

Pantheon Report

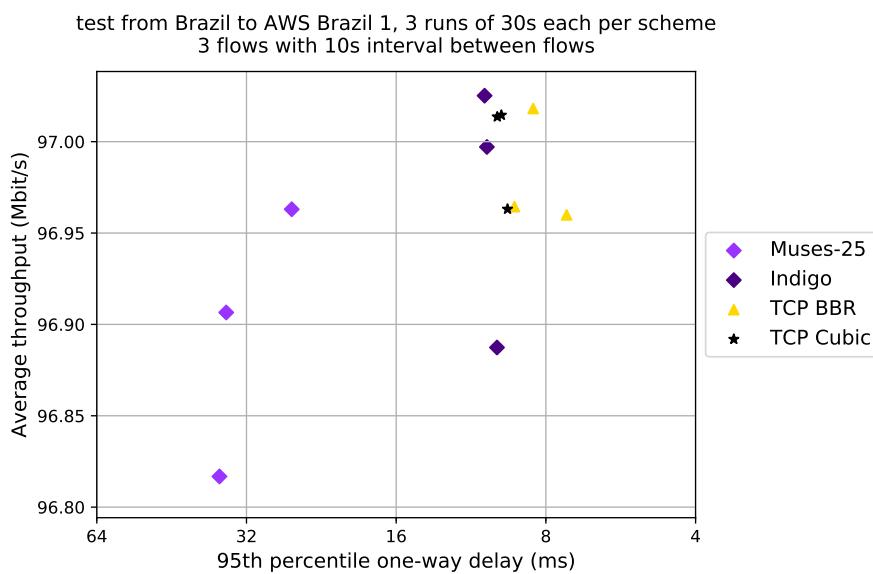
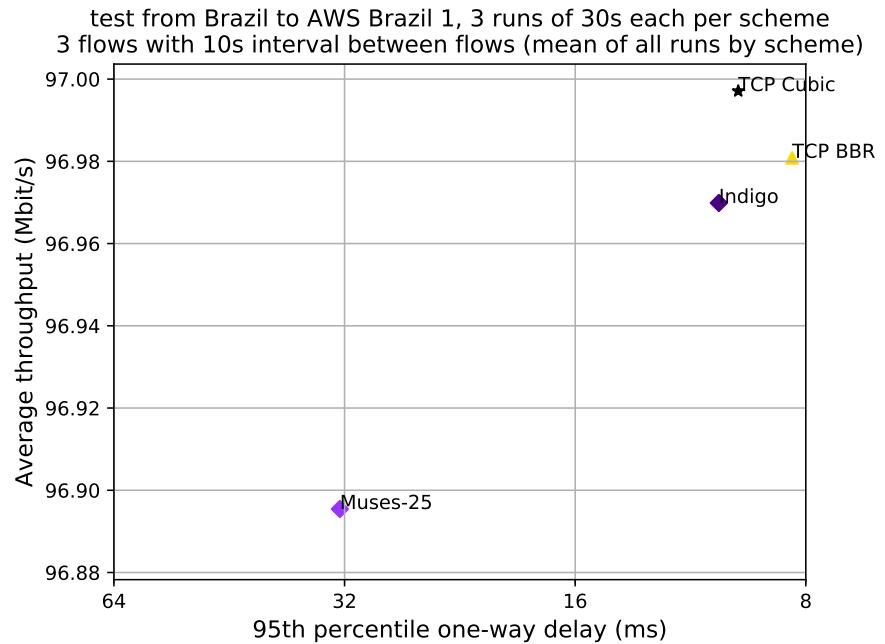
Generated at 2018-09-03 10:01:10 (UTC).
Data path: Brazil on p4p1 (*remote*) → AWS Brazil 1 on ens5 (*local*).
Repeated the test of 4 congestion control schemes 3 times.
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.
NTP offsets were measured against gps.ntp.br 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 @ 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 @ 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
```



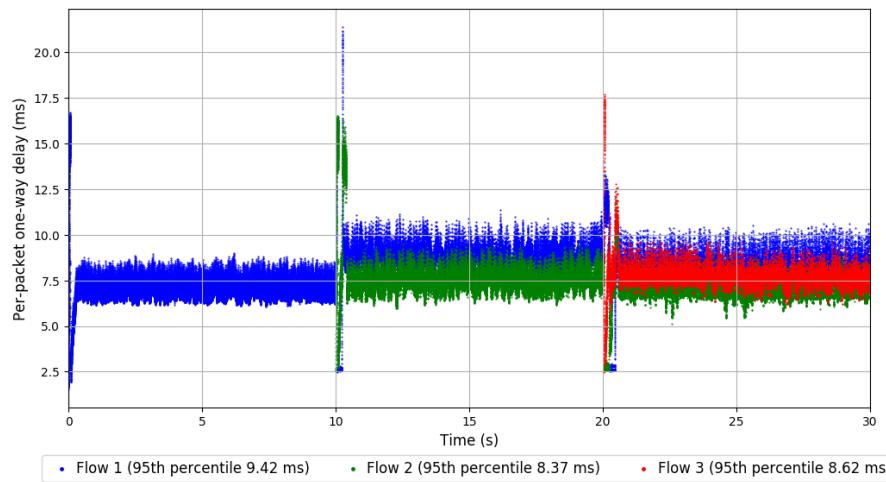
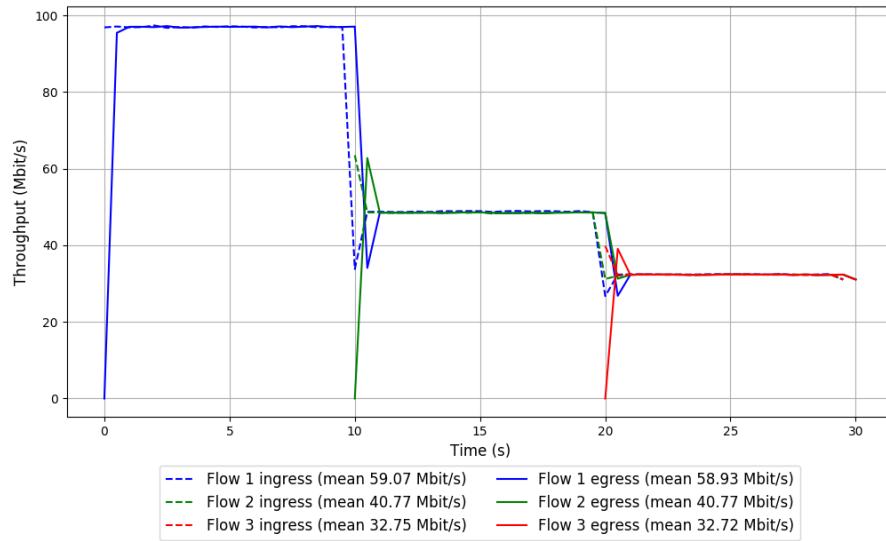
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	59.00	40.71	32.73	8.28	7.91	8.86	0.15	0.09	0.31
TCP Cubic	3	59.31	40.45	32.34	9.91	9.62	9.98	0.09	0.16	0.26
Indigo	3	59.40	40.50	32.32	9.32	10.66	9.45	0.07	1.75	0.42
Muses-25	3	59.75	39.57	32.66	19.39	36.37	48.39	0.90	1.95	6.56

Run 1: Statistics of TCP BBR

