Rate Based Congestion Control for the Internet

(work in progress)

Rui Zhang-Shen, Nandita Dukkipati, Nick McKeown
{rzhang, nanditad, nickm}@stanford.edu
Electrical Engineering Department
Stanford University

Internet Congestion Control

Goals of a congestion control scheme:

– Limit flow rates to avoid "congestion"

– Use the network resources efficiently to minimize flow durations

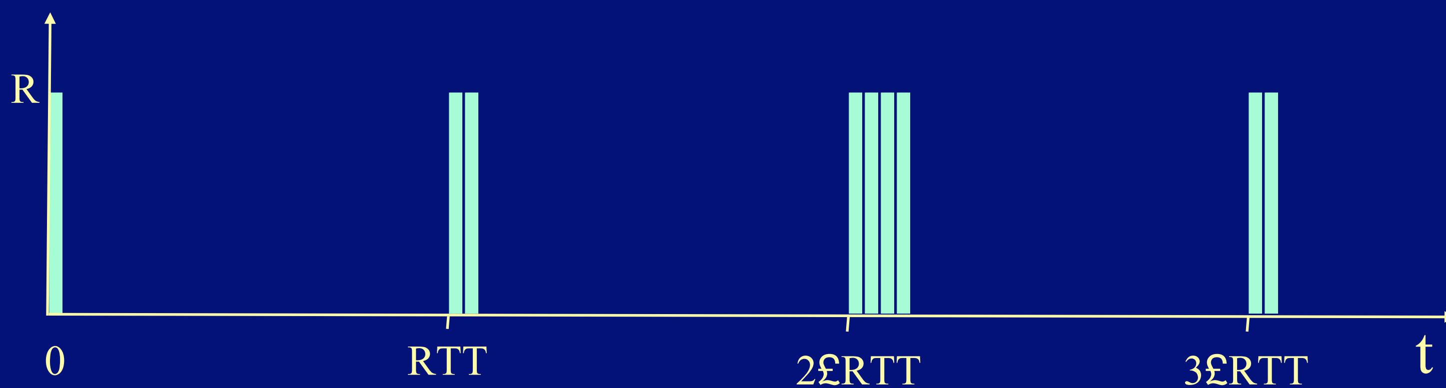
– Ensure fairness in resource allocation among flows

Problem Statement

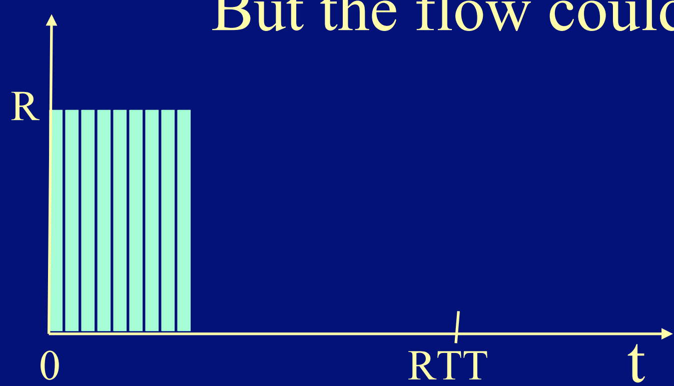
- Finding congestion control scheme for high bandwidth Internet
  - Link capacities will continue to increase
  - Flow sizes remain relatively constant
  - More and more flows could finish within a round-trip time (RTT)
- Current congestion schemes:
  - Feedback based
  - Force flows to last multiple RTTs
- Short flows: flow size / link capacity << RTT

Example: A Short Flow

TCP Congestion Control



But the flow could finish within one RTT!



