

## Pantheon Report

Generated at 2018-09-03 13:14:08 (UTC).

Data path: GCE Sydney on **ens4** (*local*) → GCE Tokyo on **ens4** (*remote*).

Repeated the test of 4 congestion control schemes twice.

Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `time.google.com` and have been applied to correct the timestamps in logs.

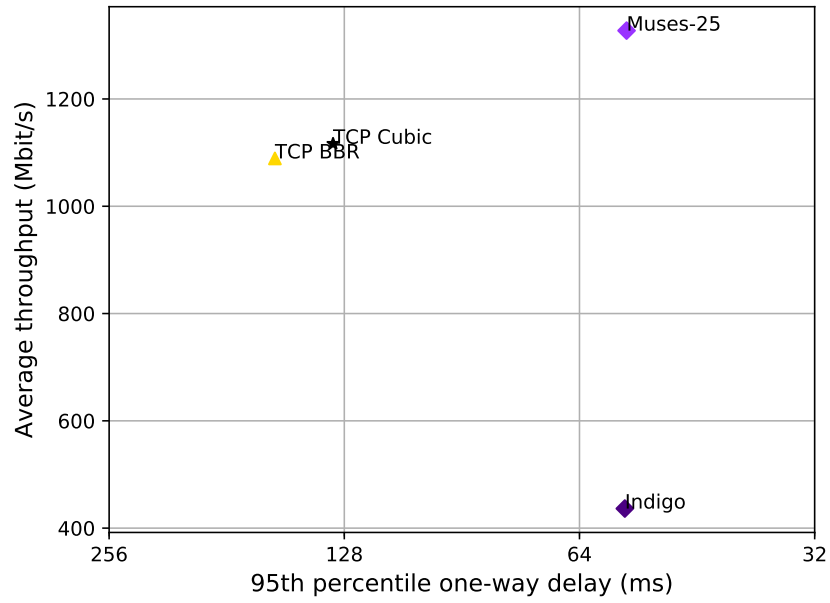
### System info:

```
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```

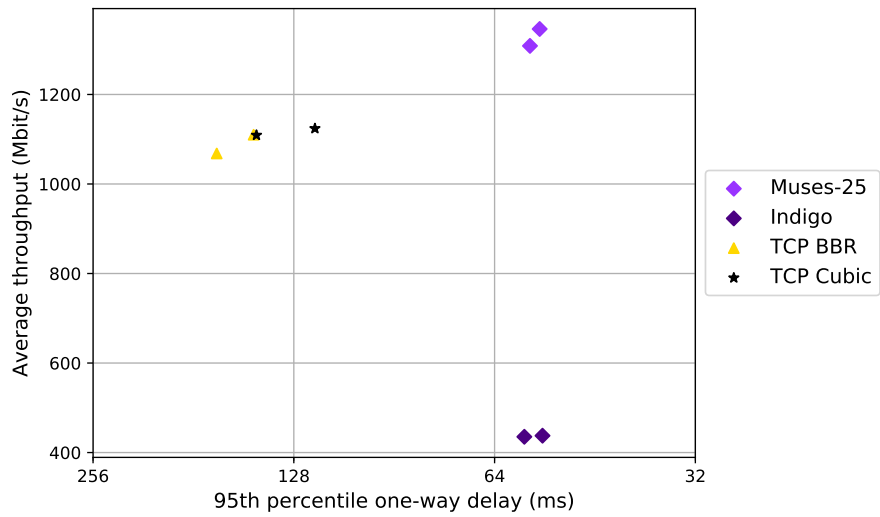
### Git summary:

```
branch: muses @ f309f5459e2c5237279a184e52ece7a2b47ef1c9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdf58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b8d5019b83a3a678804d830fcfe1da7b3a63421b
third_party/pantheon-tunnel @ cbfce6db5ff5740dafa1771f813cd646339e1952
third_party/pcc @ 1afc958fa0d66d18b623c091a55fec872b4981e1
M receiver/src/buffer.h
M receiver/src/core.cpp
M sender/src/buffer.h
M sender/src/core.cpp
third_party/pcc-experimental @ cd43e34e3f5f5613e8acd08fab92c4eb24f974ab
third_party/proto-quic @ 77961f1a82733a86b42f1bc8143ebc978f3cff42
third_party/scream-reproduce @ f099118d1421aa3131bf11ff1964974e1da3bdb2
M src/ScreamClient
M src/ScreamServer
