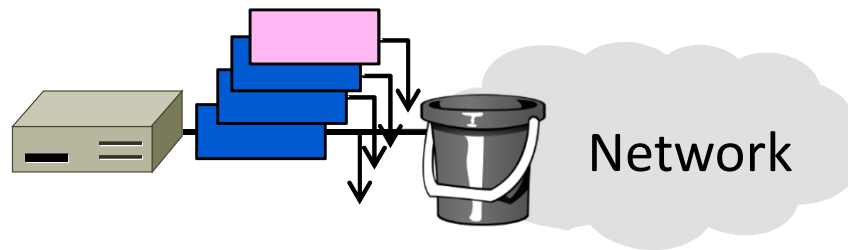# Computer Networks

Traffic Shaping (§5.4.2)

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Topic

- Shaping traffic to constrain bursts
  - Token buckets
   - Key building block for QOS

Motivation

- Shaping traffic flows constrains the load they may place on the network
    1. Limiting the total traffic enables bandwidth guarantees
    2. Limiting bursts avoids unnecessary delay and loss

- How should we shape traffic?
   - Real apps generate varying traffic – unrealistic to smooth it out

Motivation (2)

- Flow A and flow B have the same average rate
  - → 1 Mbps over 3.5 secs
  - But they have very different behaviors!

- Average rate alone is not a good descriptor of behavior ...
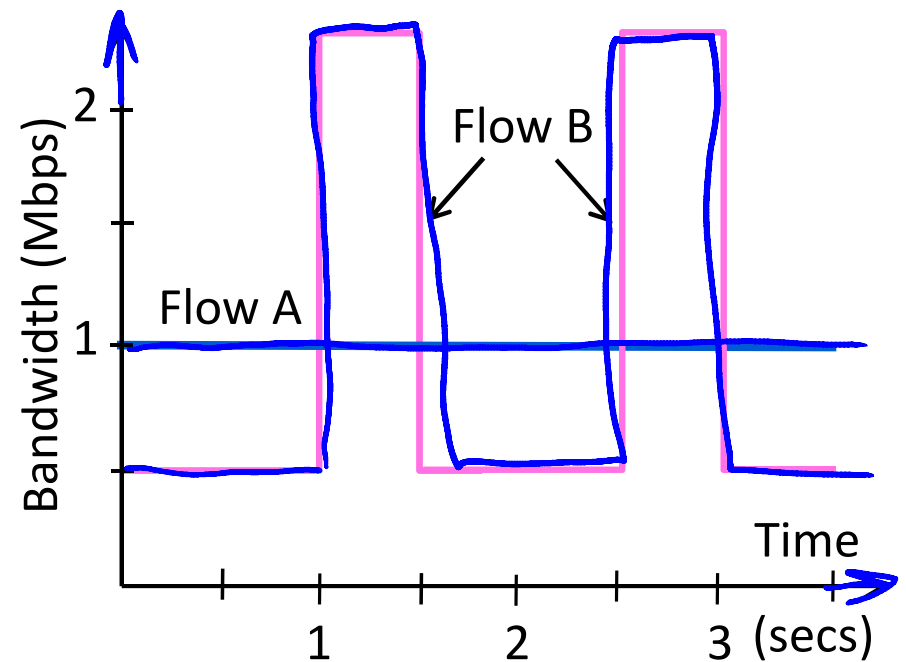
Motivation (3)

- How should we describe traffic flows to the network?
  - Average rate matters; relates to long-term bandwidth
  - Burstiness also matters; relates to short-term bandwidth