```
Start at: 2018-09-03 09:46:06
End at: 2018-09-03 09:46:36
Local clock offset: 1.489 ms
Remote clock offset: 0.378 ms

# Below is generated by plot.py at 2018-09-03 10:00:32
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.96 Mbit/s
95th percentile per-packet one-way delay: 9.255 ms
Loss rate: 0.16%
-- Flow 1:
Average throughput: 58.93 Mbit/s
95th percentile per-packet one-way delay: 9.417 ms
Loss rate: 0.23%
-- Flow 2:
Average throughput: 40.77 Mbit/s
95th percentile per-packet one-way delay: 8.372 ms
Loss rate: 0.03%
-- Flow 3:
Average throughput: 32.72 Mbit/s
95th percentile per-packet one-way delay: 8.624 ms
Loss rate: 0.08%
```

Run 1: Report of TCP BBR — Data Link

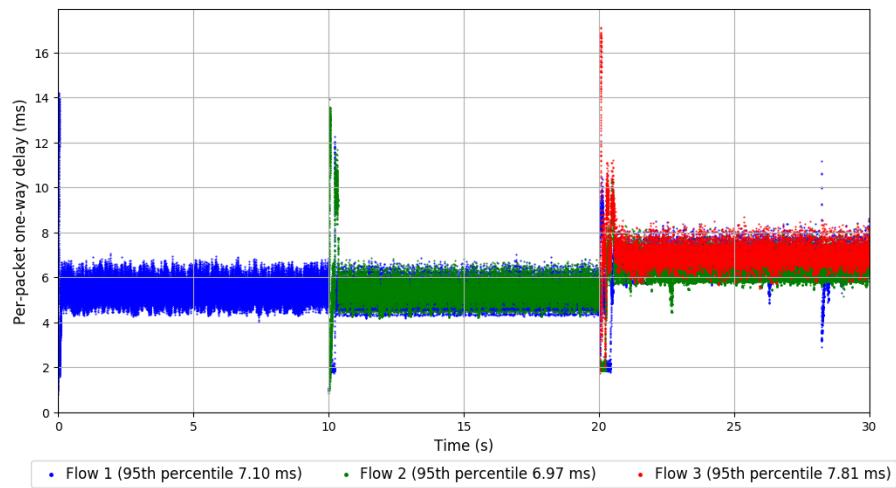
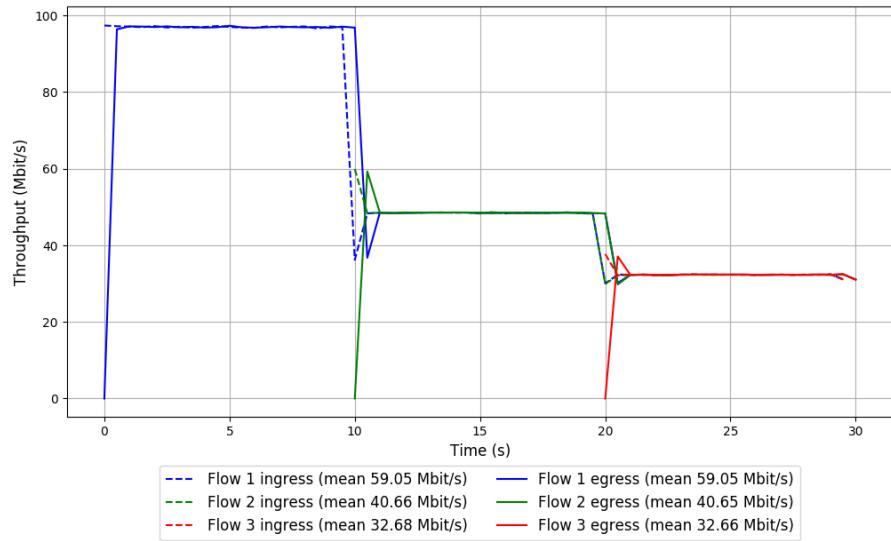


Run 2: Statistics of TCP BBR

```
Start at: 2018-09-03 09:50:36
End at: 2018-09-03 09:51:06
Local clock offset: 0.342 ms
Remote clock offset: 0.385 ms

