

Computer Networks

COSC 6377

Lecture 9

Fall 2011

September 21, 2011

Announcements

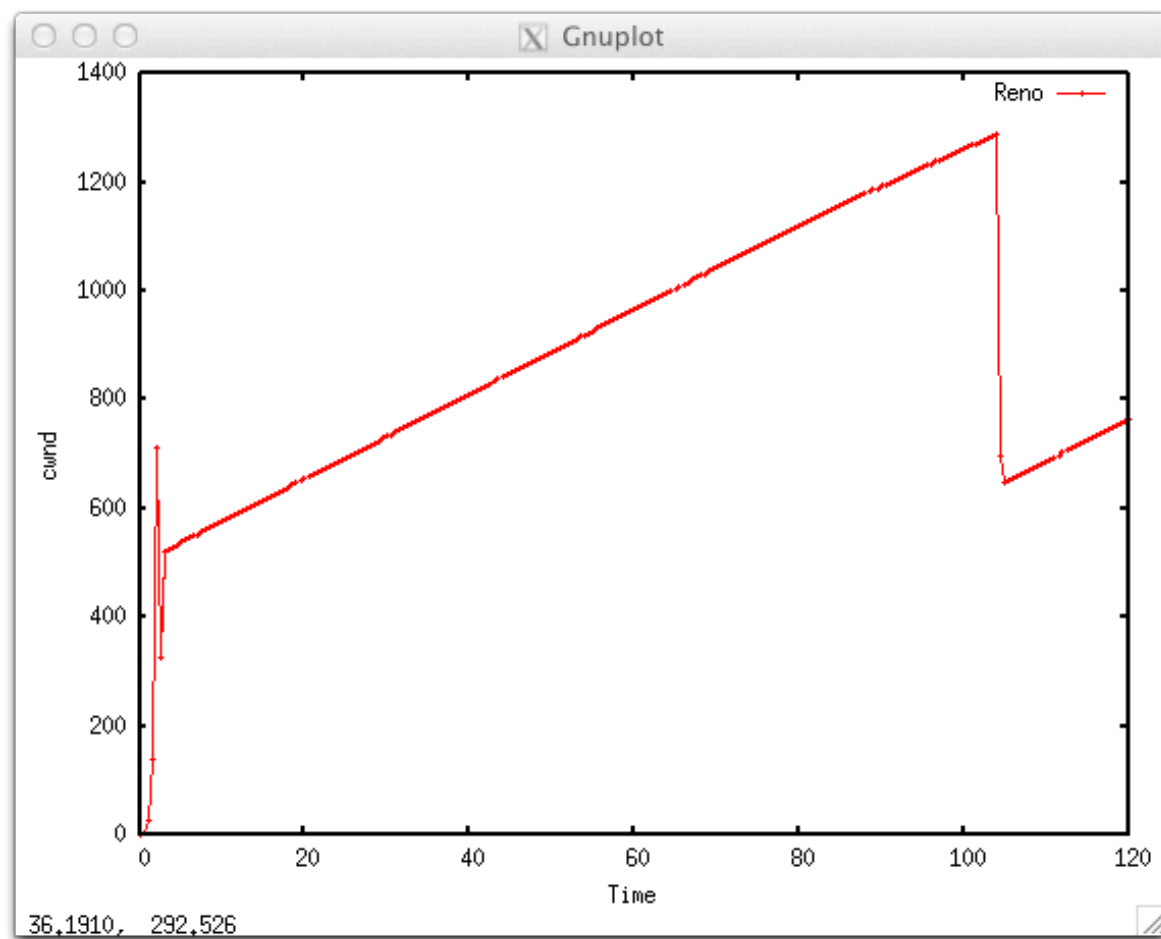
- Additional office hours on Tuesday (one day before the exam)
- P2 discussions on Monday

