

## Pantheon Report

Generated at 2018-09-05 04:54:51 (UTC).  
Data path: GCE Iowa 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.

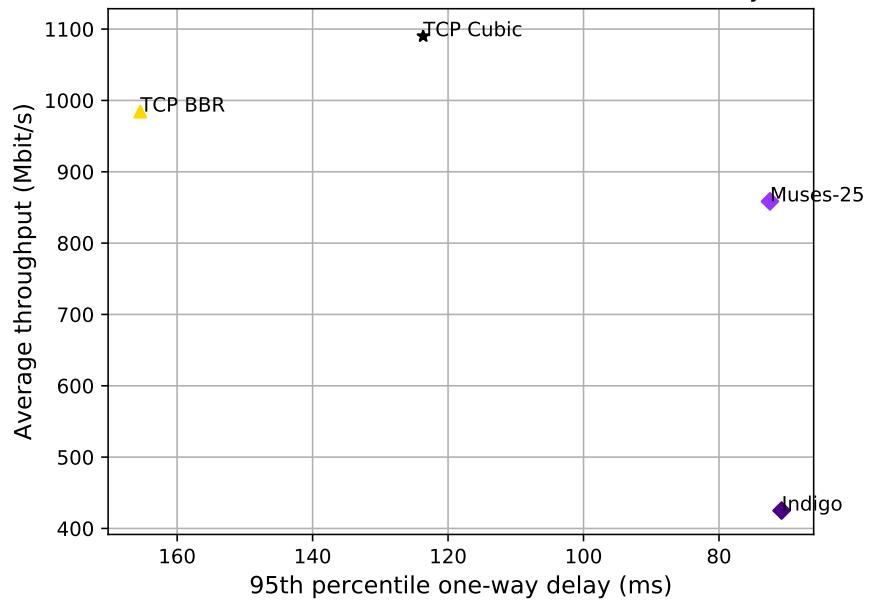
System info:

```
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
```

