The Effects of Active Queue Management on Web Performance

From the dept of CS, UNC, Chapel Hill

Sigcomm, Sep 2003

Offense : Santa

Preparation Outline

- Found out: Sigcomm 2003 best paper
  - Best Paper in Best Conference
- Tried to talk Andreas to trade places
  - Santa: Everyone does 1 offense and 1 defense
  - Andreas: Says who? Eugene assigned
  - Santa: Rice tradition. Both of you are new
- Started reading papers and googling

I Digress…

- But, I have a point to make
- Sigcomm 2001: Outrageous Opinion Session
  - Tips from a Networking Insider: Stefan Savage

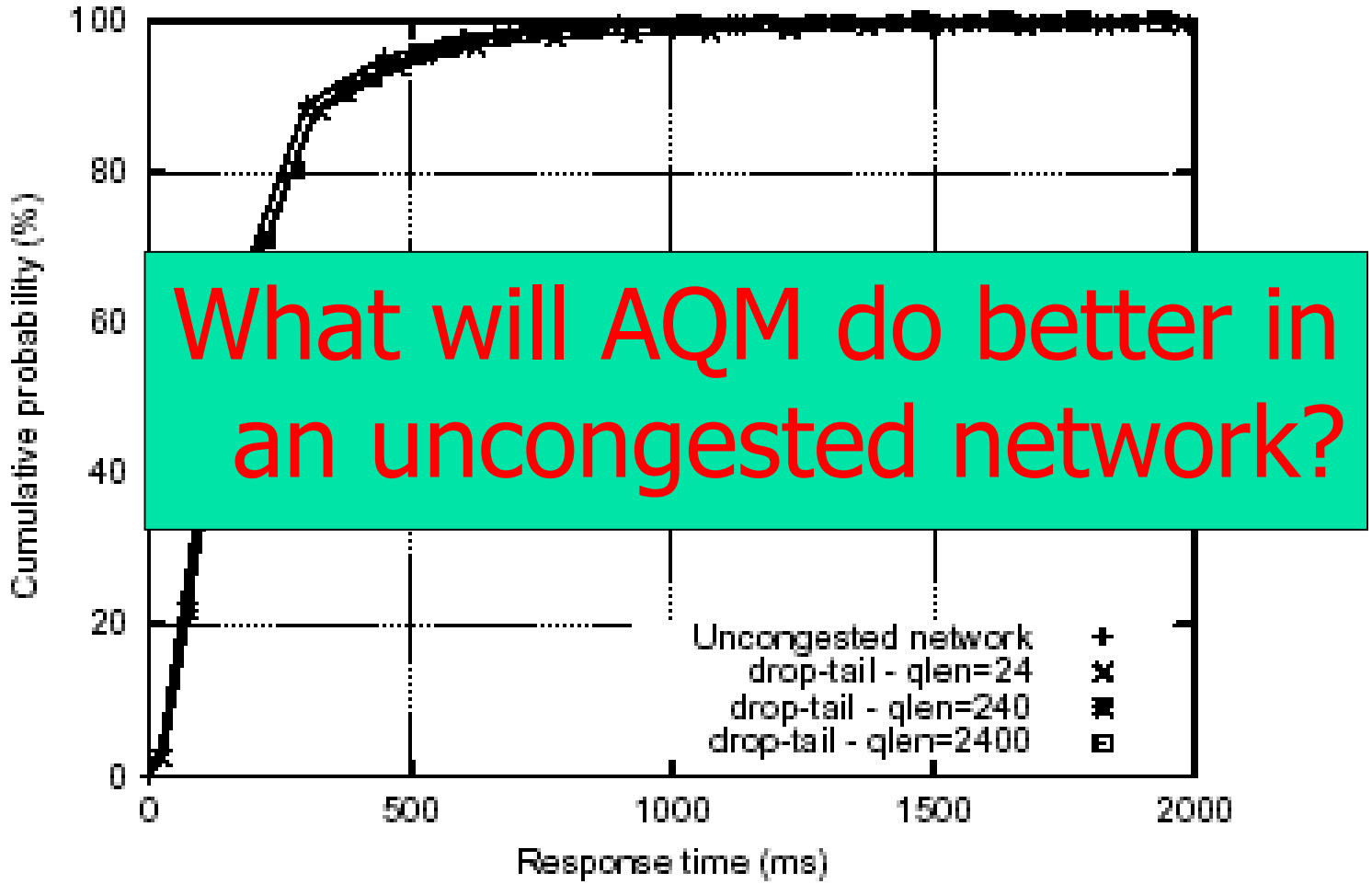
Presentation Outline

- The major results
  - And my grudge
- My other grudges

Major Result - I

- For offered loads up to 80% of bottleneck capacity, no AQM scheme provides better response times than simple drop-tail FIFO queue

80% load means uncongested



What will AQM do better in an uncongested network?