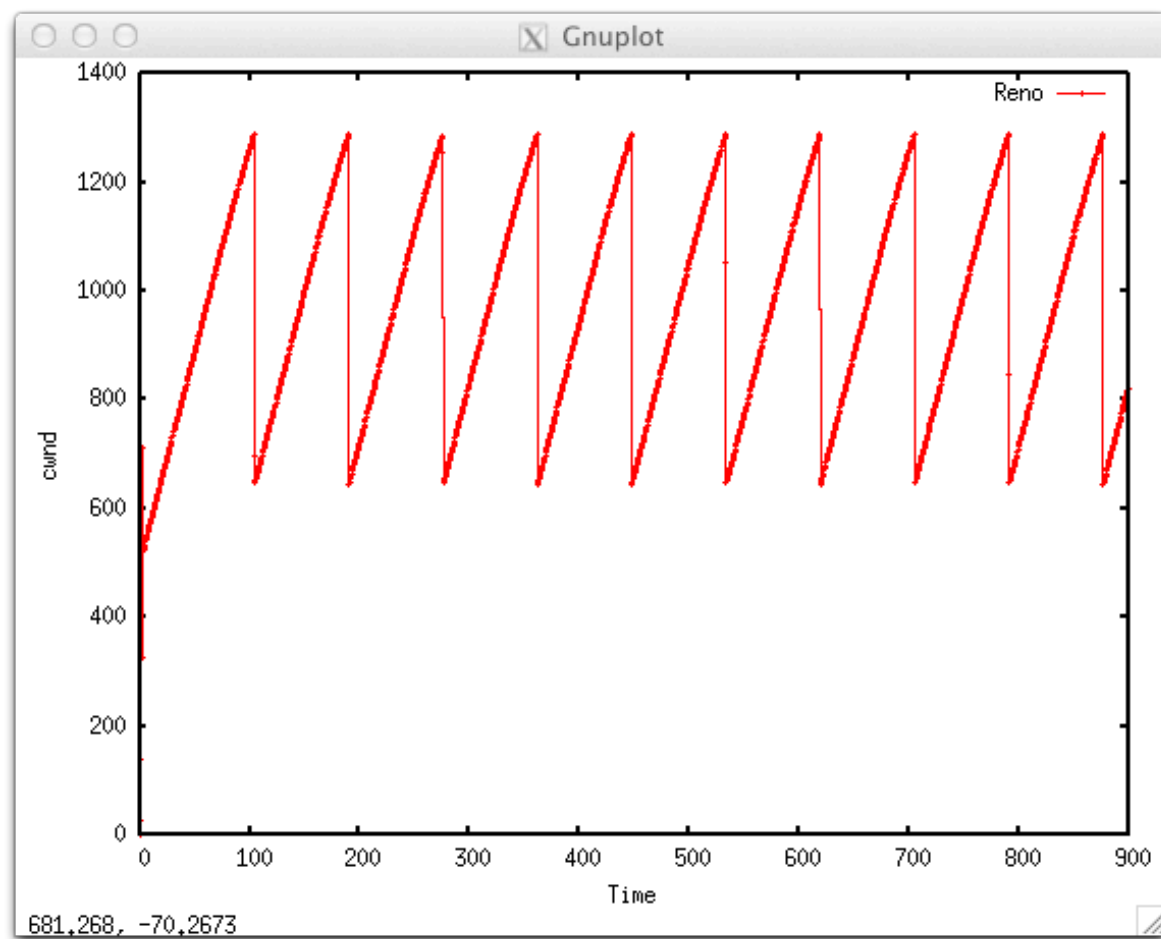
High Speed Data Transfer

- Internet applications are becoming data-intensive
 - Links today have large bandwidth
 - Short and long links
- Why do we care about bandwidth-delay product?
- If we want the link to be fully utilized, how many in-flight packets do we want?

TCP Reno Review

- Takes a long time to increase cwnd
- If there are some packet drops in between, we incur this delay multiple times within a session





BIC-TCP

- Binary search within min and max window
- Min = cwnd prior to packet loss
- Max = cwnd with packet loss

cwnd at t1



No packet loss

cwnd at t2



Some packet lost

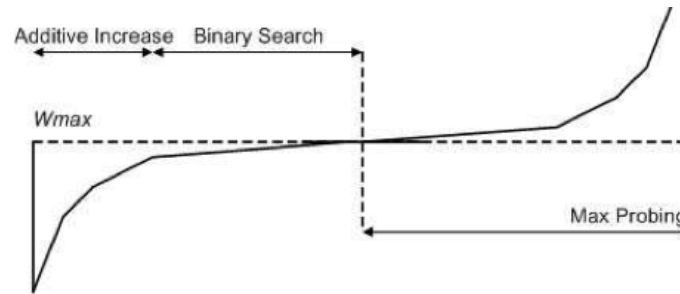


“correct” cwnd must
be somewhere here

Stability vs Agility

- Increase is larger when farther away from the capacity
- What happens if the capacity increases after the last packet loss?
- What happens if the capacity decreases after the last packet loss?