third_party/sprout @ 366e35c6178b01e31d4a46ad18c74f9415f19a26
third_party/verus @ d4b447ea74c6c60a261149af2629562939f9a494
M src/verus.hpp
M tools/plot.py
third_party/vivace @ 2baf86211435ae071a32f96b7d8c504587f5d7f4
third_party/webrtc @ 3f0cc2a9061a41b6f9dde4735770d143a1fa2851
```

test from GCE Sydney to GCE Tokyo, 2 runs of 30s each per scheme  
 3 flows with 10s interval between flows (mean of all runs by scheme)



test from GCE Sydney to GCE Tokyo, 2 runs of 30s each per scheme  
 3 flows with 10s interval between flows



| scheme    | # runs | mean avg tput (Mbit/s) |        |        | mean 95th-%ile delay (ms) |        |        | mean loss rate (%) |        |        |
|-----------|--------|------------------------|--------|--------|---------------------------|--------|--------|--------------------|--------|--------|
|           |        | flow 1                 | flow 2 | flow 3 | flow 1                    | flow 2 | flow 3 | flow 1             | flow 2 | flow 3 |
| TCP BBR   | 2      | 548.40                 | 529.52 | 570.67 | 164.95                    | 140.44 | 114.33 | 1.08               | 0.73   | 0.69   |