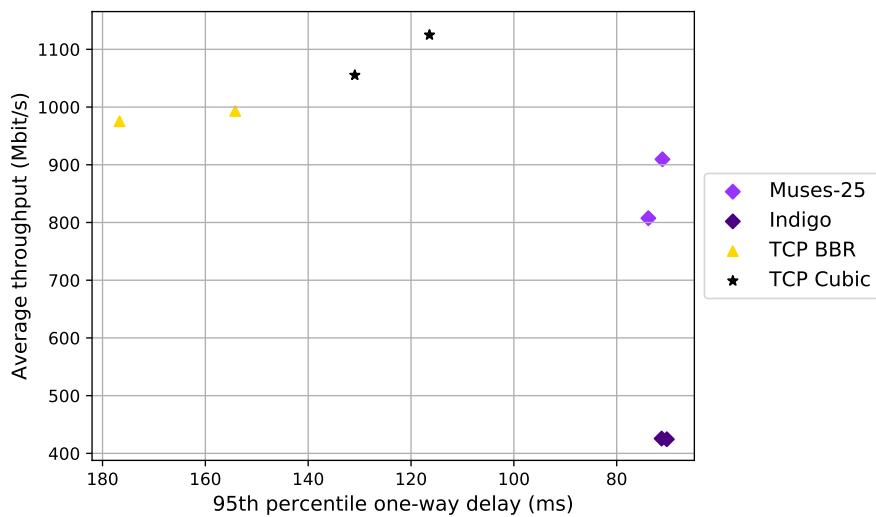
Git summary:

```
branch: muses @ 71e71e9a55b945431a7dea72180c1c9381097db9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdf58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ 96fb95fb38373d71fb80c5a105e62e7636623b
third_party/pantheon-tunnel @ cbfce6db5ff5740dafe1771f813cd646339e1952
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 Iowa 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 Iowa to GCE Tokyo, 2 runs of 30s each per scheme  
3 flows with 10s interval between flows



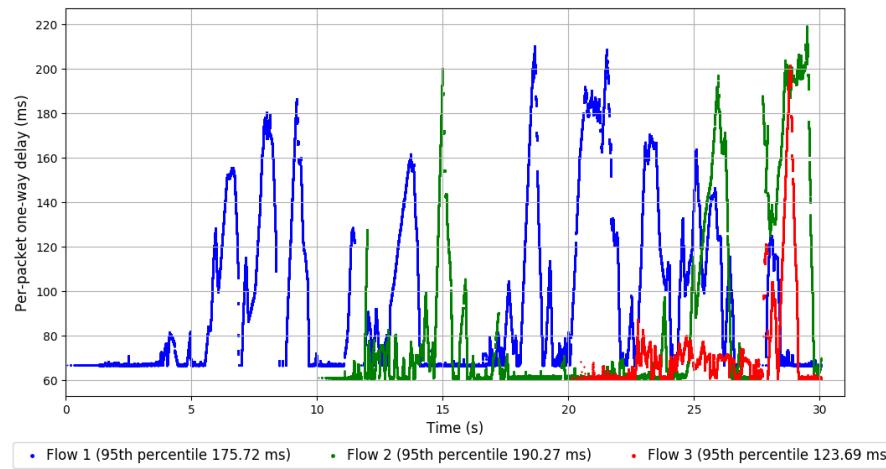
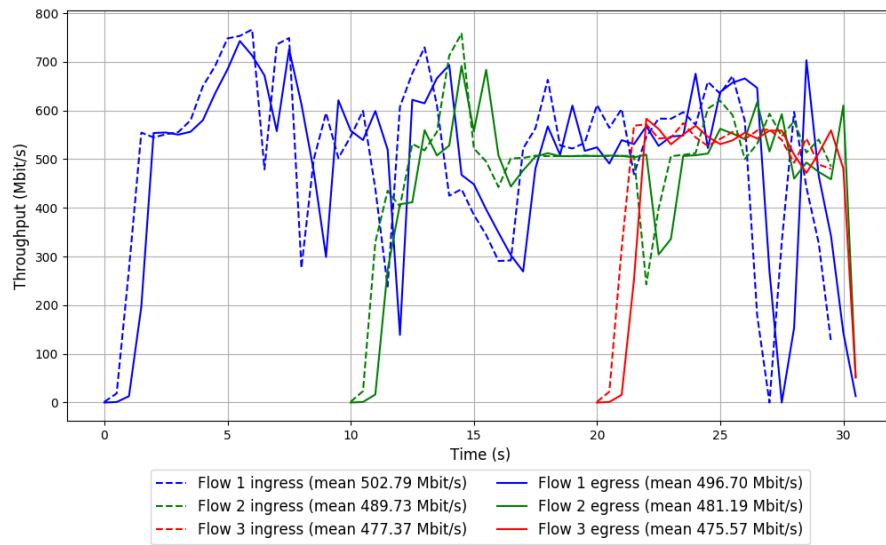
| scheme    | # runs | mean avg tput (Mbit/s) |        |        | mean 95th-%ile delay (ms) |        |        | mean loss rate (%) |        |        |
|-----------|--------|------------------------|--------|--------|---------------------------|--------|--------|--------------------|--------|--------|
|           |        | flow 1                 | flow 2 | flow 3 | flow 1                    | flow 2 | flow 3 | flow 1             | flow 2 | flow 3 |
| TCP BBR   | 2      | 526.80                 | 452.14 | 470.31 | 165.98                    | 169.68 | 142.17 | 0.85               | 1.08   | 1.10   |
| TCP Cubic | 2      | 575.82                 | 531.74 | 481.29 | 125.72                    | 93.61  | 128.14 | 0.06               | 0.17   | 0.18   |
| Indigo    | 2      | 221.10                 | 213.70 | 192.16 | 70.54                     | 70.95  | 71.18  | 0.00               | 0.00   | 0.00   |
| Muses-25  | 2      | 464.49                 | 422.25 | 348.05 | 73.71                     | 70.54  | 71.85  | 0.00               | 0.00   | 0.00   |

Run 1: Statistics of TCP BBR

