Pantheon Report

Generated at 2018-08-28 06:10:27 (UTC).

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

Repeated the test of 4 congestion control schemes 3 times.

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.
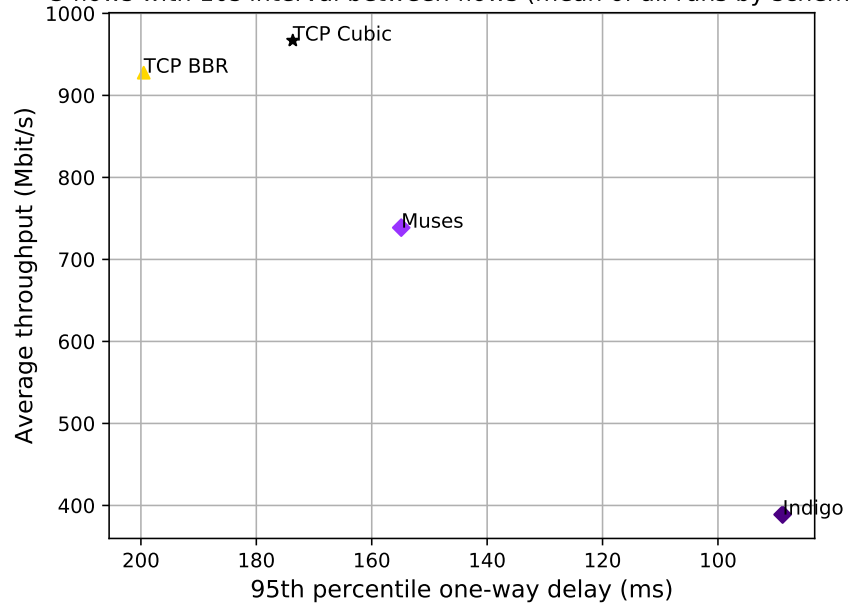
```
System info:
Linux 4.15.0-1015-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912

Git summary:
branch: muses @ 86ef433b09b2f4ecae1186d6940af93bcf0969cd
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b261c9e99c63be452bc16f94ce0caa99a4c9d39a
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
```
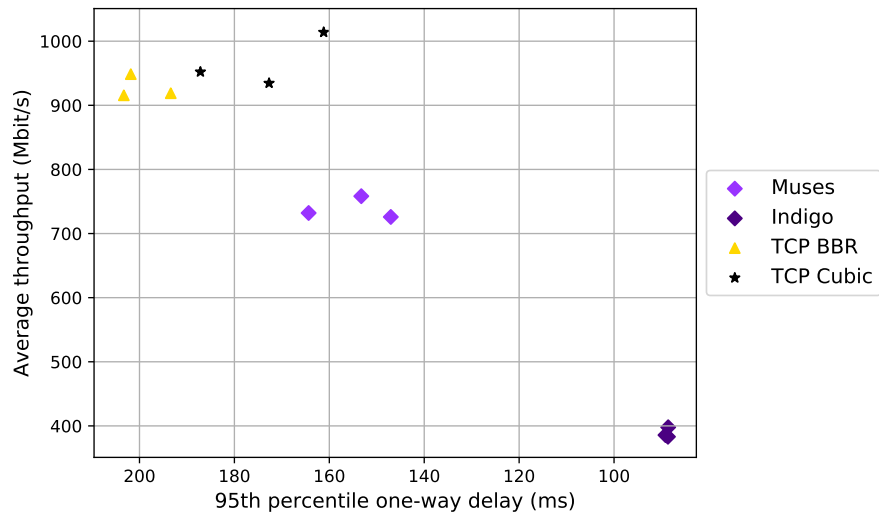
test from GCE Sydney to GCE Iowa, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

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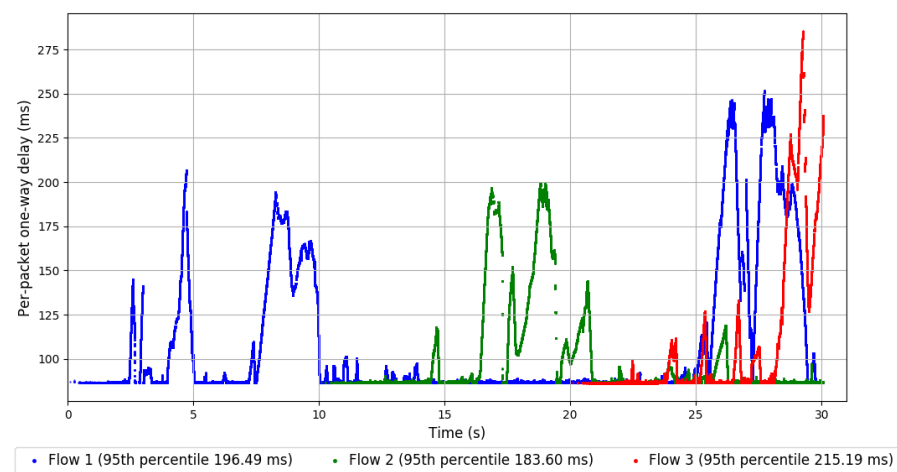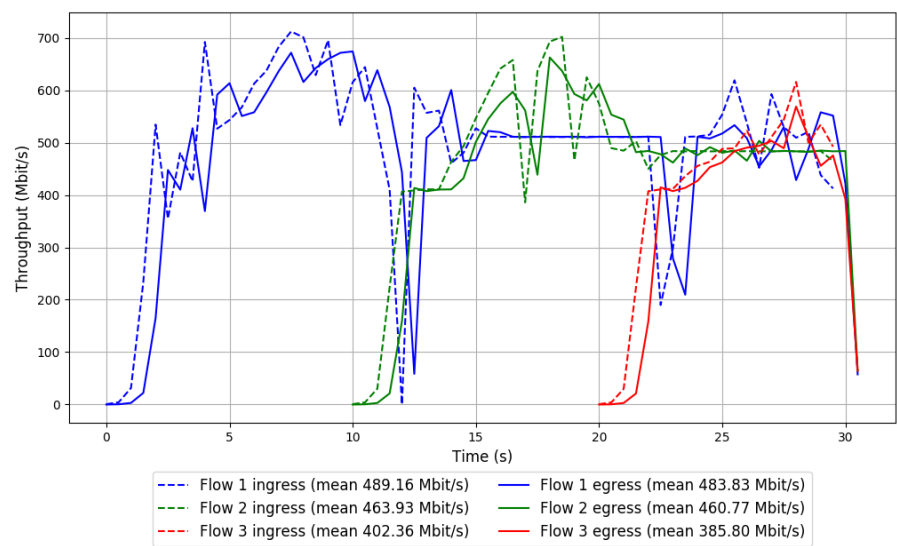3 flows with 10s interval between flows