BIC – TCP Window Growth

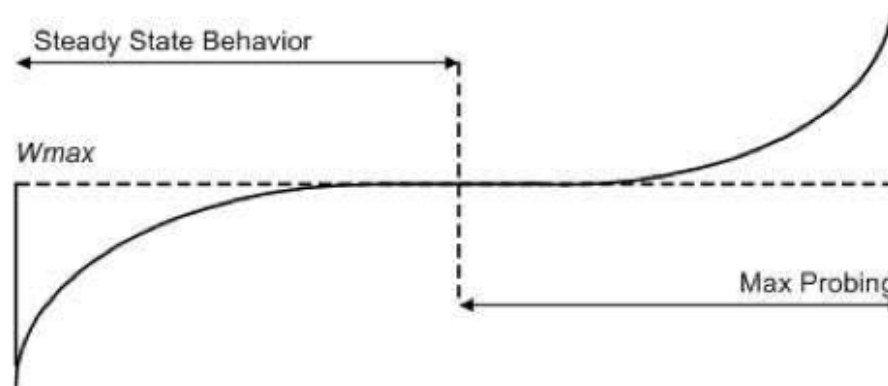


(a) BIC-TCP window growth function.

From
Ha08

- Four phases during growth
 - Additive increase (S_{max}) followed by logarithmic increase (binary search)
 - Exponential increase followed by additive increase
- CUBIC simplifies the mechanisms