Figure 5: Drop-tail performance, 80% offered load.

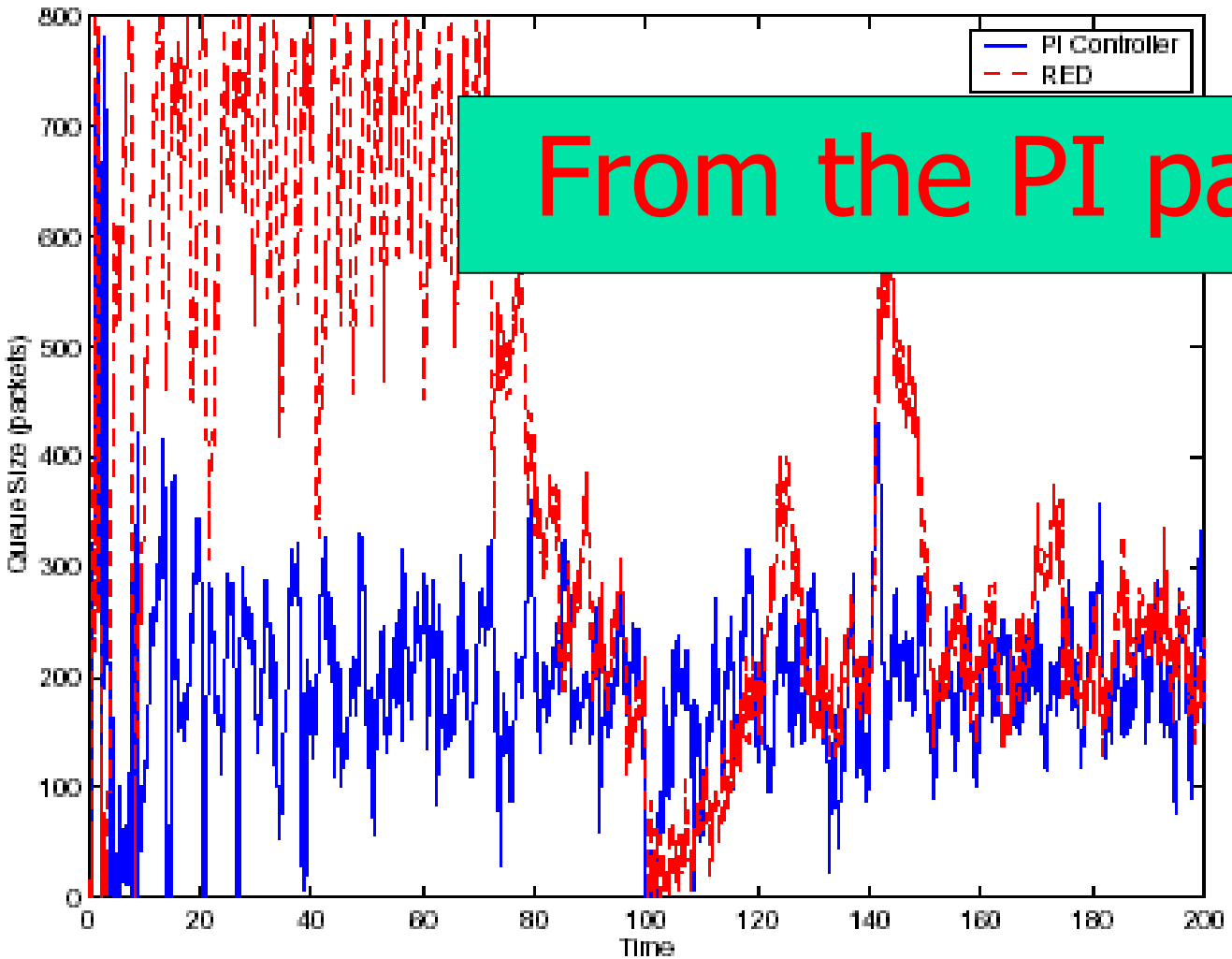
Major Result - II

- For loads of 90% link capacity or greater when ECN is not used, PI results in modest improvement over drop-tail and other AQM techniques

