

Pantheon Report

Generated at 2018-08-28 05:38:44 (UTC).

Data path: AWS California 1 on `ens5` (*local*) → Stanford on `eno1` (*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.stanford.edu` and have been applied to correct the timestamps in logs.

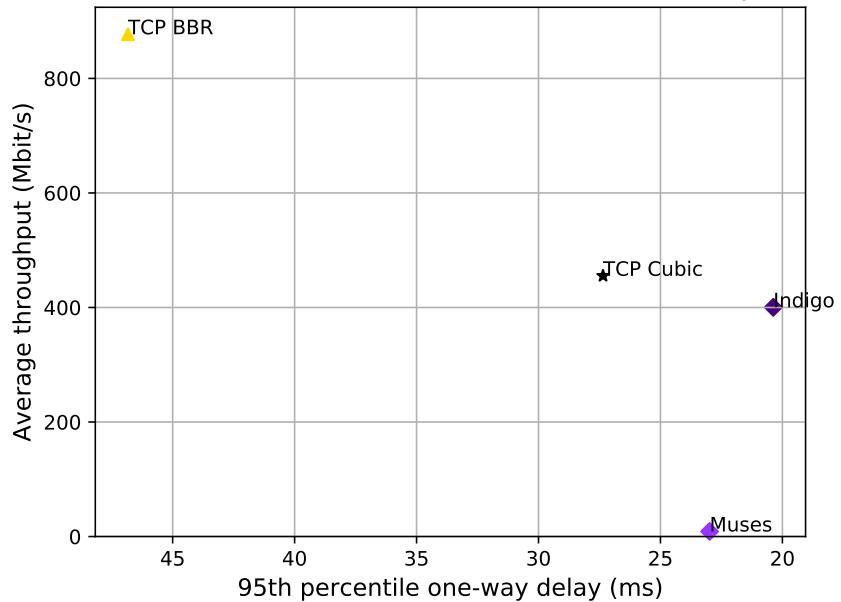
System info:

```
Linux 4.15.0-1019-aws
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
```

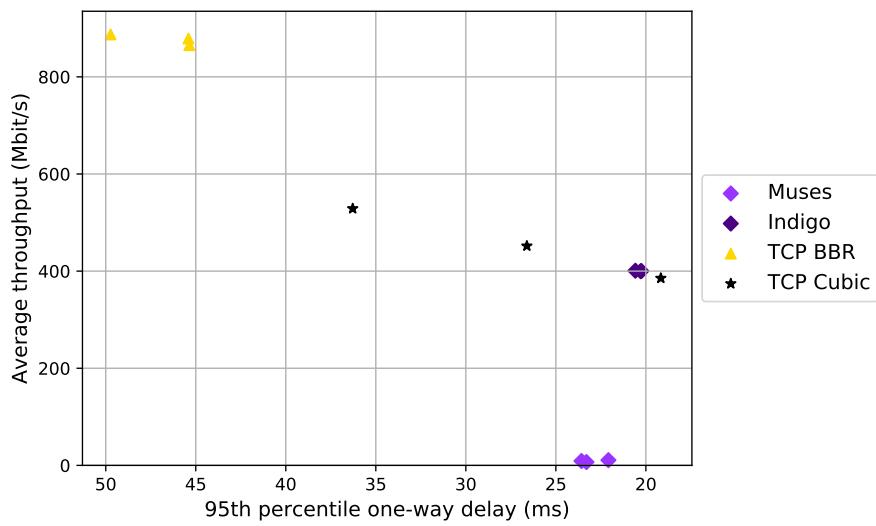
Git summary:

```
branch: muses @ 86ef433b09b2f4ecae1186d6940af93bcf0969cd
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbfe58e562f4
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 AWS California 1 to Stanford, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)



test from AWS California 1 to Stanford, 3 runs of 30s each per scheme
3 flows with 10s interval between flows



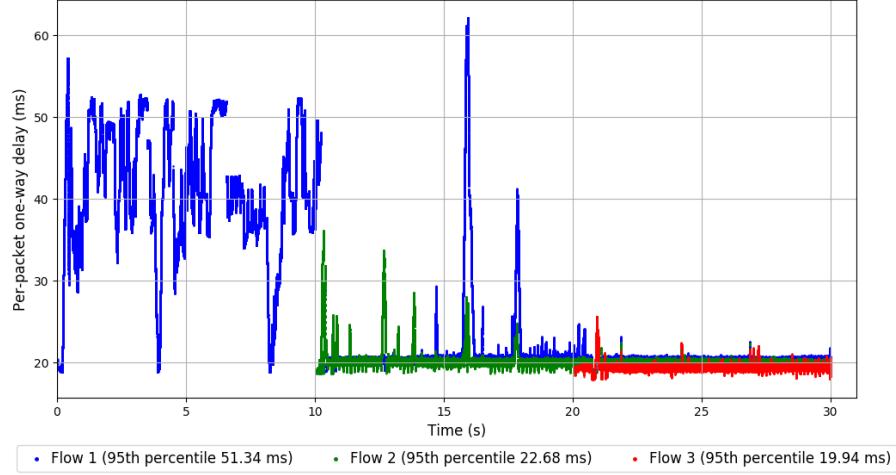
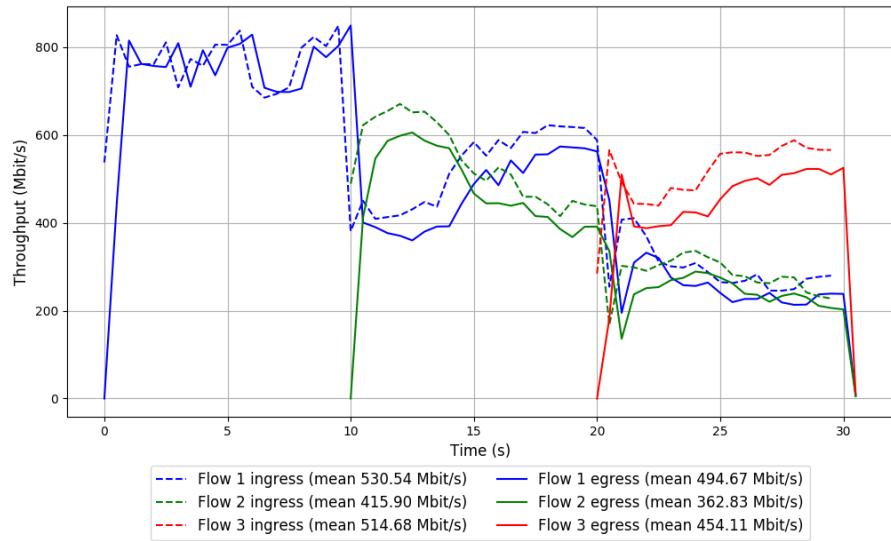
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	488.52	380.13	407.45	48.38	30.41	20.27	6.53	12.08	12.53
TCP Cubic	3	274.17	160.74	222.80	28.67	19.22	18.75	0.05	0.06	0.08
Indigo	3	205.33	198.95	194.82	19.65	20.58	20.91	0.01	0.02	0.04
Muses	3	4.17	5.32	3.82	21.38	22.24	22.41	55.30	37.49	40.00

Run 1: Statistics of TCP BBR

