The Local and Global Effects of Traffic Shaping

Massimiliano Marcon, Marcel Dischinger, Krishna P. Gummadi, and Amin Vahdat†
MPI-SWS †University of California, San Diego
mmarcon@mpi-sws.mpg.de

1. Motivation

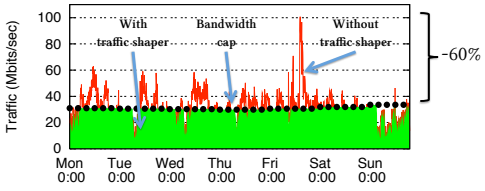
- **Traffic from bulk data applications is growing rapidly**
- **To reduce their rising transit bandwidth costs, ISPs are traffic shaping bulk flows**
- **Traffic shaping can reduce peak load**
  - Most ISPs pay for peak utilization
- **But, deployed policies are often blunt and sub-optimal**
  - e.g., bulk data apps are blocked or rate-limited 24/7
- **Further, the impact of traffic shaping policies on bulk flows is not well-understood**

2. Potential benefits of traffic shaping

- **Analysis of traces from access links of universities shows:**
  - Diurnal patterns with peak-to-trough ratio as high as 6
    - Peak utilization twice as high as the average utilization
  - A few bulk flows contribute significantly to the traffic
    - 0.5% of flows account for 68% of the bytes
    - ...and 87% of the peak bandwidth!
- **Idea: traffic shape bulk flows when utilization is high**
  - It is likely to have a large impact on peak utilization
  - It affects only a small fraction of flows

3.Findings

- **Can we achieve the optimal reduction in peak load while affecting bulk flows minimally?**



- Simple traffic shaping policies using 2 priority queues can help reduce peak bandwidth (~60%).

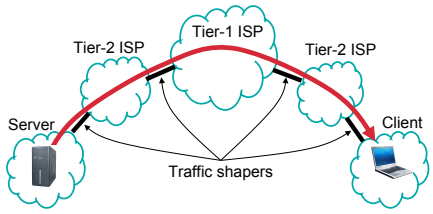
Simple traffic shaping technique (2 priority queues)		
Flow Size	Delay (90th perc.)	Killed flows / Total
10-40 MB	38 min	331 / 16675 (2%)
40-160 MB	3.3 hrs	145 / 5321 (3%)
>160 MB	10.3 hrs	94 / 1413 (7%)
All	1.8 hrs	570 / 23409 (2%)

- But, this comes at the cost of large delays in completion time for bulk flows, and some flows do not complete at all!

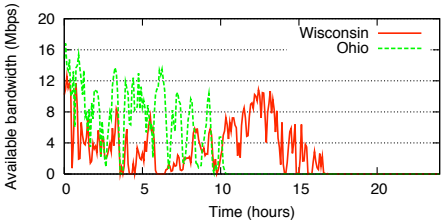
Multiple priority queues for bulk traffic		
Flow Size	Delay (90th perc.)	Killed flows / Total
10-40 MB	1.2 min	0 / 16675 (0%)
40-160 MB	26 min	0 / 5321 (0%)
>160 MB	7.5 hrs	24 / 1413(2%)
All	7.3 min	24 / 23409 (0.1%)

- Multiple priority queues fix the problem. 90th perc. delay drops below 8 minutes. Interrupted flows are reduced to a negligible fraction.

- **What are the global effects of local traffic shaping policies?**



- Every ISP along a path has an incentive to deploy traffic shaping on its access links.



- When multiple traffic shapers are active on a path, bulk flows along the path only get the minimum available bandwidth at any time.

Transfer size	Ohio	Wisconsin	Both
4 GB (DVD)	9.9 hrs	9.6 hrs	13 hrs
10 GB	12.1 hrs	12.7 hrs	1.5 days

Transfer size	1 zone UK - DE	6 zones UK - TX	12 zones UK - NZ
4 GB (DVD)	13 hrs	1.65 days	3.5 days

- As a result, multiple shapers, especially if located in different time zones, degrade throughput significantly.

4.Implications

- **Our findings suggest:**
  - ISPs have clear incentives to deploy traffic shaping to reduce their peak bandwidth consumption
  - However, as more ISPs deploy traffic shaping, the end-to-end performance of many bulk transfers will suffer
- **To preserve bulk transfer performance:**
  - One could use a different pricing model (e.g., per-byte charging model)
  - Alternatively, we could rethink routing of bulk transfers (e.g., deliver data hop-by-hop as capacity becomes available)