

## Pantheon Report

Generated at 2018-09-05 22:58:00 (UTC).  
Data path: Stanford on `eno1` (*remote*) → AWS California 1 on `ens5` (*local*).  
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.

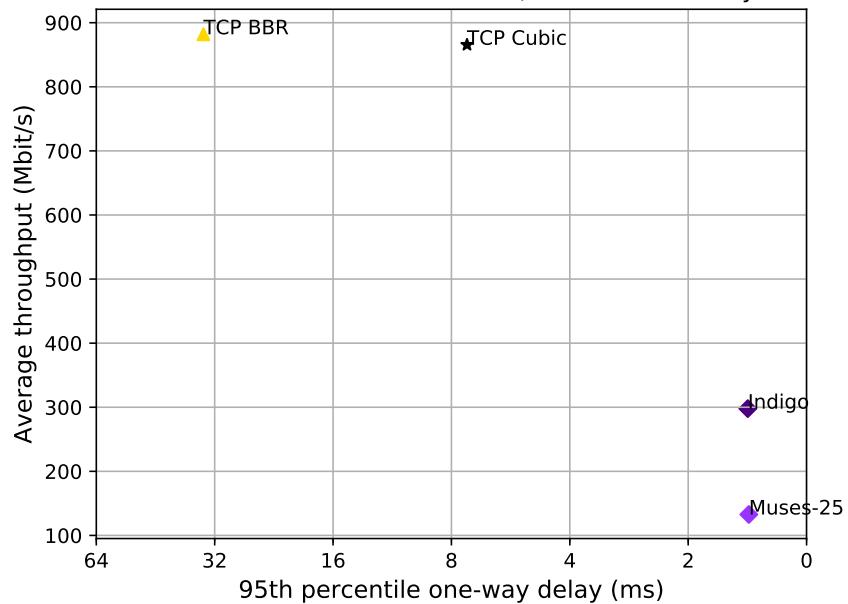
System info:

```
Linux 4.15.0-1020-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
net.ipv4.tcp_mem = 536870912 536870912 536870912
```

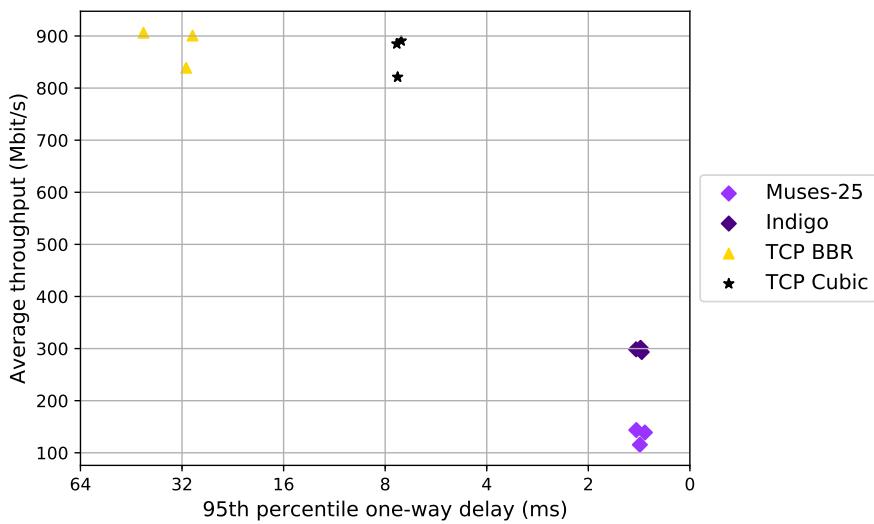
Git summary:

```
branch: muses @ 18b9165265c8ba2915c862e8713fd9ad82c1ac21
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdf58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ a28d20fb82a95a965a3da65fd1eb71b8994e9b84
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 Stanford to AWS California 1, 3 runs of 30s each per scheme  
3 flows with 10s interval between flows (mean of all runs by scheme)



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



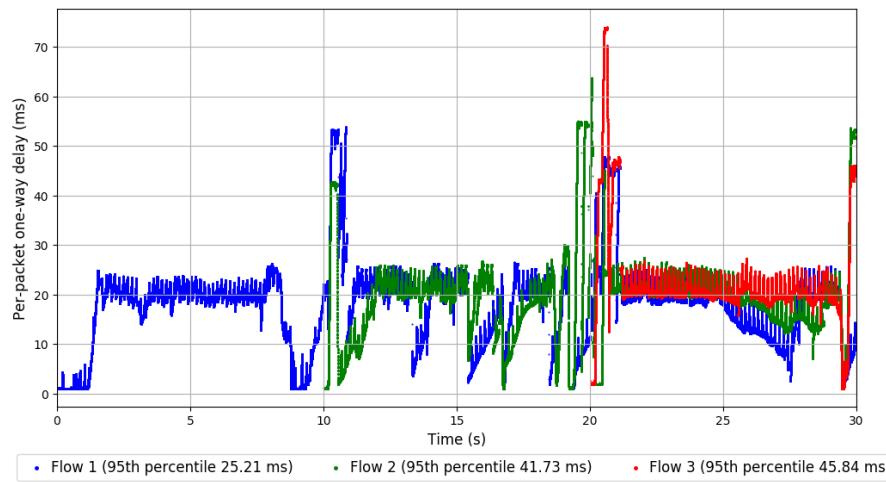
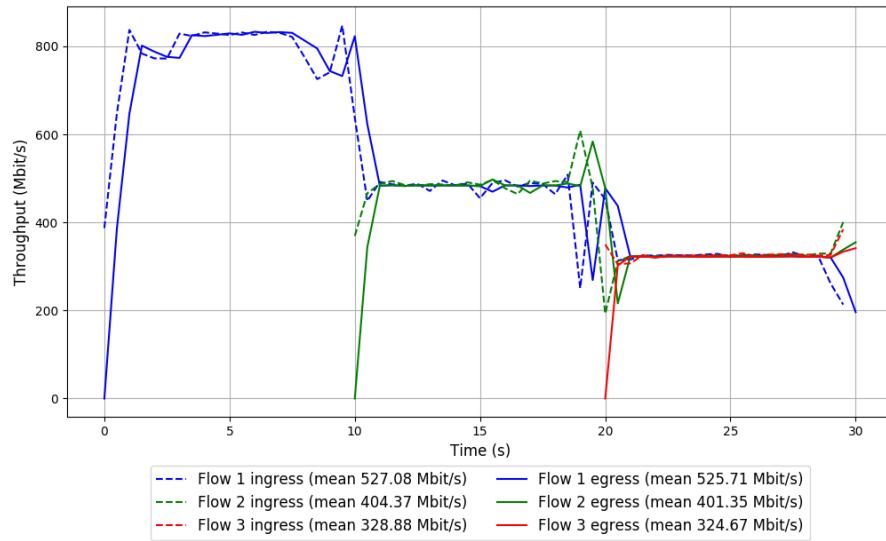
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	506.52	401.56	325.46	25.69	39.43	55.42	0.39	0.74	1.13
TCP Cubic	3	515.59	376.95	297.76	7.54	7.13	7.01	0.06	0.10	0.26
Indigo	3	161.19	148.31	115.67	0.99	1.00	1.03	0.04	0.08	0.19
Muses-25	3	54.38	79.08	77.64	0.97	0.99	0.98	0.01	0.03	0.17

Run 1: Statistics of TCP BBR