```
Start at: 2018-08-28 05:14:44
End at: 2018-08-28 05:15:14
Local clock offset: 0.956 ms
Remote clock offset: -0.16 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 887.35 Mbit/s
95th percentile per-packet one-way delay: 49.733 ms
Loss rate: 9.33%
-- Flow 1:
Average throughput: 494.67 Mbit/s
95th percentile per-packet one-way delay: 51.342 ms
Loss rate: 6.76%
-- Flow 2:
Average throughput: 362.83 Mbit/s
95th percentile per-packet one-way delay: 22.675 ms
Loss rate: 12.76%
-- Flow 3:
Average throughput: 454.11 Mbit/s
95th percentile per-packet one-way delay: 19.941 ms
Loss rate: 11.77%
```

Run 1: Report of TCP BBR — Data Link

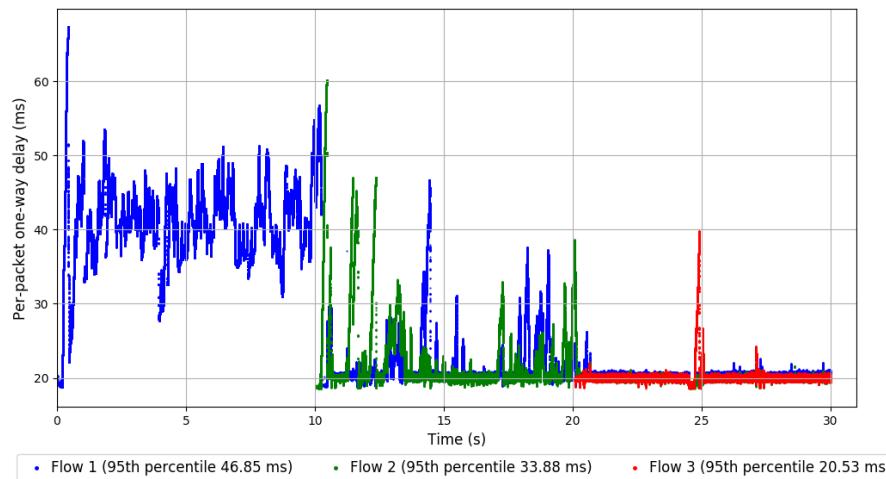
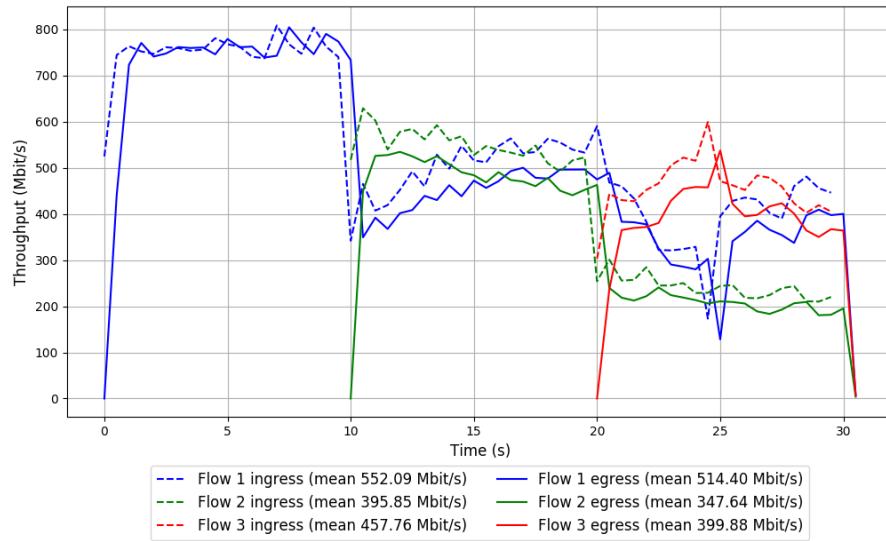


Run 2: Statistics of TCP BBR

