# Pasquale Imputato

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### XXXI Cycle - II year presentation

# Improving the performance of WiFi networks through innovative Active Queue Management algorithms

**Context**

In computer networks it has been observed the uncontrolled growth of the queuing time due to the excessive buffers size and the attitude of TCP to increase the sending rate until a packet is dropped. The term *bufferblot* refers to this problem.

Reducing and keeping the *network latency* stable is essential to provide a number of services nowadays.

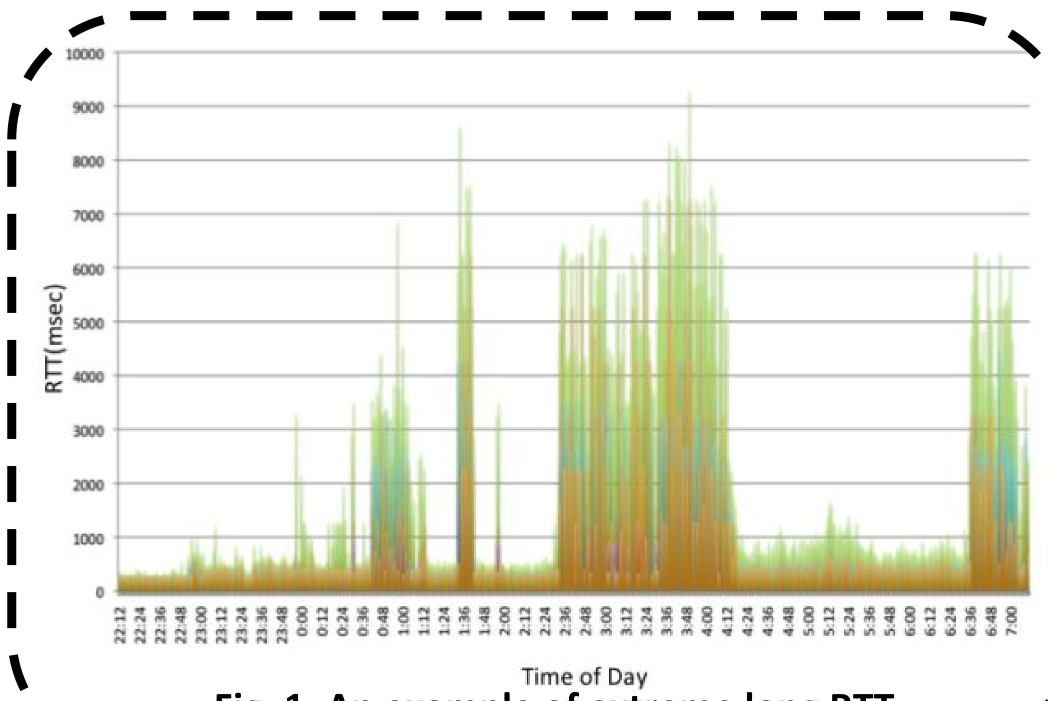


**Fig. 1: An example of extreme long RTT.**

WiFi networks are a pervasive technology to connect users to the Internet.

The bufferbloat in WiFi is exacerbated by a number of peculiar mechanisms at MAC layer.

Device queues, which absorb traffic bursts and deal with the continuous variations of the channel condition, allow packets aggregation to gain better throughput performance.

The *challenge* is dynamically sizing the device buffers to keep low overqueueing and high throughput.

**Research activity**

The Idea is to introduce innovative techniques of Active Queue Management (AQM) to improve the WiFi network performance and mitigate the bufferbloat problem.

The activity exploits both simulations with the ns-3 network simulator and real devices experiments.

We introduced models of traffic-control, queueing disciplines (qdisc) and flow-control (modelled after the Linux ones) in ns-3 for multiqueue devices.