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	3	495.00	457.80	384.80	186.90	202.55	193.53	1.11	1.72	2.74
TCP Cubic	3	528.78	478.26	359.43	169.16	168.41	147.35	0.09	0.24	0.12
Indigo	3	202.19	196.08	176.60	88.18	89.56	88.86	0.00	0.00	0.00
Muses	3	458.12	349.09	151.62	156.09	155.62	102.96	0.34	0.25	0.51

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-28 05:27:34
End at: 2018-08-28 05:28:04
Local clock offset: -0.287 ms
Remote clock offset: -0.108 ms


# Below is generated by plot.py at 2018-08-28 06:03:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 918.85 Mbit/s
95th percentile per-packet one-way delay: 193.408 ms
Loss rate: 1.39%
-- Flow 1:
Average throughput: 483.83 Mbit/s
95th percentile per-packet one-way delay: 196.486 ms
Loss rate: 1.09%
-- Flow 2:
Average throughput: 460.77 Mbit/s
95th percentile per-packet one-way delay: 183.605 ms
Loss rate: 0.68%
-- Flow 3:
Average throughput: 385.80 Mbit/s
95th percentile per-packet one-way delay: 215.191 ms
Loss rate: 4.09%
```
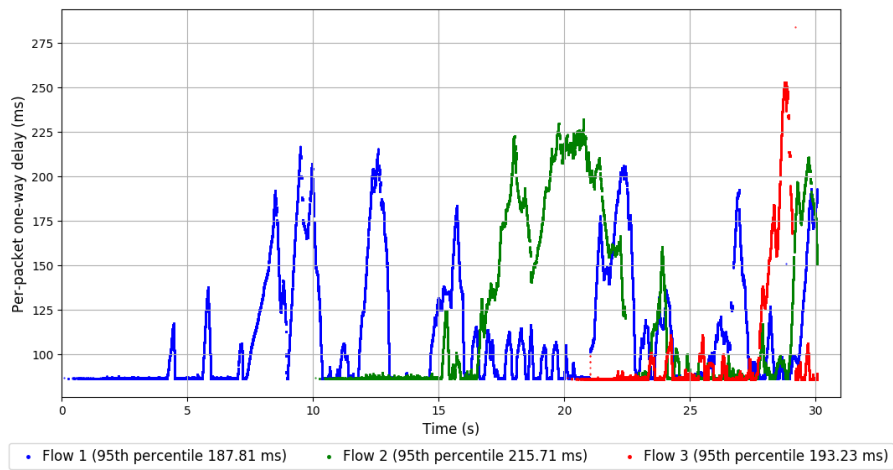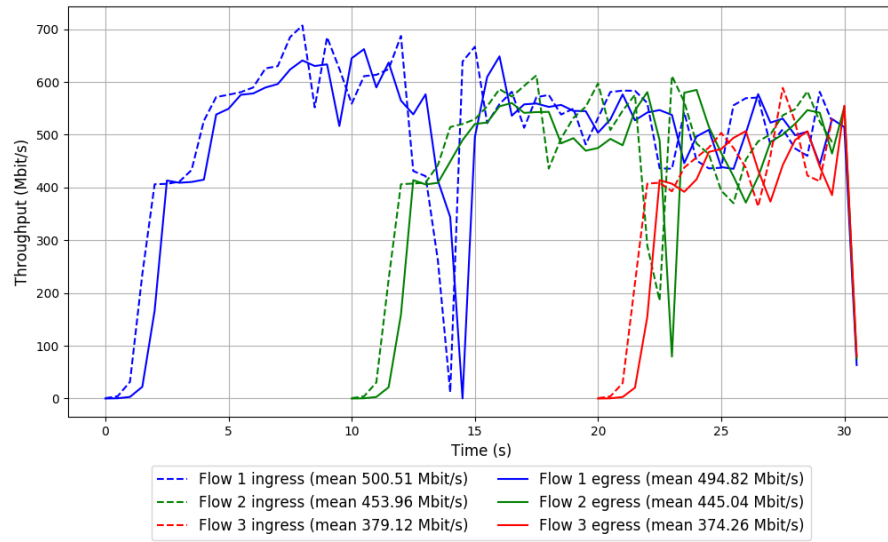
Run 1: Report of TCP BBR — Data Link

```
Run 2: Statistics of TCP BBR

Start at: 2018-08-28 05:35:26
End at: 2018-08-28 05:35:56
Local clock offset: -0.023 ms
Remote clock offset: -0.039 ms


# Below is generated by plot.py at 2018-08-28 06:03:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 915.60 Mbit/s
95th percentile per-packet one-way delay: 203.299 ms
Loss rate: 1.42%
-- Flow 1:
Average throughput: 494.82 Mbit/s
95th percentile per-packet one-way delay: 187.808 ms
Loss rate: 1.13%
-- Flow 2:
Average throughput: 445.04 Mbit/s
95th percentile per-packet one-way delay: 215.714 ms
Loss rate: 1.96%
-- Flow 3:
Average throughput: 374.26 Mbit/s
95th percentile per-packet one-way delay: 193.232 ms
Loss rate: 1.28%
```

Run 2: Report of TCP BBR — Data Link

