L4S: Low Latency, Low Loss, Scalable Throughput Internet Service Architecture and Identifier

draft-ietf-tsvwg-l4s-arch-01
draft-ietf-tsvwg-ecn-l4s-id-01

Bob Briscoe, CableLabs
Koen De Schepper, Nokia Bell Labs
Marcelo Bagnulo, UC3M

IETF-100 Nov 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.
Recap

• Motivation
  • Extremely low queuing delay for all Internet traffic
  • already 1-2 orders better than state of the art
  • 500 μs vs 5-15 ms (fq-CoDel or PIE)

• Architecture

```
\[ r \propto \frac{1}{p} \]
\[ r \propto \frac{1}{\sqrt{p}} \]

r: packet rate
p: drop/mark probability
```

```
<table>
<thead>
<tr>
<th>Host</th>
<th>Protocol</th>
<th>Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalable sender</td>
<td>L4S: [X1]</td>
<td>L4S marker</td>
</tr>
<tr>
<td>Classic sender</td>
<td>Classic: [X0]</td>
<td>Coupling</td>
</tr>
</tbody>
</table>
```

```
\[ r \propto \frac{1}{p} \]
\[ p^2 \]
```
Now in a holding pattern

- pending possible changes to main assumptions about the “TCP Prague Requirements”
- Exit holding pattern when reference implementation of TCP Prague complete

Reviews, comments from implementers etc, obviously welcome
L4S Status Update (1/3)

• Source Code
  – Dual Queue Coupled AQM, DualPI2 for Linux [UPDATED internally, release shortly]
  – Data Centre TCP (DCTCP) for Linux (in the mainline kernel), FreeBSD patch, ns2 patch.
  – Accurate ECN TCP Feedback for Linux [UPDATED, but still not fully tested]

• Implementations
  – DualQ Coupled AQM: in at least one chipset aimed at the data centre environment [NEW – availability TBA]
  – L4S Scalable congestion control: rmcat SCReAM [NEW]
  – Whole L4S system: ns3 [to be released early 2018]
SCReAM, 100Mbps, CoDel ECN
SCReAM, 100Mbps, L4S
L4S Status Update (2/3)

- IETF specs
  - Low Latency, Low Loss, Scalable Throughput (L4S) Internet Service: Architecture <draft-ietf-tsvwg-l4s-arch-01> [MINOR UPDATE]
  - A proposed new identifier for Low Latency, Low Loss, Scalable throughput (L4S) packets <draft-ietf-tsvwg-ecn-l4s-id-01> [MINOR UPDATE]
  - Dual-queue AQM: <draft-ietf-tsvwg-aqm-dualq-coupled-02> [UPDATED]
  - enabled by <draft-ietf-tsvwg-ecn-experimentation> [Passed IESG; UPDATED]
  - scalable TCP algorithms, e.g. Data Centre TCP (DCTCP) <RFC8257>, TCP Prague [RFC PUBLISHED]
  - Accurate ECN: <draft-ietf-tcpm-accurate-ecn-05> [UPDATED – WGLC LIKELY]
  - ECN++ Adding ECN to TCP control packets: <draft-ietf-tcpm-generalized-ecn-02> [UPDATED]
  - ECN support in trill <draft-ietf-trill-ecn-support-03>, motivated by L4S [Completed WGLC]
  - ECN in QUIC <draft-johansson-quic-ecn-03>, motivated by L4S [DES TEAM FORMED]
- 3GPP Proposal
  - ECN visibility to Radio Link Control (RLC) layer, motivated by L4S [Rejected for R15; Retry for R16]
L4S Status Update (3/3)

- Papers
  - “Data Centre to the Home: Deployable Ultra-Low Queuing Delay for All” [Journal submission]

- Landing page for code, specs, papers
  https://riteproject.eu/dctth/
DualQ Coupled AQM
for Low Latency Low Loss Scalable throughput (L4S)

draft-ietf-tsvwg-aqm-dualq-coupled-02
Bob Briscoe, CableLabs
Koen De Schepper, Nokia Bell Labs
IETF-100 Nov 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.
DualQ Coupled AQM: Structure

- Was $p_{CL} = p'$ and $p_c = (p'/k)^2$
- Seems trivial but this makes all the input parameters independent

$p$: drop / mark probability
$p'$: internal control variable
$k$: coupling constant

Logical OR: $\bigcirc$
DualQ Coupled AQM: modular separation

- Step marking threshold, RED-like ramp, etc.
- IP-ECN Classifier
- L4S AQM
- Base AQM
- PI² (improved PIE), Curvy RED, etc.

- not actually an AQM
  - a framework for coupling AQMs
  - drop in your chosen 'native AQM' for each queue

- aqm-dualq-coupled defines:
  - MUSTS and SHOULDs for framework
  - informational appendices explaining 2 example AQMs with pseudocode
DualQ Coupled AQM:
Management Requirements

• Configuration
  3 categories:
  1) Framework
  2) Base AQM
  3) Native L4S AQM

• Monitoring
  – per queue per sample interval
    • Bits forwarded → utilization
    • Packets arriving; enqueued; dequeued
    • Packets marked; dropped (ECT & not-ECT)

• Linux ref. implementation
  • Fixed the API so each config parameter is independent
  • Added external config of classifier (Linux classifier arch)
  • Made classful: visibility of each queue (e.g. stats) consistent externally
Status & Next Steps

- Draft is now understandable to implementers
  - thanks to Sowmini Varadhan & Gabi Bracha

Next:
- Management requirements for experiments
  - prompted by IESG review of tsvwg-ecn-experimentation
- Release changes to Linux implementation
- Relationship to Diffserv
- Policing / queue protection
Q&A