CUBIC



From
Ha08

- Replace different phases with a cubic function
- Concave and convex regions

Cubic Window Growth Function

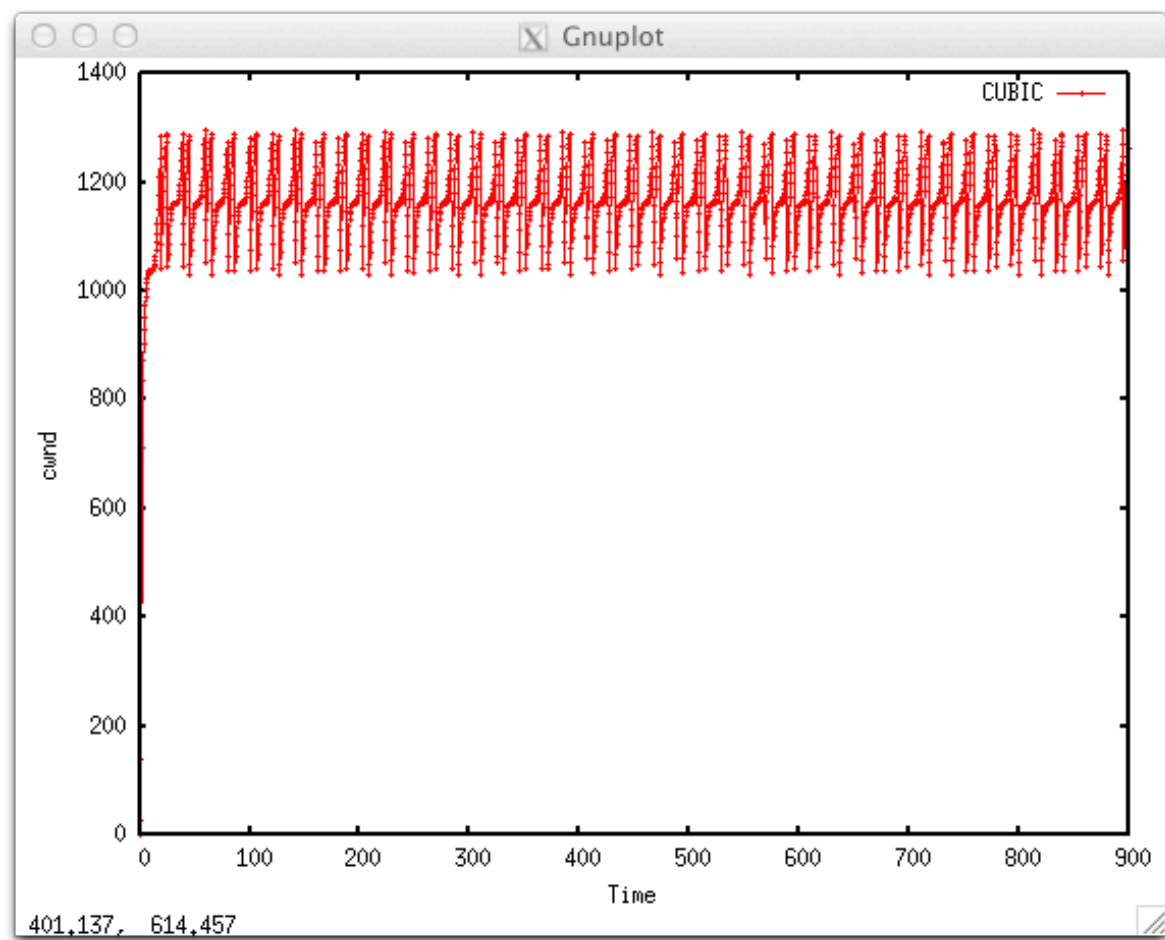
$$f(x) = ax^3 + bx^2 + cx + d$$