Our Scheme for Congestion Control

- Open loop based:
  - No feedback
  - Flow rate determined at start by interaction between routers and end-host
- Flow/user centric instead of packet centric
- Fair amongst flows: flows have same rate
- Minimize response times

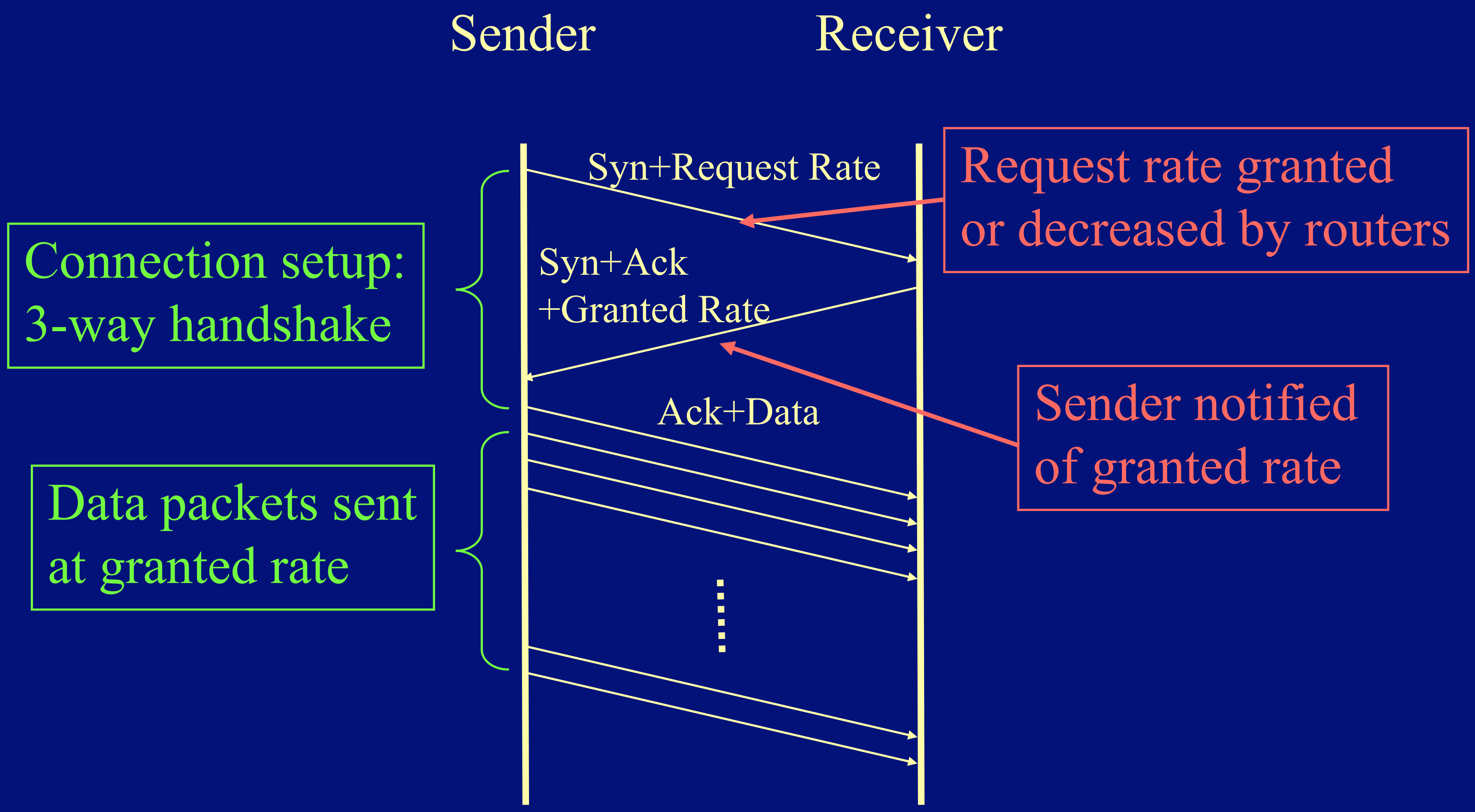
Assumptions

- Network consists of short flows only
- Flows arrive according to a Poisson Process
- Flow sizes are independent and identically distributed

Goals of Our Scheme

- With high flow rate and finite buffer
  - Probability that router is overloaded is large
  - High chance of queue overflow
- We want our scheme to:
  - Alleviate these undesirable effects
  - Provide low flow response time
  - At the same time, be fair amongst flows

