Quantifying the Effects of Recent Protocol Improvements to TCP: Web Performance

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Conventional Wisdom vs. Our Findings

• TCP SACK is better than TCP Reno
  not
• RED is better than Drop Tail
  not clearly
• ECN is better than dropping
  clearly

Why Different?
• complex traffic model
• focus on web performance
• large range of RTTs
• two-way congestion
Evaluation

TCP

- TCP Reno
  - cumulative ACKs

- TCP SACK
  - selective ACKs
  - lets sender infer which packets were lost
  - helps avoid timeouts

Evaluation

Queuing

- Drop Tail
  - high loss with bursts of packets

- Adaptive RED
  - Random Early Detection
  - lowers queue size

- Adaptive RED with ECN
  - Explicit Congestion Notification
  - marks instead of drops
Network Setup

RTTs vary from 1 ms to 3.5 seconds

Simulation Setup

- **ns-2**
  - two-way web traffic
    - Bell Labs HTTP model
  - 250,000 request-response pairs
  - offered loads of 50-105% of 10 Mbps link
  - each TCP paired with each queuing mechanism

- **Main Performance Metric**
  - HTTP response time - time between sending HTTP request and receiving HTTP response
  - no major differences below 80% load
Drop Tail: Reno vs. SACK
80% and 105% load

No difference between Reno and SACK

Drop Tail vs. Adaptive RED
80% and 105% load

Tradeoffs between Drop Tail and ARED
ARED vs. ARED+ECN
80% and 105% load

ECN beats dropping

Drop Tail vs. ARED+ECN
80% and 105% load

Tradeoffs between Drop Tail and ARED+ECN
Our Findings

For HTTP Traffic

- No benefit to using SACK over Reno
  ♦ not enough flows can take advantage of SACK

- Complex tradeoffs exist when comparing Drop Tail and ARED (even with ECN)

- ARED with ECN performs better than ARED with dropping
  ♦ drops cause retransmissions, which only increases response times

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