PI is cool

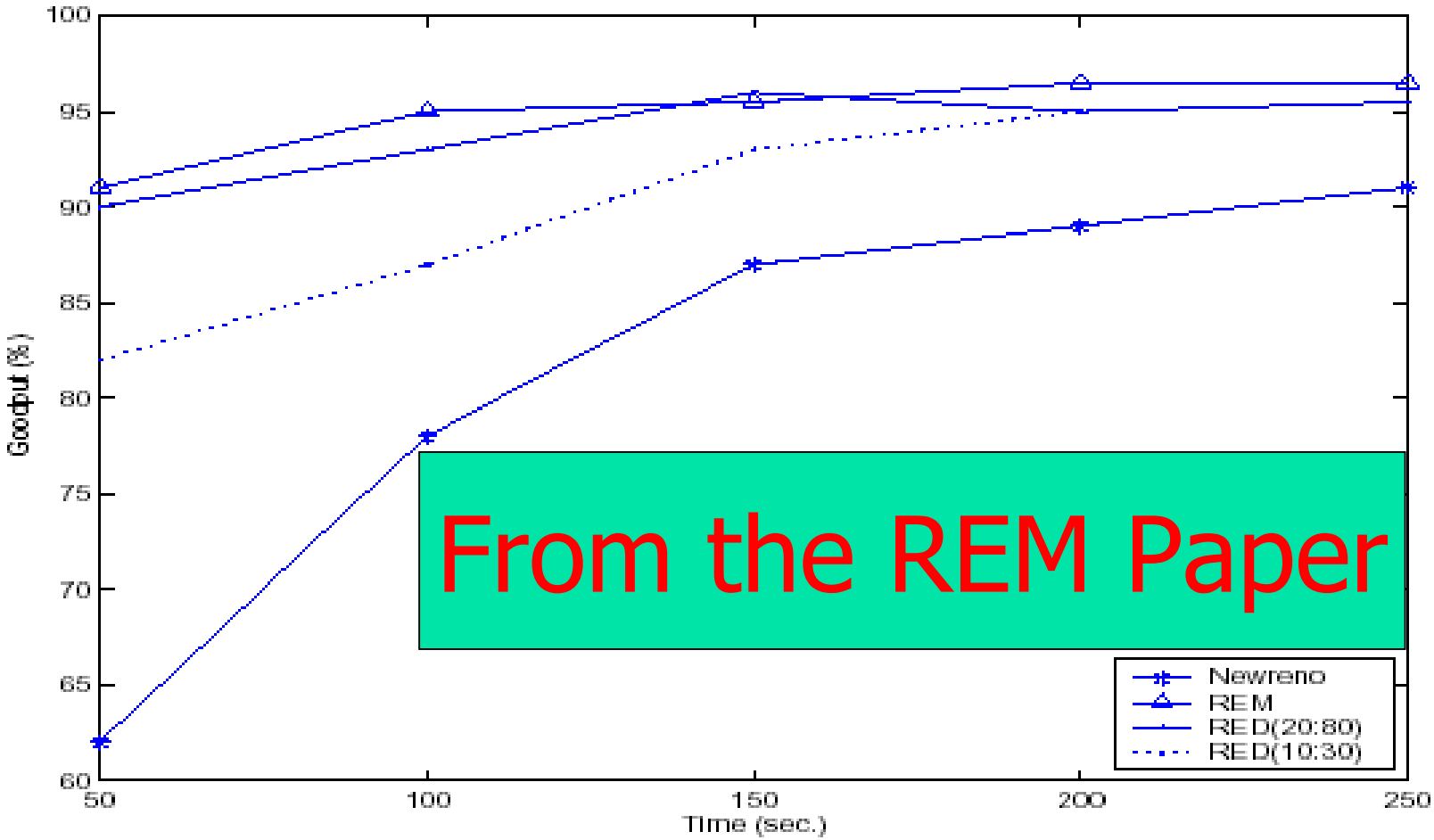
- This unfortunately was analyzed, simulated, implemented and shown in every way possible by the PI designers in Infocom, 2001
- Why bother?

