

## Pantheon Report

Generated at 2018-08-28 09:22:25 (UTC).

Data path: AWS California 2 on `ens5` (*local*) → Mexico on `em1` (*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.

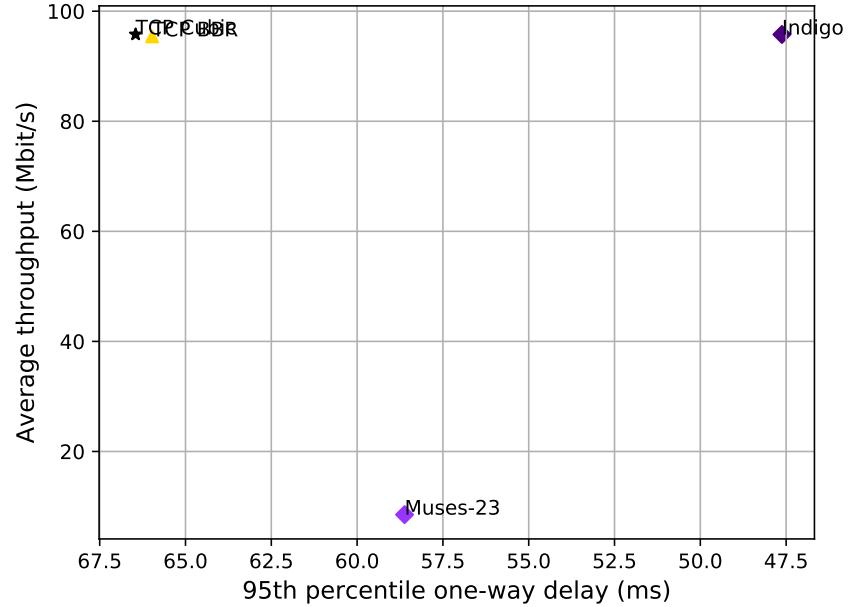
System info:

```
Linux 4.15.0-1020-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
```

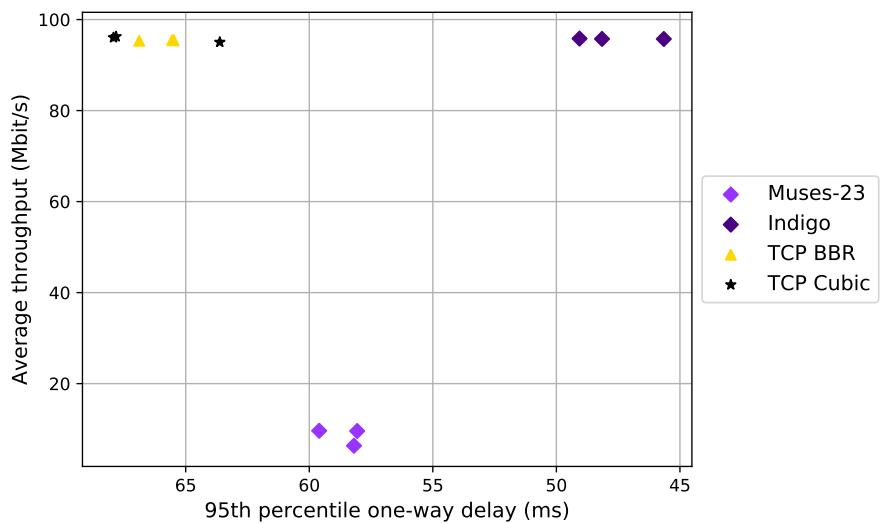
Git summary:

```
branch: muses-23 @ 88af05c5b0b7531637ca401951507a2fde628df6
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 2 to Mexico, 3 runs of 30s each per scheme  
3 flows with 10s interval between flows (mean of all runs by scheme)



test from AWS California 2 to Mexico, 3 runs of 30s each per scheme  
3 flows with 10s interval between flows



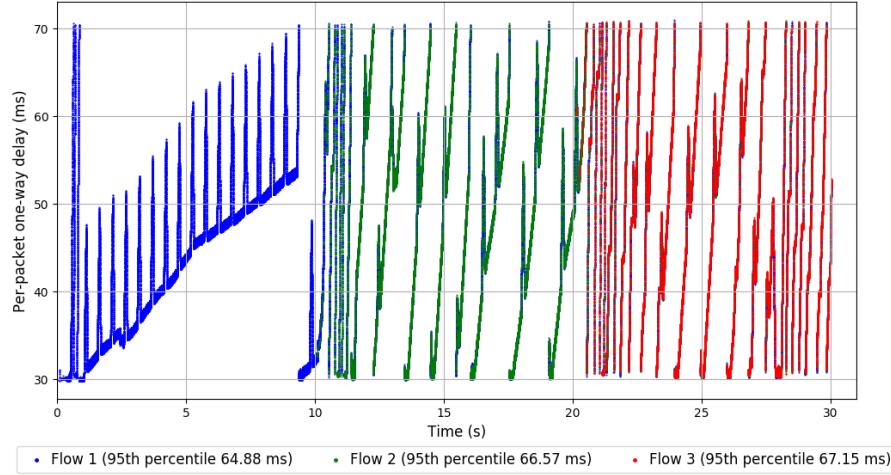
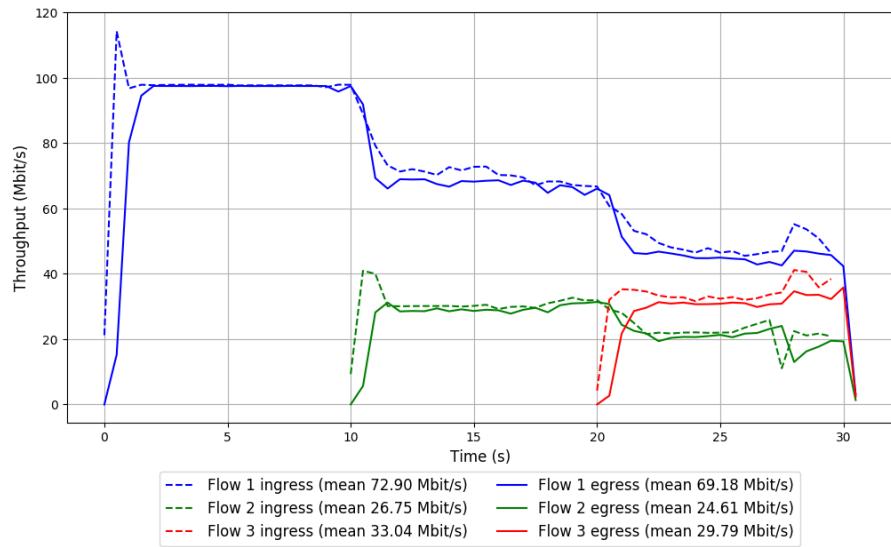
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	59.59	38.66	30.44	64.65	67.08	67.35	5.29	9.23	9.42
TCP Cubic	3	74.96	19.68	23.22	66.36	66.96	61.92	0.93	0.56	0.67
Indigo	3	66.31	28.00	33.31	44.00	50.25	53.95	0.06	0.14	0.00
Muses-23	3	3.74	5.87	3.21	47.13	56.79	65.99	67.41	51.97	70.39

Run 1: Statistics of TCP BBR

