Identifying Modified ECN Semantics for Ultra-Low Queuing Delay
draft-briscoe-tsvwg-ecn-l4s-id-02

Bob Briscoe
[ simula.research.laboratory ]

• Koen De Schepper, Inton Tsang

Nokia Bell Labs

IETF-97 Jul 2017

The authors were part-funded by the European Community under its Seventh Framework Programme through the Reducing Internet Transport Latency (RITE) project (ICT-317700). The views expressed here are solely those of the authors.
L4S: low latency, low loss, scalable throughput

3 parts to standardise

1) The identifier  
draft-briscoe-tsvwg-ecn-l4s-id  
tsvwg

2) The DualQ AQM  
draft-briscoe-tsvwg-aqm-dualq-coupled  
aqm?

3) Scalable transports  
many  
?
The goal

- Experimental RFC to assign an identifier for L4S
- Previously focused on choice of identifier: ECT(1)
  - Prerequisite: release ECT(1) from prior experimental use as ECN Nonce <draft-black-tsvwg-ecn-experimentation>

- This presentation:
  - how we've defined the meaning of ECT(1)
  - adoption call?

<table>
<thead>
<tr>
<th>ECN Codepoints</th>
<th>Not-ECT</th>
<th>Not-ECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>ECT(0)</td>
<td>ECT(1)</td>
</tr>
<tr>
<td>10</td>
<td>CE</td>
<td>Congestion Experienced</td>
</tr>
</tbody>
</table>
the MUSTs, SHOULDs, etc. pt1/2

- To use L4S, the sender:
  - **MUST** set ECT(1)
  - **SHOULD** ensure rate is inversely proportional to CE marking
  - details for each transport to be specified separately

- To support L4S, a network node:
  - **MUST** classify ECT(1) and **SHOULD** classify CE as L4S
  - **MUST** (?) also implement a Classic AQM treatment
  - **MUST** classify ECT(0) and Not-ECT as Classic

<table>
<thead>
<tr>
<th>ECN Codepoints</th>
<th>Not-ECT</th>
<th>Not-ECT</th>
<th>ECN-Capable Transport</th>
<th>Congestion Experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>ECT(0)</td>
<td></td>
<td>ECN-Capable Transport</td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>ECT(1)</td>
<td></td>
<td></td>
<td>Congestion Experienced</td>
</tr>
<tr>
<td>11</td>
<td>CE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Why should rate be inversely proportional to marking?

- Rationale: Scalable
  - invariant number of control signals per RTT
- The rule is easy to derive:
  requirement: no. of marked segments per round trip = constant, C
  → segments per round trip (W) x probability each will be marked (p) = C
  → \(Wp = C\)
  → \(W = C/p\) → rate should be inversely proportional to marking
the MUSTs, SHOULDs, etc. pt2/2

• Meaning of Classic ECN
  • AQM will mark ECT(0) packets as CE under the same conditions as it would drop Not-ECT packets [RFC3168]

• Meaning of L4S ECN
  • Likelihood that an AQM drops a Not-ECT Classic packet, $p_C$ MUST be roughly proportional to the square of the likelihood that it would mark it, if it was an L4S packet, $p_L$
    \[ p_C \approx (p_L / k)^2 \]
  • no need to standardize $k$ for interoperability, 2 is RECOMMENDED experimentally
Why squared?

\[ p_C \approx (p_L / k)^2 \]

- To shift to the scalable regime of L4S, by counterbalancing the square root in std TCP congestion avoidance [RFC5681]
  \[ W = \kappa / \sqrt{p_C} \]
  which has become the gold-standard rate per flow

- Not all traffic behaves like this
  - not all traffic is standard TCP in congestion avoidance
  - short flows
  - not all TCPs are standard, e.g. Cubic, Compound

- Principle:
  - Avoid starvation of any long flows
  - CC of short flows only needs any congestion signal
  - Do no harm to the lamest TCP

- Pragmatic:
  - Cubic, Compound are often in their TCP-friendly mode over typical low RTT paths
Next Steps

- adoption call
- consider carefully before reassigning a scarce IP header codepoint for a new experiment
- Please review, comment, implement
  - brief draft (8pp without boilerplate & appendices)
- Plenty of discussion already
  - on aqm@ietf.org when issue first raised
  - on tcpprague@ietf.org
  - in L4S BoF
- pls discuss L4S ID on tsvwg@ietf.org for now
  - cc: tcpprague@ietf.org if you like
Q&A

large saw teeth can ruin the quality of your experience