```
Start at: 2018-09-05 04:28:12
End at: 2018-09-05 04:28:42
Local clock offset: 0.357 ms
Remote clock offset: 0.651 ms

# Below is generated by plot.py at 2018-09-05 04:54:12
# Datalink statistics
-- Total of 3 flows:
Average throughput: 975.35 Mbit/s
95th percentile per-packet one-way delay: 176.688 ms
Loss rate: 1.24%
-- Flow 1:
Average throughput: 496.70 Mbit/s
95th percentile per-packet one-way delay: 175.715 ms
Loss rate: 1.21%
-- Flow 2:
Average throughput: 481.19 Mbit/s
95th percentile per-packet one-way delay: 190.269 ms
Loss rate: 1.71%
-- Flow 3:
Average throughput: 475.57 Mbit/s
95th percentile per-packet one-way delay: 123.688 ms
Loss rate: 0.38%
```

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

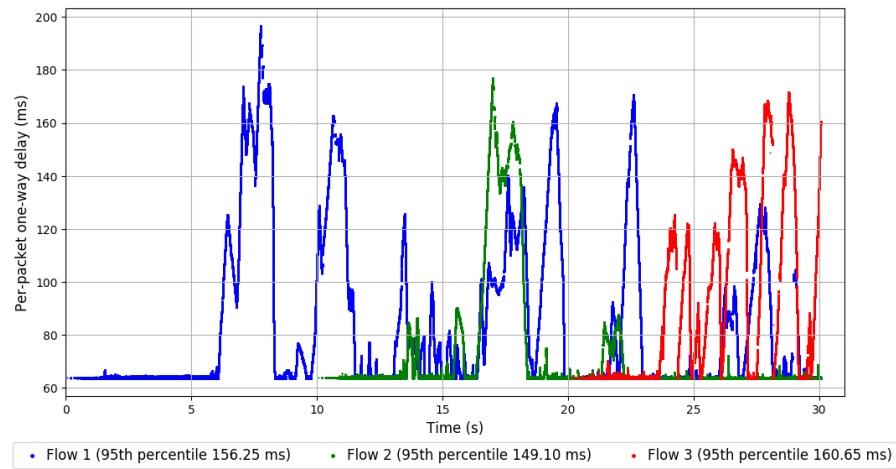
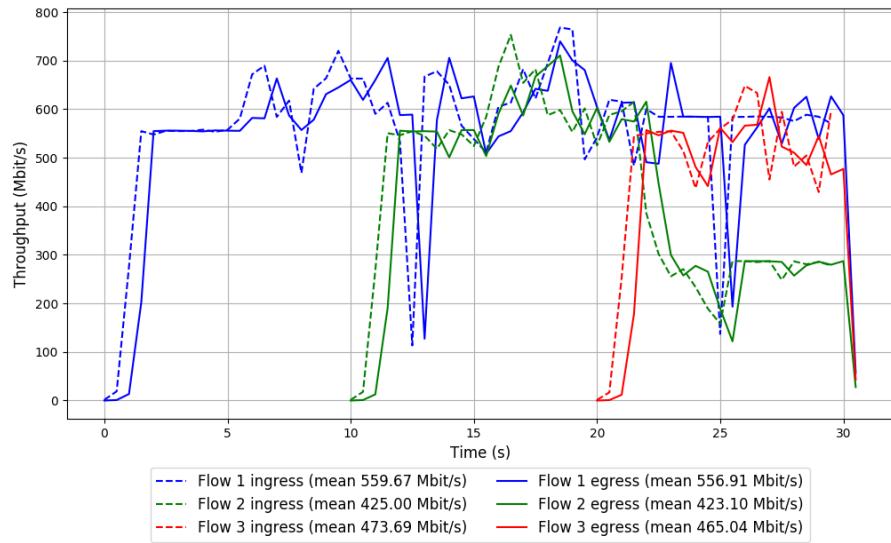


Run 2: Statistics of TCP BBR

