DSRED: Improving Performance of Active Queue Management over Heterogeneous Networks

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Queue Management

- Passive
  - No preventive packet drop until buffer reaches a threshold when packets are dropped with probability of one
  - Examples:
    - Tail Drop
    - Drop from Front
    - Pushout

- Active
  - Preventive random packet drop
  - Example: Random Early Detection
  - Suggested by IETF (RFC 2309)
Random Early Detection (RED)

- **Uses**
  - four parameters: min_th, max_p, w, max_drop
  - average queue size

- **Solves**
  - Global synchronization problem
RED Gateway Buffer

Aggregated TCP Traffic

Drop

Max_th Min_th

Drop Probability

Max_drop

Min_th Max_th

Average queue size

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For Each Packet Arrival

Calculate the average queue size $\text{avg}$

If $\text{Min\_Threshold} \leq \text{avg} < \text{Max\_Threshold}$

Calculate probability $p$

with probability $p$:

Mark the arriving packet

else if $\text{Max\_Threshold} \leq \text{avg}$

Mark the arriving packet
Shortcoming of the RED Algorithm

- Low throughput
- Large delay
- Unfairness to connections
Previous work

- RED with aggregate control
  - Stabilized RED (SRED)
  - Random Exponential Marking (REM)
  - Double Slope RED (DSRED)
- RED with per flow accounting
  - Fair RED (FRED)
  - Fair Buffering RED (FBRED)
  - XRED
- RED with class based threshold
  - Class based threshold RED (CBT-RED)
  - Balanced RED (BRED)
  - Stochastic Fair BLUE (SFBLUE)
### Summary of RED Variants

<table>
<thead>
<tr>
<th></th>
<th>Drop Function</th>
<th>Control Variable</th>
<th>Changes from original RED</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRED</td>
<td>Single linear</td>
<td>Per-flow queue length</td>
<td>Per-flow queue length, number of active flow</td>
</tr>
<tr>
<td>FBRED</td>
<td>Single linear</td>
<td>Average queue length</td>
<td>Per-flow $Max_{drop}$</td>
</tr>
<tr>
<td>SRED</td>
<td>3 segment step</td>
<td>instantaneous queue length and number of active flow</td>
<td>Step drop function, number of active flows, instantaneous queue</td>
</tr>
<tr>
<td>CBT-RED</td>
<td>Single linear</td>
<td>Average queue length</td>
<td>Class based threshold</td>
</tr>
<tr>
<td>XRED</td>
<td>Single linear</td>
<td>Average queue length</td>
<td>Priority based drop</td>
</tr>
<tr>
<td>BRED</td>
<td>4 segment step</td>
<td>Per-flow queue length and number of active flows</td>
<td>Per-flow queue length, number of active flows, step drop function</td>
</tr>
<tr>
<td>DSRED</td>
<td>Two linear</td>
<td>Average queue length</td>
<td>Two linear drop function with different slope</td>
</tr>
<tr>
<td>BLUE</td>
<td>Step function</td>
<td>Link utilization and packet loss</td>
<td>Step increase/decrease function, link rate, packet loss</td>
</tr>
<tr>
<td>REM</td>
<td>Exponential function</td>
<td>Link rate mismatch and buffer difference</td>
<td>Exponential function, link rate mismatch and buffer difference</td>
</tr>
<tr>
<td>SFB</td>
<td>Step function</td>
<td>Instantaneous queue length</td>
<td>Organize sub-queue in Bloom filter</td>
</tr>
</tbody>
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 Objective of this work

- Evaluate the performance of DSRED
Drop function of DSRED
\[ p_d(\text{avg}) = \begin{cases} 
0 & \text{avg} < K_l \\
\alpha(\text{avg} - K_l) & K_l \leq \text{avg} < K_m \\
1 - \gamma + \beta(\text{avg} - K_m) & K_m \leq \text{avg} < K_h \\
1 & K_h \leq \text{avg} \leq N \end{cases} \]
Simulation Configuration

- Router buffer size = 200 packets.
- $K_l = 6$
- $K_h = 20$
- $W = 0.07$
- Max_drop = 0.1
- $\gamma = 0.96$

ATM is viewed as a subnet to the IP network
Performance measure

- Comparison of the performance of DSRED and RED
- Performance criteria
  - Throughput
  - Delay
  - Packet drop
  - Queue size
- ATM traffic contracts: best effort service of IP based networks is mapped to the following ATM services (RFC 2382)
  - nrt-CBR
  - UBR
Throughput: nrt-VBR

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Queue Size: nrt-VBR
Packet drop: nrt-VBR
Queuing delay: nrt-VBR

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Throughput: UBR

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Queue size: UBR
Packet drop: UBR

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Queuing delay: UBR
Conclusion

- Evaluated the performance of DSRED under heterogeneous network environment
- DSRED performs better than RED
- DSRED is robust for different traffic contracts at the edge
- DSRED is suitable for the next generation Internet routers