```
Start at: 2018-09-05 22:29:51
End at: 2018-09-05 22:30:21
Local clock offset: -2.779 ms
Remote clock offset: 3.901 ms

# Below is generated by plot.py at 2018-09-05 22:57:56
# Datalink statistics
-- Total of 3 flows:
Average throughput: 900.77 Mbit/s
95th percentile per-packet one-way delay: 29.780 ms
Loss rate: 0.61%
-- Flow 1:
Average throughput: 525.71 Mbit/s
95th percentile per-packet one-way delay: 25.210 ms
Loss rate: 0.32%
-- Flow 2:
Average throughput: 401.35 Mbit/s
95th percentile per-packet one-way delay: 41.726 ms
Loss rate: 0.84%
-- Flow 3:
Average throughput: 324.67 Mbit/s
95th percentile per-packet one-way delay: 45.843 ms
Loss rate: 1.48%
```

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

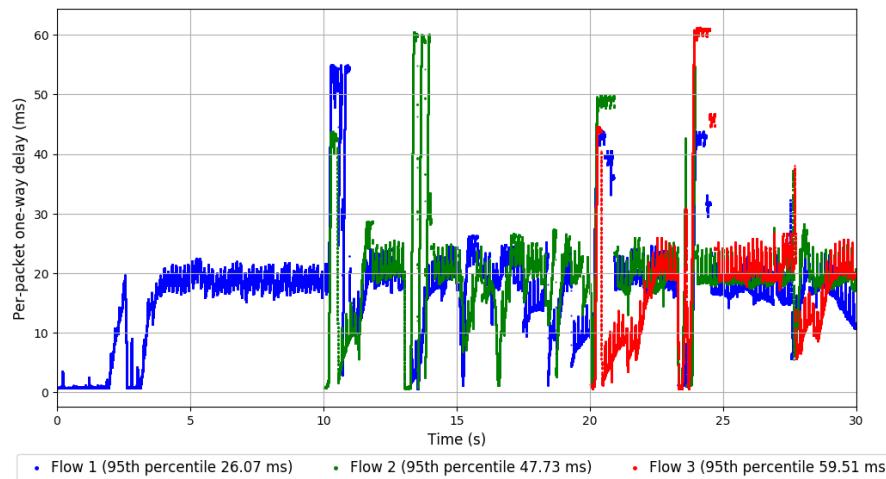
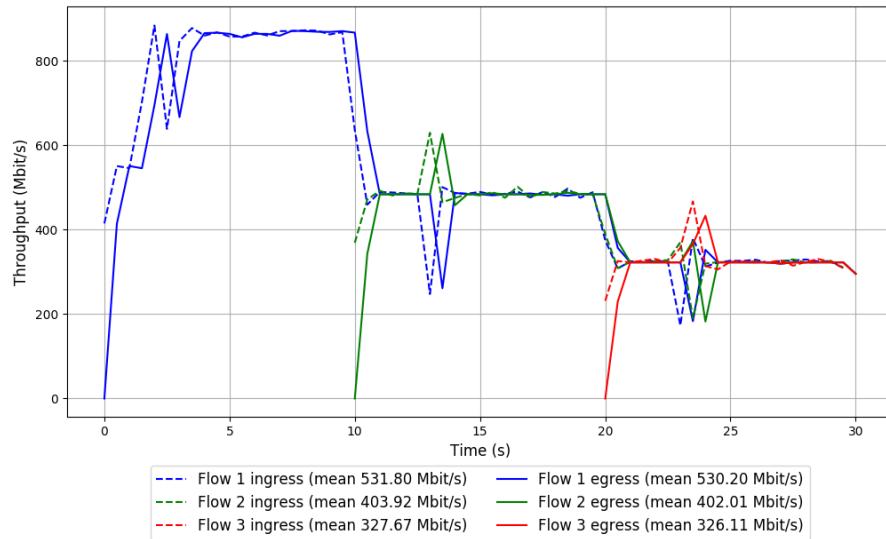


Run 2: Statistics of TCP BBR