```
Start at: 2018-09-05 04:36:16
End at: 2018-09-05 04:36:46
Local clock offset: 0.29 ms
Remote clock offset: -2.101 ms

# Below is generated by plot.py at 2018-09-05 04:54:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 993.28 Mbit/s
95th percentile per-packet one-way delay: 154.198 ms
Loss rate: 0.69%
-- Flow 1:
Average throughput: 556.91 Mbit/s
95th percentile per-packet one-way delay: 156.254 ms
Loss rate: 0.50%
-- Flow 2:
Average throughput: 423.10 Mbit/s
95th percentile per-packet one-way delay: 149.098 ms
Loss rate: 0.45%
-- Flow 3:
Average throughput: 465.04 Mbit/s
95th percentile per-packet one-way delay: 160.649 ms
Loss rate: 1.83%
```

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

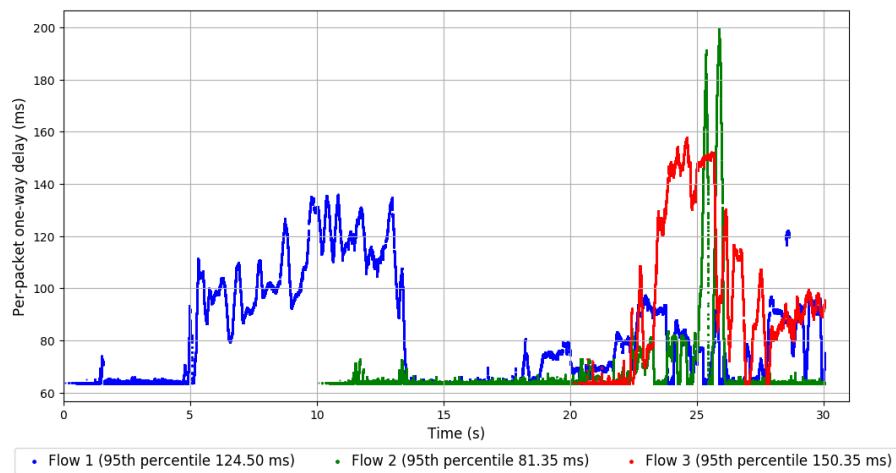
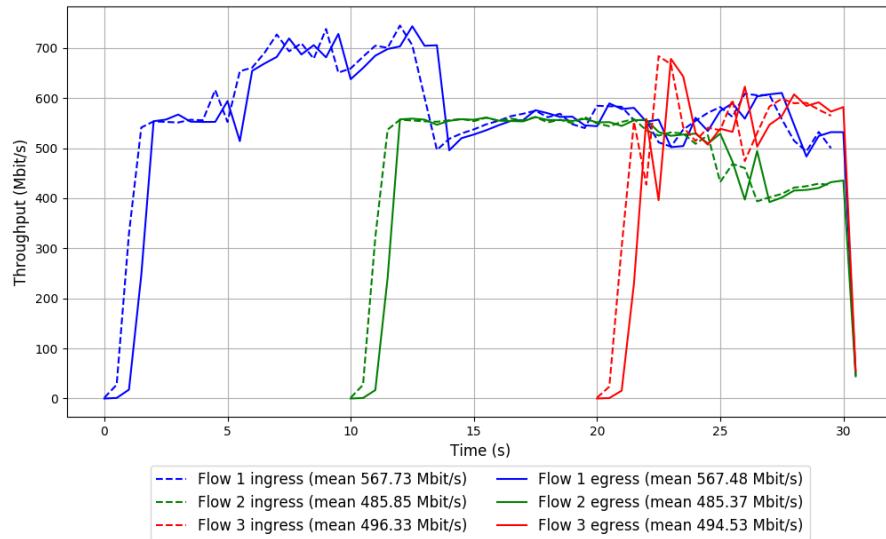


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-09-05 04:22:22
End at: 2018-09-05 04:22:52
Local clock offset: 0.312 ms
Remote clock offset: -2.288 ms

# Below is generated by plot.py at 2018-09-05 04:54:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1055.20 Mbit/s
95th percentile per-packet one-way delay: 130.936 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 567.48 Mbit/s
95th percentile per-packet one-way delay: 124.503 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 485.37 Mbit/s
95th percentile per-packet one-way delay: 81.346 ms
Loss rate: 0.10%
-- Flow 3:
Average throughput: 494.53 Mbit/s
95th percentile per-packet one-way delay: 150.352 ms
Loss rate: 0.37%
```