```
Start at: 2018-08-28 09:08:06
End at: 2018-08-28 09:08:36
Local clock offset: -15.296 ms
Remote clock offset: 3.967 ms

# Below is generated by plot.py at 2018-08-28 09:22:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.47 Mbit/s
95th percentile per-packet one-way delay: 65.549 ms
Loss rate: 6.06%
-- Flow 1:
Average throughput: 69.18 Mbit/s
95th percentile per-packet one-way delay: 64.883 ms
Loss rate: 5.04%
-- Flow 2:
Average throughput: 24.61 Mbit/s
95th percentile per-packet one-way delay: 66.568 ms
Loss rate: 7.91%
-- Flow 3:
Average throughput: 29.79 Mbit/s
95th percentile per-packet one-way delay: 67.149 ms
Loss rate: 9.83%
```

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

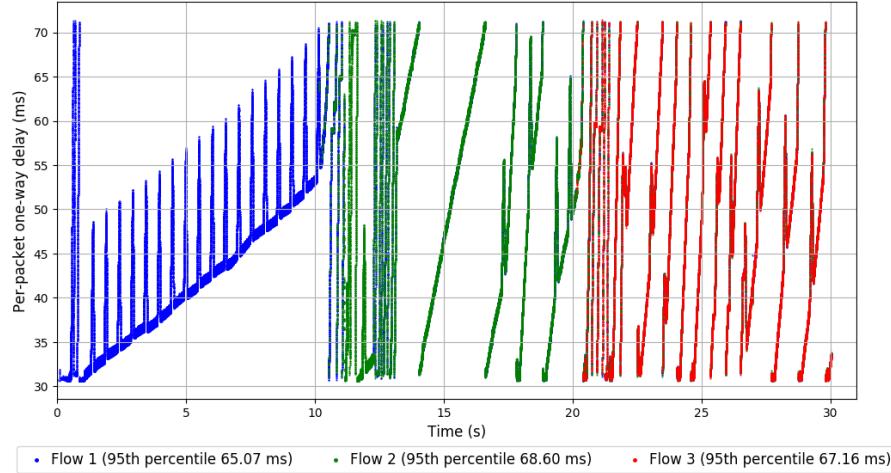
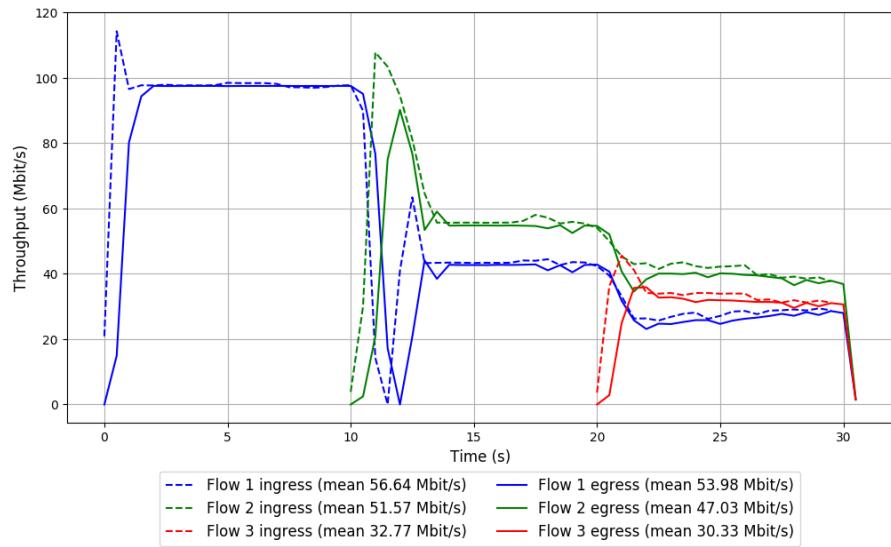


Run 2: Statistics of TCP BBR

```
Start at: 2018-08-28 09:13:28
End at: 2018-08-28 09:13:58
Local clock offset: -13.534 ms
Remote clock offset: 3.849 ms