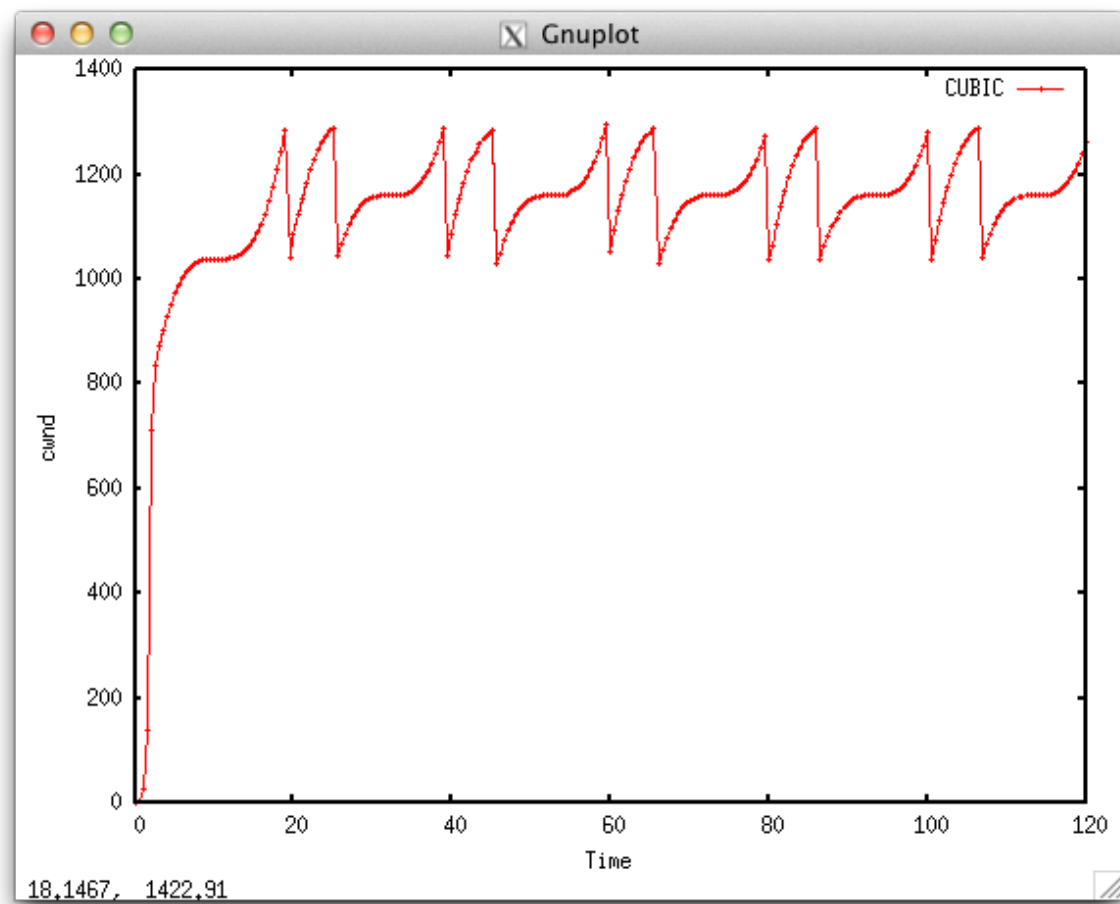
$$W(t) = C(t-K)^3 + W_{\max}$$

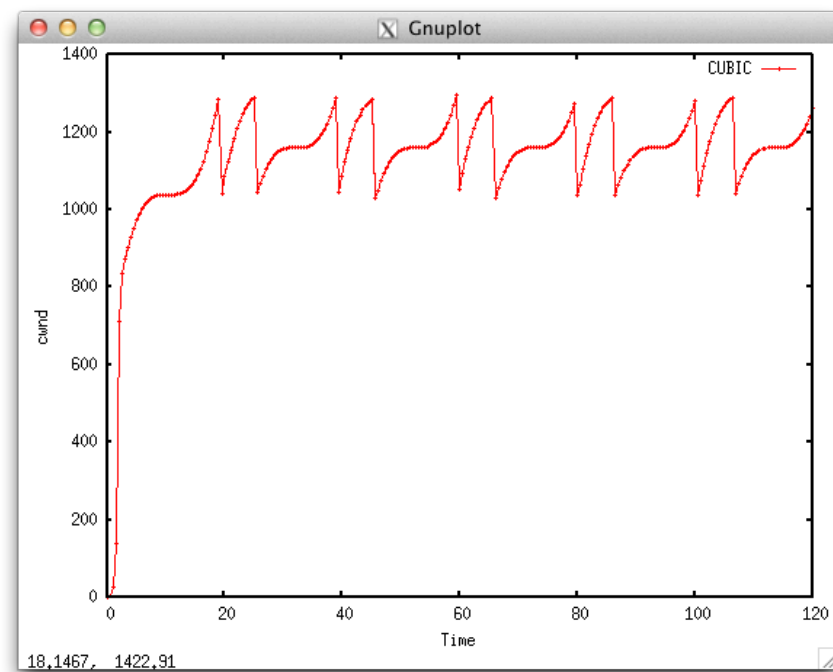
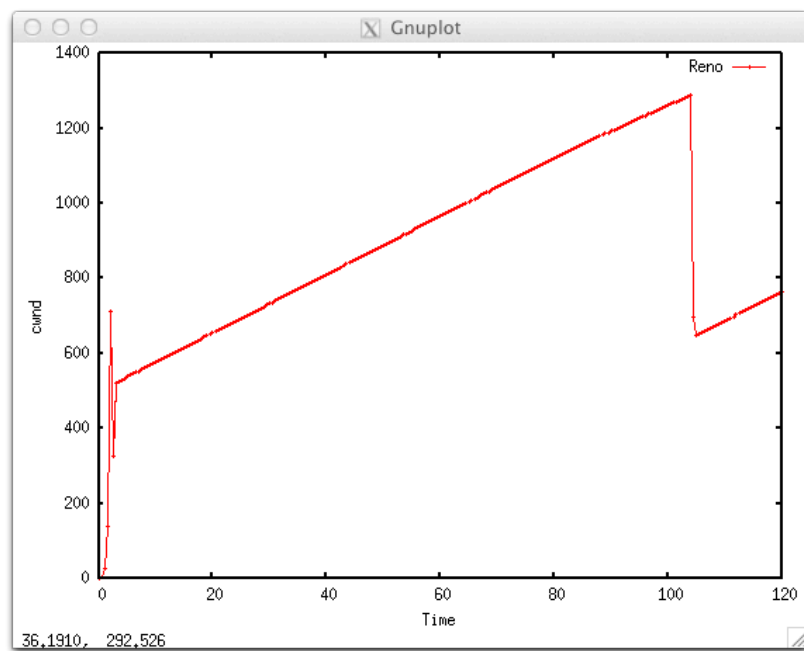
$$K = \sqrt[3]{\frac{W_{\max} b}{C}}$$