```
Run 3: Statistics of TCP BBR

Start at: 2018-08-28 05:43:23
End at: 2018-08-28 05:43:53
Local clock offset: 0.363 ms
Remote clock offset: 0.005 ms


# Below is generated by plot.py at 2018-08-28 06:04:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 948.61 Mbit/s
95th percentile per-packet one-way delay: 201.831 ms
Loss rate: 1.82%
-- Flow 1:
Average throughput: 506.35 Mbit/s
95th percentile per-packet one-way delay: 176.401 ms
Loss rate: 1.11%
-- Flow 2:
Average throughput: 467.58 Mbit/s
95th percentile per-packet one-way delay: 208.318 ms
Loss rate: 2.52%
-- Flow 3:
Average throughput: 394.34 Mbit/s
95th percentile per-packet one-way delay: 172.154 ms
Loss rate: 2.85%
```
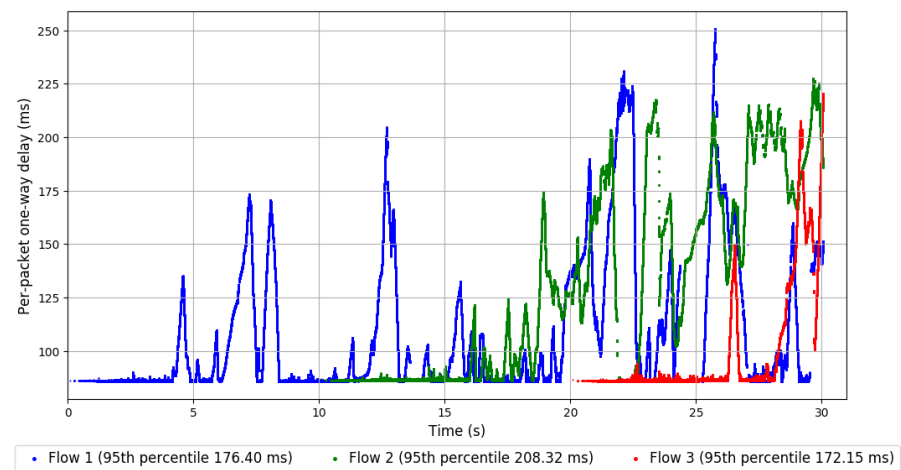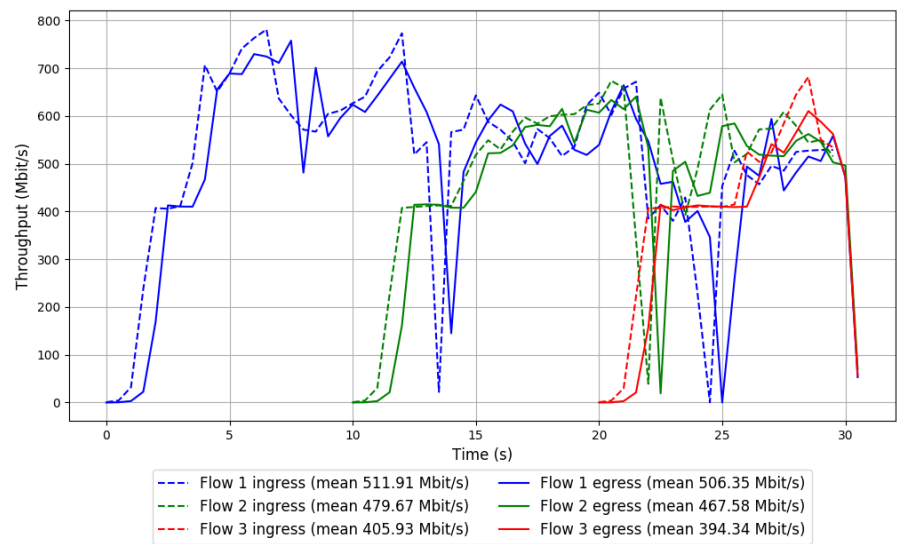
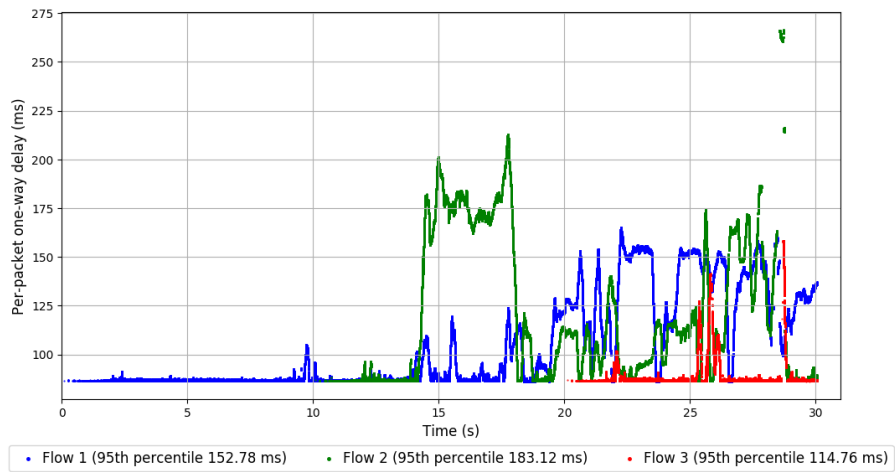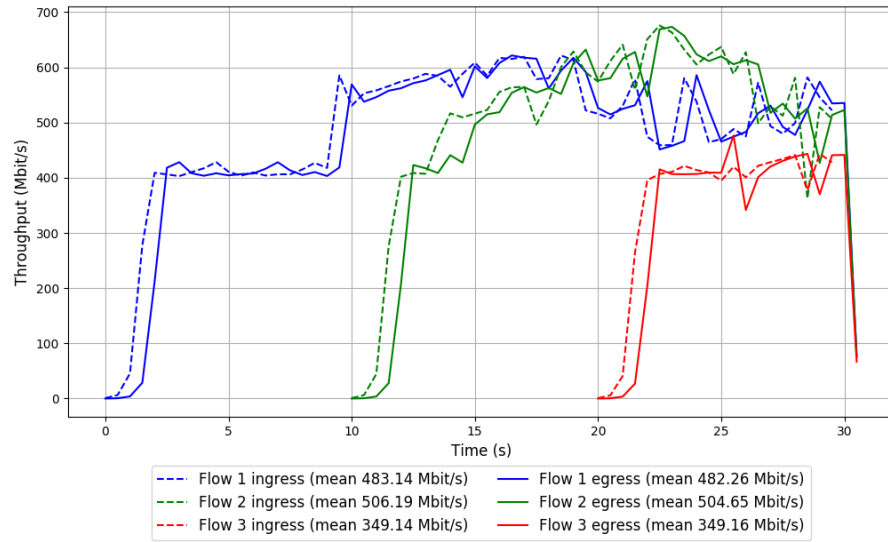Run 3: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 05:23:40
End at: 2018-08-28 05:24:10
Local clock offset: -0.473 ms
Remote clock offset: -0.072 ms


# Below is generated by plot.py at 2018-08-28 06:04:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 934.53 Mbit/s
95th percentile per-packet one-way delay: 172.691 ms
Loss rate: 0.20%
-- Flow 1:
Average throughput: 482.26 Mbit/s
95th percentile per-packet one-way delay: 152.781 ms
Loss rate: 0.18%
-- Flow 2:
Average throughput: 504.65 Mbit/s
95th percentile per-packet one-way delay: 183.123 ms
Loss rate: 0.30%
-- Flow 3:
Average throughput: 349.16 Mbit/s
95th percentile per-packet one-way delay: 114.764 ms
Loss rate: 0.00%
```