# Below is generated by plot.py at 2018-09-03 10:00:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.96 Mbit/s
95th percentile per-packet one-way delay: 7.268 ms
Loss rate: 0.03%
-- Flow 1:
Average throughput: 59.05 Mbit/s
95th percentile per-packet one-way delay: 7.097 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 40.65 Mbit/s
95th percentile per-packet one-way delay: 6.969 ms
Loss rate: 0.03%
-- Flow 3:
Average throughput: 32.66 Mbit/s
95th percentile per-packet one-way delay: 7.814 ms
Loss rate: 0.07%
```

Run 2: Report of TCP BBR — Data Link

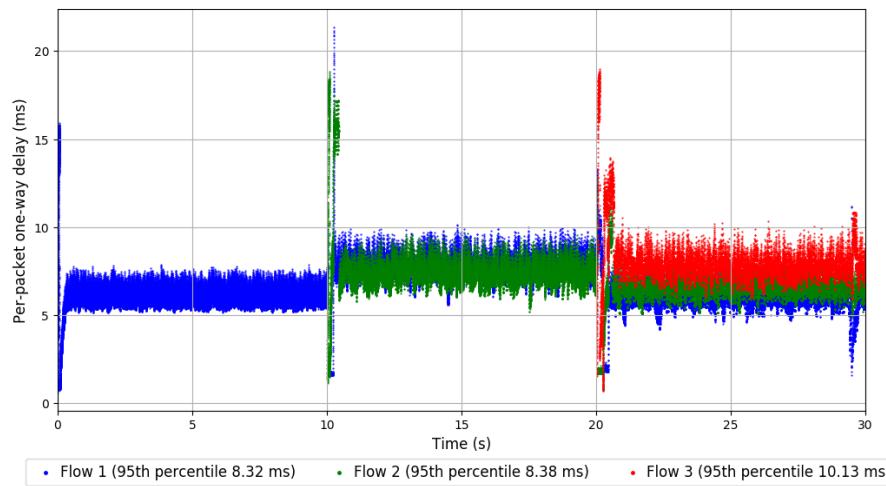
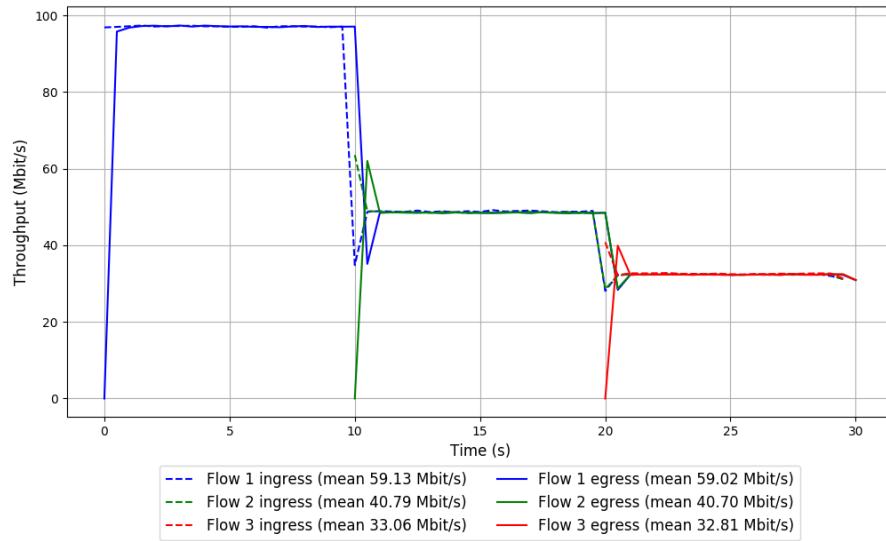


Run 3: Statistics of TCP BBR

```
Start at: 2018-09-03 09:55:06
End at: 2018-09-03 09:55:36
Local clock offset: 0.902 ms
Remote clock offset: 0.421 ms

# Below is generated by plot.py at 2018-09-03 10:00:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.02 Mbit/s
95th percentile per-packet one-way delay: 8.484 ms
Loss rate: 0.27%
-- Flow 1:
Average throughput: 59.02 Mbit/s
95th percentile per-packet one-way delay: 8.317 ms
Loss rate: 0.20%
-- Flow 2:
Average throughput: 40.70 Mbit/s
95th percentile per-packet one-way delay: 8.382 ms
Loss rate: 0.22%
-- Flow 3:
Average throughput: 32.81 Mbit/s
95th percentile per-packet one-way delay: 10.129 ms
Loss rate: 0.78%
```

Run 3: Report of TCP BBR — Data Link

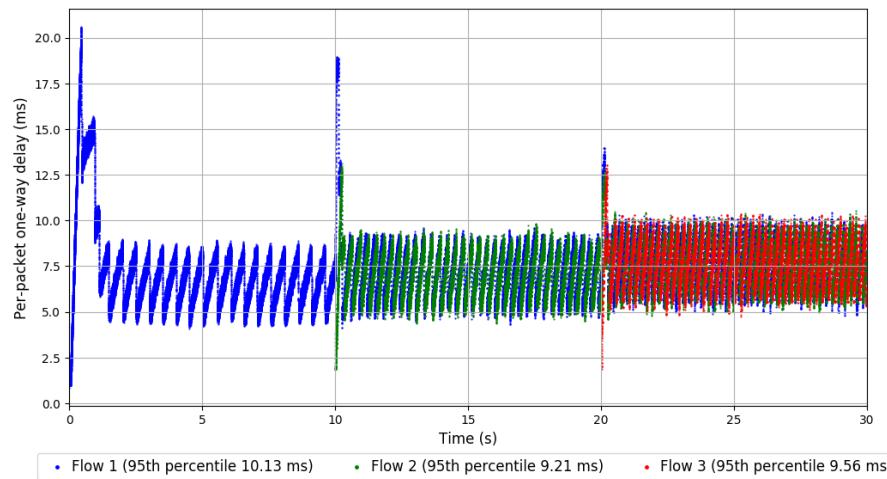
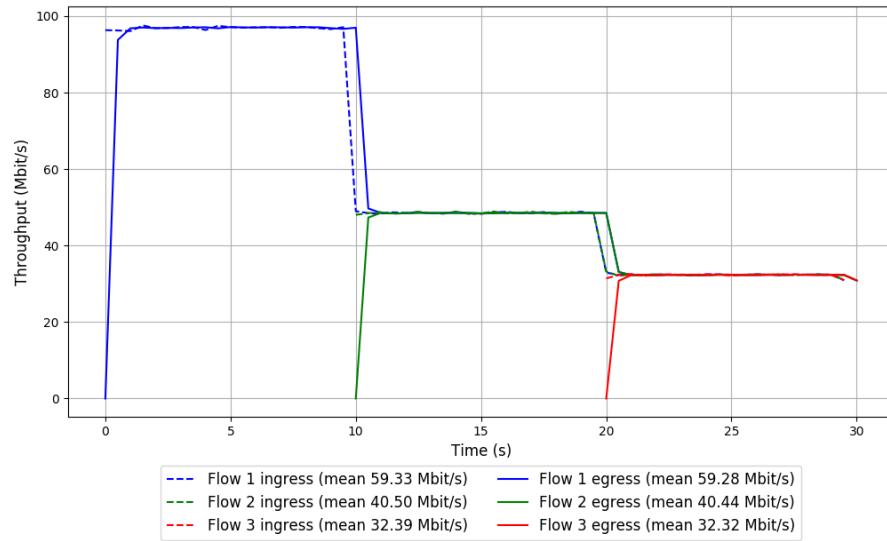


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-09-03 09:47:13
End at: 2018-09-03 09:47:43
Local clock offset: 0.642 ms
Remote clock offset: 0.309 ms

# Below is generated by plot.py at 2018-09-03 10:00:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.96 Mbit/s
95th percentile per-packet one-way delay: 9.555 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 59.28 Mbit/s
95th percentile per-packet one-way delay: 10.134 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 40.44 Mbit/s
95th percentile per-packet one-way delay: 9.210 ms
Loss rate: 0.15%
-- Flow 3:
Average throughput: 32.32 Mbit/s
95th percentile per-packet one-way delay: 9.558 ms
Loss rate: 0.22%
```

