CS 268: Router Support for Congestion Control

Ion Stoica February 13, 2003















Problems with RED

No protection: if a flow misbehaves it will hurt the other flows

Example: 1 UDP (10 Mbps) and 31 TCP's sharing a 10 Mbps link

10 13 16 19 22 25 28 31 Flow Number istoica@cs.berkeley.edu

11

RED

. 10

UDP

Throughput(Mbps)

0.

4 7 1



Queue Size — Avg. Queue Size —

8

10

5 6

25

20

15 Number o

8 9 10

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Round-Robin Discussion

- Advantages: protection among flows
 Misbehaving flows will not affect the performance of wellbehaving flows
 FIFO does not have such a property
- Disadvantages:
 - More complex than FIFO: per flow queue/state
 - Biased toward large packets a flow receives service proportional to the number of packets (When is this bad?)
 - proportional to the number of packets (When is this bad?)

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13

15

Solution?

- Bit-by-bit round robin
- Can you do this in practice?
- No, packets cannot be preempted (why?)
- ...we can only approximate it

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14

16

Fair Queueing (FQ) [DKS'89]

- Define a fluid flow system: a system in which flows are served bit-by-bit
- Then serve packets in the increasing order of their deadlines
- Advantages

- Each flow will receive exactly its fair rate

- Note:
 - FQ achieves max-min fairness

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Max-Min Fairness

- Denote
 - C link capacity
 - N-number of flows
 - r_i arrival rate
- Max-min fair rate computation:
 - 1. compute C/N
 - 2. if there are flows *i* such that $r_i \le C/N$, update C and N

$$C = C - \sum_{i \text{ s.t } r_i \leq C} r_i$$

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- if no, f = C/N; terminate
 go to 1
- A flow can receive at most the fair rate, i.e., min(*f*, *r*_i)

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