```
Start at: 2018-08-28 05:21:03
End at: 2018-08-28 05:21:33
Local clock offset: 1.009 ms
Remote clock offset: -0.138 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 878.83 Mbit/s
95th percentile per-packet one-way delay: 45.404 ms
Loss rate: 9.20%
-- Flow 1:
Average throughput: 514.40 Mbit/s
95th percentile per-packet one-way delay: 46.852 ms
Loss rate: 6.82%
-- Flow 2:
Average throughput: 347.64 Mbit/s
95th percentile per-packet one-way delay: 33.875 ms
Loss rate: 12.17%
-- Flow 3:
Average throughput: 399.88 Mbit/s
95th percentile per-packet one-way delay: 20.531 ms
Loss rate: 12.65%
```

Run 2: Report of TCP BBR — Data Link

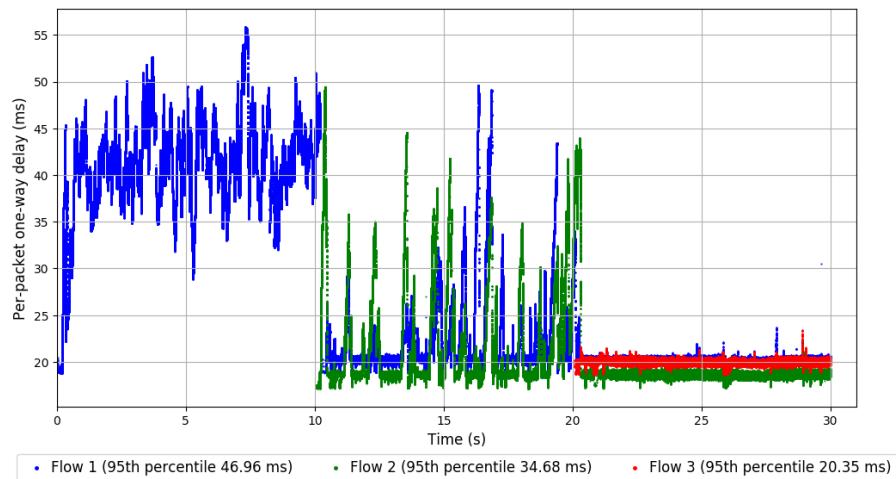
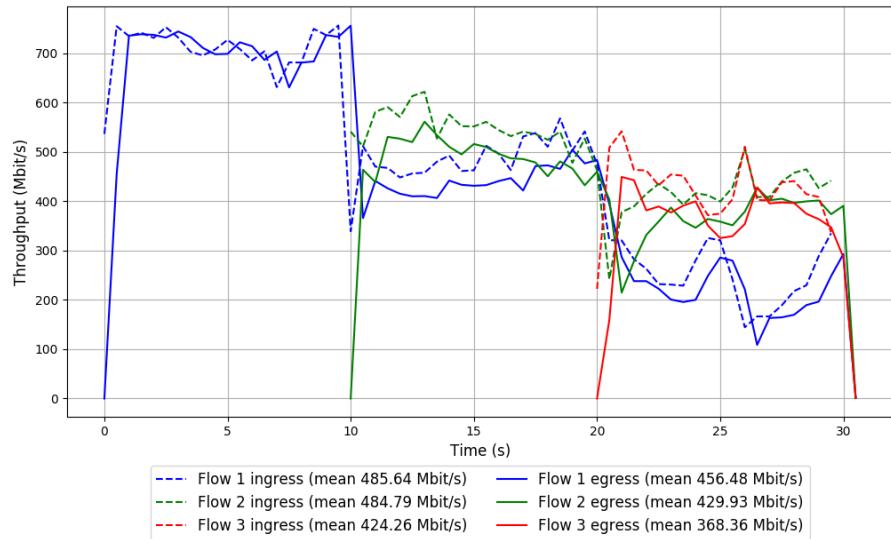


Run 3: Statistics of TCP BBR

```
Start at: 2018-08-28 05:27:23
End at: 2018-08-28 05:27:53
Local clock offset: 1.107 ms
Remote clock offset: -0.053 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 865.26 Mbit/s
95th percentile per-packet one-way delay: 45.356 ms
Loss rate: 8.87%
-- Flow 1:
Average throughput: 456.48 Mbit/s
95th percentile per-packet one-way delay: 46.957 ms
Loss rate: 6.00%
-- Flow 2:
Average throughput: 429.93 Mbit/s
95th percentile per-packet one-way delay: 34.683 ms
Loss rate: 11.31%
-- Flow 3:
Average throughput: 368.36 Mbit/s
95th percentile per-packet one-way delay: 20.351 ms
Loss rate: 13.18%
```

Run 3: Report of TCP BBR — Data Link

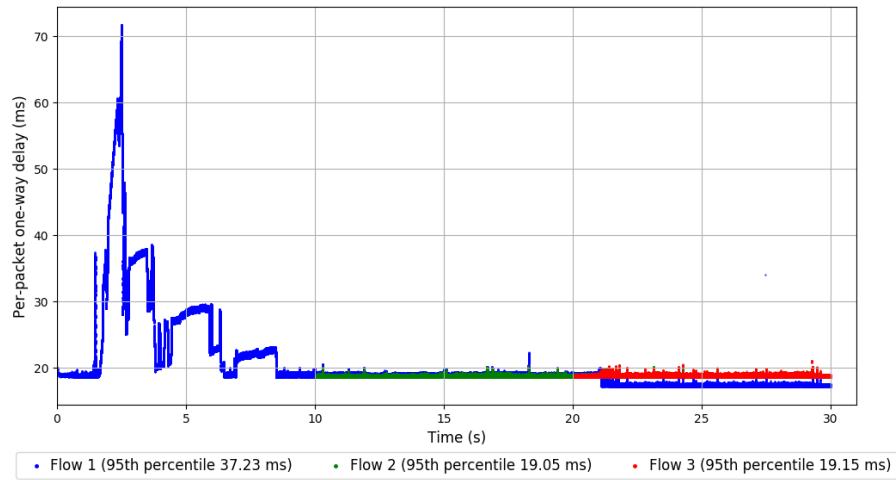
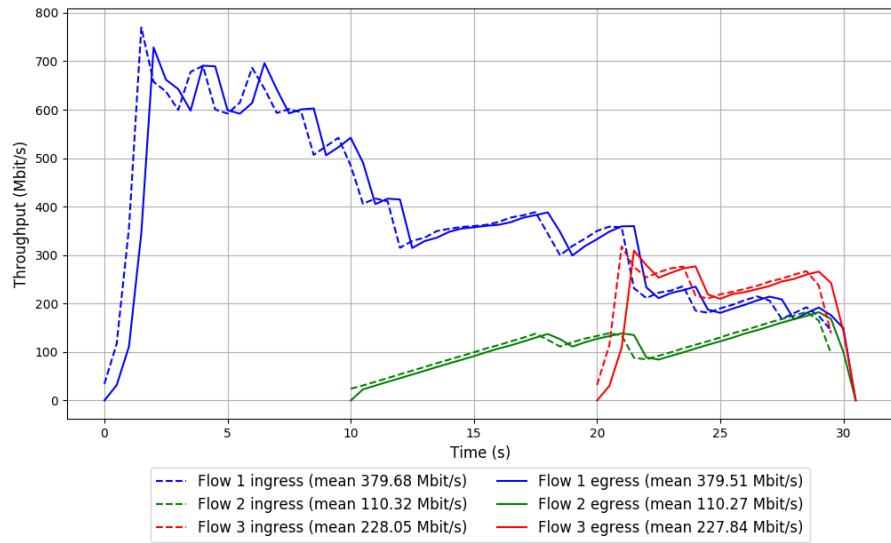


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-08-28 05:13:09
End at: 2018-08-28 05:13:39
Local clock offset: 0.978 ms
Remote clock offset: -0.195 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 528.67 Mbit/s
95th percentile per-packet one-way delay: 36.284 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 379.51 Mbit/s
95th percentile per-packet one-way delay: 37.232 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 110.27 Mbit/s
95th percentile per-packet one-way delay: 19.054 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 227.84 Mbit/s
95th percentile per-packet one-way delay: 19.154 ms
Loss rate: 0.09%
```