| TCP Cubic | 2      | 582.37                 | 552.30 | 500.20 | 133.09                    | 94.15  | 109.62 | 0.10               | 0.11   | 0.09   |
| Indigo    | 2      | 236.41                 | 212.24 | 182.52 | 53.07                     | 57.04  | 56.35  | 0.00               | 0.01   | 0.02   |
| Muses-25  | 2      | 715.41                 | 637.05 | 578.28 | 55.75                     | 55.62  | 55.17  | 0.00               | 0.01   | 0.03   |

Run 1: Statistics of TCP BBR

Start at: 2018-09-03 12:39:57

End at: 2018-09-03 12:40:27

Local clock offset: 0.39 ms

Remote clock offset: -0.08 ms

# Below is generated by plot.py at 2018-09-03 13:13:07

# Datalink statistics

-- Total of 3 flows:

Average throughput: 1110.10 Mbit/s

95th percentile per-packet one-way delay: 147.056 ms

Loss rate: 0.72%

-- Flow 1:

Average throughput: 563.20 Mbit/s

95th percentile per-packet one-way delay: 154.961 ms

Loss rate: 0.65%

-- Flow 2:

Average throughput: 545.62 Mbit/s

95th percentile per-packet one-way delay: 149.104 ms

Loss rate: 1.19%

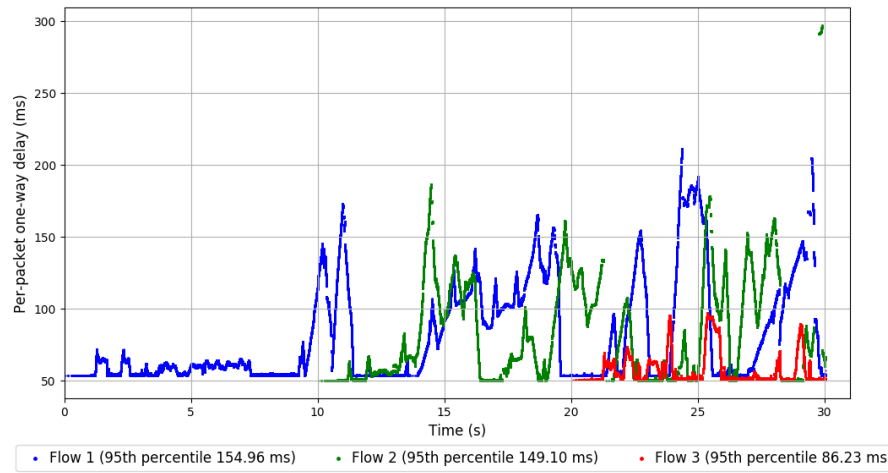
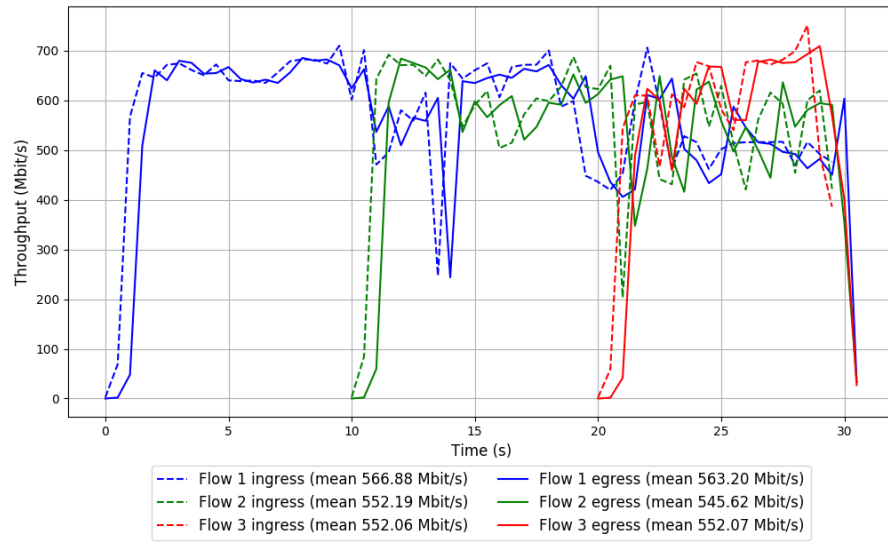
-- Flow 3:

Average throughput: 552.07 Mbit/s

95th percentile per-packet one-way delay: 86.234 ms