Comparing: PI with RED



From the PI paper

Comparing: REM with RED



Major Result - III

- With ECN, both PI and REM provide significant response time improvement at offered loads above 90% link capacity

Importance of ECN

A. The importance of ECN

It is critical for the success of any AQM scheme that attempts to control the router queue that it be used in conjunction with ECN [17]. For instance, the PI controller can regulate queue length to a low level. This results in a lower delay than a corresponding drop-tail system. However, when dropping instead of marking packets, this may not result in more efficient performance, especially in the case of short lived flows.

From the PI paper

Major Result - IV

- ARED with recommended parameter settings consistently resulted in the poorest response times

Goals of AQM

- Primary goals
  - Controlled average queuing delay
  - Maintain high link utilization
- Secondary goals
  - Improving fairness
  - Reducing global synchronization
  - Accommodating transient congestion

RED on Web Traffic

- M. Christiansen, K. Jeffay, D. Ott, and F.D. Smith, Tuning RED for Web Traffic, ACM SIGCOMM, August 2000.
  - "We conclude that for links carrying only web traffic, RED queue management appears to provide no clear advantage over tail-drop FIFO for end-user response times”
- Same as Major Result #4, albeit 3 years before

A Recommendation

- RFC-2309: Recommendations on Queue Management and Congestion Avoidance in the Internet
  - Authors: B. Braden, D. Clark, J. Crowcroft, B. Davie, S. Deering, D. Estrin, S. Floyd, V. Jacobson, G. Minshall, C. Partridge, L. Peterson, K. Ramakrishnan, S. Shenker, J. Wroclawski, L. Zhang
- Internet routers should implement some active queue management mechanism to manage queue lengths, reduce end-to-end latency, reduce packet dropping, and avoid lock-out phenomena within the Internet. The default mechanism for managing queue lengths to meet these goals in FIFO queues is Random Early Detection (RED) [RED93]. Unless a developer has reasons to provide another equivalent mechanism, we recommend that RED be used.

RED Deployment

- RED is deployment in a lot of today's routers
  - Most simple and efficient scheme
- "Most current core routers are enabled with RED queue management algorithms"
  - Cisco Systems, "Technical specification from cisco, *random early detection on the cisco* routers".
- Would Juniper & Cisco deploy a new technology without convincing proof of benefit?

RED Parameter Setting

- May M., Bolot J., Diot C., and Lyles B., Reasons not to deploy RED, TR-June '99.
  - Parameter tuning in RED remains an inexact science."
- Floyd, S., RED: Discussions of Setting Parameters
- Showing bad performance of RED for some parameter setting does not prove anything
- More research may be needed

RED parameters in this paper

- How did the authors come to the shown parameter setting if RED?
  - Admittedly an inexact science
- What about byte mode? Why did they not try it?
  - Were they just out to prove RED is BAD

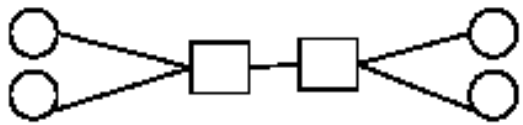
Presentation Outline

- Other grudges

Evaluation Criterion

- "These conclusions are based on a premise that user-perceived response times are the primary yardstick of performance"
- Not the primary or secondary goals of RED

Experimental Methodology

- 2 ISP Networks. 1 peering link
  - A realistic topology 
  - Carries solely web traffic between sources and destinations on both sides
  - Equally balanced in both directions

Traffic Scenario

- Experiments using only HTTP Traffic model
  - Why not a realistic mix non-HTTP traffic
- Specially, as RED was previously shown to work not so well with web traffic

Queue Sizes

- Viola… Some magic numbers
  - 24 & 240
- What about a range of numbers maybe?

Conclusion

- Sigcomm decided to accept different sort of papers than it traditionally accepts
  - Savage jokes hurt too much
- What better way to prove than give best paper award to a "RED is bad" paper
- Paper is a well-written good comparison paper….. But, Best Paper Award?