Run 1: Report of TCP Cubic — Data Link

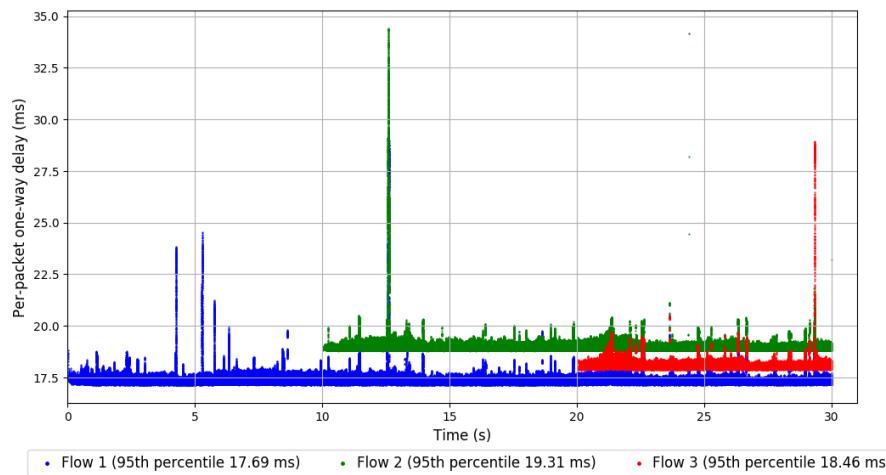
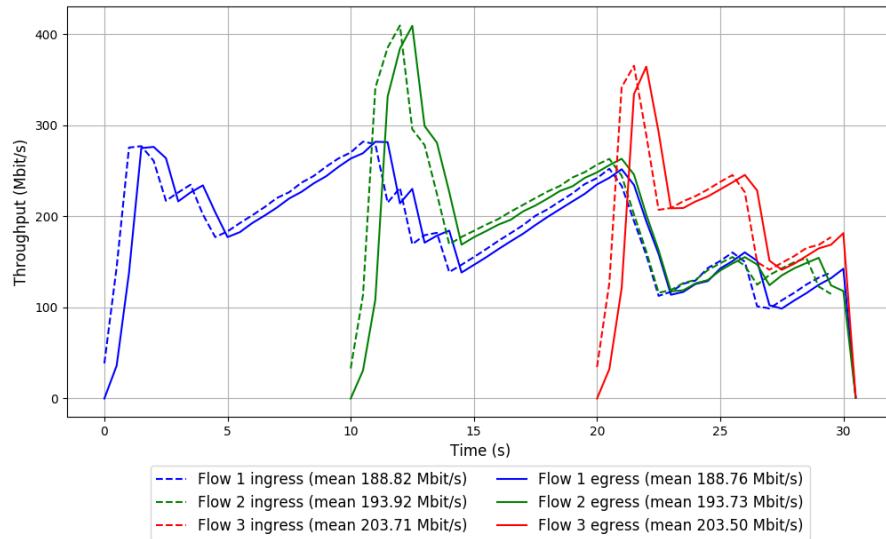


Run 2: Statistics of TCP Cubic

```
Start at: 2018-08-28 05:19:32
End at: 2018-08-28 05:20:02
Local clock offset: 0.996 ms
Remote clock offset: -0.14 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 385.41 Mbit/s
95th percentile per-packet one-way delay: 19.169 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 188.76 Mbit/s
95th percentile per-packet one-way delay: 17.689 ms
Loss rate: 0.03%
-- Flow 2:
Average throughput: 193.73 Mbit/s
95th percentile per-packet one-way delay: 19.311 ms
Loss rate: 0.08%
-- Flow 3:
Average throughput: 203.50 Mbit/s
95th percentile per-packet one-way delay: 18.461 ms
Loss rate: 0.10%
```