```
Start at: 2018-09-05 22:36:32
End at: 2018-09-05 22:37:02
Local clock offset: -1.712 ms
Remote clock offset: 4.24 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 906.15 Mbit/s
95th percentile per-packet one-way delay: 41.631 ms
Loss rate: 0.46%
-- Flow 1:
Average throughput: 530.20 Mbit/s
95th percentile per-packet one-way delay: 26.073 ms
Loss rate: 0.36%
-- Flow 2:
Average throughput: 402.01 Mbit/s
95th percentile per-packet one-way delay: 47.735 ms
Loss rate: 0.57%
-- Flow 3:
Average throughput: 326.11 Mbit/s
95th percentile per-packet one-way delay: 59.511 ms
Loss rate: 0.67%
```

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

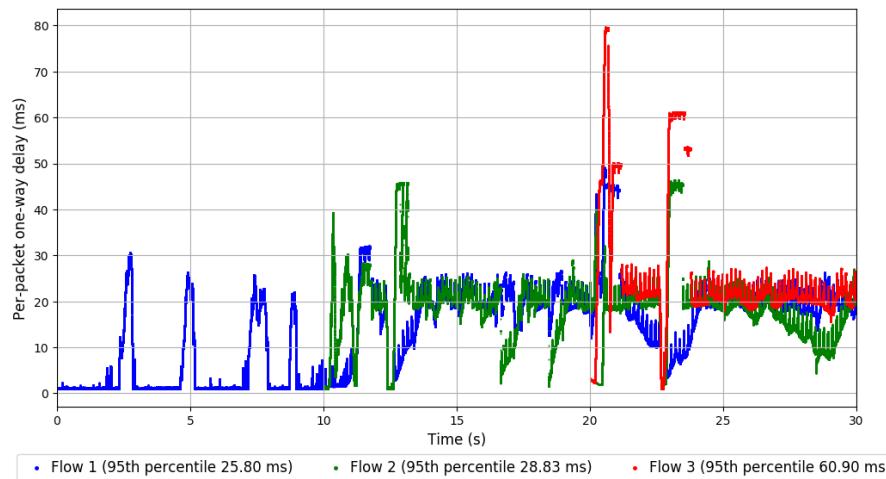
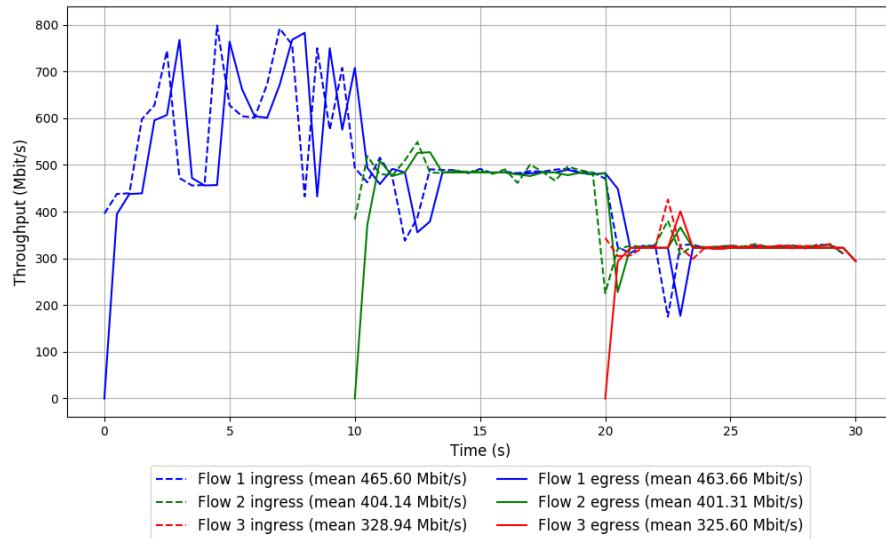


Run 3: Statistics of TCP BBR