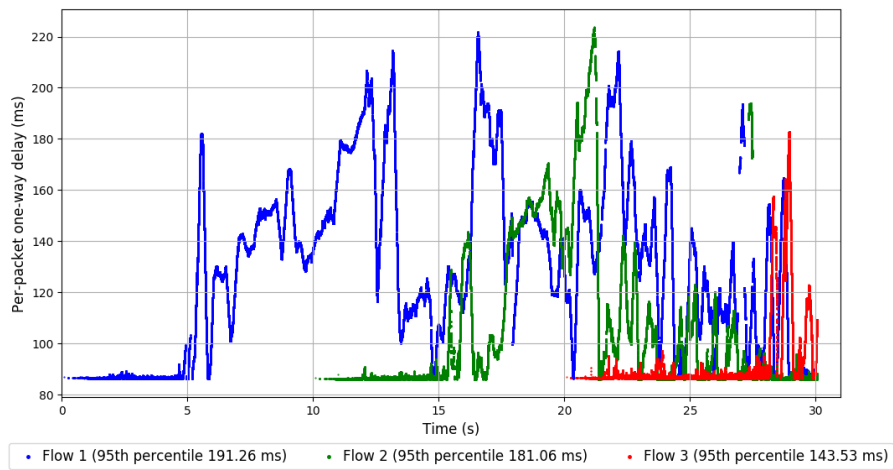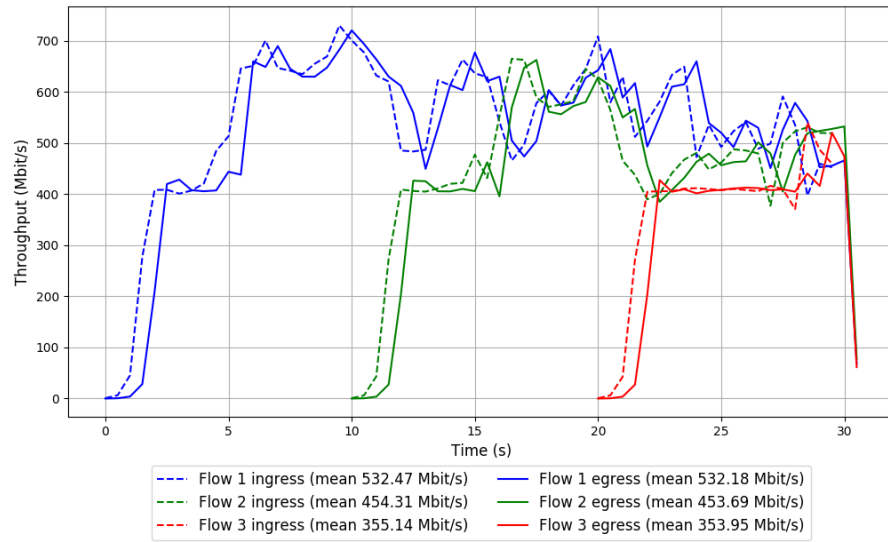Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 05:31:30
End at: 2018-08-28 05:32:00
Local clock offset: -0.045 ms
Remote clock offset: -0.043 ms


# Below is generated by plot.py at 2018-08-28 06:04:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 952.11 Mbit/s
95th percentile per-packet one-way delay: 187.161 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 532.18 Mbit/s
95th percentile per-packet one-way delay: 191.256 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 453.69 Mbit/s
95th percentile per-packet one-way delay: 181.055 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 353.95 Mbit/s
95th percentile per-packet one-way delay: 143.530 ms
Loss rate: 0.33%
```

Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 532.47 Mbit/s) --- Flow 1 egress (mean 532.18 Mbit/s)
Flow 2 ingress (mean 454.31 Mbit/s) --- Flow 2 egress (mean 453.69 Mbit/s)
Flow 3 ingress (mean 355.14 Mbit/s) --- Flow 3 egress (mean 353.95 Mbit/s)

Flow 1 (95th percentile 191.26 ms) • Flow 2 (95th percentile 181.06 ms) • Flow 3 (95th percentile 143.53 ms)

