GSP - Global Synchronization Protection

Update

draft-lauten-aqm-gsp-02.txt

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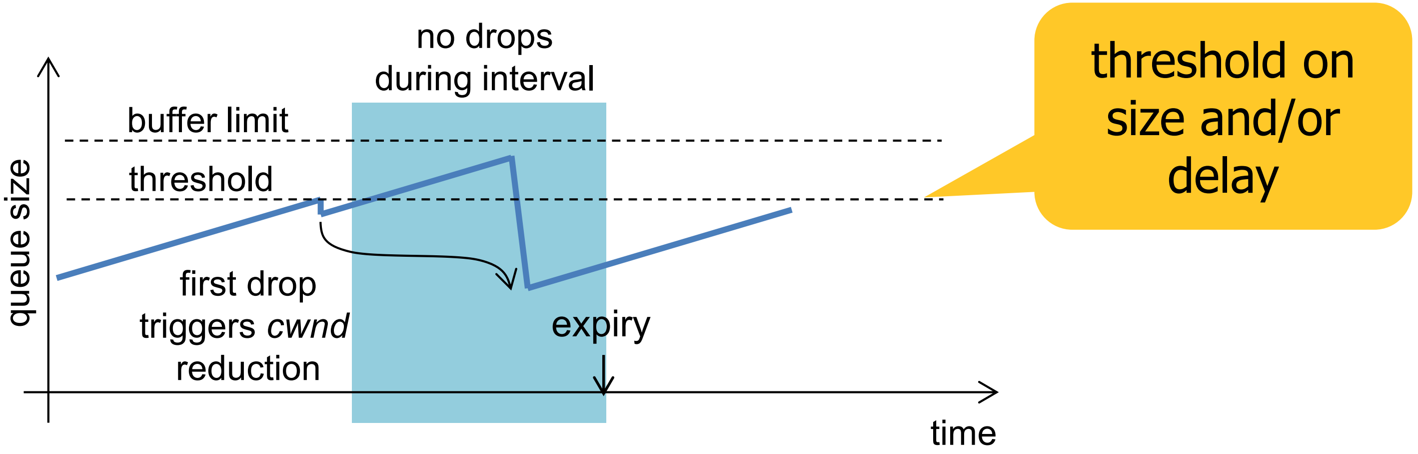
Global Synchronization Protection

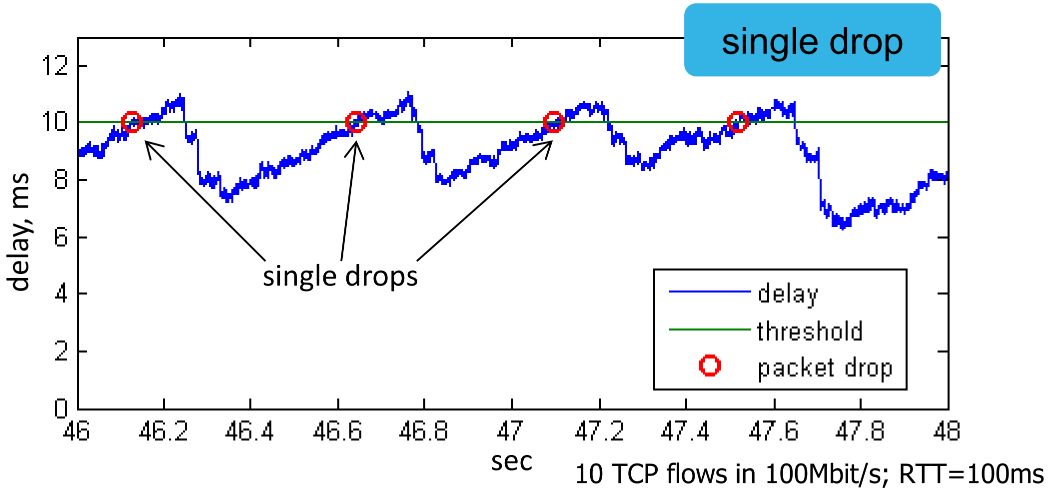
The basic GSP algorithm




```
on packet arrival DO:
   IF (queue > threshold) && (now() > expiry):
      drop this packet (do nothing)
      expiry = now() + interval
   ELSE:
      enqueue this packet
```