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

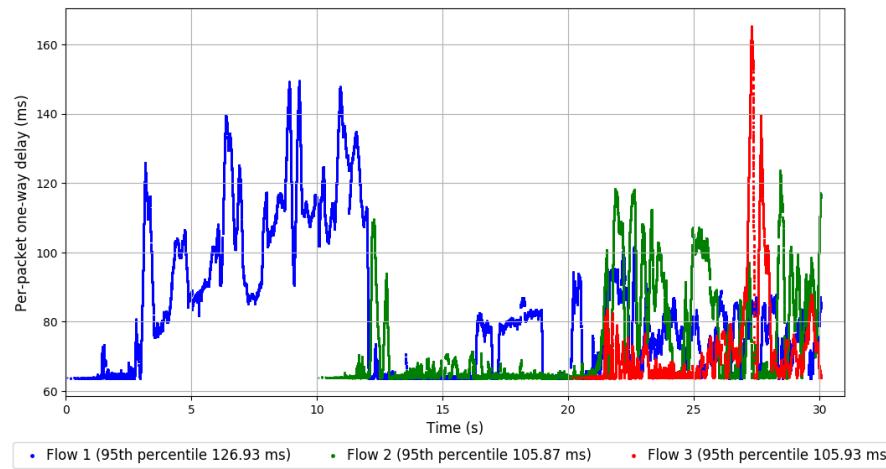
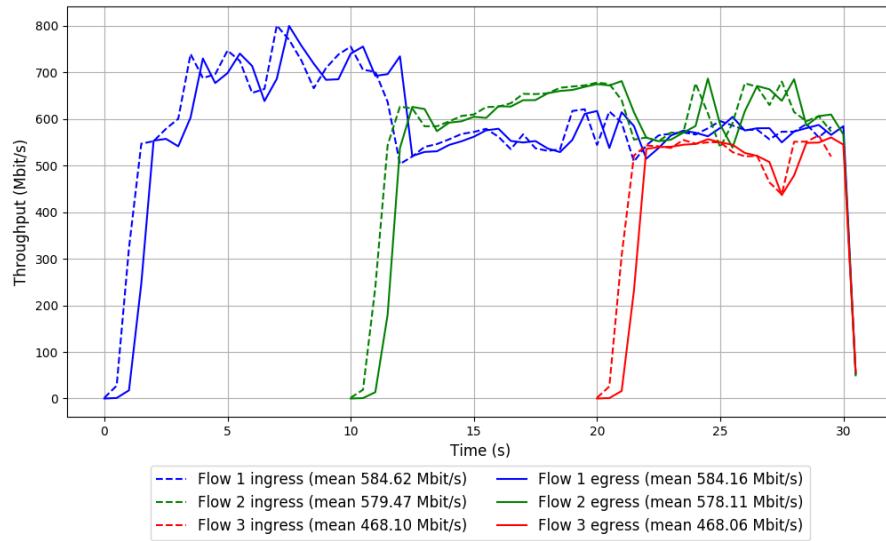


Run 2: Statistics of TCP Cubic

```
Start at: 2018-09-05 04:30:18
End at: 2018-09-05 04:30:48
Local clock offset: 0.376 ms
Remote clock offset: -2.19 ms

# Below is generated by plot.py at 2018-09-05 04:54:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1124.93 Mbit/s
95th percentile per-packet one-way delay: 116.409 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 584.16 Mbit/s
95th percentile per-packet one-way delay: 126.931 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 578.11 Mbit/s
95th percentile per-packet one-way delay: 105.868 ms
Loss rate: 0.23%
-- Flow 3:
Average throughput: 468.06 Mbit/s
95th percentile per-packet one-way delay: 105.930 ms
Loss rate: 0.00%
```