```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-28 05:39:22
End at: 2018-08-28 05:39:52
Local clock offset: -0.086 ms
Remote clock offset: 0.036 ms


# Below is generated by plot.py at 2018-08-28 06:04:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1013.96 Mbit/s
95th percentile per-packet one-way delay: 161.187 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 571.91 Mbit/s
95th percentile per-packet one-way delay: 163.429 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 476.44 Mbit/s
95th percentile per-packet one-way delay: 141.040 ms
Loss rate: 0.28%
-- Flow 3:
Average throughput: 375.17 Mbit/s
95th percentile per-packet one-way delay: 183.766 ms
Loss rate: 0.02%
```
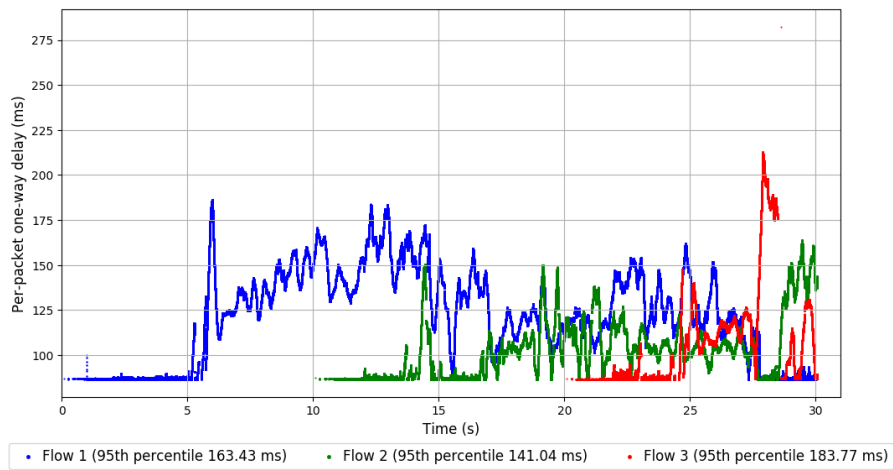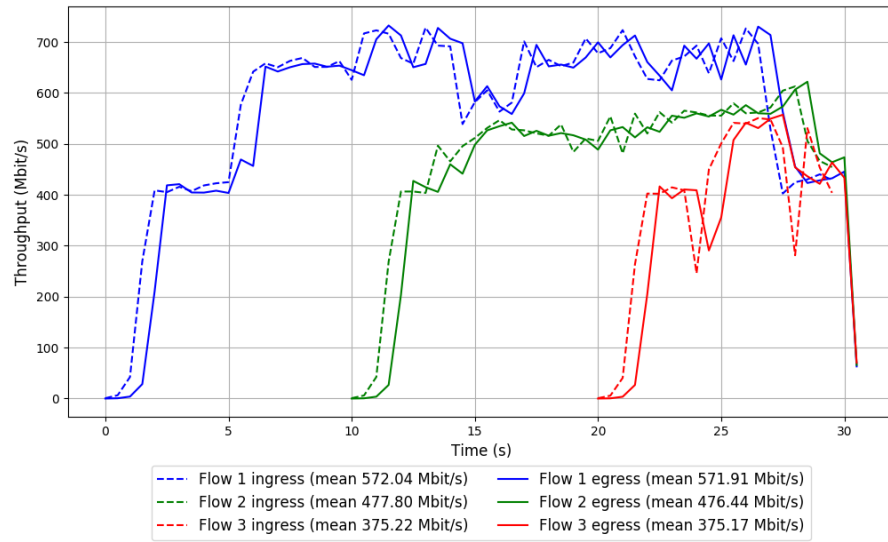
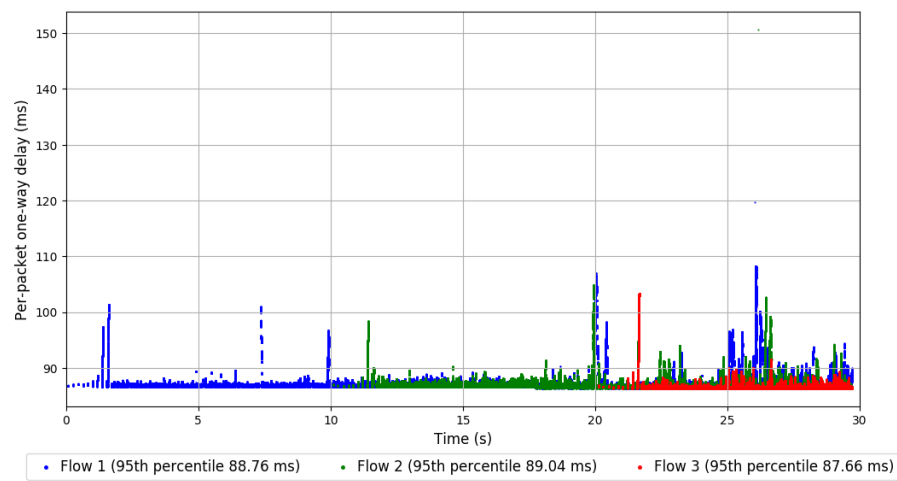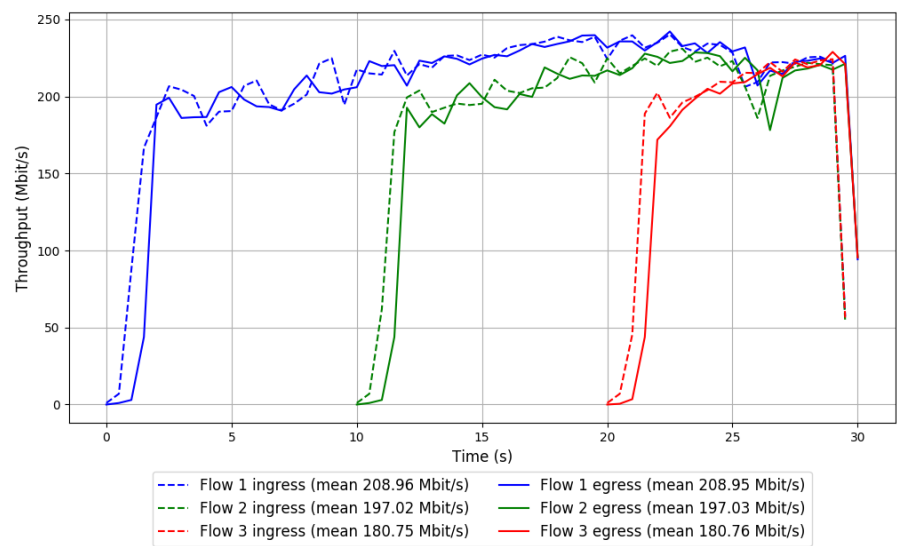Run 3: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-08-28 05:21:50
End at: 2018-08-28 05:22:20
Local clock offset: -0.614 ms
Remote clock offset: -0.102 ms


# Below is generated by plot.py at 2018-08-28 06:04:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 397.88 Mbit/s
95th percentile per-packet one-way delay: 88.588 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 208.95 Mbit/s
95th percentile per-packet one-way delay: 88.756 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 197.03 Mbit/s
95th percentile per-packet one-way delay: 89.037 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 180.76 Mbit/s
95th percentile per-packet one-way delay: 87.662 ms
Loss rate: 0.00%
```