```
Start at: 2018-09-05 22:43:12
End at: 2018-09-05 22:43:42
Local clock offset: -1.068 ms
Remote clock offset: 3.702 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 838.94 Mbit/s
95th percentile per-packet one-way delay: 31.118 ms
Loss rate: 0.68%
-- Flow 1:
Average throughput: 463.66 Mbit/s
95th percentile per-packet one-way delay: 25.796 ms
Loss rate: 0.48%
-- Flow 2:
Average throughput: 401.31 Mbit/s
95th percentile per-packet one-way delay: 28.826 ms
Loss rate: 0.80%
-- Flow 3:
Average throughput: 325.60 Mbit/s
95th percentile per-packet one-way delay: 60.900 ms
Loss rate: 1.23%
```

### Run 3: Report of TCP BBR — Data Link

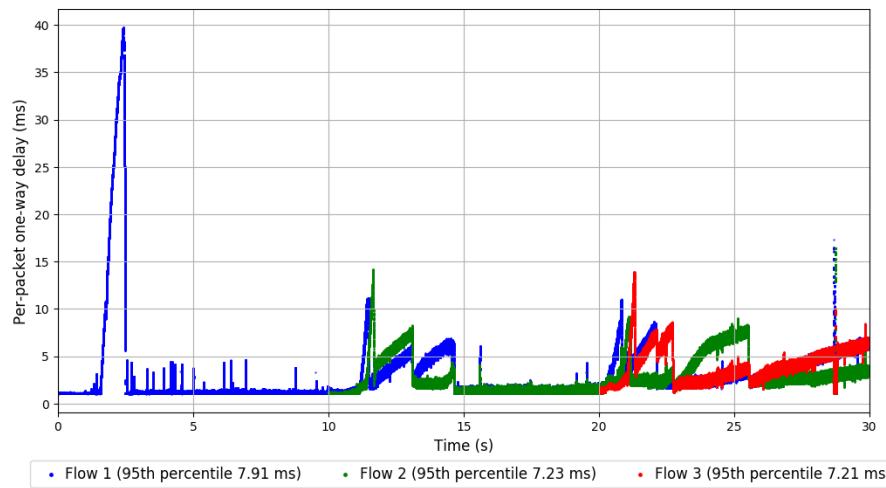
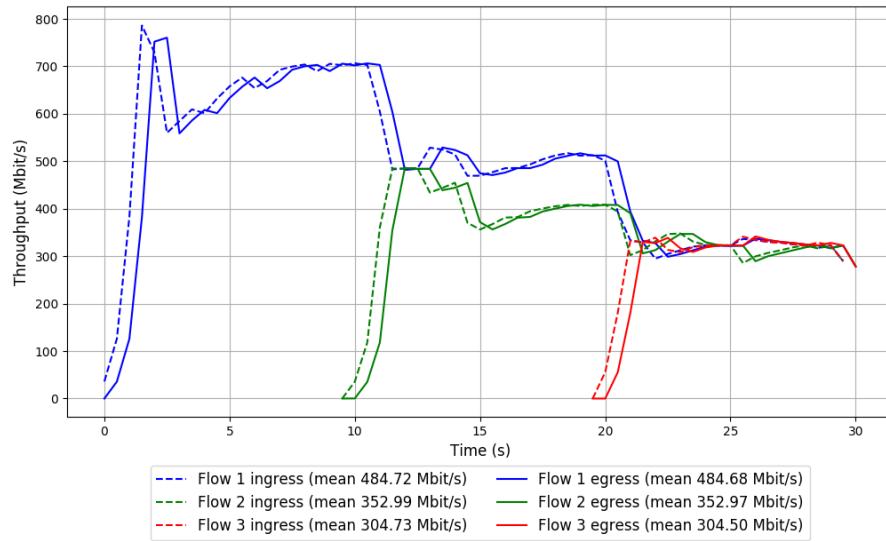


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-09-05 22:28:04
End at: 2018-09-05 22:28:34
Local clock offset: -2.561 ms
Remote clock offset: 3.861 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 821.12 Mbit/s
95th percentile per-packet one-way delay: 7.349 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 484.68 Mbit/s
95th percentile per-packet one-way delay: 7.908 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 352.97 Mbit/s
95th percentile per-packet one-way delay: 7.226 ms
Loss rate: 0.09%
-- Flow 3:
Average throughput: 304.50 Mbit/s
95th percentile per-packet one-way delay: 7.213 ms
Loss rate: 0.26%
```

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

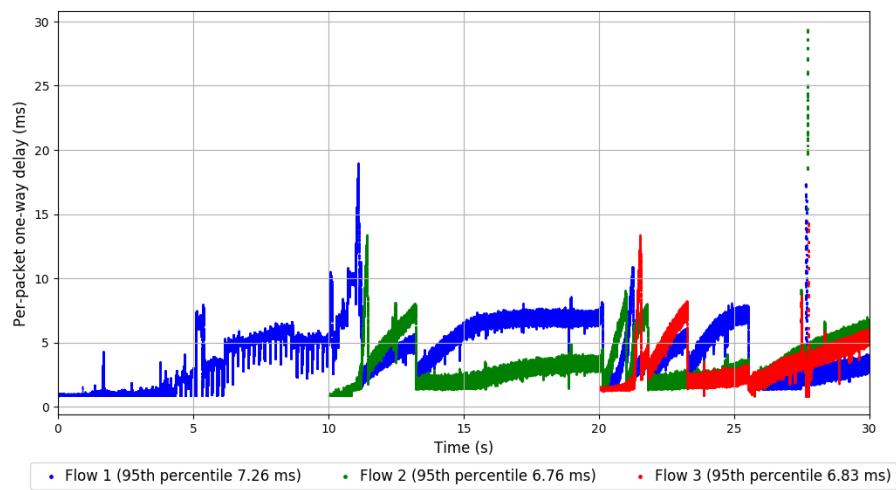
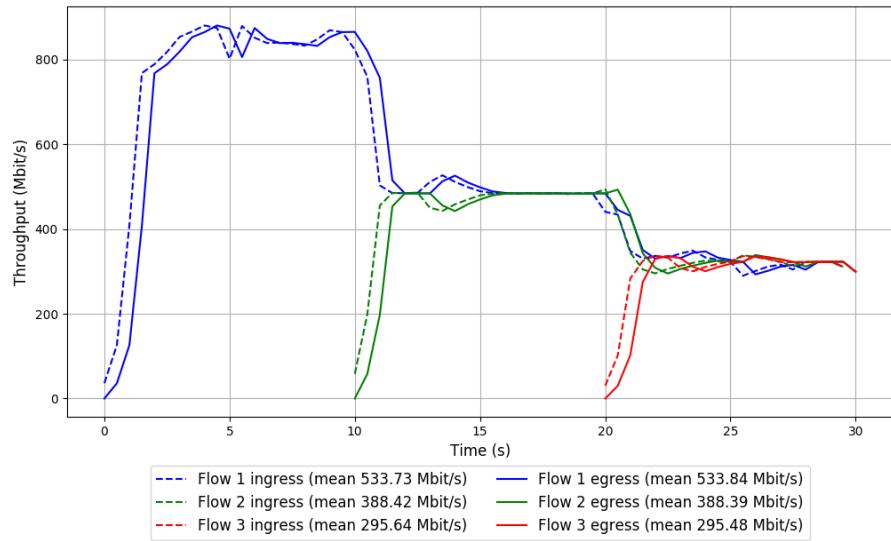


Run 2: Statistics of TCP Cubic

```
Start at: 2018-09-05 22:34:43
End at: 2018-09-05 22:35:13
Local clock offset: -1.91 ms
Remote clock offset: 4.281 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 890.58 Mbit/s
95th percentile per-packet one-way delay: 7.171 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 533.84 Mbit/s
95th percentile per-packet one-way delay: 7.262 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 388.39 Mbit/s
95th percentile per-packet one-way delay: 6.761 ms
Loss rate: 0.10%
-- Flow 3:
Average throughput: 295.48 Mbit/s
95th percentile per-packet one-way delay: 6.830 ms
Loss rate: 0.25%
```