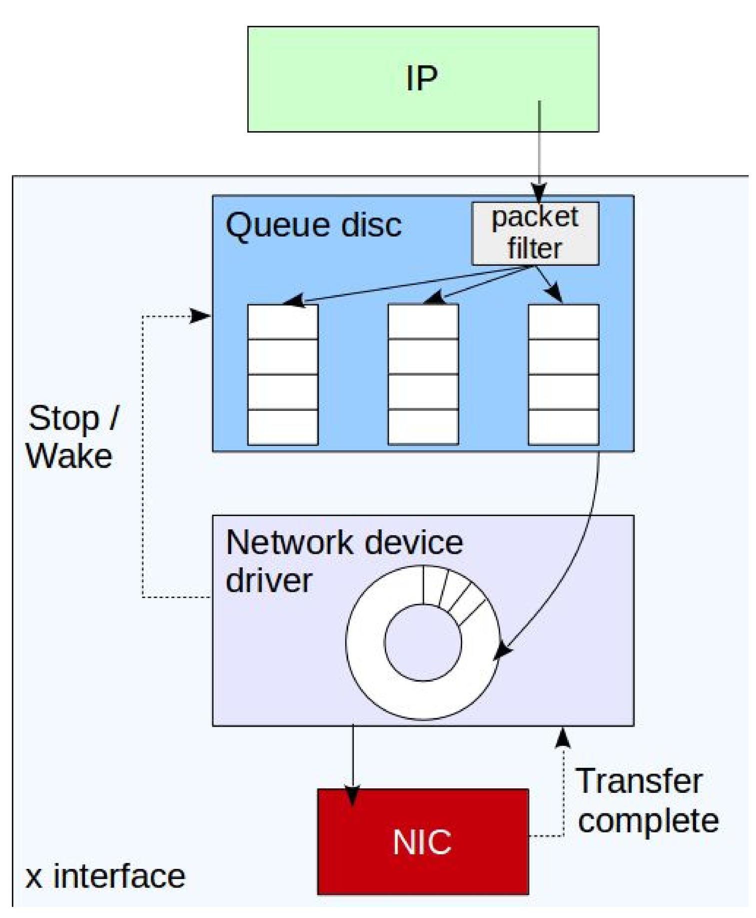


**Fig. 2: Traffic-control and flow-control in case of single queue network device modelled in ns-3.**

The models have been validated.

The results show that the simulator reproduces in a realistic manner the networks performance in term of RTT, throughput, packets backlog and bytes inflight for different qdisc and various device queue sizes.

We introduced a kernel-bypass approach to validate our models (work partially carried out with ESA).