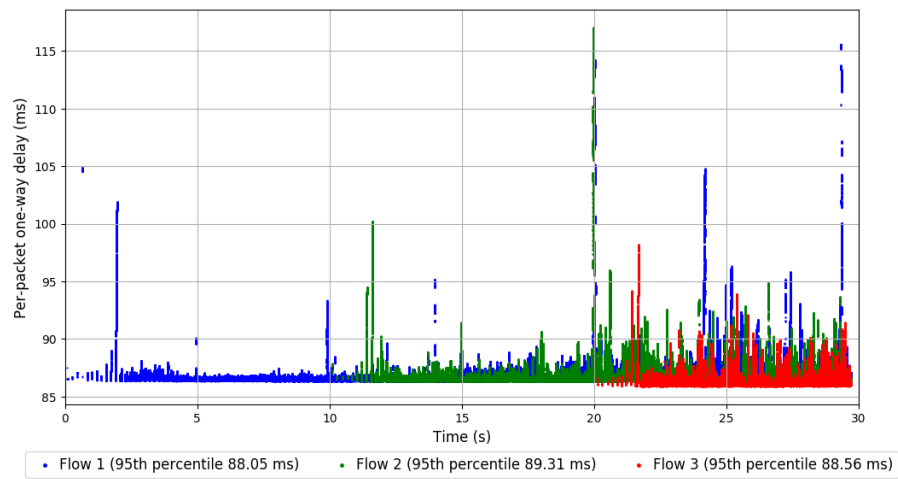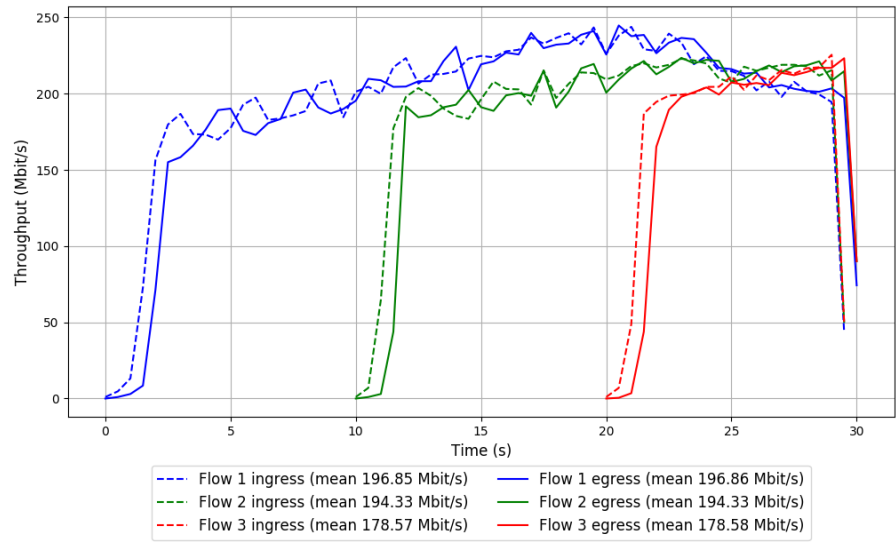Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2018-08-28 05:29:40
End at: 2018-08-28 05:30:10
Local clock offset: -0.161 ms
Remote clock offset: -0.051 ms


# Below is generated by plot.py at 2018-08-28 06:04:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 383.13 Mbit/s
95th percentile per-packet one-way delay: 88.642 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 196.86 Mbit/s
95th percentile per-packet one-way delay: 88.054 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 194.33 Mbit/s
95th percentile per-packet one-way delay: 89.309 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 178.58 Mbit/s
95th percentile per-packet one-way delay: 88.556 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-08-28 05:37:32
End at: 2018-08-28 05:38:02
Local clock offset: -0.131 ms
Remote clock offset: 0.054 ms