Loss rate: 0.00%

# Run 1: Report of TCP BBR — Data Link

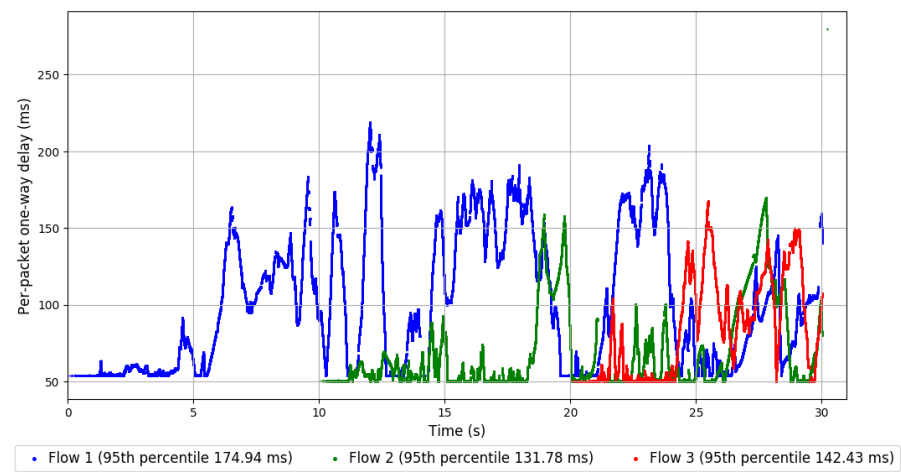
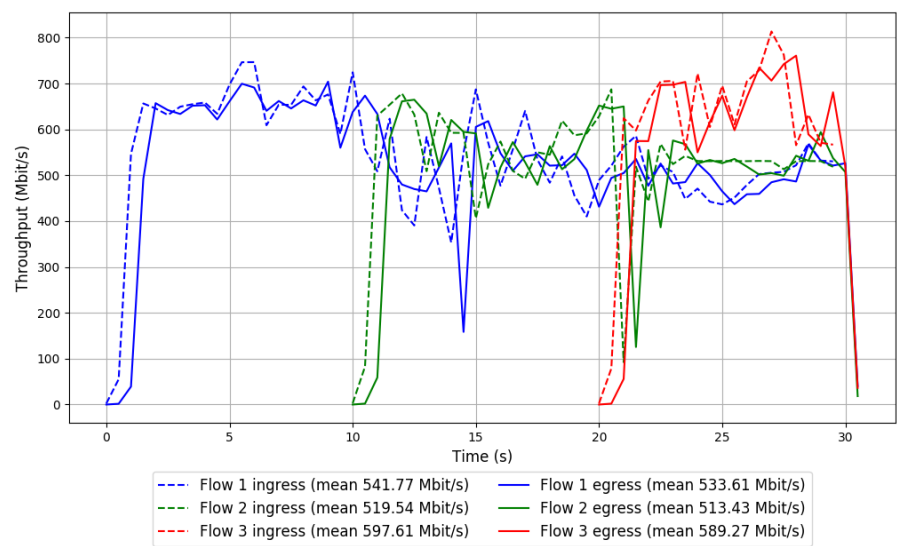


Run 2: Statistics of TCP BBR

Start at: 2018-09-03 12:47:51  
End at: 2018-09-03 12:48:21  
Local clock offset: 0.591 ms  
Remote clock offset: -0.232 ms

# Below is generated by plot.py at 2018-09-03 13:13:07  
# Datalink statistics  
-- Total of 3 flows:  
Average throughput: 1068.20 Mbit/s  
95th percentile per-packet one-way delay: 167.034 ms  
Loss rate: 1.10%  
-- Flow 1:  
Average throughput: 533.61 Mbit/s  
95th percentile per-packet one-way delay: 174.938 ms  
Loss rate: 1.52%  
-- Flow 2:  
Average throughput: 513.43 Mbit/s  
95th percentile per-packet one-way delay: 131.780 ms  
Loss rate: 0.28%  
-- Flow 3:  
Average throughput: 589.27 Mbit/s  
95th percentile per-packet one-way delay: 142.431 ms  
Loss rate: 1.39%

Run 2: Report of TCP BBR — Data Link



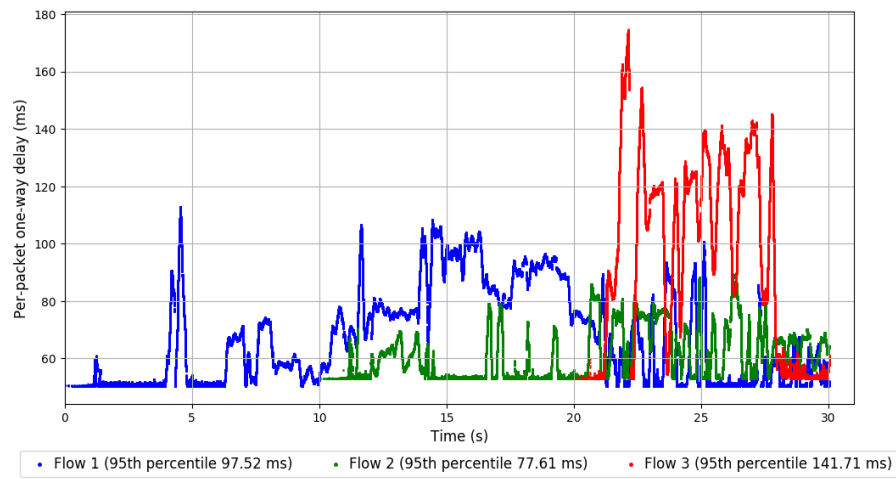
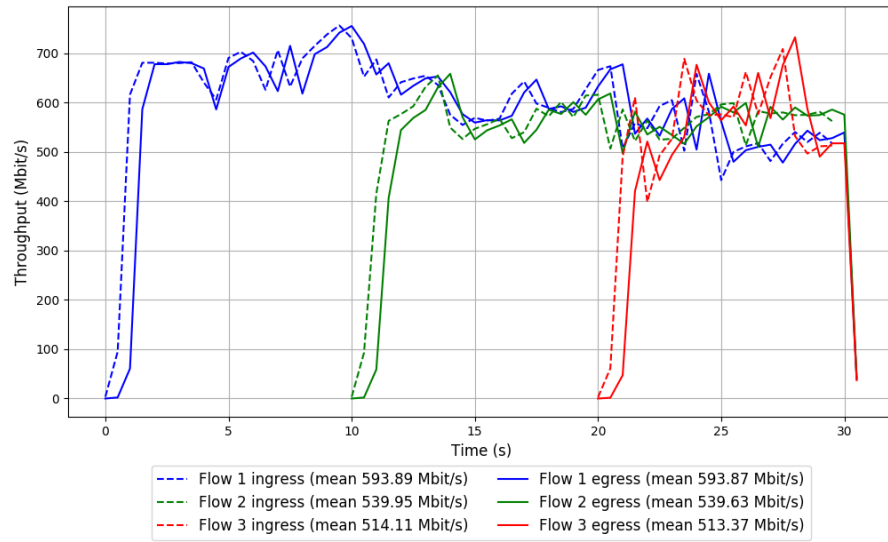
Run 1: Statistics of TCP Cubic

Start at: 2018-09-03 12:45:49  
End at: 2018-09-03 12:46:19  
Local clock offset: 0.664 ms  
Remote clock offset: -0.156 ms