# Below is generated by plot.py at 2018-08-28 09:22:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.34 Mbit/s
95th percentile per-packet one-way delay: 66.881 ms
Loss rate: 6.42%
-- Flow 1:
Average throughput: 53.98 Mbit/s
95th percentile per-packet one-way delay: 65.072 ms
Loss rate: 4.69%
-- Flow 2:
Average throughput: 47.03 Mbit/s
95th percentile per-packet one-way delay: 68.599 ms
Loss rate: 8.90%
-- Flow 3:
Average throughput: 30.33 Mbit/s
95th percentile per-packet one-way delay: 67.158 ms
Loss rate: 7.63%
```

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

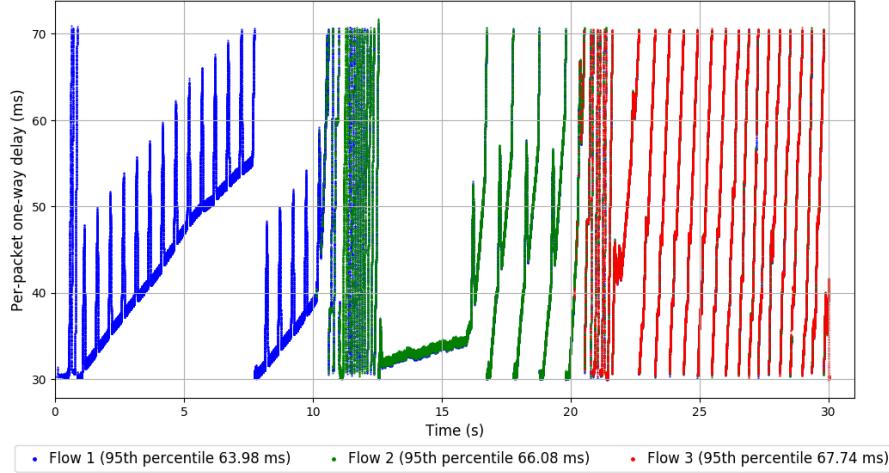
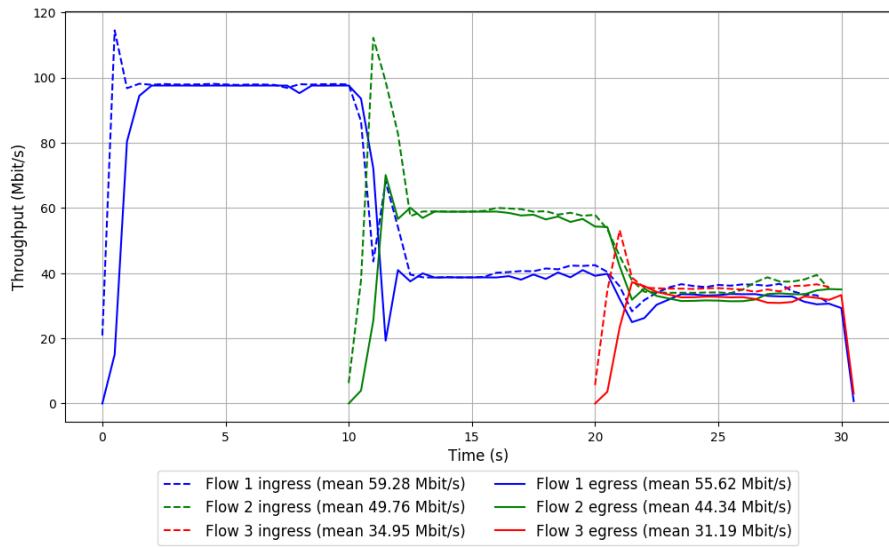


Run 3: Statistics of TCP BBR

```
Start at: 2018-08-28 09:18:55
End at: 2018-08-28 09:19:25
Local clock offset: -14.839 ms
Remote clock offset: 3.643 ms

# Below is generated by plot.py at 2018-08-28 09:22:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.46 Mbit/s
95th percentile per-packet one-way delay: 65.487 ms
Loss rate: 8.17%
-- Flow 1:
Average throughput: 55.62 Mbit/s
95th percentile per-packet one-way delay: 63.984 ms
Loss rate: 6.14%
-- Flow 2:
Average throughput: 44.34 Mbit/s
95th percentile per-packet one-way delay: 66.085 ms
Loss rate: 10.87%
-- Flow 3:
Average throughput: 31.19 Mbit/s
95th percentile per-packet one-way delay: 67.741 ms
Loss rate: 10.81%
```

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

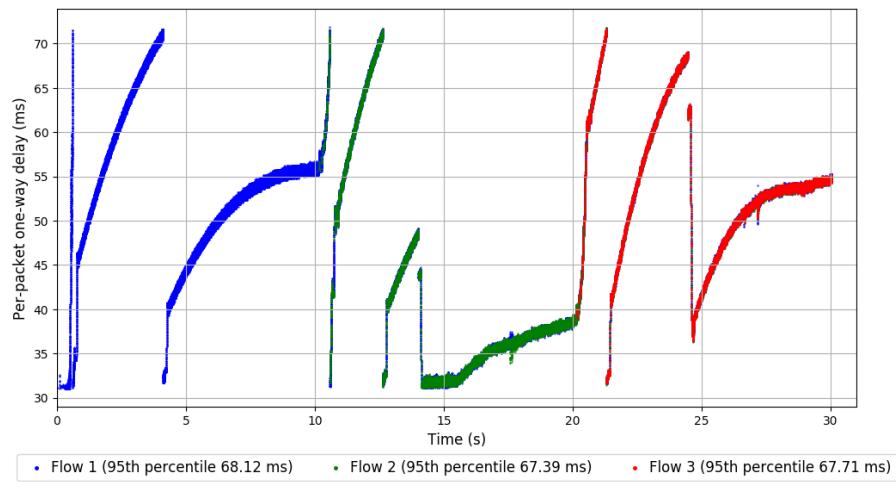
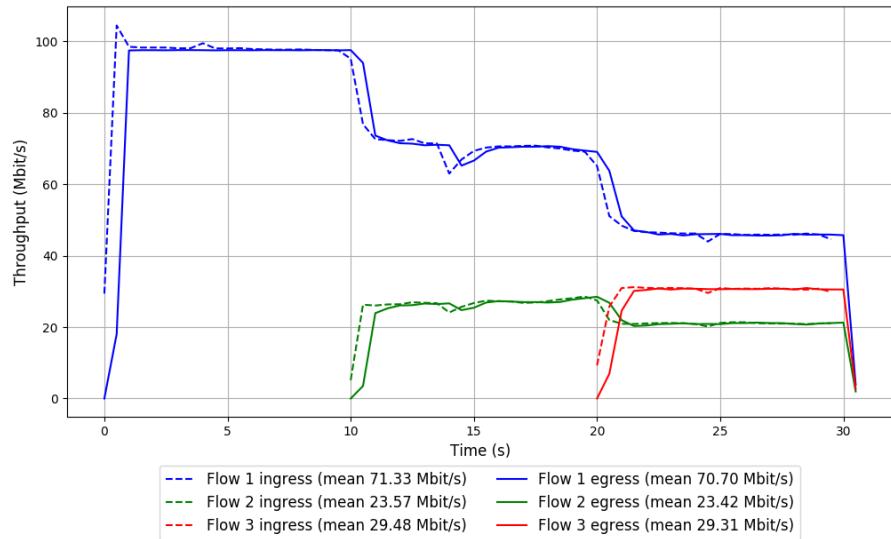


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-08-28 09:09:28
End at: 2018-08-28 09:09:58
Local clock offset: -15.441 ms
Remote clock offset: 3.766 ms

# Below is generated by plot.py at 2018-08-28 09:22:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.04 Mbit/s
95th percentile per-packet one-way delay: 67.922 ms
Loss rate: 0.74%
-- Flow 1:
Average throughput: 70.70 Mbit/s
95th percentile per-packet one-way delay: 68.116 ms
Loss rate: 0.81%
-- Flow 2:
Average throughput: 23.42 Mbit/s
95th percentile per-packet one-way delay: 67.388 ms
Loss rate: 0.64%
-- Flow 3:
Average throughput: 29.31 Mbit/s
95th percentile per-packet one-way delay: 67.712 ms
Loss rate: 0.42%
```