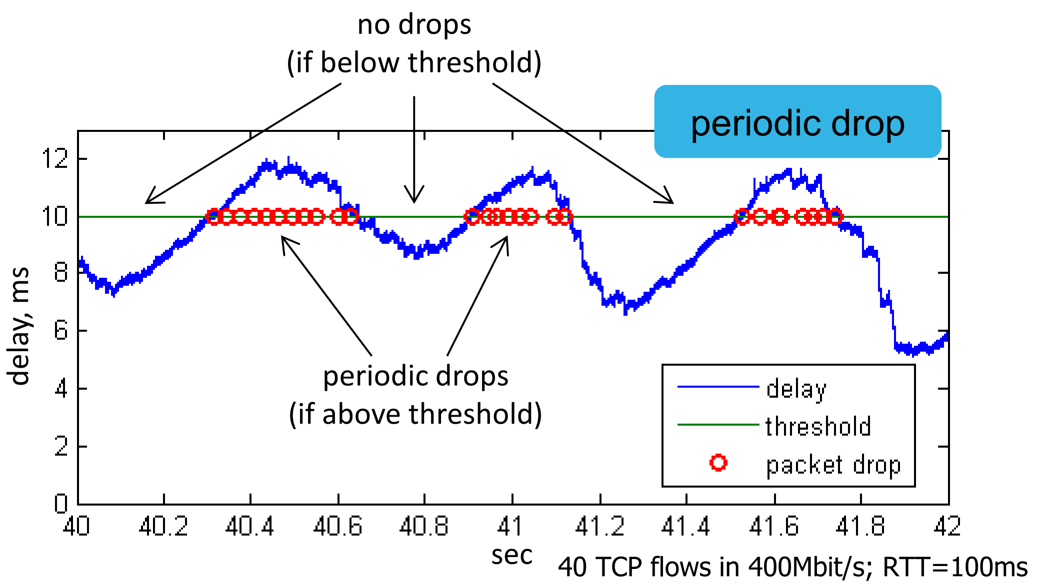
Adaptive GSP

- At aggressive traffic: reduce the no-drop interval
  - large N – too many flows
  - RTT is smaller than expected
  - aggressive TCP flavor
  - partially unresponsive traffic