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

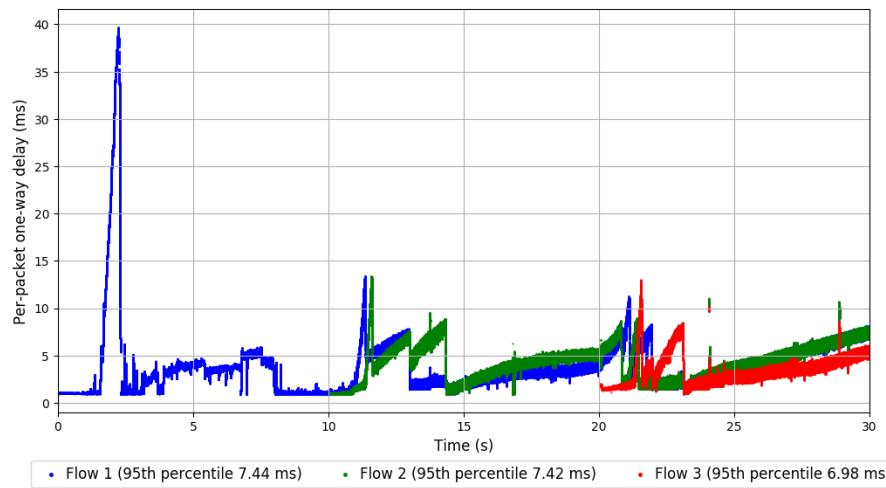
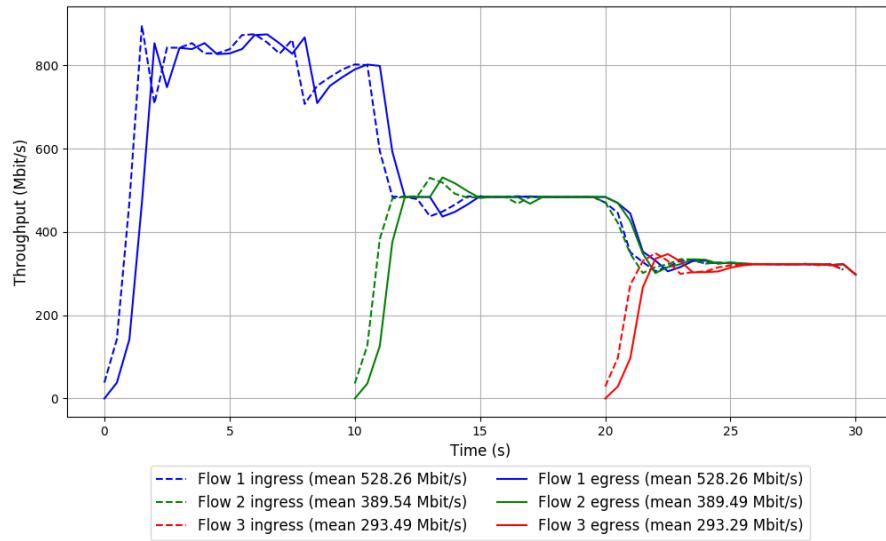


Run 3: Statistics of TCP Cubic

```
Start at: 2018-09-05 22:41:24
End at: 2018-09-05 22:41:54
Local clock offset: -1.232 ms
Remote clock offset: 3.766 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 884.90 Mbit/s
95th percentile per-packet one-way delay: 7.389 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 528.26 Mbit/s
95th percentile per-packet one-way delay: 7.442 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 389.49 Mbit/s
95th percentile per-packet one-way delay: 7.416 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 293.29 Mbit/s
95th percentile per-packet one-way delay: 6.981 ms
Loss rate: 0.26%
```

Run 3: Report of TCP Cubic — Data Link

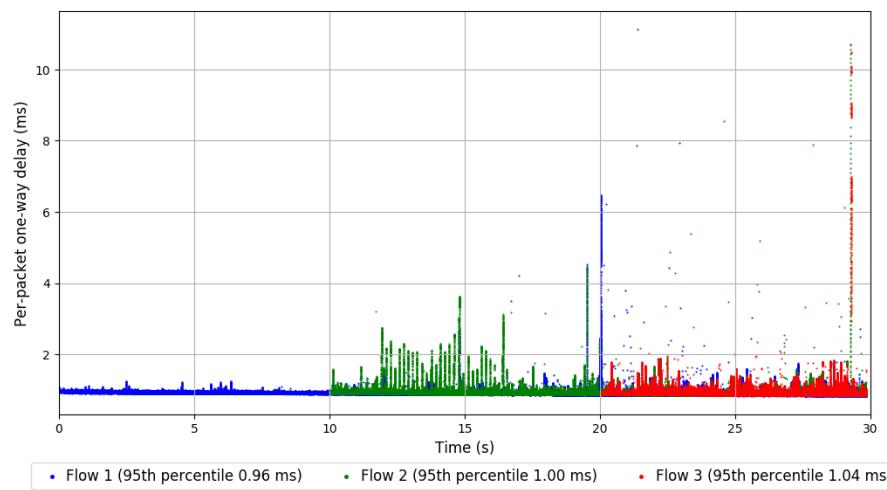
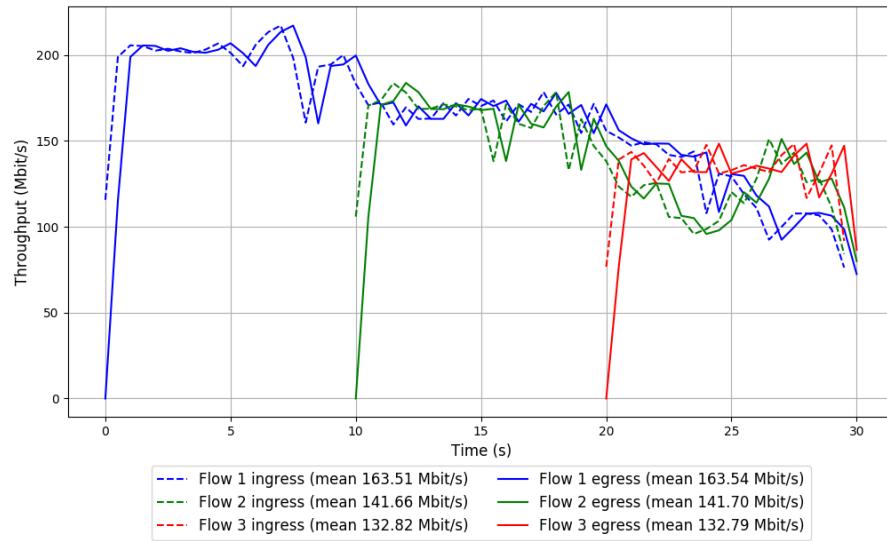