- Two characteristics useful
  - More expressive than average
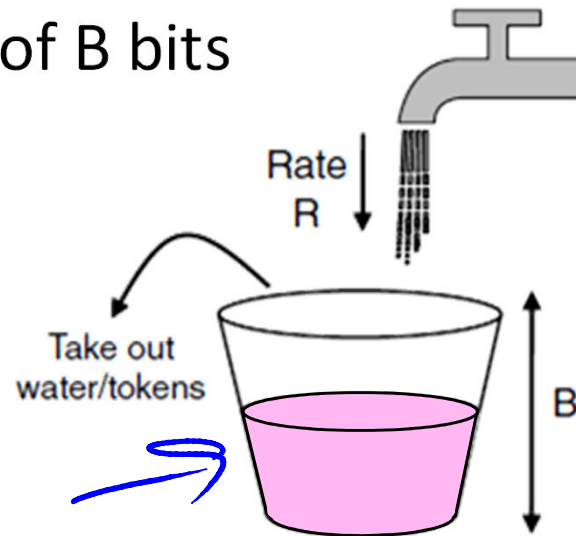 - Still relatively simple
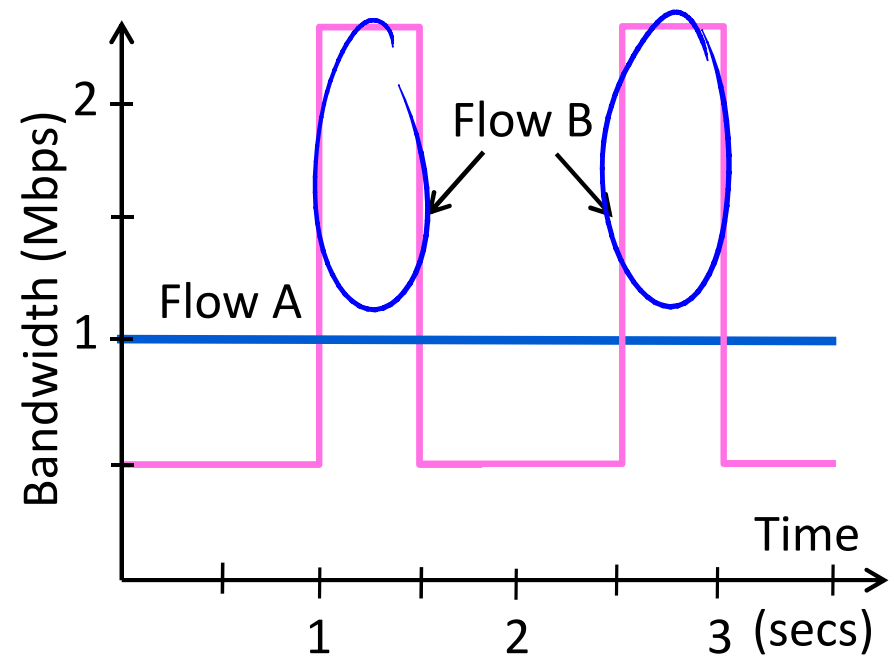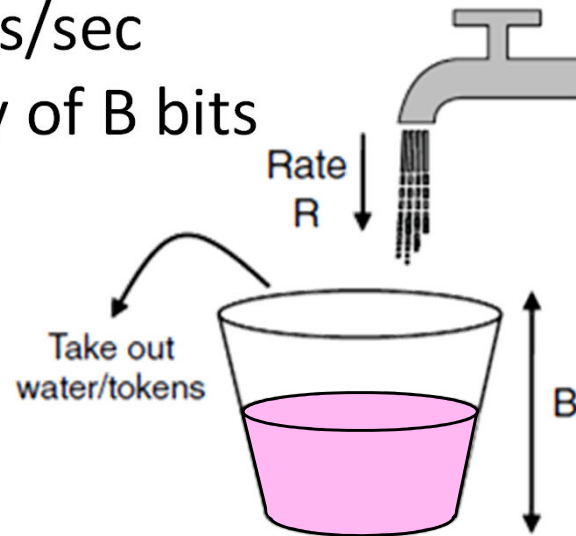
Token Bucket

- (R, B) token bucket constrains:
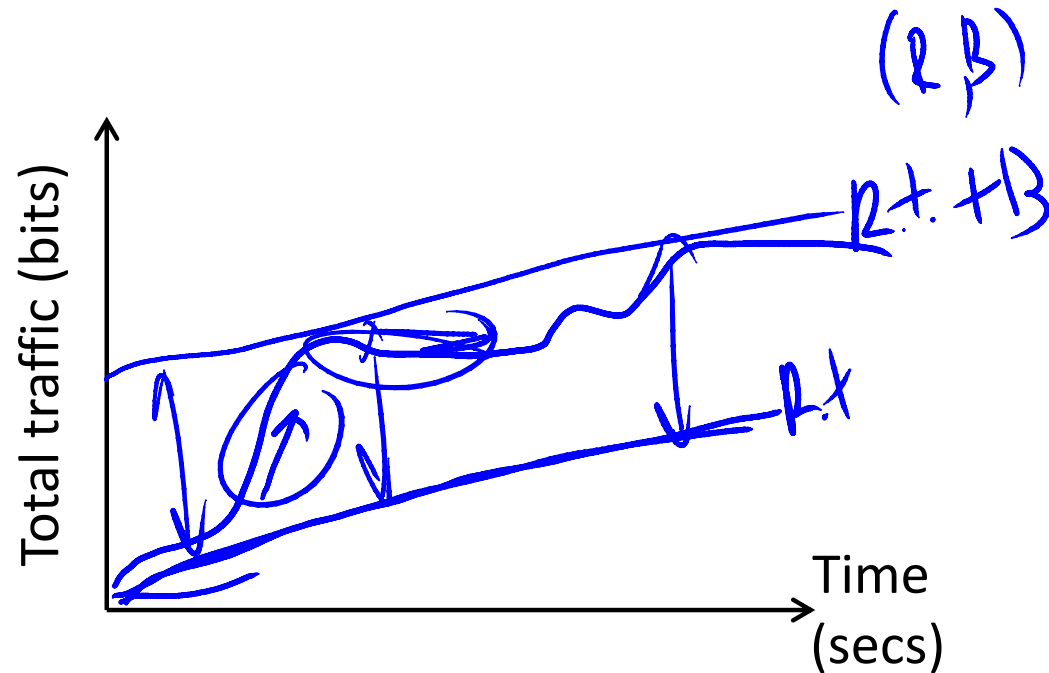 - Average rate of R bits/sec
  - Bursts (over R) of B bits