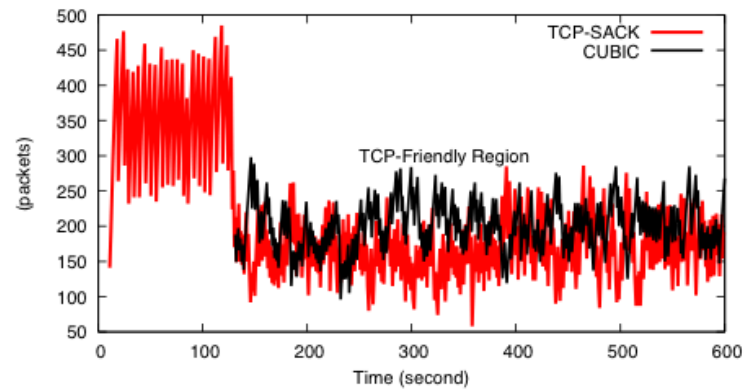
Regions of Window Adjustment

- TCP Friendly region
 - How do we know we are in this region?
- Concave region
- Convex region
- Multiplicative decrease
- Fast Convergence
 - How do we know we should go into this region?

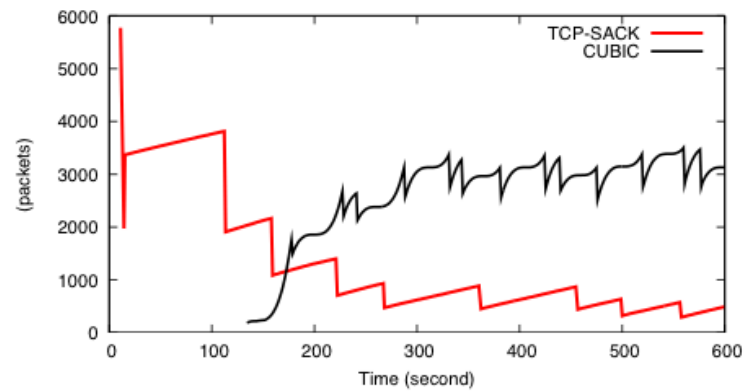






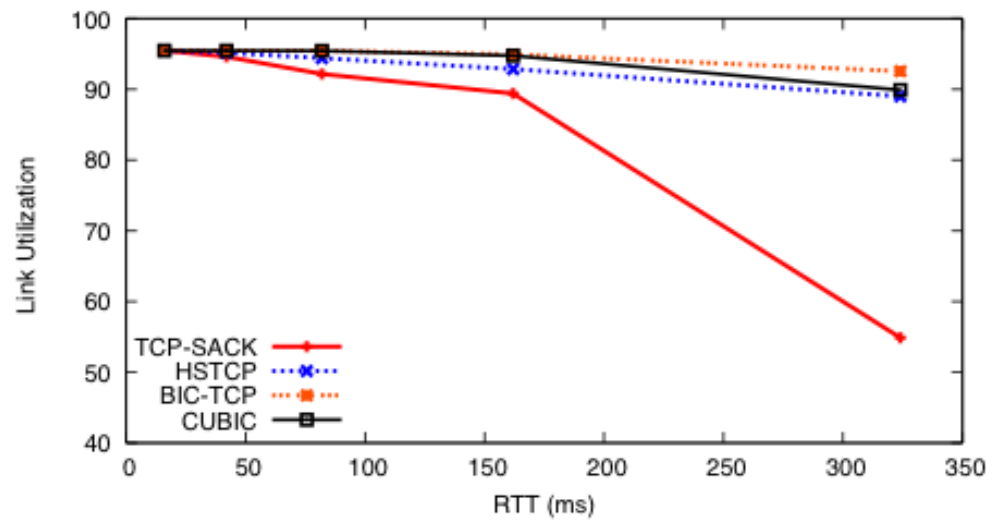


(a) RTT 8ms.