# Below is generated by plot.py at 2018-08-28 06:07:32
# Datalink statistics
-- Total of 3 flows:
Average throughput: 385.70 Mbit/s
95th percentile per-packet one-way delay: 89.161 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 200.76 Mbit/s
95th percentile per-packet one-way delay: 87.722 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 196.89 Mbit/s
95th percentile per-packet one-way delay: 90.326 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 170.45 Mbit/s
95th percentile per-packet one-way delay: 90.373 ms
Loss rate: 0.00%
```
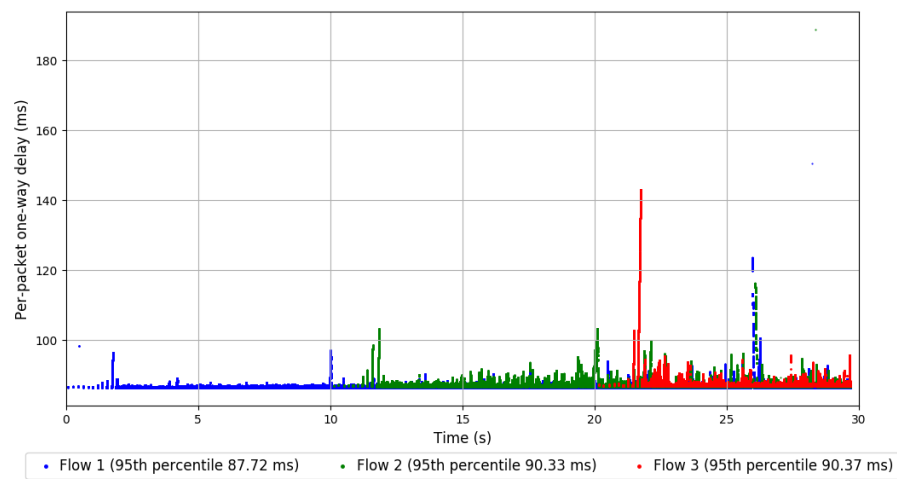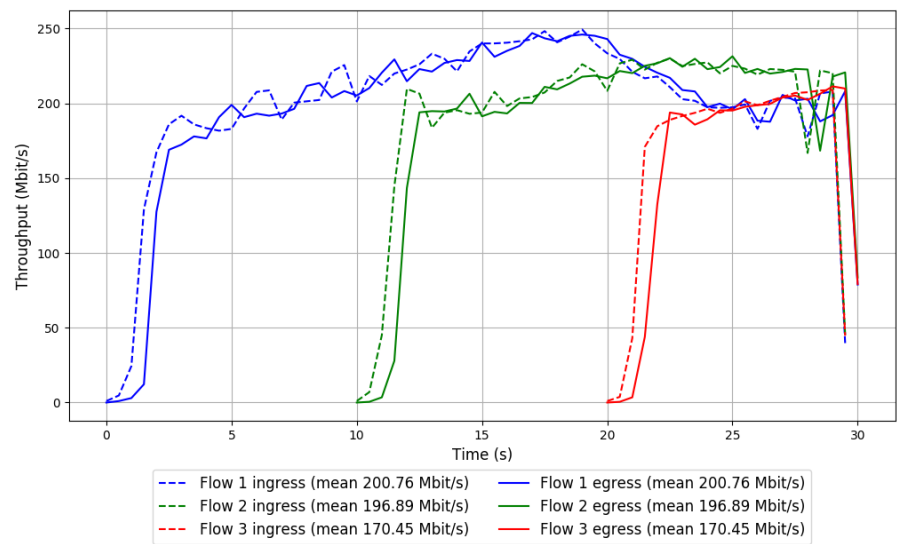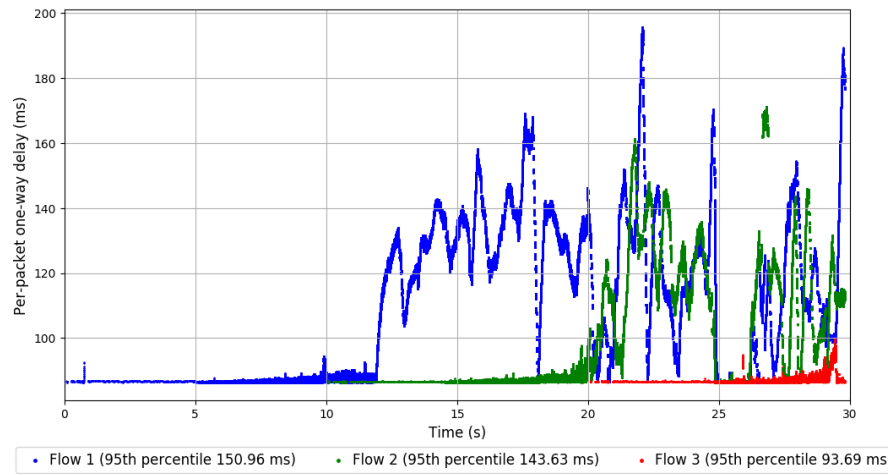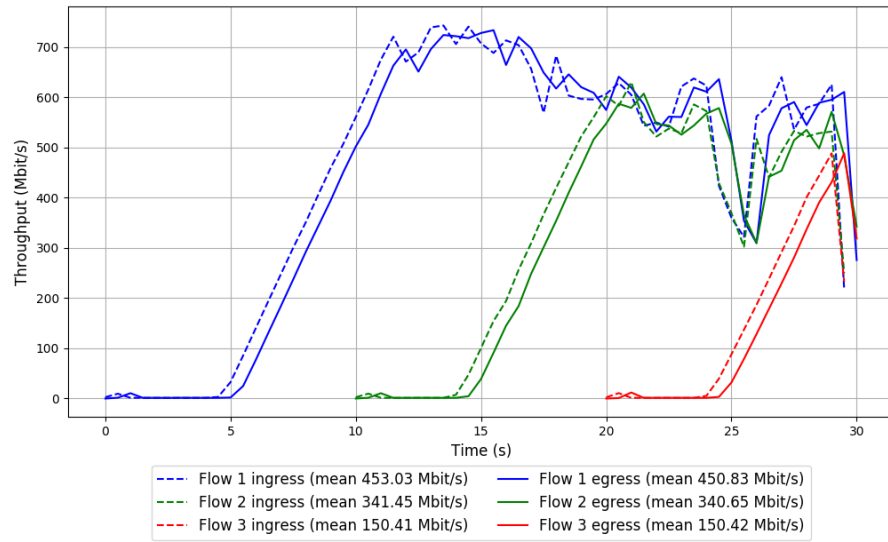
Run 3: Report of Indigo — Data Link