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

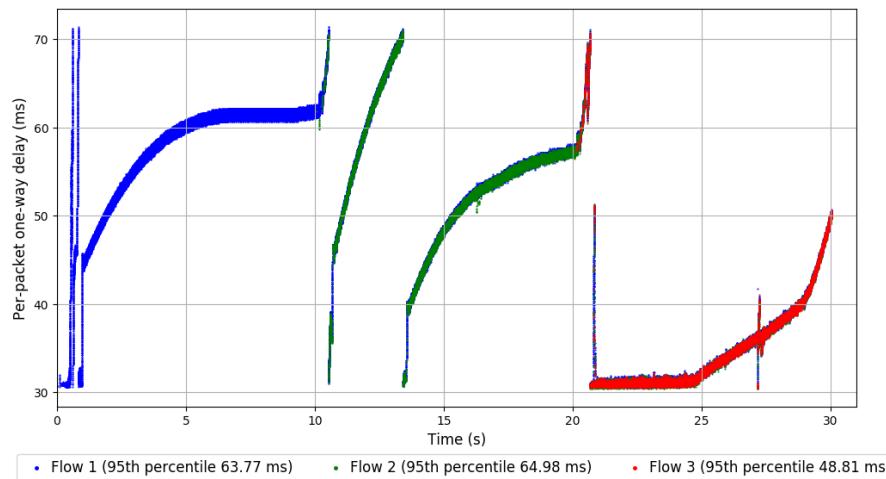
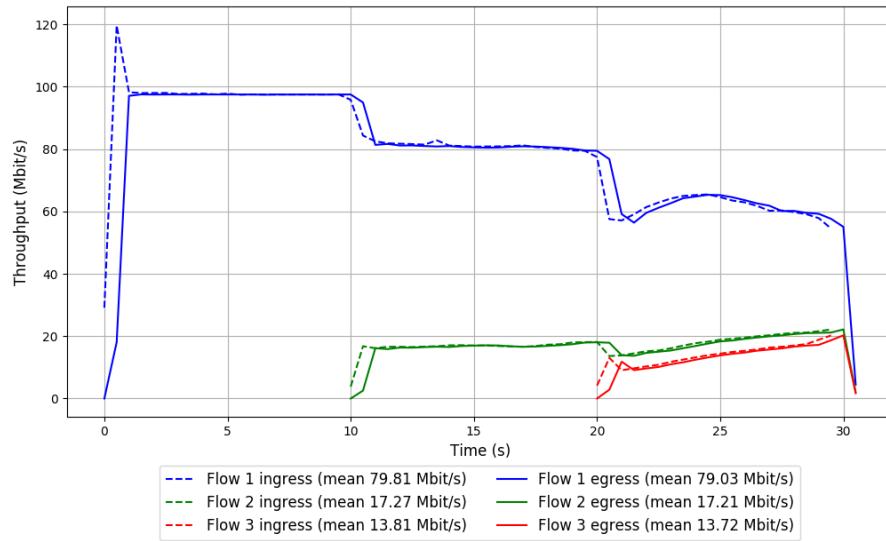


Run 2: Statistics of TCP Cubic

```
Start at: 2018-08-28 09:14:50
End at: 2018-08-28 09:15:20
Local clock offset: -13.529 ms
Remote clock offset: 3.913 ms

# Below is generated by plot.py at 2018-08-28 09:22:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.04 Mbit/s
95th percentile per-packet one-way delay: 63.622 ms
Loss rate: 0.85%
-- Flow 1:
Average throughput: 79.03 Mbit/s
95th percentile per-packet one-way delay: 63.772 ms
Loss rate: 0.91%
-- Flow 2:
Average throughput: 17.21 Mbit/s
95th percentile per-packet one-way delay: 64.980 ms
Loss rate: 0.41%
-- Flow 3:
Average throughput: 13.72 Mbit/s
95th percentile per-packet one-way delay: 48.812 ms
Loss rate: 0.73%
```