Run 2: Report of TCP Cubic — Data Link

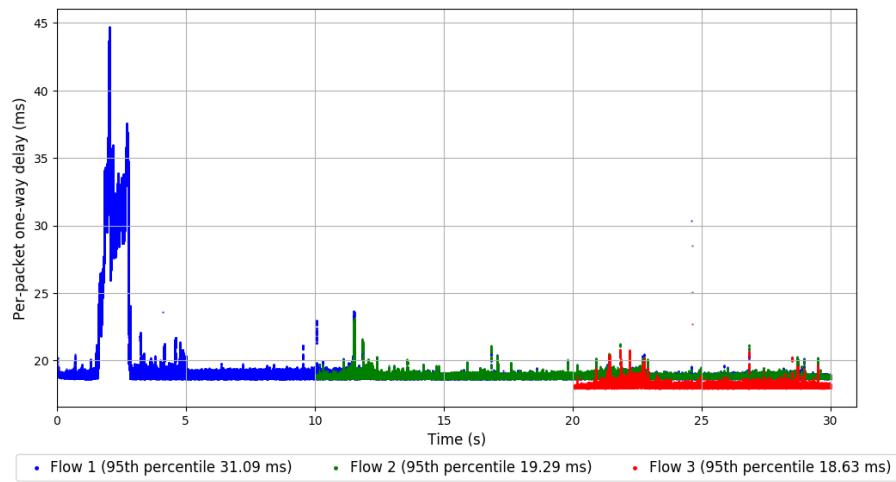
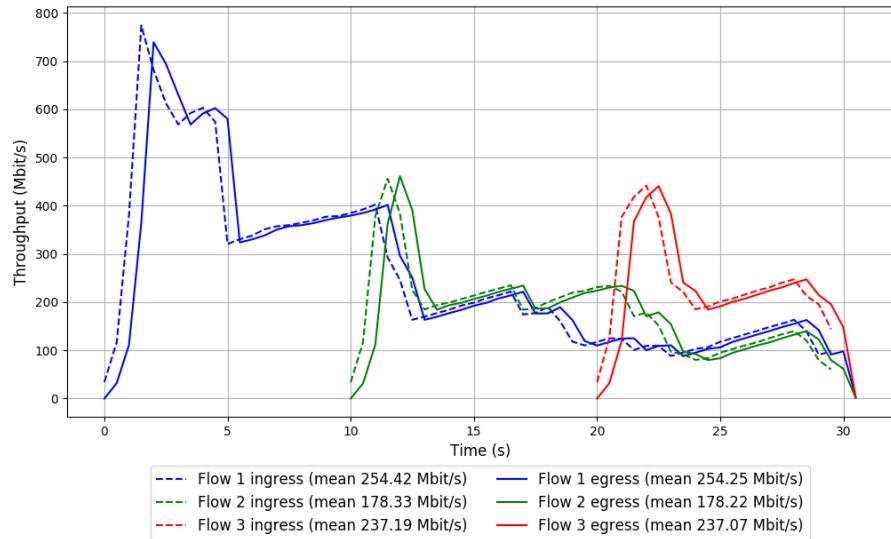


Run 3: Statistics of TCP Cubic

```
Start at: 2018-08-28 05:25:50
End at: 2018-08-28 05:26:20
Local clock offset: 1.08 ms
Remote clock offset: 0.005 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 451.81 Mbit/s
95th percentile per-packet one-way delay: 26.611 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 254.25 Mbit/s
95th percentile per-packet one-way delay: 31.091 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 178.22 Mbit/s
95th percentile per-packet one-way delay: 19.294 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 237.07 Mbit/s
95th percentile per-packet one-way delay: 18.631 ms
Loss rate: 0.05%
```

Run 3: Report of TCP Cubic — Data Link

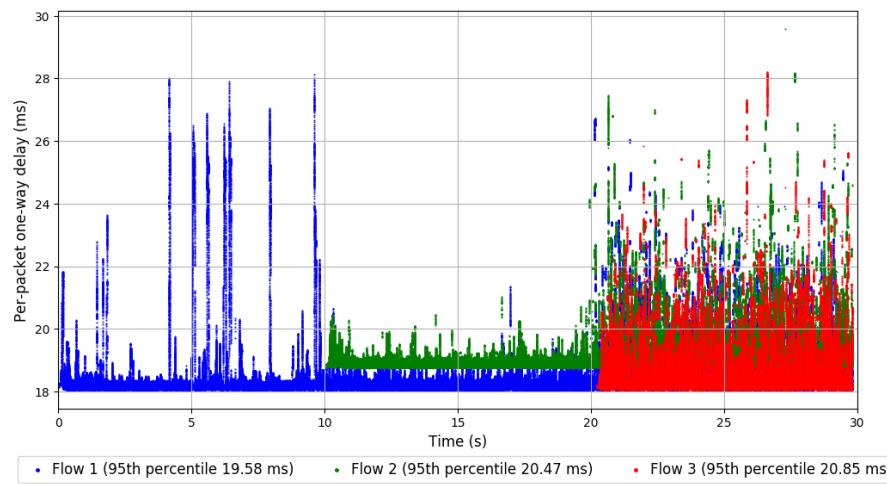
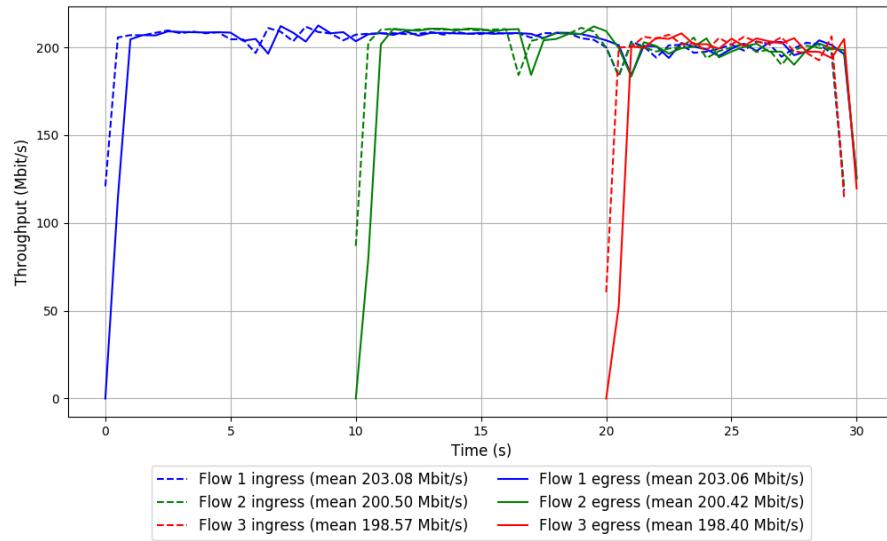