Run 1: Report of TCP Cubic — Data Link

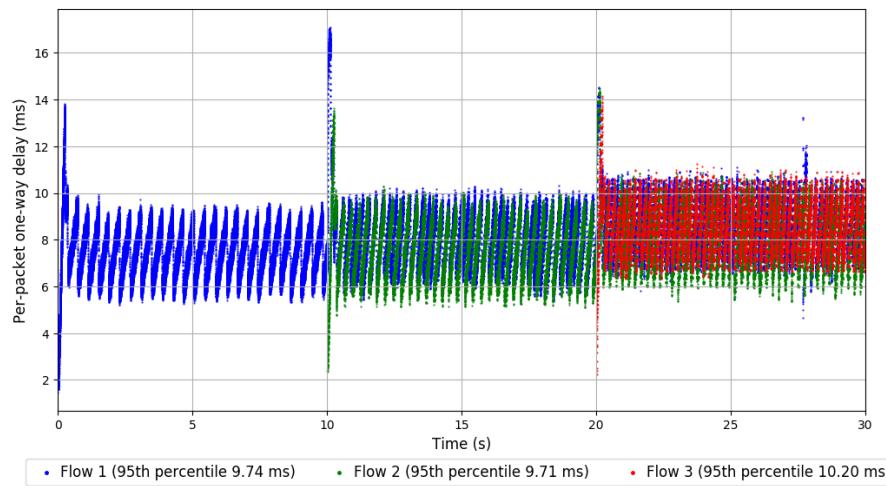
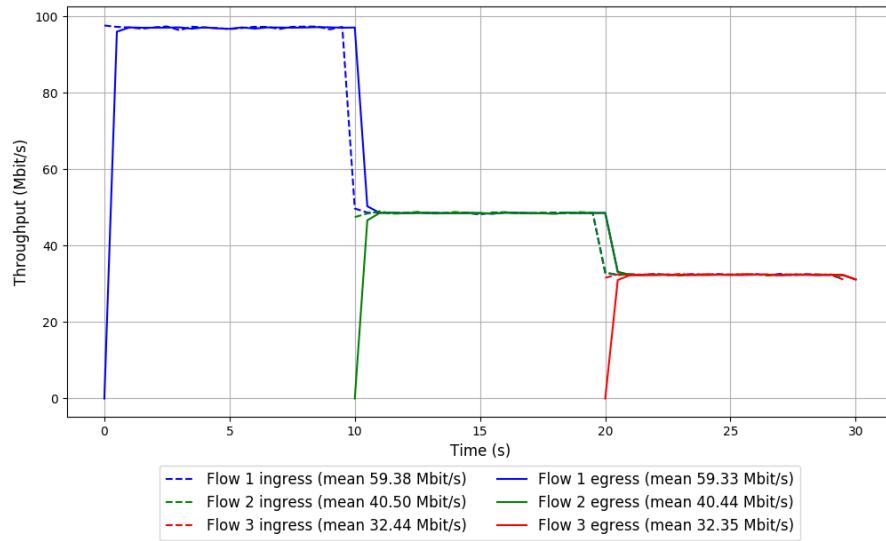


Run 2: Statistics of TCP Cubic

```
Start at: 2018-09-03 09:51:43
End at: 2018-09-03 09:52:13
Local clock offset: 1.037 ms
Remote clock offset: 0.34 ms

# Below is generated by plot.py at 2018-09-03 10:00:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.01 Mbit/s
95th percentile per-packet one-way delay: 9.830 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 59.33 Mbit/s
95th percentile per-packet one-way delay: 9.744 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 40.44 Mbit/s
95th percentile per-packet one-way delay: 9.709 ms
Loss rate: 0.15%
-- Flow 3:
Average throughput: 32.35 Mbit/s
95th percentile per-packet one-way delay: 10.200 ms
Loss rate: 0.27%
```