(b) RTT 82ms.

From
Ha08



From
Ha08

Sender1

Receiver1



Sender2

Receiver2

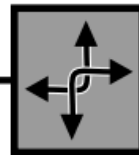
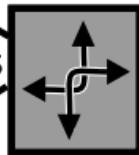


1Gb/s

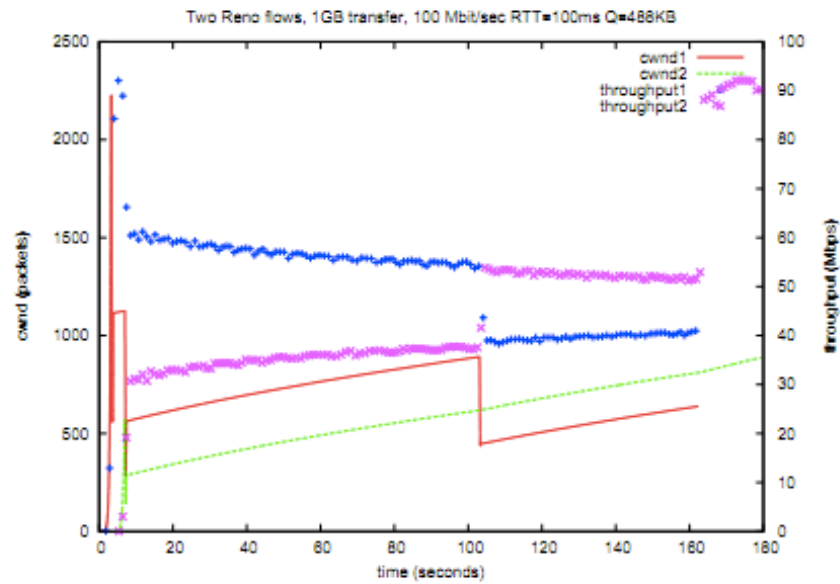
100Mb/s

1Gb/s

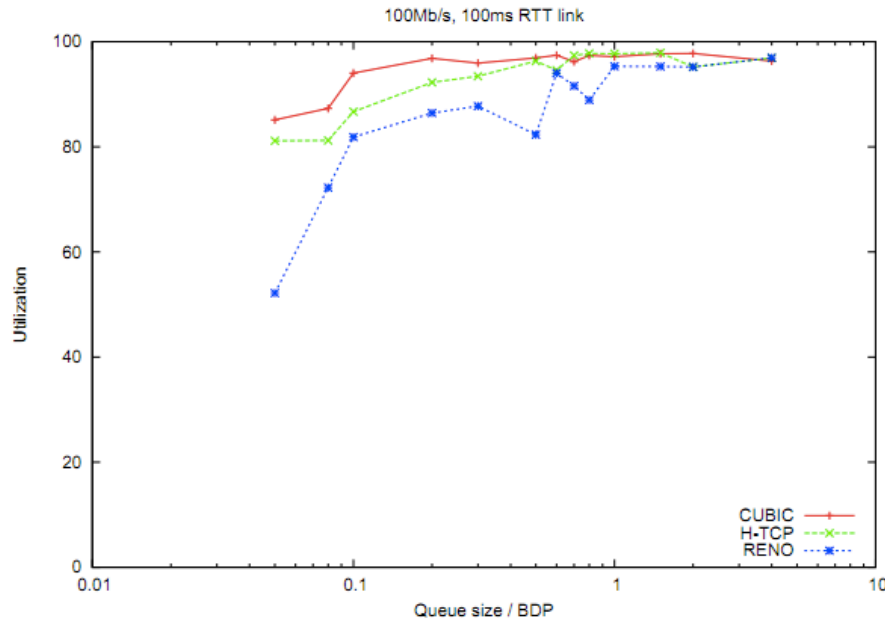
100ms



From
Hemminger07



From
Hemminger07



From
Hemminger07

- Why larger buffer leads to more utilization?
- What happens if the buffer is too large?