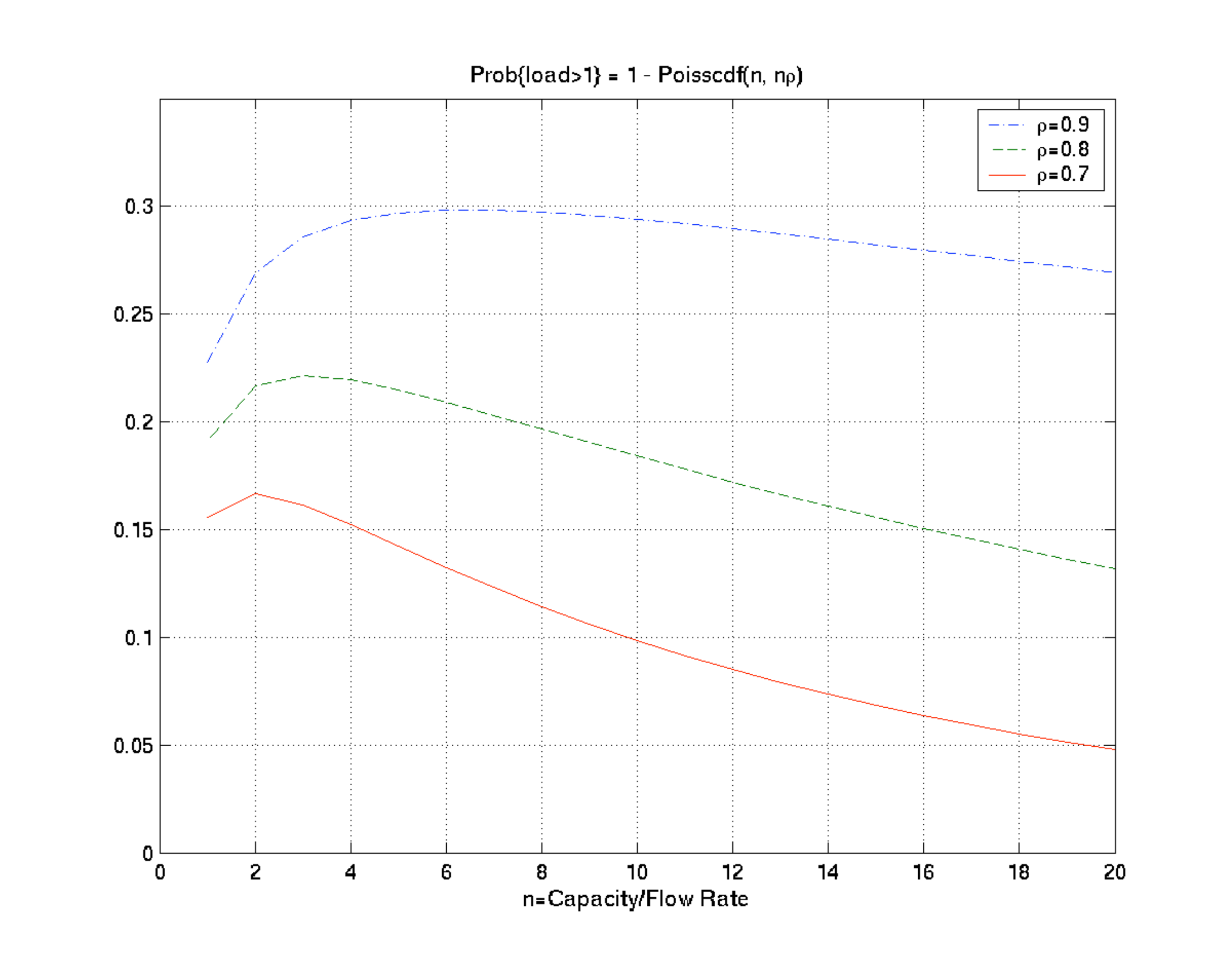
Rate Control Protocol (RCP)