# Below is generated by plot.py at 2018-09-03 13:13:11  
# Datalink statistics  
-- Total of 3 flows:  
Average throughput: 1123.88 Mbit/s  
95th percentile per-packet one-way delay: 119.008 ms  
Loss rate: 0.05%  
-- Flow 1:  
Average throughput: 593.87 Mbit/s  
95th percentile per-packet one-way delay: 97.521 ms  
Loss rate: 0.00%  
-- Flow 2:  
Average throughput: 539.63 Mbit/s  
95th percentile per-packet one-way delay: 77.605 ms  
Loss rate: 0.07%  
-- Flow 3:  
Average throughput: 513.37 Mbit/s  
95th percentile per-packet one-way delay: 141.705 ms  
Loss rate: 0.16%



## Run 1: Report of TCP Cubic — Data Link

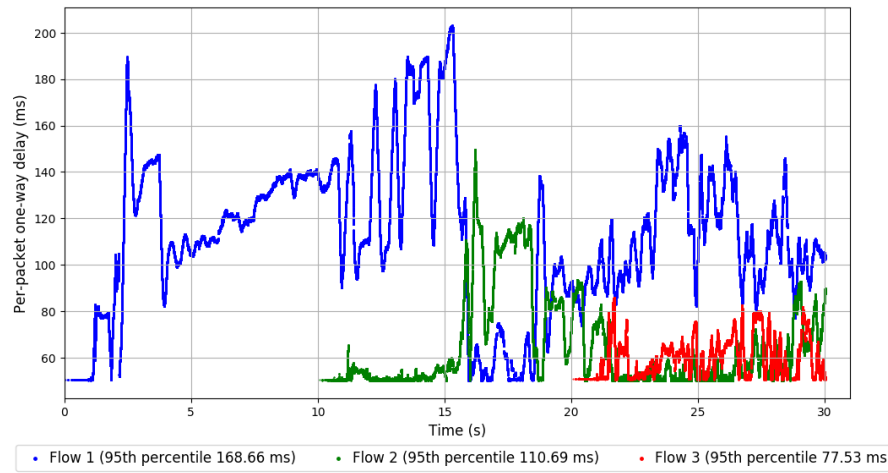
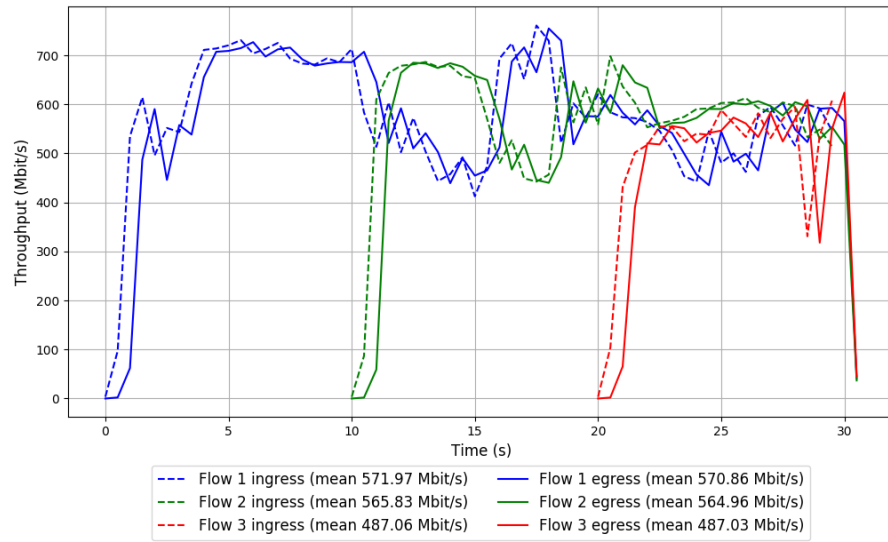


Run 2: Statistics of TCP Cubic

Start at: 2018-09-03 12:53:46  
End at: 2018-09-03 12:54:16  
Local clock offset: 0.718 ms  
Remote clock offset: -0.087 ms

# Below is generated by plot.py at 2018-09-03 13:13:11  
# Datalink statistics  
-- Total of 3 flows:  
Average throughput: 1109.06 Mbit/s  
95th percentile per-packet one-way delay: 145.616 ms  
Loss rate: 0.15%  
-- Flow 1:  
Average throughput: 570.86 Mbit/s  
95th percentile per-packet one-way delay: 168.656 ms  
Loss rate: 0.19%  
-- Flow 2:  