Run 1: Statistics of Indigo

```
Start at: 2018-08-28 05:16:39
End at: 2018-08-28 05:17:09
Local clock offset: 0.864 ms
Remote clock offset: -0.12 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 399.78 Mbit/s
95th percentile per-packet one-way delay: 20.289 ms
Loss rate: 0.03%
-- Flow 1:
Average throughput: 203.06 Mbit/s
95th percentile per-packet one-way delay: 19.577 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 200.42 Mbit/s
95th percentile per-packet one-way delay: 20.473 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 198.40 Mbit/s
95th percentile per-packet one-way delay: 20.851 ms
Loss rate: 0.08%
```

Run 1: Report of Indigo — Data Link

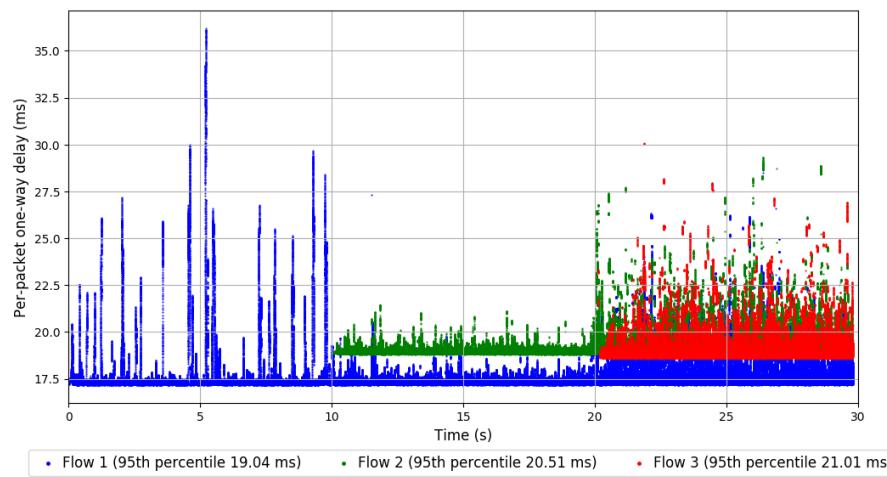
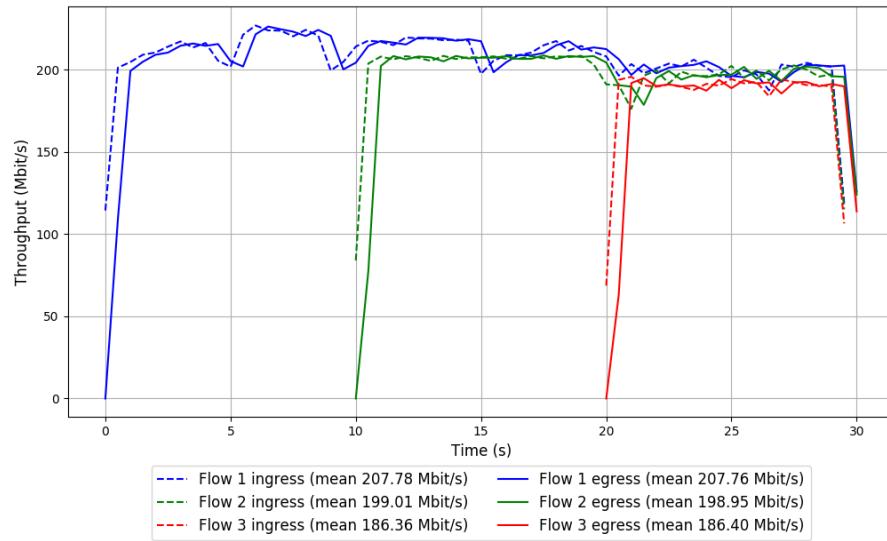


Run 2: Statistics of Indigo

```
Start at: 2018-08-28 05:22:57
End at: 2018-08-28 05:23:27
Local clock offset: 1.03 ms
Remote clock offset: -0.101 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 400.21 Mbit/s
95th percentile per-packet one-way delay: 20.250 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 207.76 Mbit/s
95th percentile per-packet one-way delay: 19.043 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 198.95 Mbit/s
95th percentile per-packet one-way delay: 20.506 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 186.40 Mbit/s
95th percentile per-packet one-way delay: 21.007 ms
Loss rate: 0.03%
```