Run 1: Statistics of Indigo

```
Start at: 2018-09-05 22:31:46
End at: 2018-09-05 22:32:16
Local clock offset: -2.521 ms
Remote clock offset: 4.034 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 301.41 Mbit/s
95th percentile per-packet one-way delay: 0.971 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 163.54 Mbit/s
95th percentile per-packet one-way delay: 0.961 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 141.70 Mbit/s
95th percentile per-packet one-way delay: 1.000 ms
Loss rate: 0.07%
-- Flow 3:
Average throughput: 132.79 Mbit/s
95th percentile per-packet one-way delay: 1.039 ms
Loss rate: 0.22%
```

Run 1: Report of Indigo — Data Link

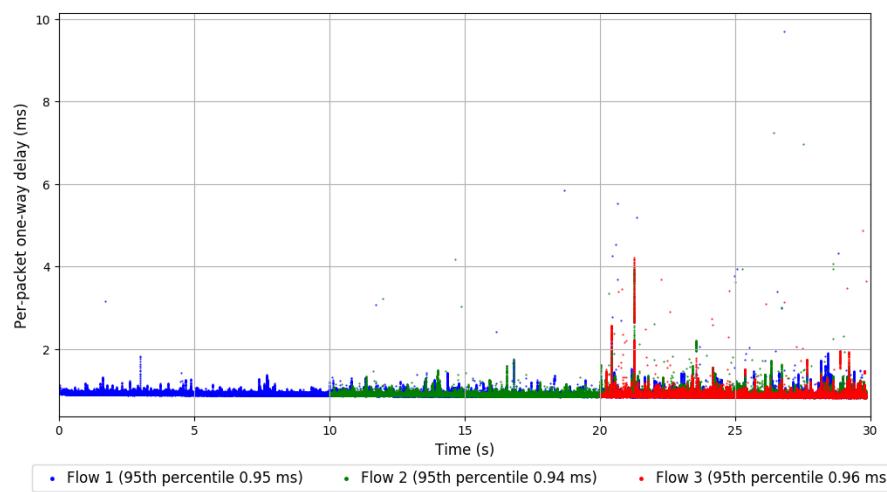
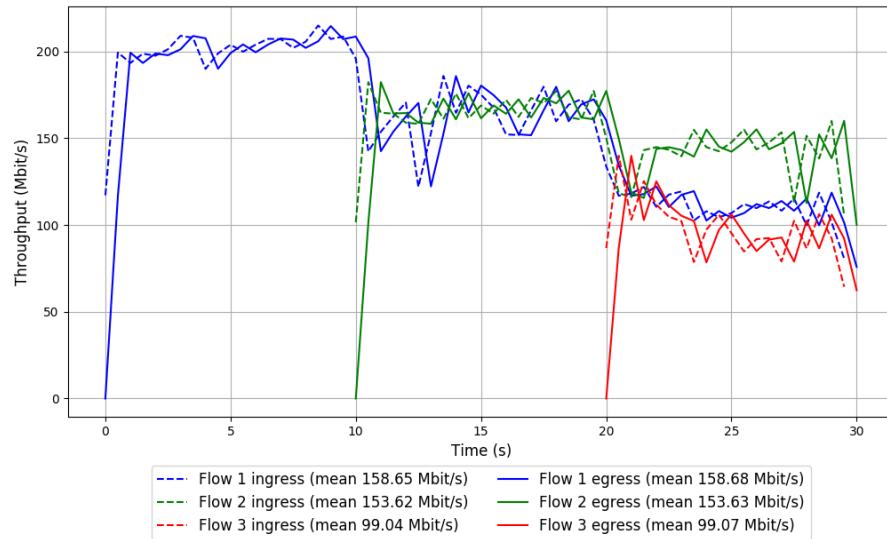


Run 2: Statistics of Indigo

```
Start at: 2018-09-05 22:38:27
End at: 2018-09-05 22:38:57
Local clock offset: -1.387 ms
Remote clock offset: 4.029 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 293.39 Mbit/s
95th percentile per-packet one-way delay: 0.948 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 158.68 Mbit/s
95th percentile per-packet one-way delay: 0.950 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 153.63 Mbit/s
95th percentile per-packet one-way delay: 0.936 ms
Loss rate: 0.09%
-- Flow 3:
Average throughput: 99.07 Mbit/s
95th percentile per-packet one-way delay: 0.960 ms
Loss rate: 0.13%
```