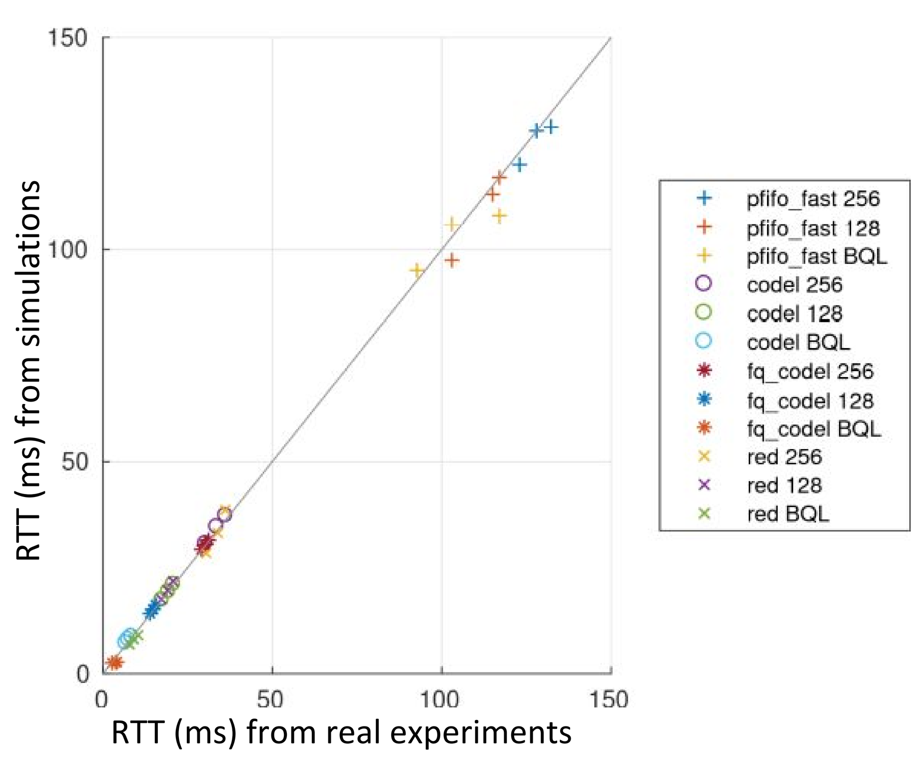


**Fig. 3: Comparison of the 25-th, 50-th and 75-th percentiles of RTT obtained via simulations and real experiments.**

We carried out an analysis (through experiments and simulations) to estimate the impact of the device buffer *fixed* and *dynamically sized* (BQL) on packet schedulers.

The results show that the device queueing has a not negligible impact on the AQMs effectiveness.

Moreover, modern AQMs need to evaluate accurately the actual departure rate to better estimate the queueing time.

A *WiFi-aware AQM* should rely on reduced device buffers and able to follow the continuous variations of the transmission rate.

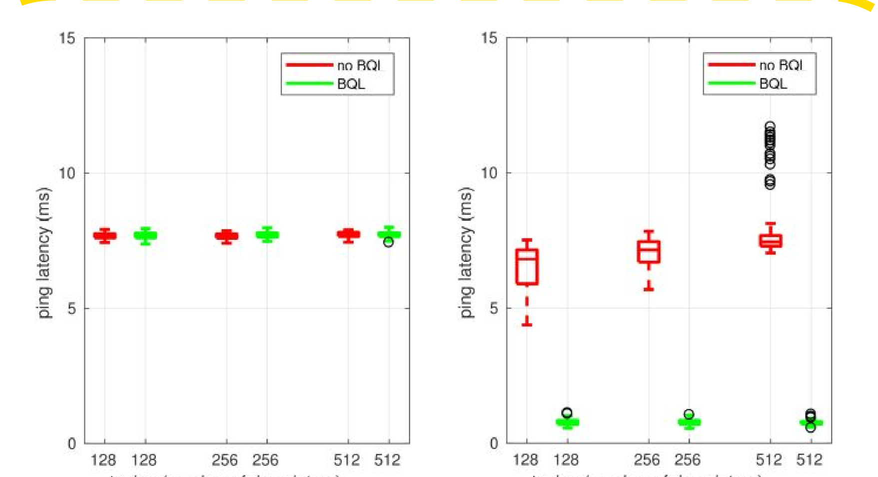

**Fig. 4: RTT for pfifo_fast qdisc (left side) and fq_codel qdisc (rigth side) with BQL enabled or not from real experiments.**

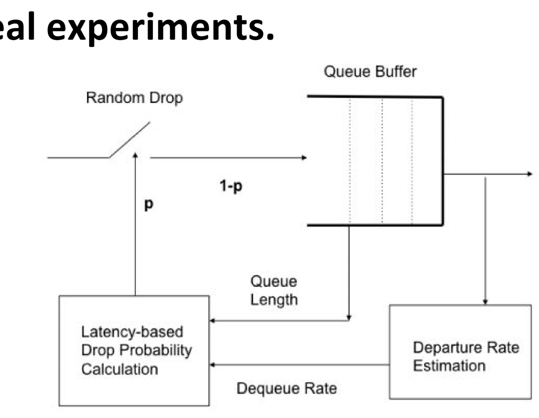


**Fig. 5: Design schema of the PIE AQM as an example of a modern AQM.**


**Contacts**

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**Next year**

**Impact evaluation of the dynamic sizing of the device queues in WiFi.**

Evaluation of aggregation-aware technique at device layer and its impact on the effectiveness of the AQM algorithms in WiFi.

**An AQM tailored for the WiFi case.**

Design and evaluation of an AQM to deal with the variations of the actual transmission rate. The idea is to use robust control techniques to design an AQM algorithm.

**Traffic-control techniques in 11ax and LTE.**

Study of access schedulers aware of the status of per-station queue and able to provide resources access accordingly.