Average throughput: 564.96 Mbit/s  
95th percentile per-packet one-way delay: 110.688 ms  
Loss rate: 0.15%  
-- Flow 3:  
Average throughput: 487.03 Mbit/s  
95th percentile per-packet one-way delay: 77.535 ms  
Loss rate: 0.01%

## Run 2: Report of TCP Cubic — Data Link



Run 1: Statistics of Indigo

Start at: 2018-09-03 12:44:02

End at: 2018-09-03 12:44:32

Local clock offset: 0.465 ms

Remote clock offset: 2.968 ms

# Below is generated by plot.py at 2018-09-03 13:13:11

# Datalink statistics

-- Total of 3 flows:

Average throughput: 435.26 Mbit/s

95th percentile per-packet one-way delay: 57.750 ms

Loss rate: 0.00%

-- Flow 1:

Average throughput: 237.13 Mbit/s

95th percentile per-packet one-way delay: 54.633 ms

Loss rate: 0.00%

-- Flow 2:

Average throughput: 209.84 Mbit/s

95th percentile per-packet one-way delay: 58.597 ms

Loss rate: 0.00%

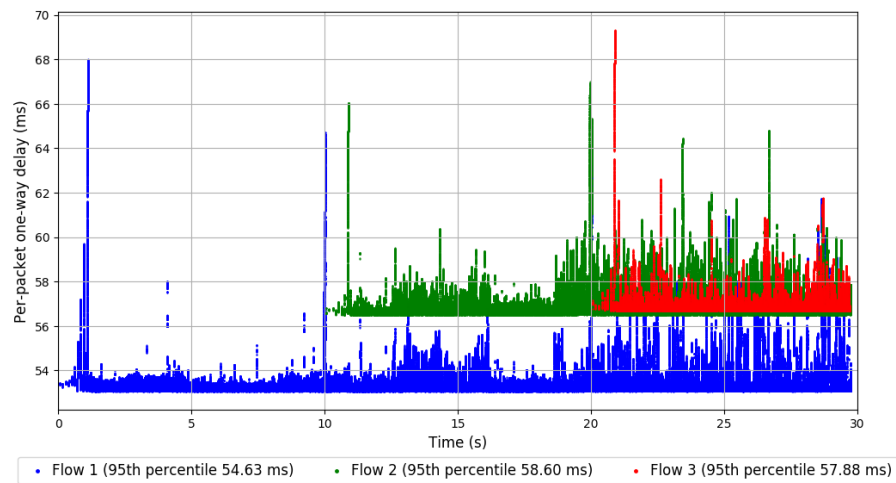
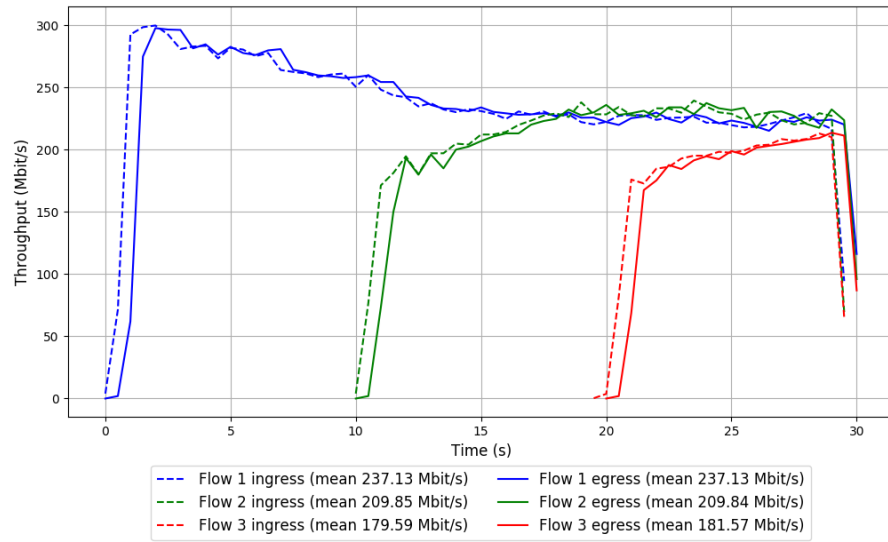
-- Flow 3:

Average throughput: 181.57 Mbit/s

95th percentile per-packet one-way delay: 57.878 ms

Loss rate: 0.00%

## Run 1: Report of Indigo — Data Link

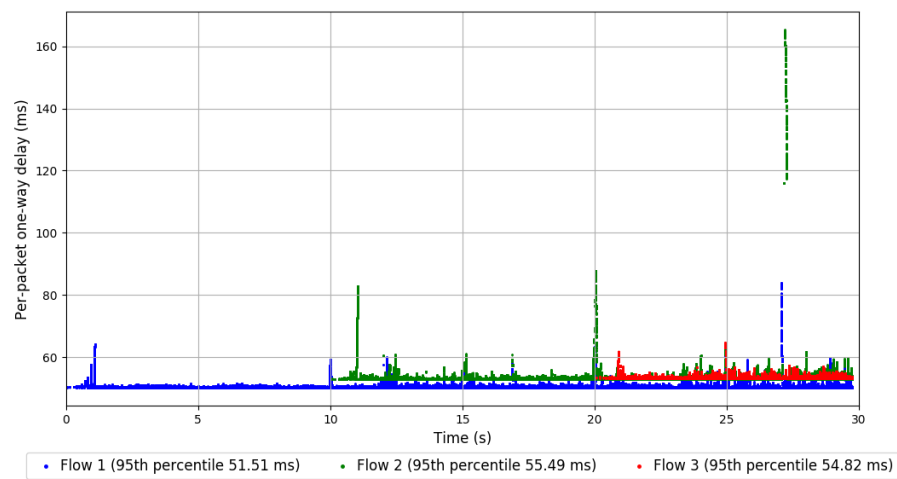
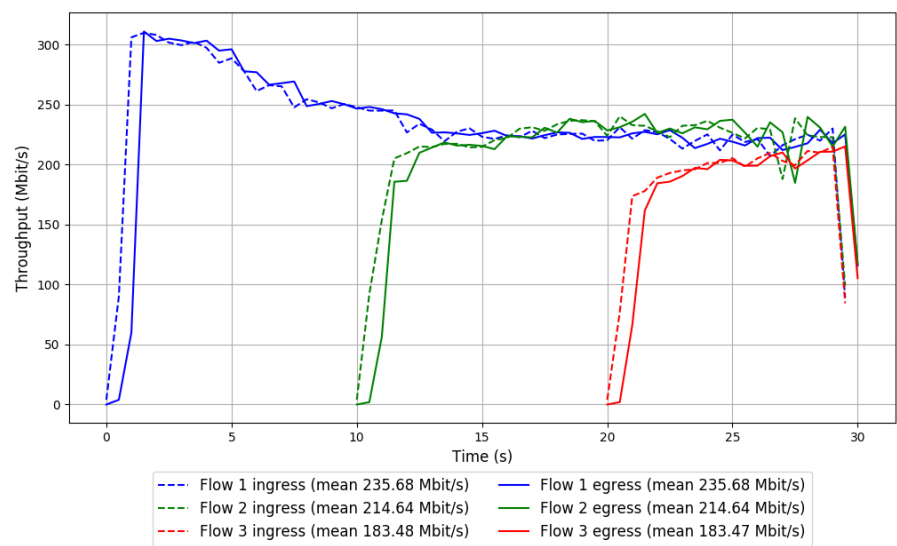