Run 2: Report of TCP Cubic — Data Link

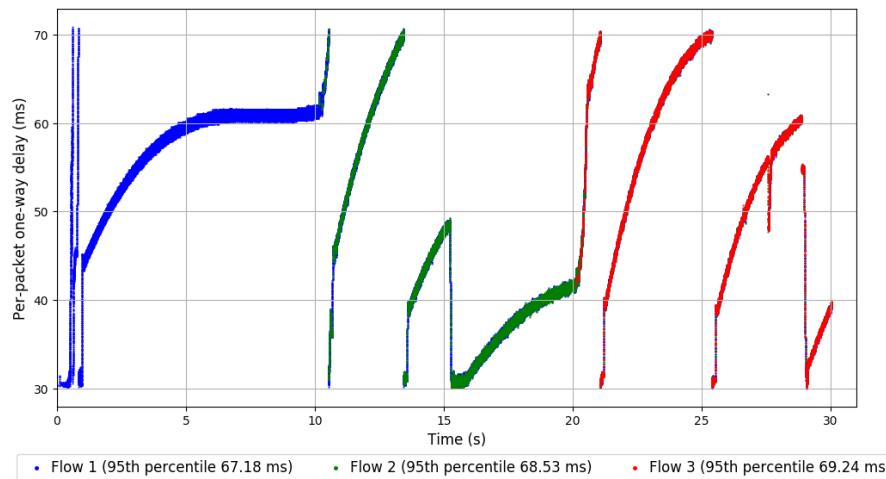
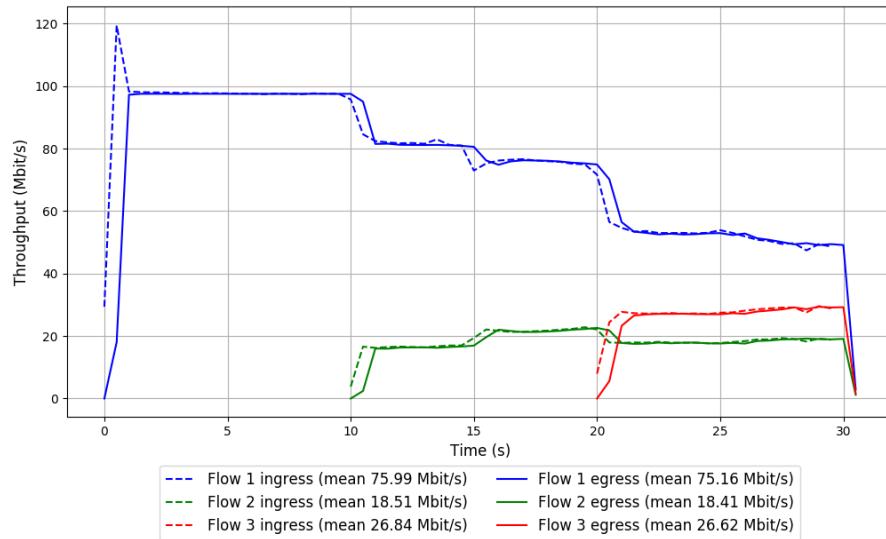


Run 3: Statistics of TCP Cubic

```
Start at: 2018-08-28 09:20:16
End at: 2018-08-28 09:20:46
Local clock offset: -15.495 ms
Remote clock offset: 3.803 ms

# Below is generated by plot.py at 2018-08-28 09:22:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.25 Mbit/s
95th percentile per-packet one-way delay: 67.817 ms
Loss rate: 0.98%
-- Flow 1:
Average throughput: 75.16 Mbit/s
95th percentile per-packet one-way delay: 67.184 ms
Loss rate: 1.06%
-- Flow 2:
Average throughput: 18.41 Mbit/s
95th percentile per-packet one-way delay: 68.527 ms
Loss rate: 0.64%
-- Flow 3:
Average throughput: 26.62 Mbit/s
95th percentile per-packet one-way delay: 69.237 ms
Loss rate: 0.85%
```

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

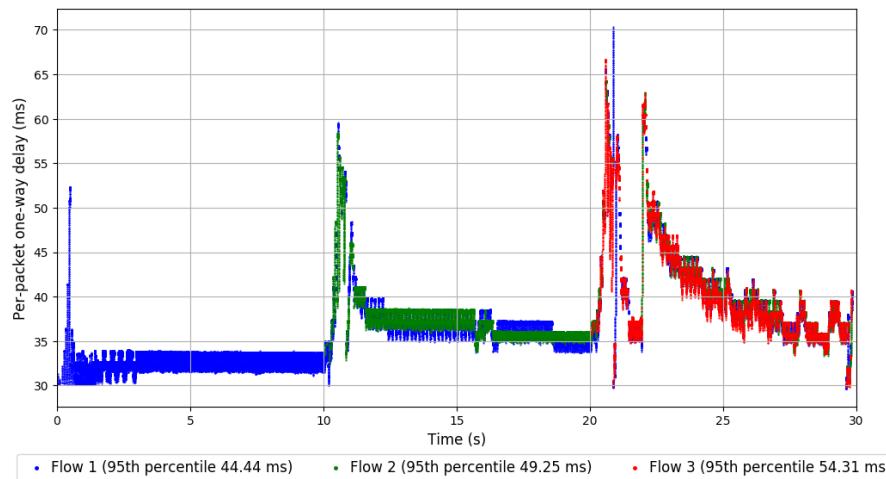
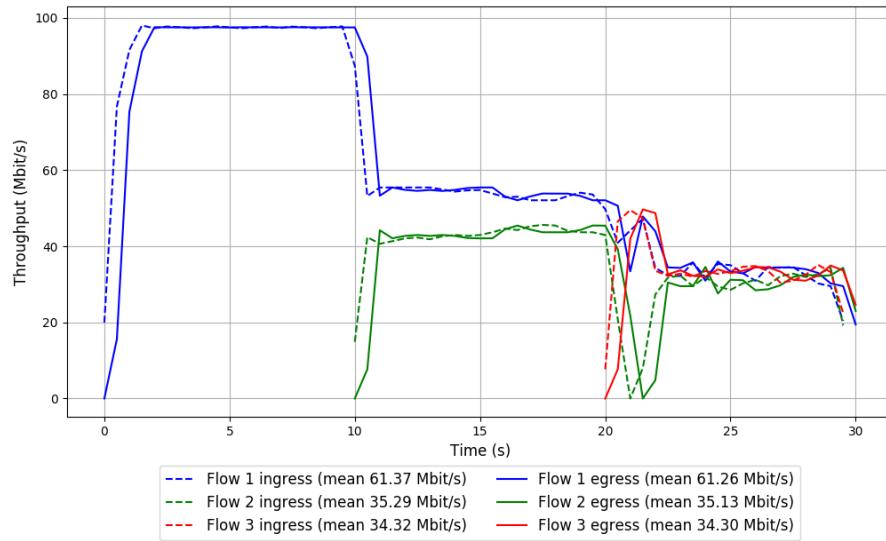