Run 2: Report of Indigo — Data Link

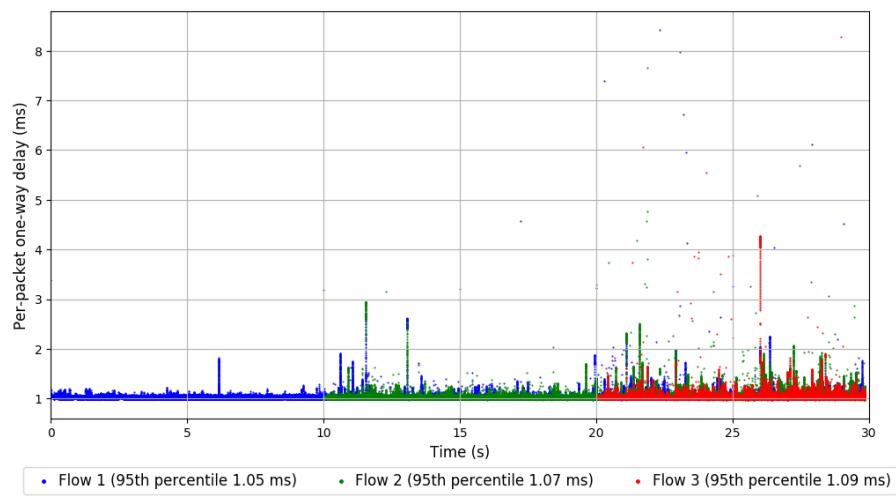
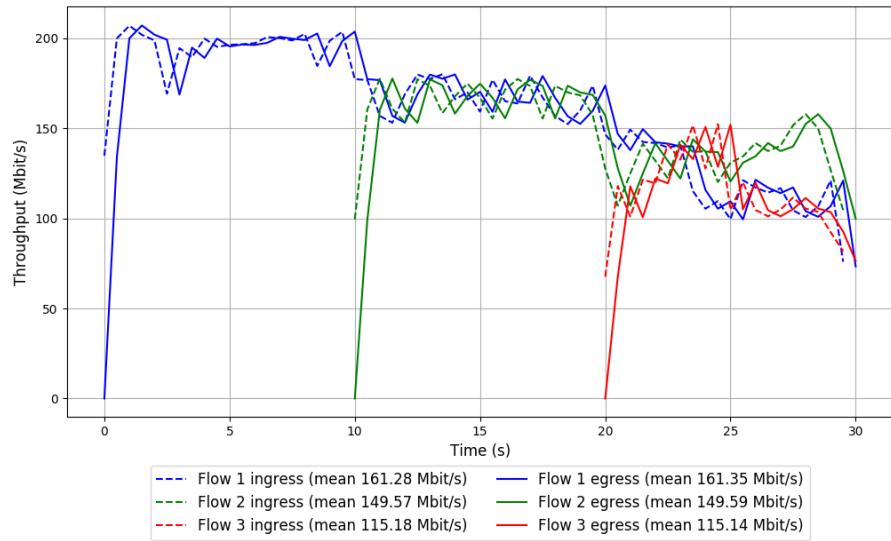


Run 3: Statistics of Indigo

```
Start at: 2018-09-05 22:45:06
End at: 2018-09-05 22:45:36
Local clock offset: -1.011 ms
Remote clock offset: 3.745 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 298.60 Mbit/s
95th percentile per-packet one-way delay: 1.060 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 161.35 Mbit/s
95th percentile per-packet one-way delay: 1.051 ms
Loss rate: 0.03%
-- Flow 2:
Average throughput: 149.59 Mbit/s
95th percentile per-packet one-way delay: 1.075 ms
Loss rate: 0.09%
-- Flow 3:
Average throughput: 115.14 Mbit/s
95th percentile per-packet one-way delay: 1.094 ms
Loss rate: 0.23%
```

Run 3: Report of Indigo — Data Link

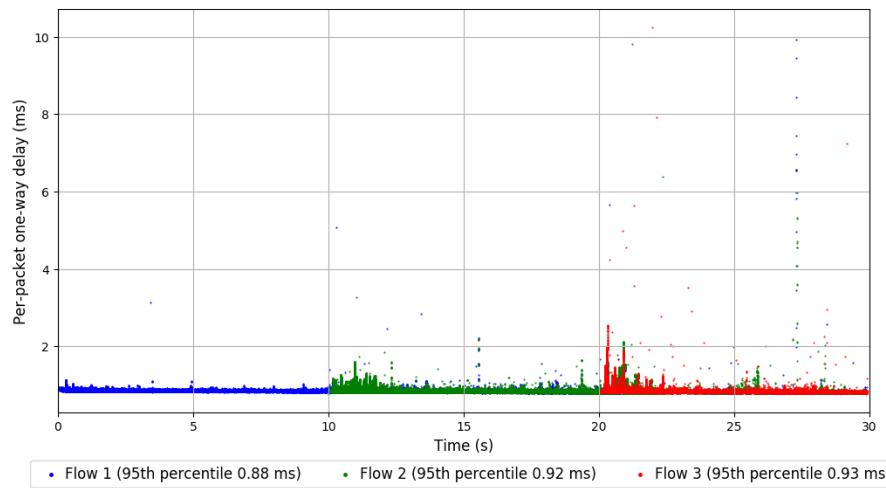
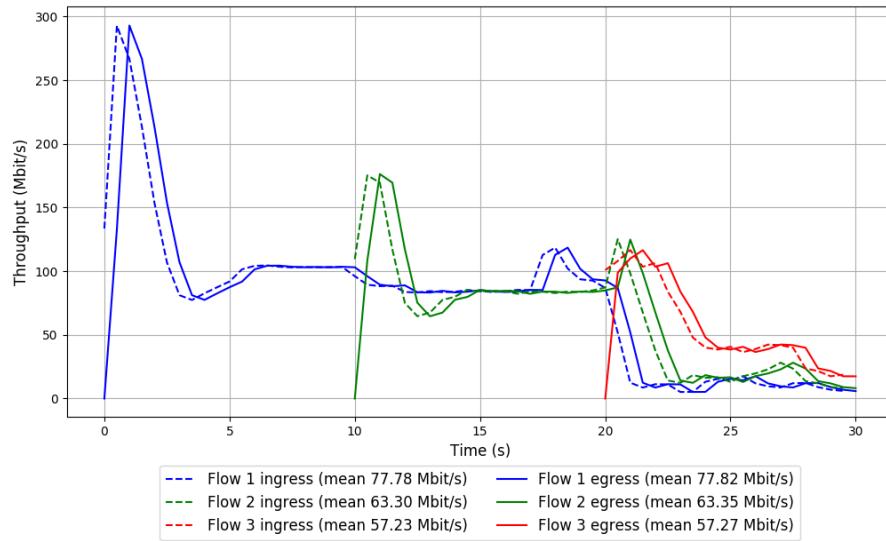


```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 22:33:19
End at: 2018-09-05 22:33:49
Local clock offset: -2.285 ms
Remote clock offset: 4.102 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 138.92 Mbit/s
95th percentile per-packet one-way delay: 0.886 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 77.82 Mbit/s
95th percentile per-packet one-way delay: 0.878 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 63.35 Mbit/s
95th percentile per-packet one-way delay: 0.921 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 57.27 Mbit/s
95th percentile per-packet one-way delay: 0.926 ms
Loss rate: 0.11%
```