```
Run 1: Statistics of Muses

Start at: 2018-08-28 05:25:41
End at: 2018-08-28 05:26:11
Local clock offset: -0.312 ms
Remote clock offset: -0.081 ms

# Below is generated by plot.py at 2018-08-28 06:09:40
# Datalink statistics
-- Total of 3 flows:
Average throughput: 725.89 Mbit/s
95th percentile per-packet one-way delay: 147.042 ms
Loss rate: 0.36%
-- Flow 1:
Average throughput: 450.83 Mbit/s
95th percentile per-packet one-way delay: 150.963 ms
Loss rate: 0.47%
-- Flow 2:
Average throughput: 340.65 Mbit/s
95th percentile per-packet one-way delay: 143.626 ms
Loss rate: 0.22%
-- Flow 3:
Average throughput: 150.42 Mbit/s
95th percentile per-packet one-way delay: 93.687 ms
Loss rate: 0.00%
```

Run 1: Report of Muses — Data Link

```
Run 2: Statistics of Muses

Start at: 2018-08-28 05:33:33
End at: 2018-08-28 05:34:03
Local clock offset: 0.159 ms
Remote clock offset: -0.01 ms

# Below is generated by plot.py at 2018-08-28 06:10:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 732.06 Mbit/s
95th percentile per-packet one-way delay: 164.356 ms
Loss rate: 0.43%
-- Flow 1:
Average throughput: 451.77 Mbit/s
95th percentile per-packet one-way delay: 165.063 ms
Loss rate: 0.47%
-- Flow 2:
Average throughput: 347.48 Mbit/s
95th percentile per-packet one-way delay: 166.160 ms
Loss rate: 0.34%
-- Flow 3:
Average throughput: 154.07 Mbit/s
95th percentile per-packet one-way delay: 95.615 ms
Loss rate: 0.52%
```
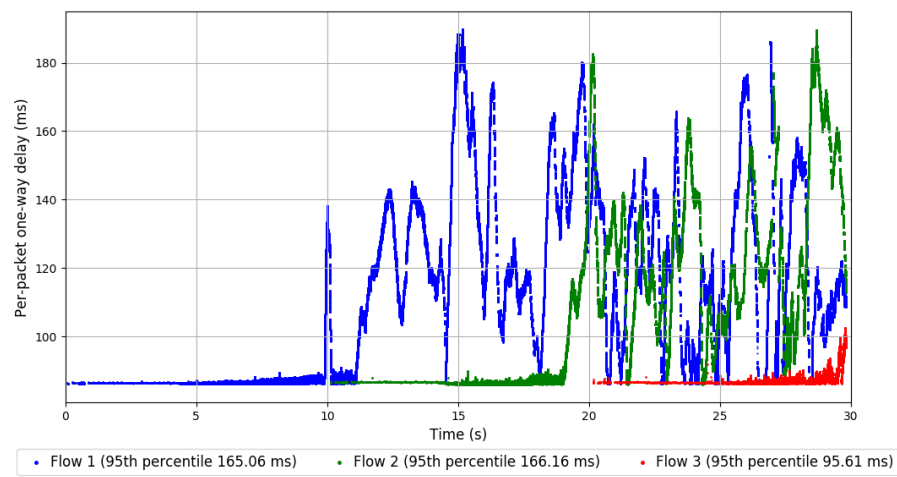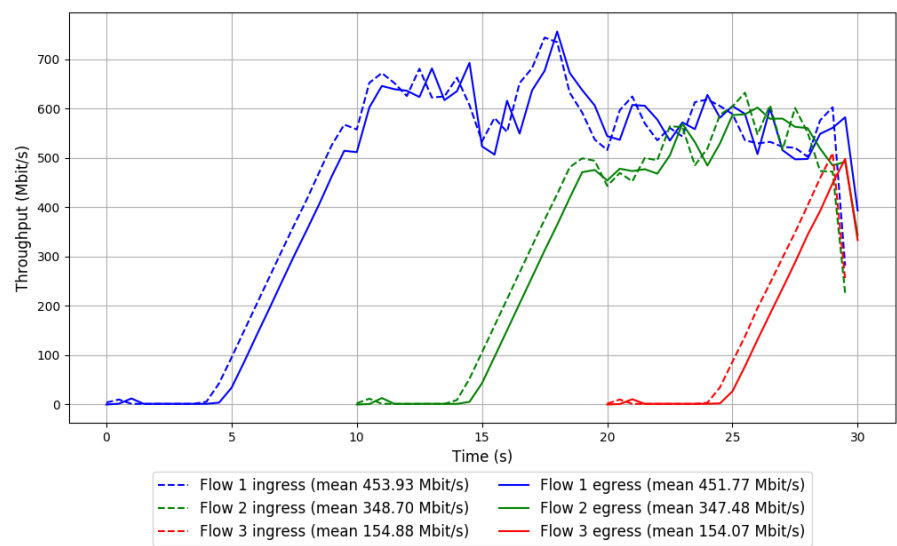
Run 2: Report of Muses — Data Link

```
Run 3: Statistics of Muses

Start at: 2018-08-28 05:41:28
End at: 2018-08-28 05:41:58
Local clock offset: 0.363 ms
Remote clock offset: 0.049 ms


# Below is generated by plot.py at 2018-08-28 06:10:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 758.27 Mbit/s
95th percentile per-packet one-way delay: 153.261 ms
Loss rate: 0.19%
-- Flow 1:
Average throughput: 471.77 Mbit/s
95th percentile per-packet one-way delay: 152.241 ms
Loss rate: 0.09%
-- Flow 2:
Average throughput: 359.13 Mbit/s
95th percentile per-packet one-way delay: 157.066 ms
Loss rate: 0.20%
-- Flow 3:
Average throughput: 150.38 Mbit/s
95th percentile per-packet one-way delay: 119.584 ms
Loss rate: 1.01%
```

Run 3: Report of Muses — Data Link