Run 1: Statistics of Indigo

```
Start at: 2018-08-28 09:06:44
End at: 2018-08-28 09:07:14
Local clock offset: -14.054 ms
Remote clock offset: 4.019 ms

# Below is generated by plot.py at 2018-08-28 09:22:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.75 Mbit/s
95th percentile per-packet one-way delay: 48.153 ms
Loss rate: 0.21%
-- Flow 1:
Average throughput: 61.26 Mbit/s
95th percentile per-packet one-way delay: 44.443 ms
Loss rate: 0.16%
-- Flow 2:
Average throughput: 35.13 Mbit/s
95th percentile per-packet one-way delay: 49.250 ms
Loss rate: 0.43%
-- Flow 3:
Average throughput: 34.30 Mbit/s
95th percentile per-packet one-way delay: 54.307 ms
Loss rate: 0.00%
```

## Run 1: Report of Indigo — Data Link

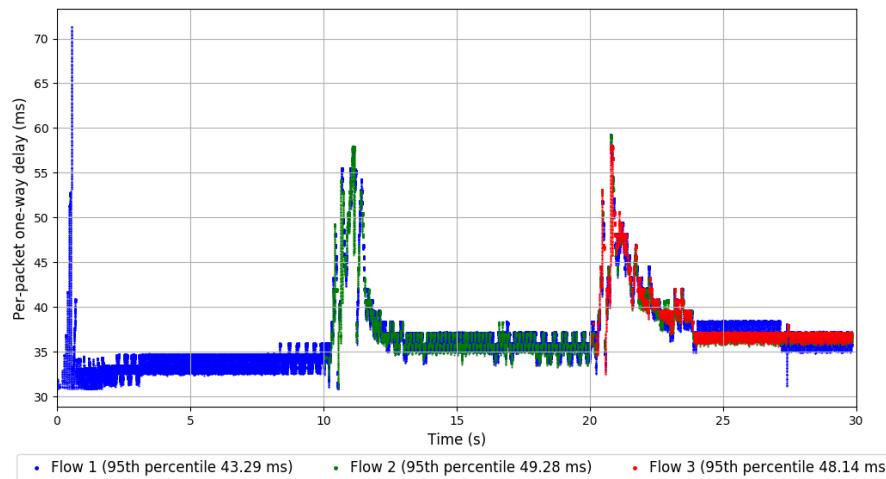
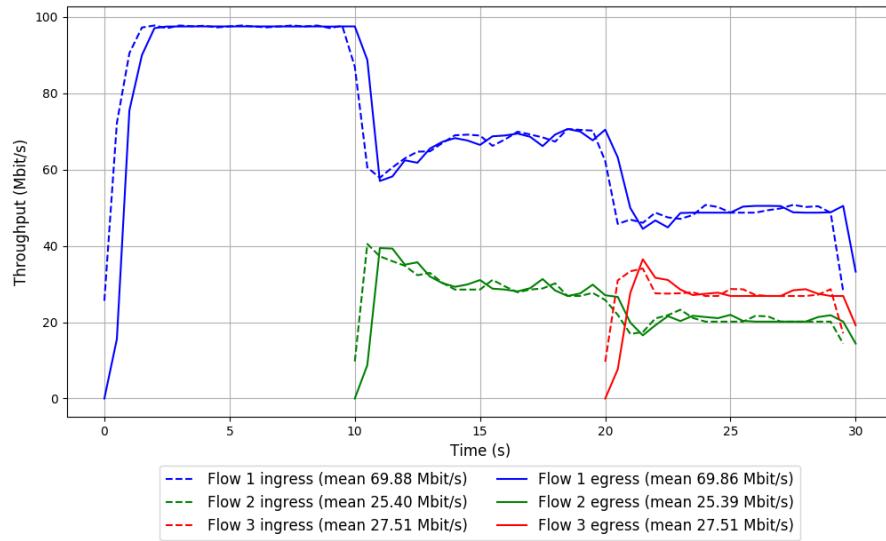


Run 2: Statistics of Indigo

```
Start at: 2018-08-28 09:12:06
End at: 2018-08-28 09:12:36
Local clock offset: -13.879 ms
Remote clock offset: 3.935 ms

# Below is generated by plot.py at 2018-08-28 09:22:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.73 Mbit/s
95th percentile per-packet one-way delay: 45.652 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 69.86 Mbit/s
95th percentile per-packet one-way delay: 43.291 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 25.39 Mbit/s
95th percentile per-packet one-way delay: 49.282 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 27.51 Mbit/s
95th percentile per-packet one-way delay: 48.137 ms
Loss rate: 0.00%
```