Run 1: Report of Muses-25 — Data Link

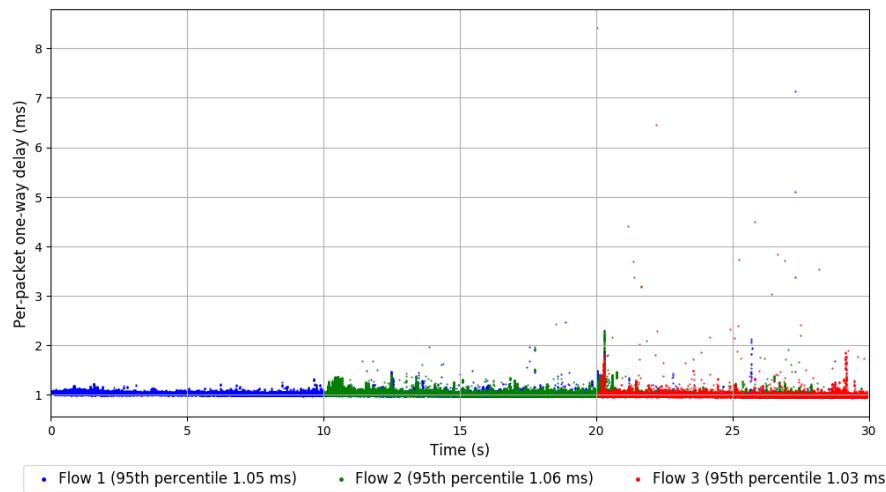
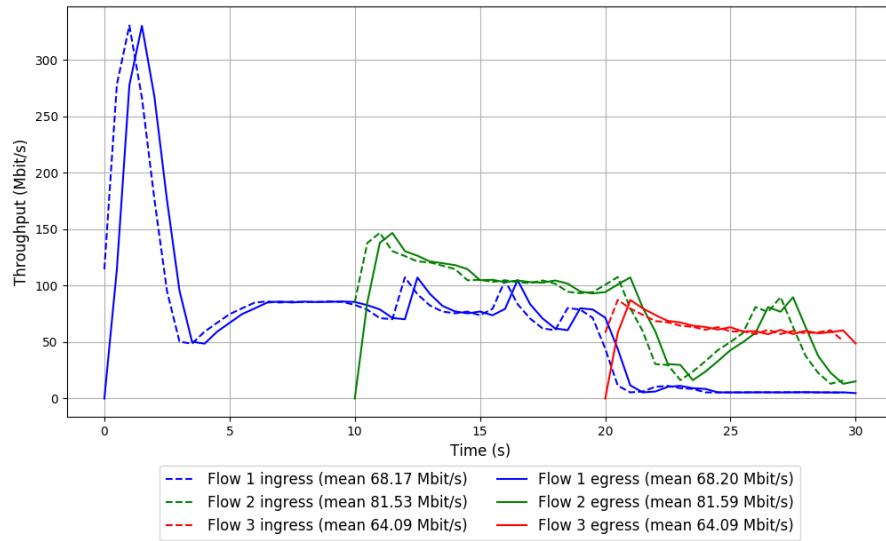


Run 2: Statistics of Muses-25

```
Start at: 2018-09-05 22:39:59
End at: 2018-09-05 22:40:29
Local clock offset: -1.258 ms
Remote clock offset: 3.839 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 143.67 Mbit/s
95th percentile per-packet one-way delay: 1.055 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 68.20 Mbit/s
95th percentile per-packet one-way delay: 1.055 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 81.59 Mbit/s
95th percentile per-packet one-way delay: 1.062 ms
Loss rate: 0.03%
-- Flow 3:
Average throughput: 64.09 Mbit/s
95th percentile per-packet one-way delay: 1.033 ms
Loss rate: 0.18%
```

Run 2: Report of Muses-25 — Data Link



Run 3: Statistics of Muses-25

```
Start at: 2018-09-05 22:46:39
End at: 2018-09-05 22:47:09
Local clock offset: -1.094 ms
Remote clock offset: 3.713 ms

# Below is generated by plot.py at 2018-09-05 22:57:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 115.46 Mbit/s
95th percentile per-packet one-way delay: 0.985 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 17.12 Mbit/s
95th percentile per-packet one-way delay: 0.972 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 92.30 Mbit/s
95th percentile per-packet one-way delay: 0.988 ms
Loss rate: 0.05%
-- Flow 3:
Average throughput: 111.56 Mbit/s
95th percentile per-packet one-way delay: 0.991 ms
Loss rate: 0.21%
```

Run 3: Report of Muses-25 — Data Link