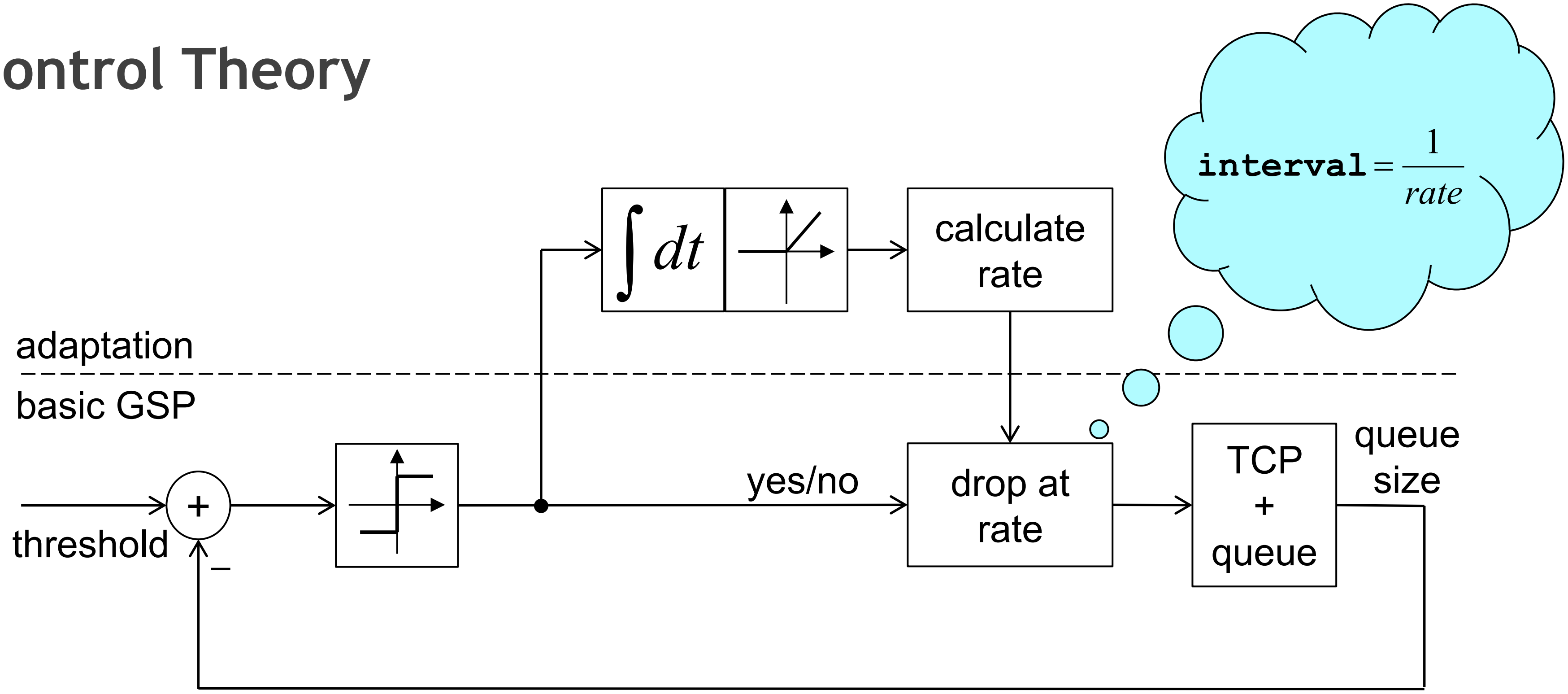


- Criterion: cumulative time above threshold exceeds cumulative time below

→ Periodic drops if queue above threshold
→ No drops if below threshold
→ Bang-bang controller



Control Theory

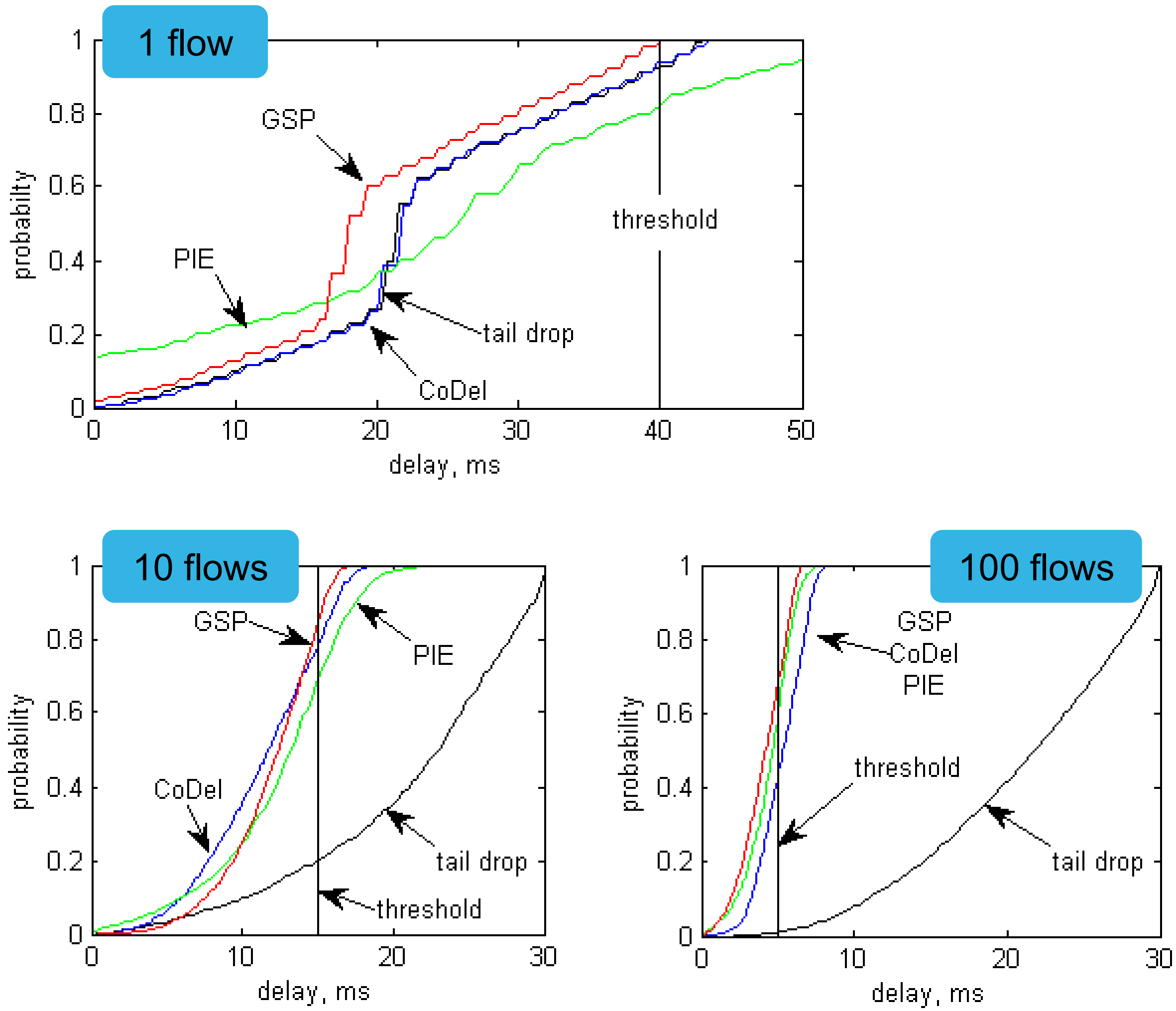


- Basic GSP and periodic dropping are intrinsically the same algorithm
- Smooth transition between both regimes
- Adaptation is not part of the inner control loop
  - can be slower; not a part of the fast path packet processing pipeline
  - does not impact the stability
  - open for heuristics