Run 2: Report of TCP Cubic — Data Link

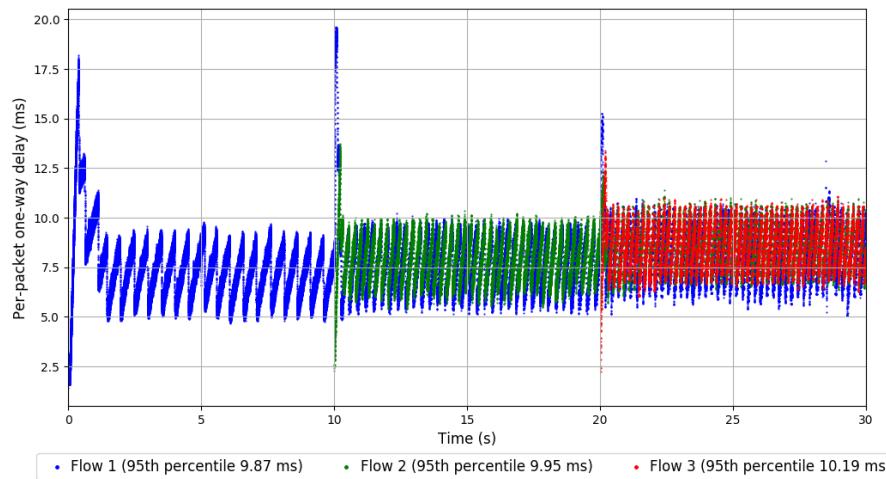
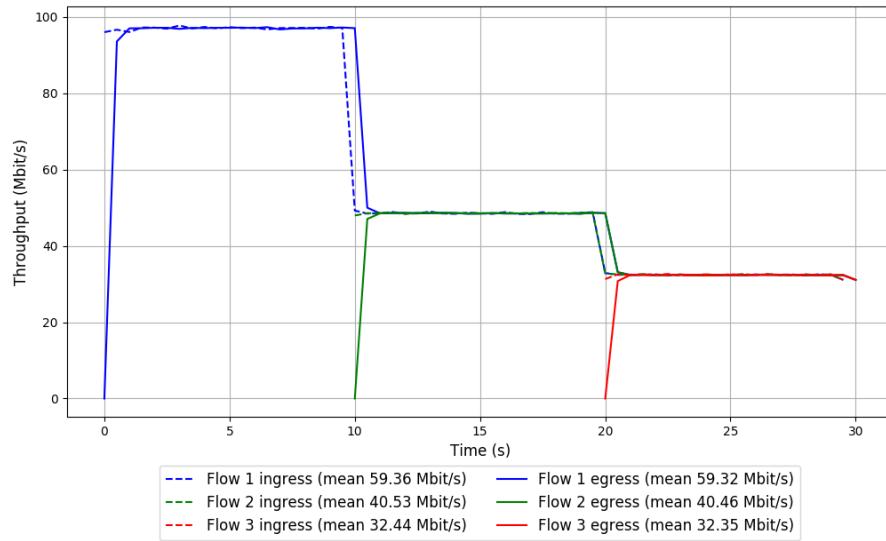


Run 3: Statistics of TCP Cubic

```
Start at: 2018-09-03 09:56:14
End at: 2018-09-03 09:56:44
Local clock offset: 1.843 ms
Remote clock offset: 0.416 ms

# Below is generated by plot.py at 2018-09-03 10:00:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.01 Mbit/s
95th percentile per-packet one-way delay: 10.020 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 59.32 Mbit/s
95th percentile per-packet one-way delay: 9.866 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 40.46 Mbit/s
95th percentile per-packet one-way delay: 9.949 ms
Loss rate: 0.17%
-- Flow 3:
Average throughput: 32.35 Mbit/s
95th percentile per-packet one-way delay: 10.186 ms
Loss rate: 0.28%
```

Run 3: Report of TCP Cubic — Data Link

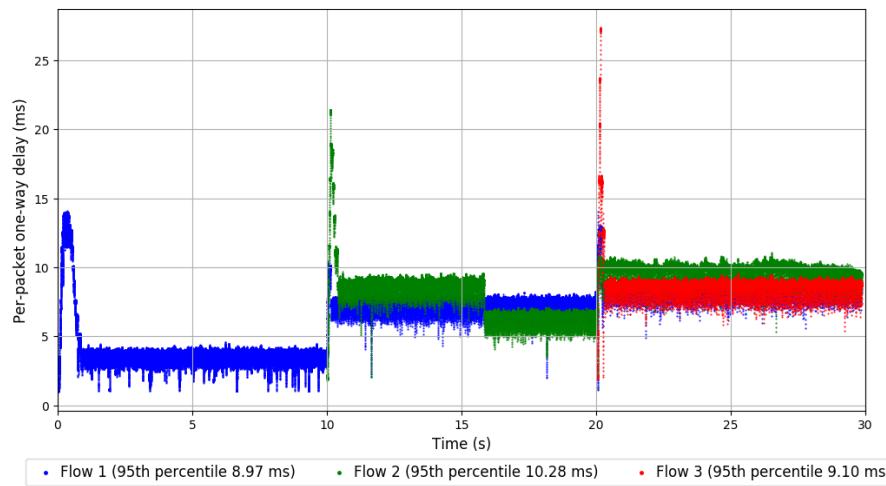
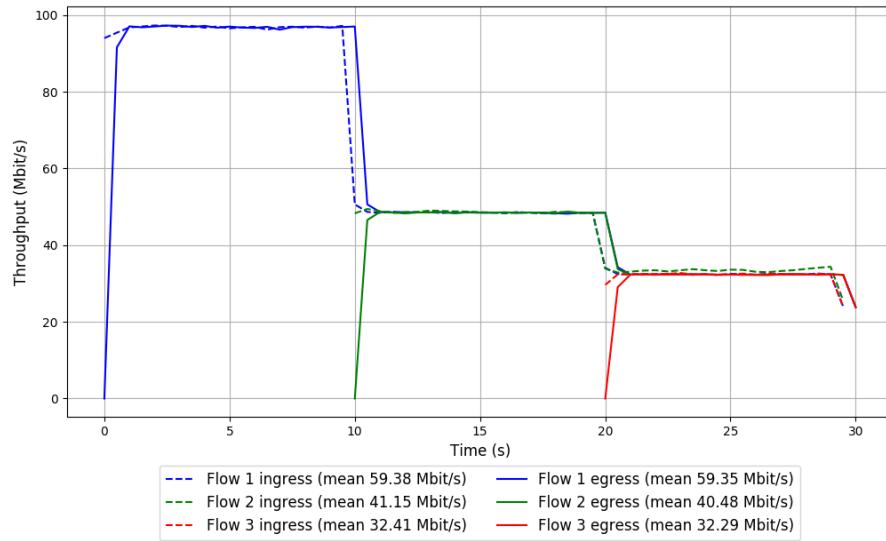