Rate Control Protocol: Router

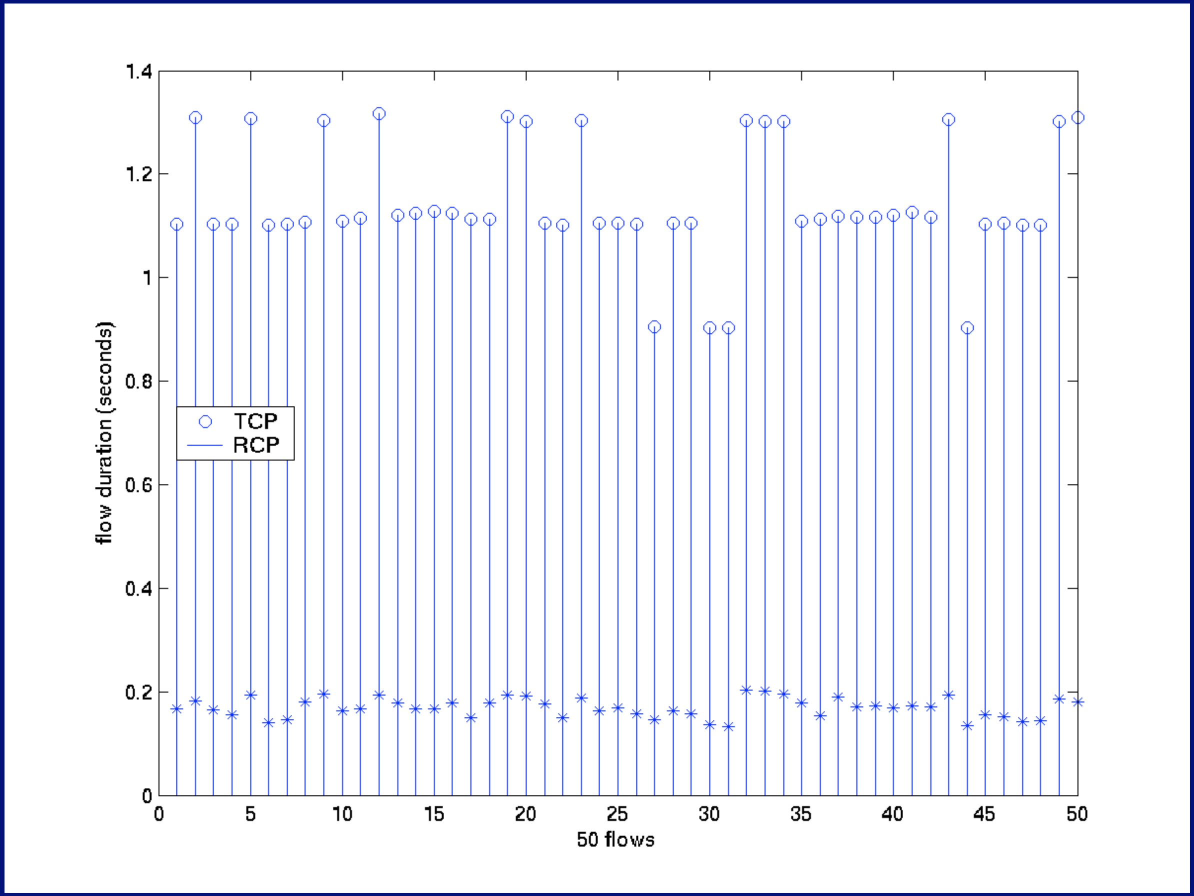
- Router grants 1/n of its capacity to each flow
- This provides fairness amongst flows
- Choosing n is a tradeoff between
  - Buffer requirements
  - And flow response time

How to Choose “n”



□: average load; Poisscdf(x,□): cdf of Poisson(□) evaluated at x.

Simulation Comparison of TCP and RCP



Single bottleneck link of 100Mb/s; RTT=200ms; =0.8; *n*=8; flow size~Uniform[50, 150]kB

Prob{overload} matches theoretical value in simulation