## Run 2: Report of Indigo — Data Link

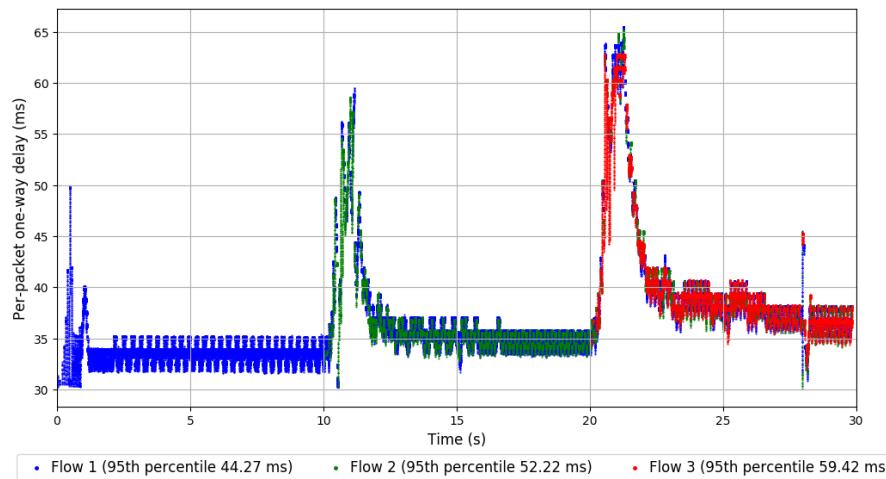
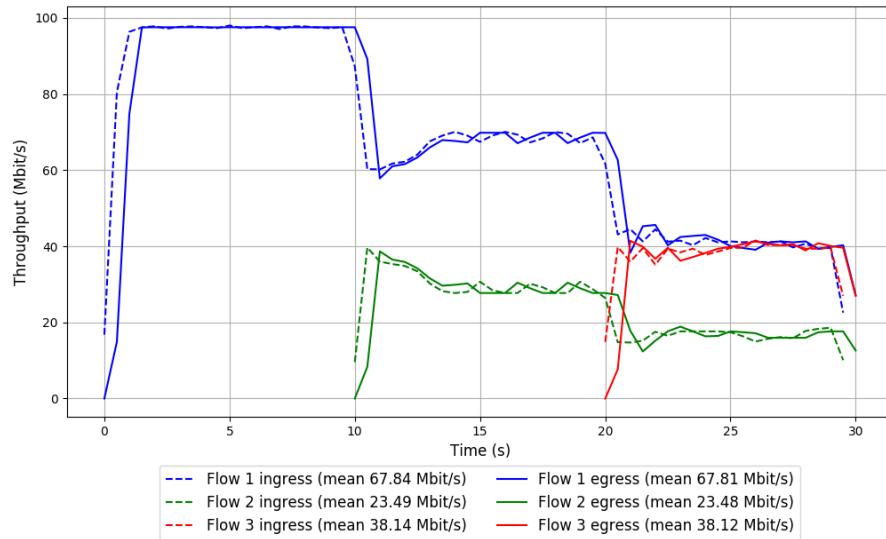


Run 3: Statistics of Indigo

```
Start at: 2018-08-28 09:17:33
End at: 2018-08-28 09:18:03
Local clock offset: -14.239 ms
Remote clock offset: 3.692 ms

# Below is generated by plot.py at 2018-08-28 09:22:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.82 Mbit/s
95th percentile per-packet one-way delay: 49.063 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 67.81 Mbit/s
95th percentile per-packet one-way delay: 44.269 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 23.48 Mbit/s
95th percentile per-packet one-way delay: 52.216 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 38.12 Mbit/s
95th percentile per-packet one-way delay: 59.420 ms
Loss rate: 0.00%
```

### Run 3: Report of Indigo — Data Link

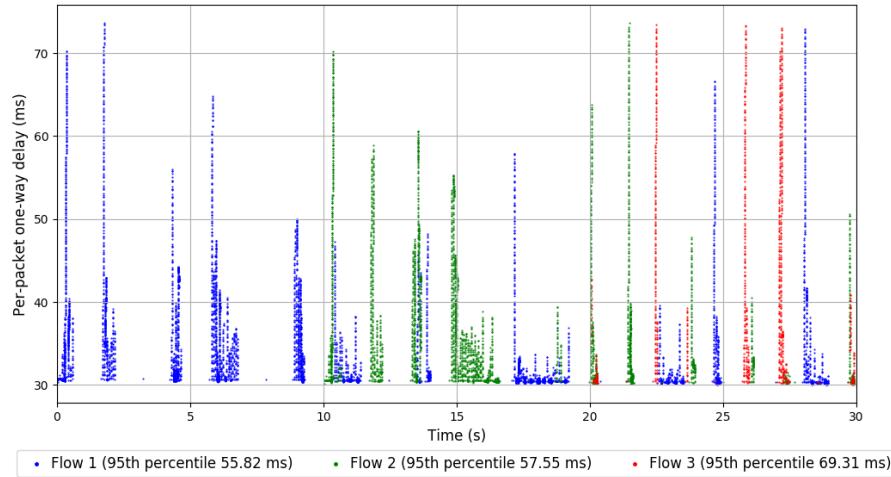
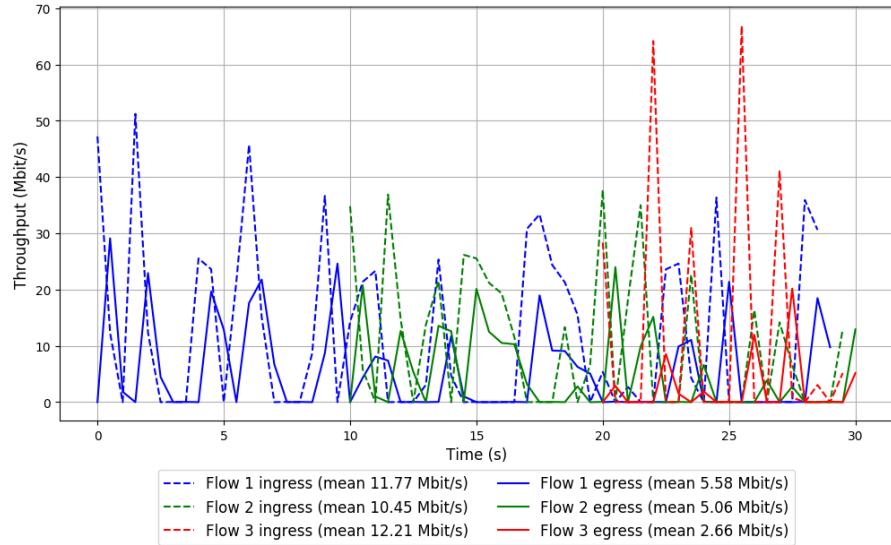