Rate
R

Take out
water/tokens

B

Token Bucket (2)

- Sending removes tokens (or credits) from the bucket; no credit, no send
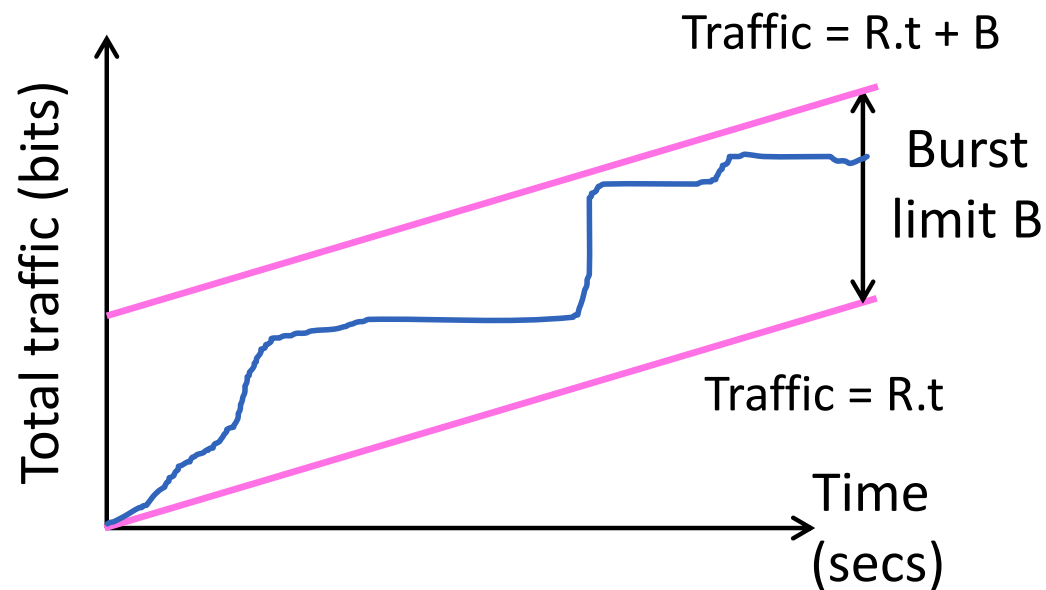 - Fill rate of R bits/sec
  - Bucket capacity of B bits

Rate
R

Take out
water/tokens

B

Token Bucket (3)

- Constrains greatest traffic over time

$(R\ B)$

$R \cdot t \cdot + B$

$R \cdot t$

Total traffic (bits)

Time
(secs)

Token Bucket (4)

- Constrains greatest traffic over time

Traffic = R.t + B

Total traffic (bits)

Burst limit B

Traffic = R.t

Time (secs)

Shaping vs. Policing

- Shaping modifies traffic near the source to fit within an (R, B) profile
  - Run (R, B) token bucket at the source
  - Pass sent packets to the network when there are tokens
  - Delay (queue) packets while more tokens arrive

- Lets user condition their traffic to meet the network contract

Shaping vs. Policing (2)

- Policing verifies that traffic within the network fits an (R, B) profile
  - Run (R, B) token bucket at network edge
  - Let packets into the network when there are tokens
  - Demote or discard packets when there are insufficient tokens

- Lets network check traffic to verify it meets the user's contract

Usage for QOS

- Token buckets help the user and network regulate traffic for QOS

  - Network can limit the traffic for preferential treatment

  - User can flexibly select that traffic

- Special treatment is implemented with other means such as WFQ

END