Run 1: Statistics of Indigo

```
Start at: 2018-09-03 09:49:27
End at: 2018-09-03 09:49:57
Local clock offset: 0.457 ms
Remote clock offset: 0.316 ms

# Below is generated by plot.py at 2018-09-03 10:00:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.89 Mbit/s
95th percentile per-packet one-way delay: 10.032 ms
Loss rate: 0.54%
-- Flow 1:
Average throughput: 59.35 Mbit/s
95th percentile per-packet one-way delay: 8.972 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 40.48 Mbit/s
95th percentile per-packet one-way delay: 10.284 ms
Loss rate: 1.63%
-- Flow 3:
Average throughput: 32.29 Mbit/s
95th percentile per-packet one-way delay: 9.102 ms
Loss rate: 0.40%
```

Run 1: Report of Indigo — Data Link

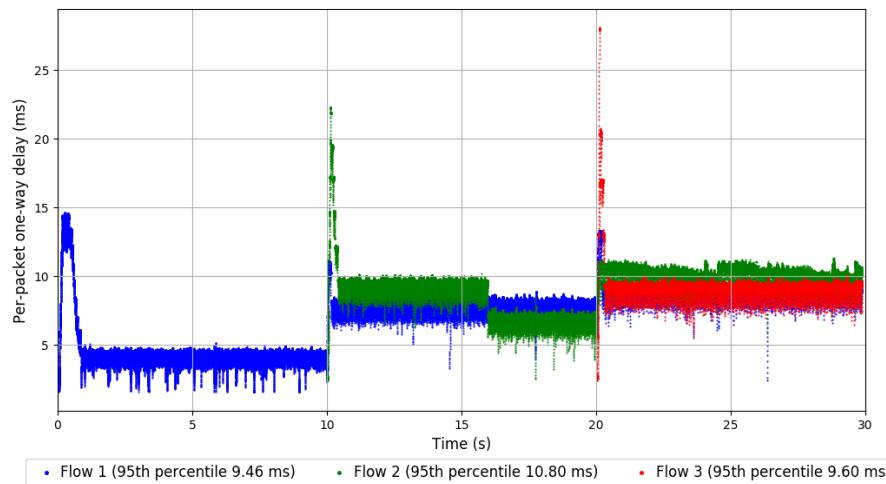
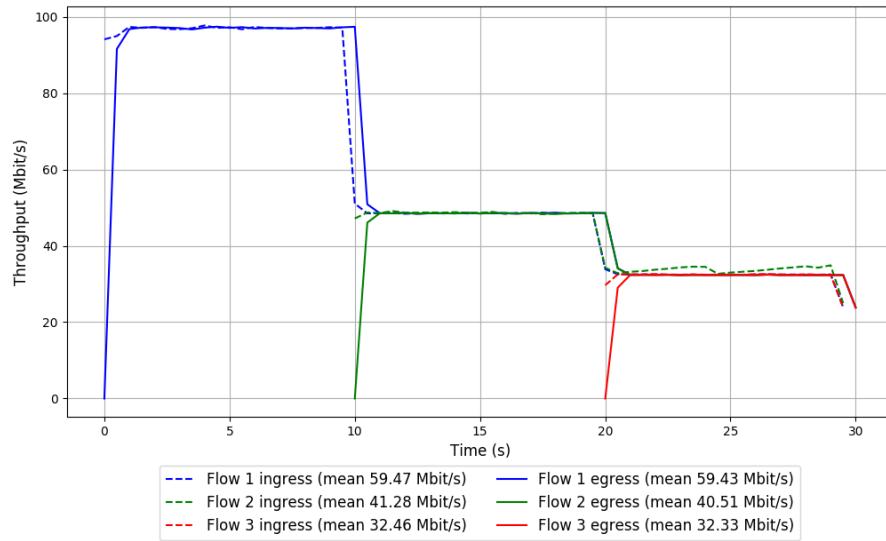


Run 2: Statistics of Indigo

```
Start at: 2018-09-03 09:53:58
End at: 2018-09-03 09:54:28
Local clock offset: 1.546 ms
Remote clock offset: 0.346 ms

# Below is generated by plot.py at 2018-09-03 10:00:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.00 Mbit/s
95th percentile per-packet one-way delay: 10.512 ms
Loss rate: 0.62%
-- Flow 1:
Average throughput: 59.43 Mbit/s
95th percentile per-packet one-way delay: 9.459 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 40.51 Mbit/s
95th percentile per-packet one-way delay: 10.797 ms
Loss rate: 1.88%
-- Flow 3:
Average throughput: 32.33 Mbit/s
95th percentile per-packet one-way delay: 9.602 ms
Loss rate: 0.44%
```