Run 2: Report of Indigo — Data Link

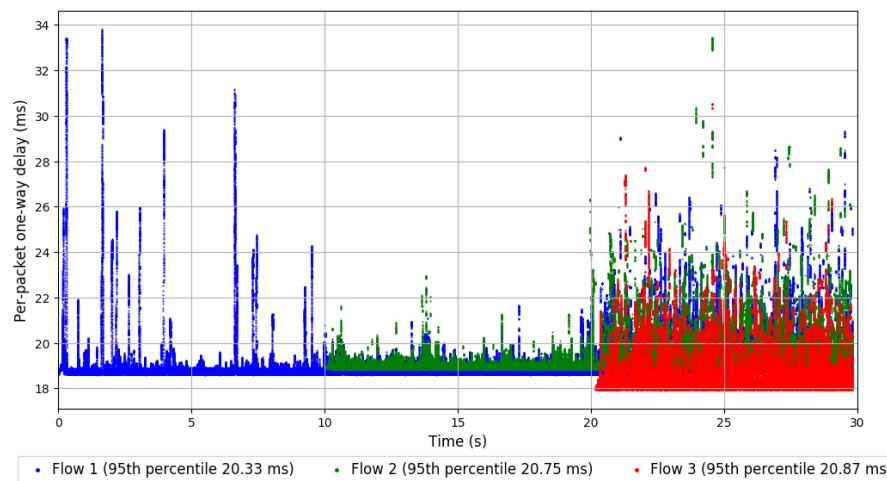
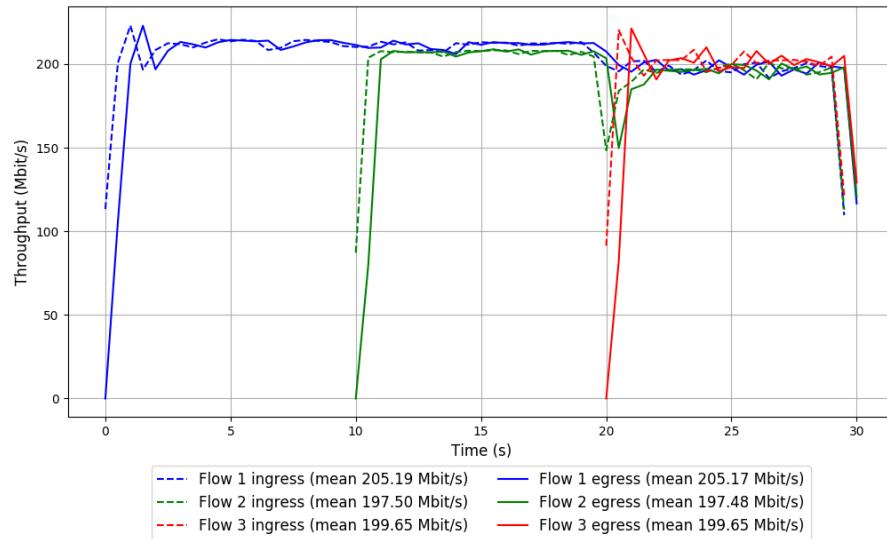


Run 3: Statistics of Indigo

```
Start at: 2018-08-28 05:29:16
End at: 2018-08-28 05:29:46
Local clock offset: 1.148 ms
Remote clock offset: 0.021 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 400.83 Mbit/s
95th percentile per-packet one-way delay: 20.583 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 205.17 Mbit/s
95th percentile per-packet one-way delay: 20.333 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 197.48 Mbit/s
95th percentile per-packet one-way delay: 20.748 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 199.65 Mbit/s
95th percentile per-packet one-way delay: 20.870 ms
Loss rate: 0.00%
```

Run 3: Report of Indigo — Data Link

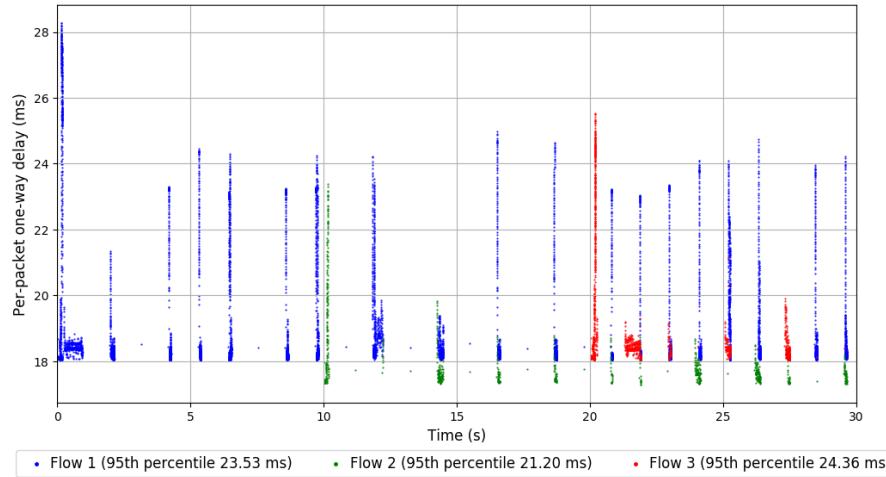
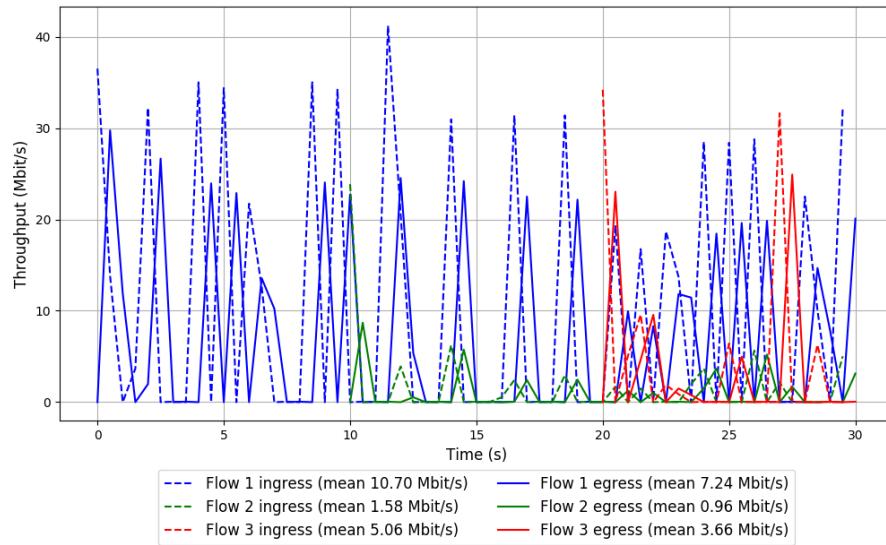