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

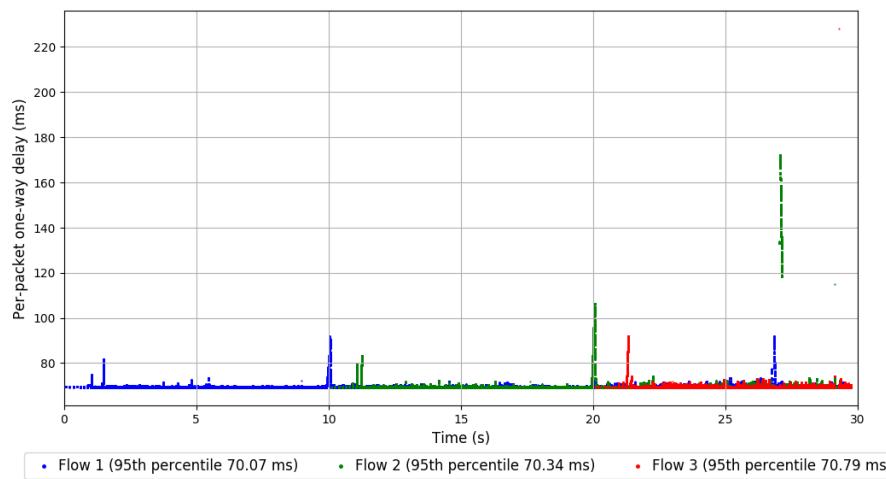
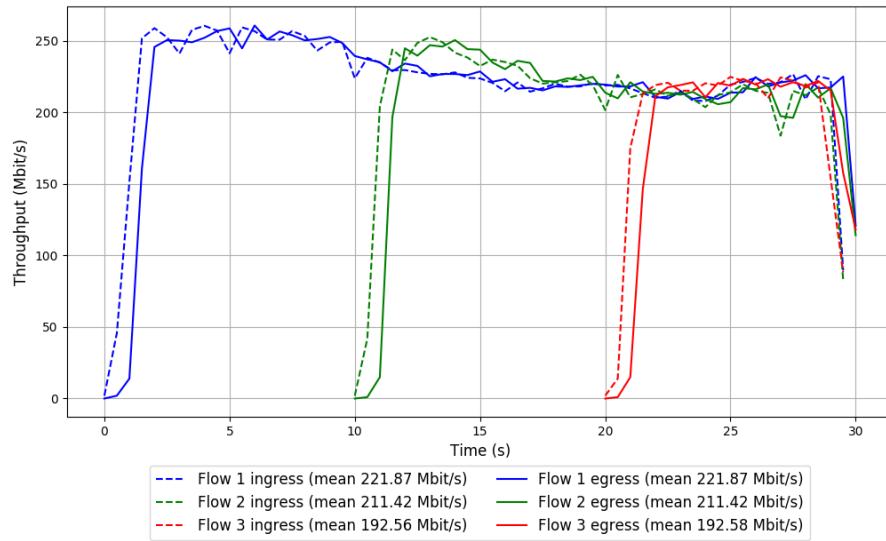


Run 1: Statistics of Indigo

```
Start at: 2018-09-05 04:24:27
End at: 2018-09-05 04:24:57
Local clock offset: 0.348 ms
Remote clock offset: 3.397 ms

# Below is generated by plot.py at 2018-09-05 04:54:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 424.47 Mbit/s
95th percentile per-packet one-way delay: 70.247 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 221.87 Mbit/s
95th percentile per-packet one-way delay: 70.066 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 211.42 Mbit/s
95th percentile per-packet one-way delay: 70.336 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 192.58 Mbit/s
95th percentile per-packet one-way delay: 70.789 ms
Loss rate: 0.00%
```