Run 2: Report of Indigo — Data Link

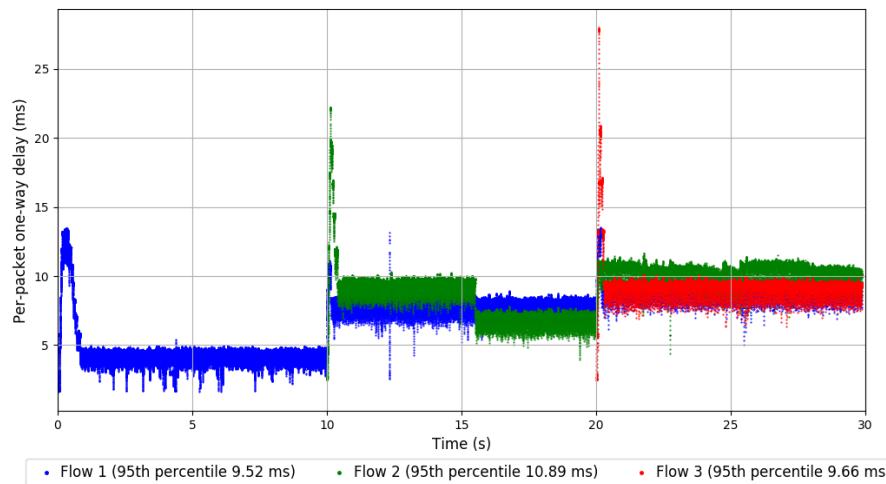
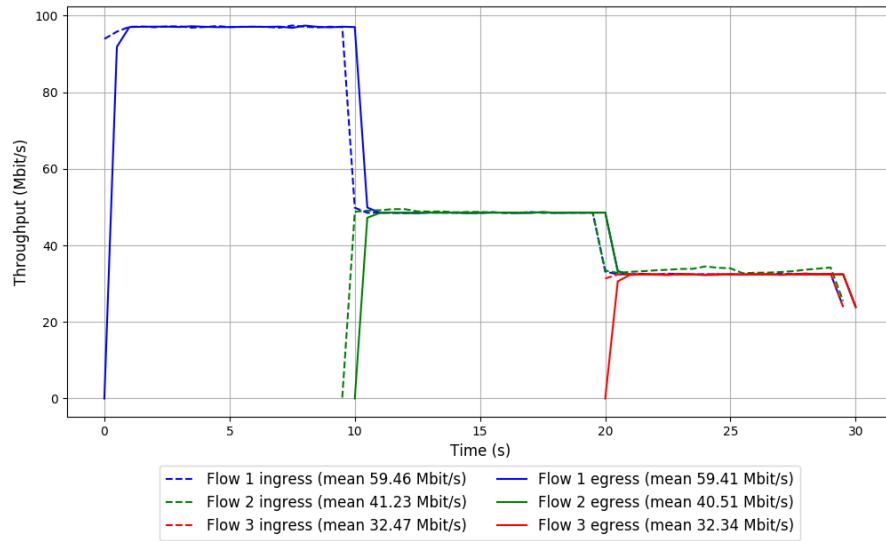


Run 3: Statistics of Indigo

```
Start at: 2018-09-03 09:58:28
End at: 2018-09-03 09:58:58
Local clock offset: 2.118 ms
Remote clock offset: 0.393 ms

# Below is generated by plot.py at 2018-09-03 10:01:07
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.03 Mbit/s
95th percentile per-packet one-way delay: 10.626 ms
Loss rate: 0.59%
-- Flow 1:
Average throughput: 59.41 Mbit/s
95th percentile per-packet one-way delay: 9.521 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 40.51 Mbit/s
95th percentile per-packet one-way delay: 10.895 ms
Loss rate: 1.75%
-- Flow 3:
Average throughput: 32.34 Mbit/s
95th percentile per-packet one-way delay: 9.659 ms
Loss rate: 0.42%
```

Run 3: Report of Indigo — Data Link

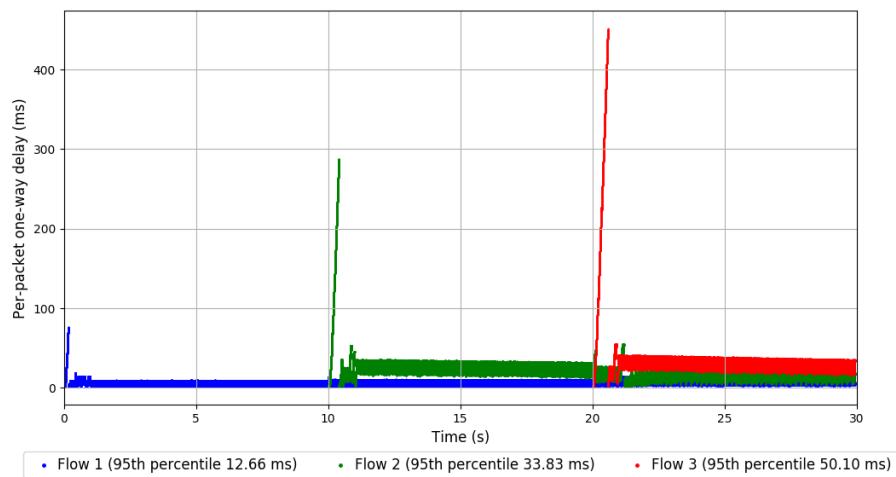
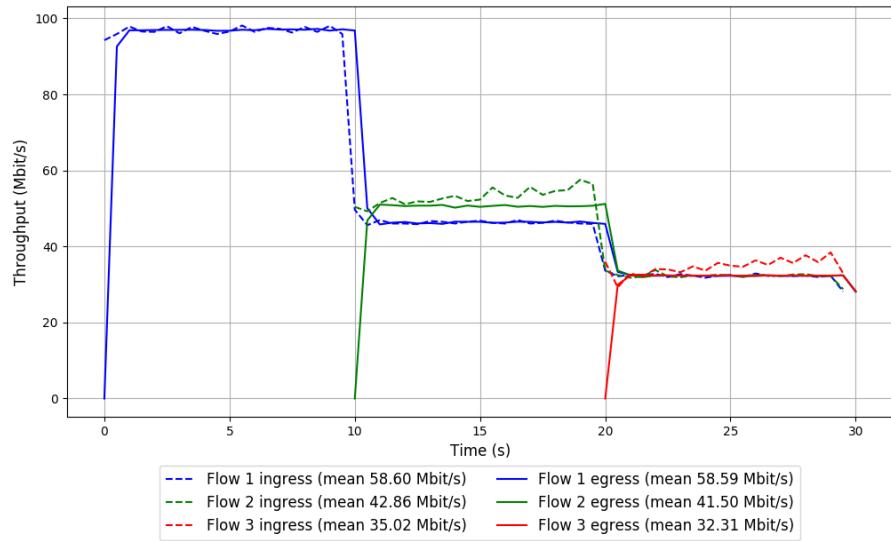


