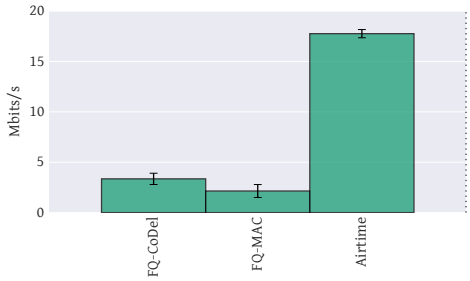
Also With 30 Stations





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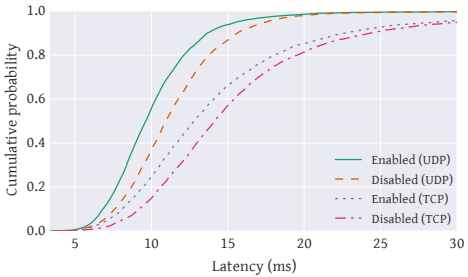
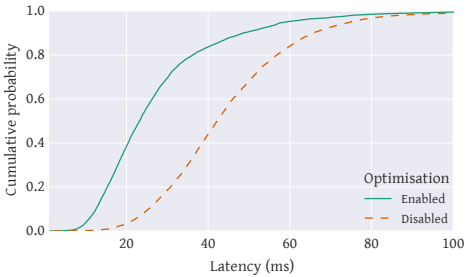
Slow Station Optimisation





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Going Forward

- More drivers
- Scaling CoDel
- Smarter aggregate sizing
- Airtime share policy
- Airtime fairness in mesh networks
- Rate selection
- Cutting down on multicast

Questions?