## Run 1: Report of Indigo — Data Link

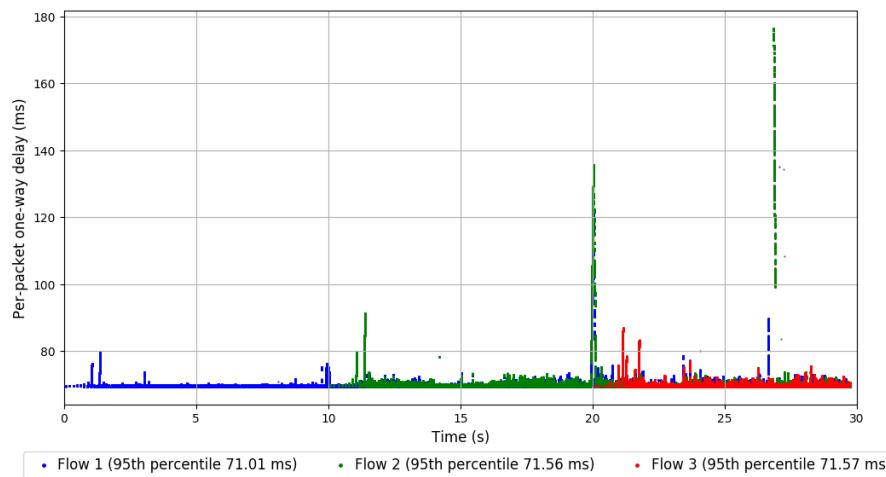
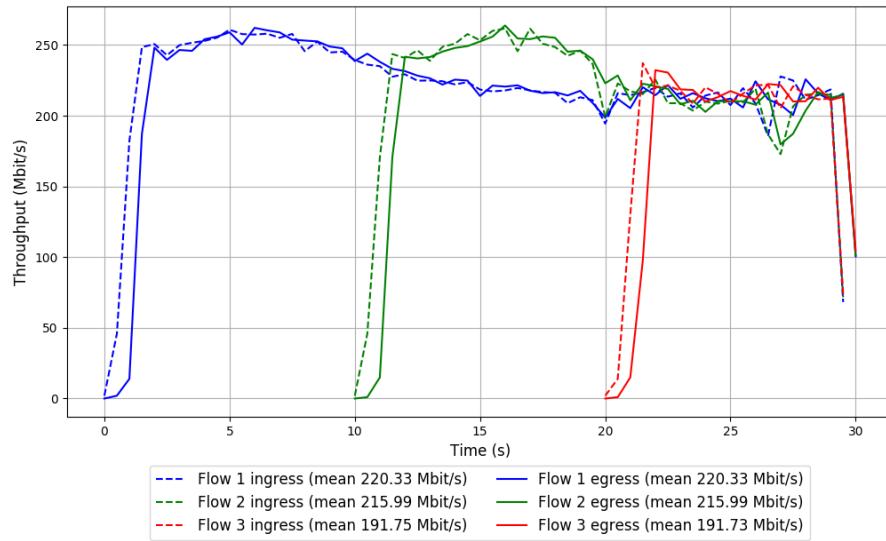


Run 2: Statistics of Indigo

```
Start at: 2018-09-05 04:32:27
End at: 2018-09-05 04:32:57
Local clock offset: 0.389 ms
Remote clock offset: 3.572 ms

# Below is generated by plot.py at 2018-09-05 04:54:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 425.67 Mbit/s
95th percentile per-packet one-way delay: 71.263 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 220.33 Mbit/s
95th percentile per-packet one-way delay: 71.011 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 215.99 Mbit/s
95th percentile per-packet one-way delay: 71.556 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 191.73 Mbit/s
95th percentile per-packet one-way delay: 71.567 ms
Loss rate: 0.00%
```