Run 1: Statistics of Muses-23

```
Start at: 2018-08-28 09:05:27
End at: 2018-08-28 09:05:57
Local clock offset: -12.974 ms
Remote clock offset: 4.036 ms

# Below is generated by plot.py at 2018-08-28 09:22:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 9.64 Mbit/s
95th percentile per-packet one-way delay: 59.599 ms
Loss rate: 56.94%
-- Flow 1:
Average throughput: 5.58 Mbit/s
95th percentile per-packet one-way delay: 55.816 ms
Loss rate: 52.64%
-- Flow 2:
Average throughput: 5.06 Mbit/s
95th percentile per-packet one-way delay: 57.551 ms
Loss rate: 51.63%
-- Flow 3:
Average throughput: 2.66 Mbit/s
95th percentile per-packet one-way delay: 69.308 ms
Loss rate: 78.25%
```

Run 1: Report of Muses-23 — Data Link

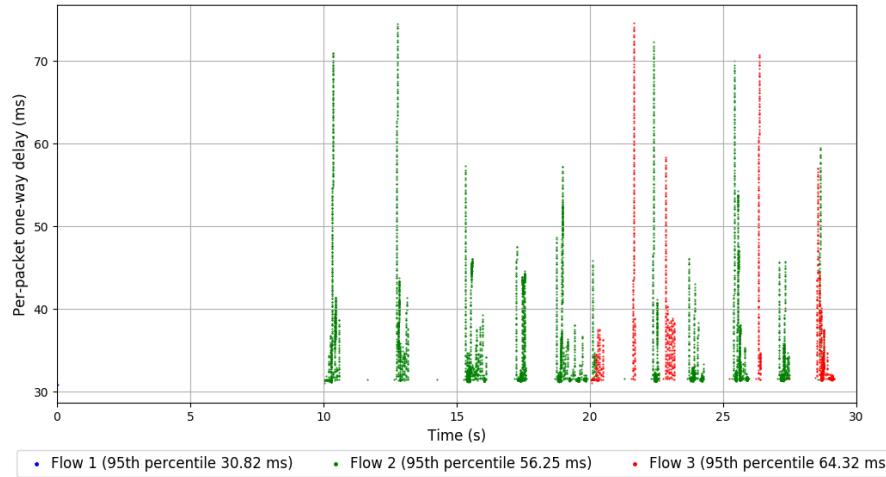
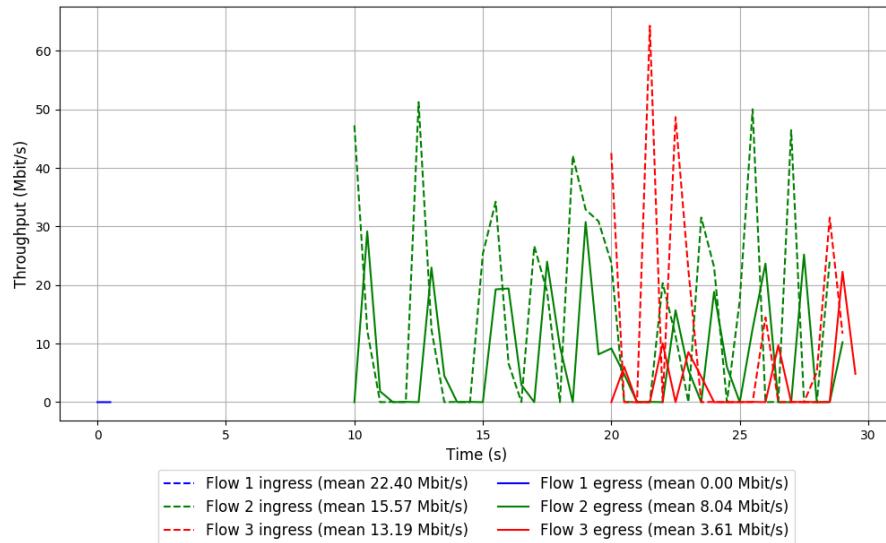


Run 2: Statistics of Muses-23

```
Start at: 2018-08-28 09:10:49
End at: 2018-08-28 09:11:19
Local clock offset: -14.44 ms
Remote clock offset: 3.907 ms

# Below is generated by plot.py at 2018-08-28 09:22:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 6.35 Mbit/s
95th percentile per-packet one-way delay: 58.191 ms
Loss rate: 55.41%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.818 ms
Loss rate: 97.39%
-- Flow 2:
Average throughput: 8.04 Mbit/s
95th percentile per-packet one-way delay: 56.253 ms
Loss rate: 48.36%
-- Flow 3:
Average throughput: 3.61 Mbit/s
95th percentile per-packet one-way delay: 64.321 ms
Loss rate: 72.65%
```

Run 2: Report of Muses-23 — Data Link



Run 3: Statistics of Muses-23

```
Start at: 2018-08-28 09:16:11
End at: 2018-08-28 09:16:41
Local clock offset: -13.762 ms
Remote clock offset: 3.794 ms

# Below is generated by plot.py at 2018-08-28 09:22:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 9.58 Mbit/s
95th percentile per-packet one-way delay: 58.061 ms
Loss rate: 54.47%
-- Flow 1:
Average throughput: 5.64 Mbit/s
95th percentile per-packet one-way delay: 54.762 ms
Loss rate: 52.20%
-- Flow 2:
Average throughput: 4.52 Mbit/s
95th percentile per-packet one-way delay: 56.556 ms
Loss rate: 55.93%
-- Flow 3:
Average throughput: 3.36 Mbit/s
95th percentile per-packet one-way delay: 64.335 ms
Loss rate: 60.28%
```

Run 3: Report of Muses-23 — Data Link