Run 1: Statistics of Muses-25

```
Start at: 2018-09-03 09:48:21
End at: 2018-09-03 09:48:51
Local clock offset: 0.473 ms
Remote clock offset: 0.37 ms

# Below is generated by plot.py at 2018-09-03 10:01:09
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.91 Mbit/s
95th percentile per-packet one-way delay: 35.147 ms
Loss rate: 1.84%
-- Flow 1:
Average throughput: 58.59 Mbit/s
95th percentile per-packet one-way delay: 12.664 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 41.50 Mbit/s
95th percentile per-packet one-way delay: 33.834 ms
Loss rate: 3.21%
-- Flow 3:
Average throughput: 32.31 Mbit/s
95th percentile per-packet one-way delay: 50.103 ms
Loss rate: 7.75%
```

Run 1: Report of Muses-25 — Data Link

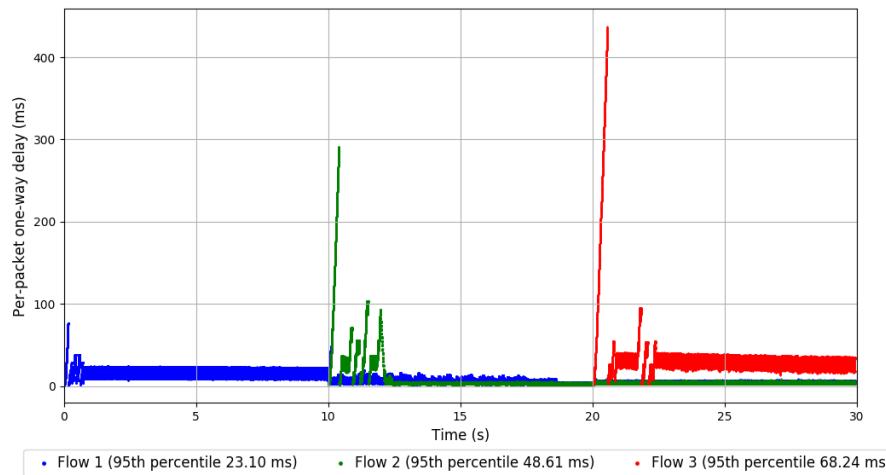
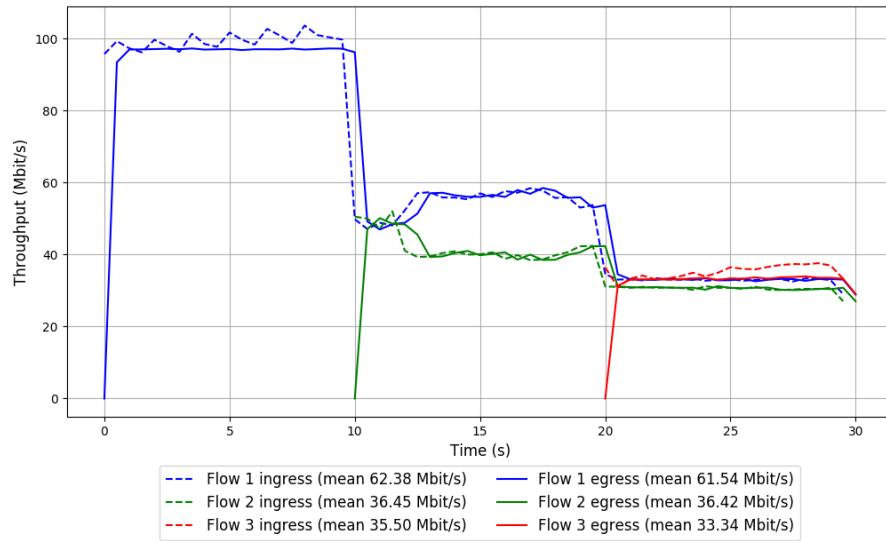


Run 2: Statistics of Muses-25

```
Start at: 2018-09-03 09:52:51
End at: 2018-09-03 09:53:21
Local clock offset: 1.281 ms
Remote clock offset: 0.374 ms

# Below is generated by plot.py at 2018-09-03 10:01:09
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.82 Mbit/s
95th percentile per-packet one-way delay: 36.265 ms
Loss rate: 1.59%
-- Flow 1:
Average throughput: 61.54 Mbit/s
95th percentile per-packet one-way delay: 23.098 ms
Loss rate: 1.35%
-- Flow 2:
Average throughput: 36.42 Mbit/s
95th percentile per-packet one-way delay: 48.610 ms
Loss rate: 0.08%
-- Flow 3:
Average throughput: 33.34 Mbit/s
95th percentile per-packet one-way delay: 68.242 ms
Loss rate: 6.04%
```

Run 2: Report of Muses-25 — Data Link



Run 3: Statistics of Muses-25

```
Start at: 2018-09-03 09:57:21
End at: 2018-09-03 09:57:51
Local clock offset: 1.189 ms
Remote clock offset: 0.443 ms

# Below is generated by plot.py at 2018-09-03 10:01:09
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.96 Mbit/s
95th percentile per-packet one-way delay: 25.951 ms
Loss rate: 2.20%
-- Flow 1:
Average throughput: 59.12 Mbit/s
95th percentile per-packet one-way delay: 22.396 ms
Loss rate: 1.33%
-- Flow 2:
Average throughput: 40.79 Mbit/s
95th percentile per-packet one-way delay: 26.680 ms
Loss rate: 2.56%
-- Flow 3:
Average throughput: 32.32 Mbit/s
95th percentile per-packet one-way delay: 26.834 ms
Loss rate: 5.88%
```

Run 3: Report of Muses-25 — Data Link