Steady state performance

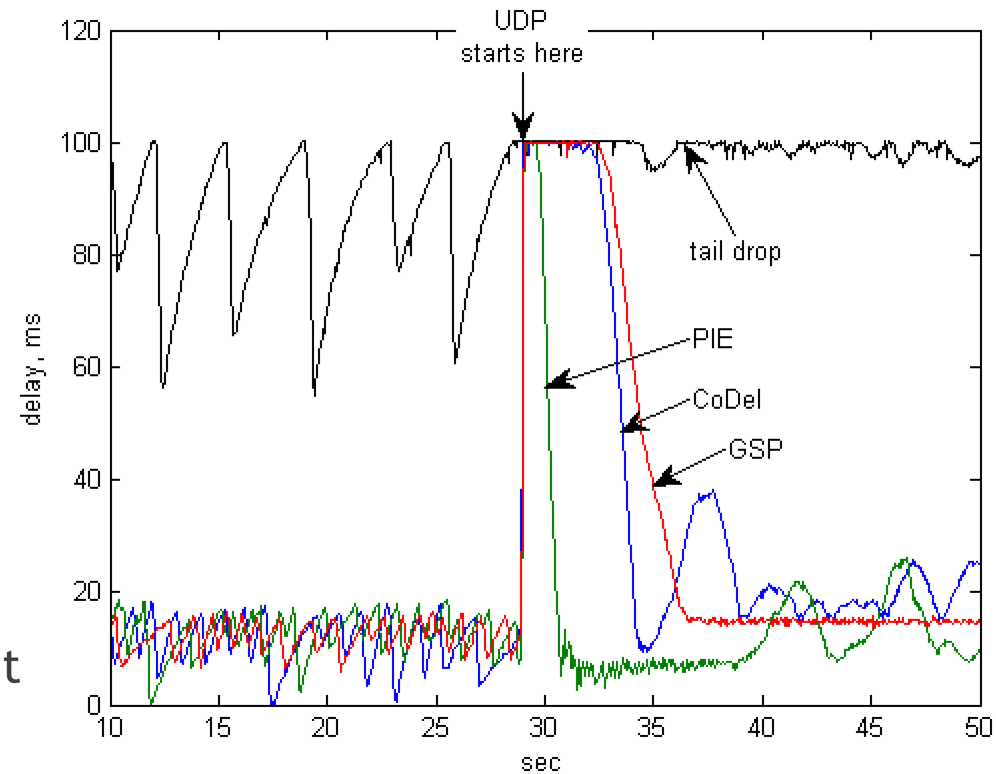
compared to tail drop, CoDel, and PIE

- Probability distribution of queuing delay (CDF)
  - Best if starts at zero and steeply reaches one
- No gain in single flow case
  - Obvious for GSP – there cannot be any synchronization
  - Not obvious but true for other AQMs
  - think of fq_<AQM> discussion
- Increasing gain with increasing flow numbers
- GSP performs equally well as CoDel and PIE
- PIE fails in single flow case – tail drop is better



Unsteady traffic conditions
Unresponsive traffic

- Drop signals get lost if part of the traffic is unresponsive
- Is the algorithm strong enough to keep the remaining responsive fraction under control?
- Experiment:
  - capacity 100Mbit/s; RTT=100ms
  - 90% UDP (unresponsive traffic)
  - 10% TCP (responsive; 10 flows)



→ CoDel and PIE are fast, but exhibit unsteady convergence

→ GSP settles close to the threshold with and without UDP injection

Conclusion

- Global Synchronization Protection (GSP) reduces queuing delay and jitter by suppressing the TCP flow synchronization

- Other AQMs don't do anything better

- GSP requires minimalistic effort in the fast path of a packet processor

- References:
  - **`draft-lauten-aqm-gsp-02.txt`**
  - W. Lautenschlaeger, A. Francini, "Global Synchronization Protection for Bandwidth Sharing TCP Flows in High-Speed Links," Proc. IEEE HPSR 2015, Budapest, Hungary, July 2015