Run 2: Statistics of Indigo

Start at: 2018-09-03 12:51:59  
End at: 2018-09-03 12:52:29  
Local clock offset: 0.897 ms  
Remote clock offset: -0.254 ms

# Below is generated by plot.py at 2018-09-03 13:13:11  
# Datalink statistics  
-- Total of 3 flows:  
Average throughput: 437.68 Mbit/s  
95th percentile per-packet one-way delay: 54.240 ms  
Loss rate: 0.01%  
-- Flow 1:  
Average throughput: 235.68 Mbit/s  
95th percentile per-packet one-way delay: 51.508 ms  
Loss rate: 0.00%  
-- Flow 2:  
Average throughput: 214.64 Mbit/s  
95th percentile per-packet one-way delay: 55.492 ms  
Loss rate: 0.01%  
-- Flow 3:  
Average throughput: 183.47 Mbit/s  
95th percentile per-packet one-way delay: 54.819 ms  
Loss rate: 0.04%

Run 2: Report of Indigo — Data Link



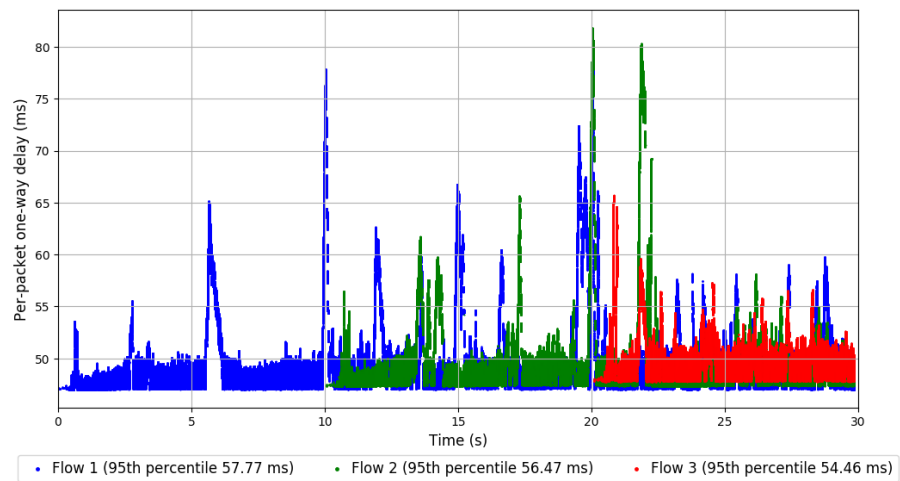
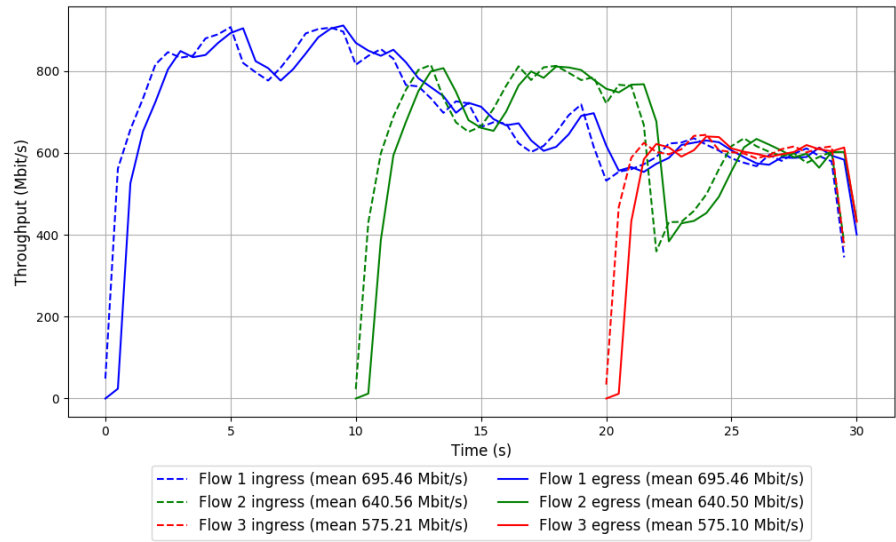
Run 1: Statistics of Muses-25

Start at: 2018-09-03 12:42:03  
End at: 2018-09-03 12:42:33  
Local clock offset: 0.535 ms  
Remote clock offset: -2.959 ms

# Below is generated by plot.py at 2018-09-03 13:14:01  
# Datalink statistics  
-- Total of 3 flows:  
Average throughput: 1308.55 Mbit/s  
95th percentile per-packet one-way delay: 56.640 ms  