Run 1: Statistics of Muses

```
Start at: 2018-08-28 05:11:51
End at: 2018-08-28 05:12:21
Local clock offset: 0.882 ms
Remote clock offset: -0.225 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 9.05 Mbit/s
95th percentile per-packet one-way delay: 23.576 ms
Loss rate: 32.31%
-- Flow 1:
Average throughput: 7.24 Mbit/s
95th percentile per-packet one-way delay: 23.530 ms
Loss rate: 32.36%
-- Flow 2:
Average throughput: 0.96 Mbit/s
95th percentile per-packet one-way delay: 21.197 ms
Loss rate: 39.10%
-- Flow 3:
Average throughput: 3.66 Mbit/s
95th percentile per-packet one-way delay: 24.360 ms
Loss rate: 27.59%
```

Run 1: Report of Muses — Data Link

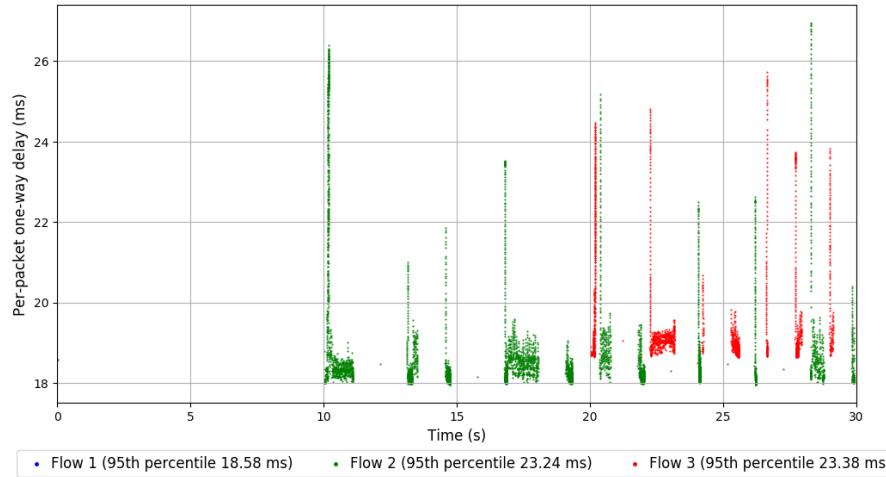
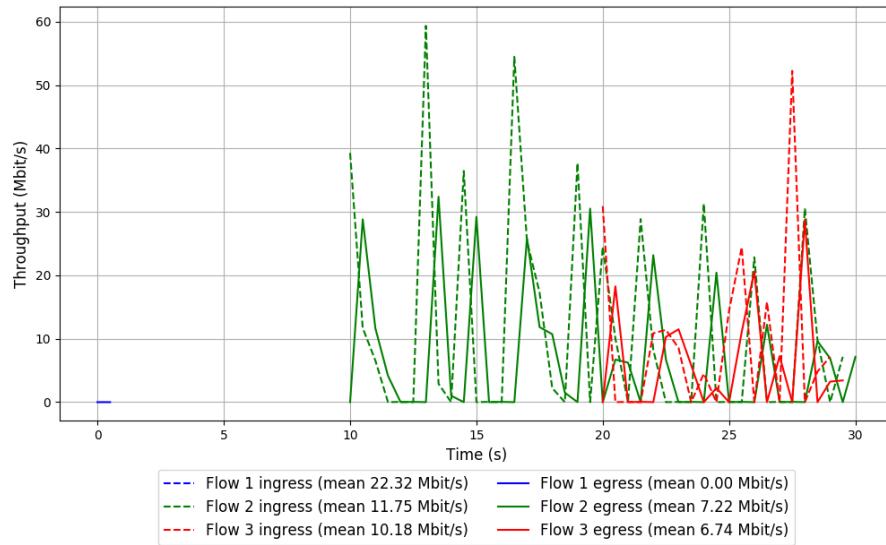


Run 2: Statistics of Muses

```
Start at: 2018-08-28 05:18:14
End at: 2018-08-28 05:18:44
Local clock offset: 0.978 ms
Remote clock offset: -0.119 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 6.85 Mbit/s
95th percentile per-packet one-way delay: 23.299 ms
Loss rate: 37.19%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 18.576 ms
Loss rate: 97.39%
-- Flow 2:
Average throughput: 7.22 Mbit/s
95th percentile per-packet one-way delay: 23.241 ms
Loss rate: 38.52%
-- Flow 3:
Average throughput: 6.74 Mbit/s
95th percentile per-packet one-way delay: 23.376 ms
Loss rate: 33.83%
```

Run 2: Report of Muses — Data Link



Run 3: Statistics of Muses

```
Start at: 2018-08-28 05:24:32
End at: 2018-08-28 05:25:02
Local clock offset: 1.051 ms
Remote clock offset: -0.086 ms

# Below is generated by plot.py at 2018-08-28 05:38:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 10.75 Mbit/s
95th percentile per-packet one-way delay: 22.080 ms
Loss rate: 36.64%
-- Flow 1:
Average throughput: 5.28 Mbit/s
95th percentile per-packet one-way delay: 22.022 ms
Loss rate: 36.15%
-- Flow 2:
Average throughput: 7.78 Mbit/s
95th percentile per-packet one-way delay: 22.280 ms
Loss rate: 34.85%
-- Flow 3:
Average throughput: 1.05 Mbit/s
95th percentile per-packet one-way delay: 19.492 ms
Loss rate: 58.58%
```

Run 3: Report of Muses — Data Link