## Run 2: Report of Indigo — Data Link

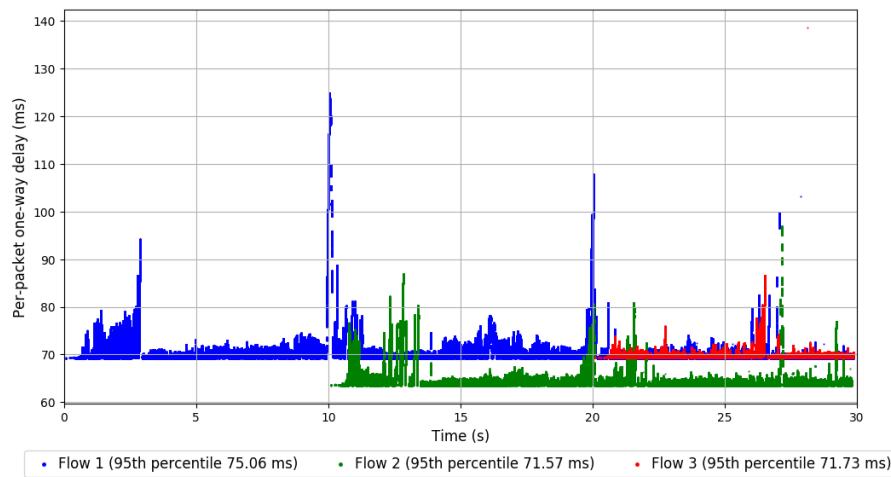
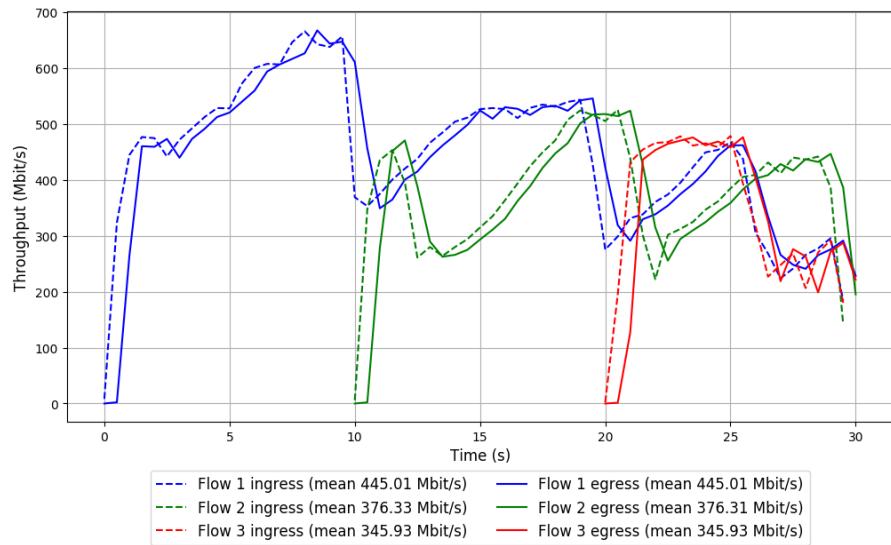


Run 1: Statistics of Muses-25

```
Start at: 2018-09-05 04:26:19
End at: 2018-09-05 04:26:49
Local clock offset: 0.328 ms
Remote clock offset: 3.377 ms

# Below is generated by plot.py at 2018-09-05 04:54:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 807.46 Mbit/s
95th percentile per-packet one-way delay: 73.840 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 445.01 Mbit/s
95th percentile per-packet one-way delay: 75.061 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 376.31 Mbit/s
95th percentile per-packet one-way delay: 71.567 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 345.93 Mbit/s
95th percentile per-packet one-way delay: 71.731 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link



Run 2: Statistics of Muses-25

```
Start at: 2018-09-05 04:34:18
End at: 2018-09-05 04:34:48
Local clock offset: 0.359 ms
Remote clock offset: 0.787 ms

# Below is generated by plot.py at 2018-09-05 04:54:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 909.47 Mbit/s
95th percentile per-packet one-way delay: 71.103 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 483.97 Mbit/s
95th percentile per-packet one-way delay: 72.350 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 468.20 Mbit/s
95th percentile per-packet one-way delay: 69.511 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 350.17 Mbit/s
95th percentile per-packet one-way delay: 71.966 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link