Loss rate: 0.01%  
-- Flow 1:  
Average throughput: 695.46 Mbit/s  
95th percentile per-packet one-way delay: 57.774 ms  
Loss rate: 0.00%  
-- Flow 2:  
Average throughput: 640.50 Mbit/s  
95th percentile per-packet one-way delay: 56.473 ms  
Loss rate: 0.01%  
-- Flow 3:  
Average throughput: 575.10 Mbit/s  
95th percentile per-packet one-way delay: 54.457 ms  
Loss rate: 0.02%



# Run 1: Report of Muses-25 — Data Link



Run 2: Statistics of Muses-25

Start at: 2018-09-03 12:49:57

End at: 2018-09-03 12:50:27

Local clock offset: 0.493 ms

Remote clock offset: -3.01 ms

# Below is generated by plot.py at 2018-09-03 13:14:05

# Datalink statistics

-- Total of 3 flows:

Average throughput: 1346.30 Mbit/s

95th percentile per-packet one-way delay: 54.775 ms

Loss rate: 0.01%

-- Flow 1:

Average throughput: 735.37 Mbit/s

95th percentile per-packet one-way delay: 53.730 ms

Loss rate: 0.00%

-- Flow 2:

Average throughput: 633.59 Mbit/s

95th percentile per-packet one-way delay: 54.763 ms

Loss rate: 0.01%

-- Flow 3:

Average throughput: 581.45 Mbit/s

95th percentile per-packet one-way delay: 55.879 ms

Loss rate: 0.03%

## Run 2: Report of Muses-25 — Data Link

