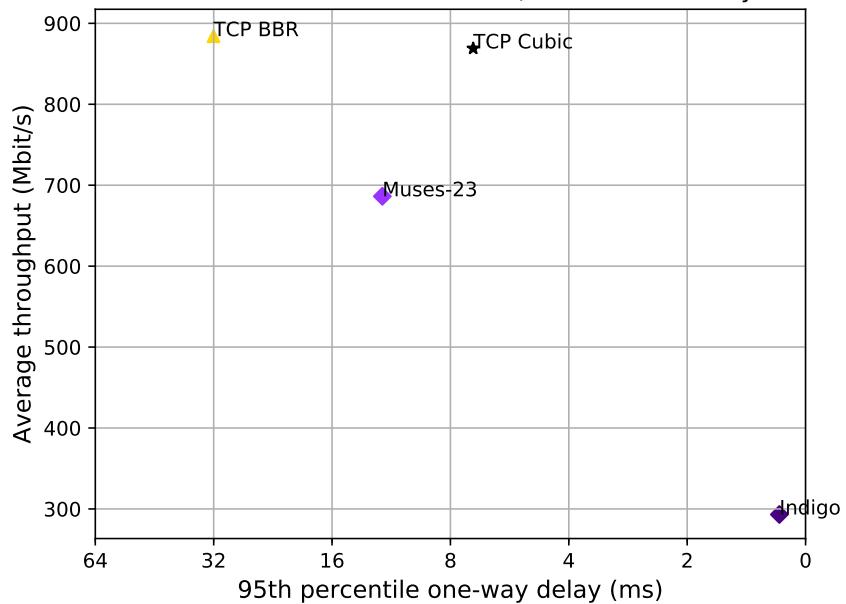


Pantheon Report

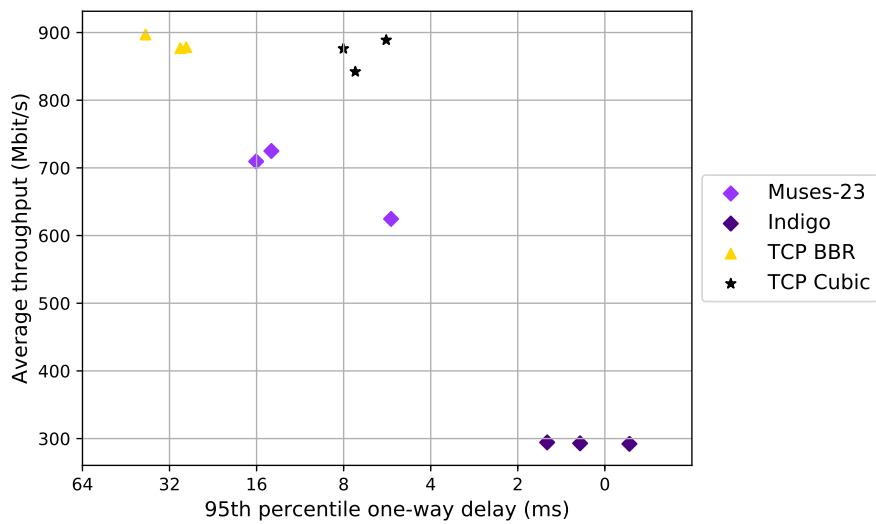
Generated at 2018-08-28 10:40:00 (UTC).
Data path: Stanford on `eno1` (*remote*) → AWS California 1 on `ens5` (*local*).
Repeated the test of 4 congestion control schemes 3 times.
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.
NTP offsets were measured against `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  
  
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 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



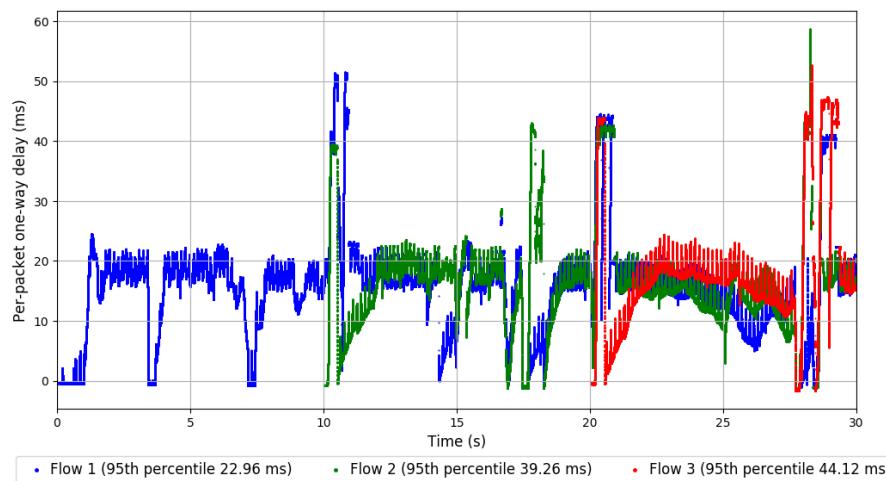
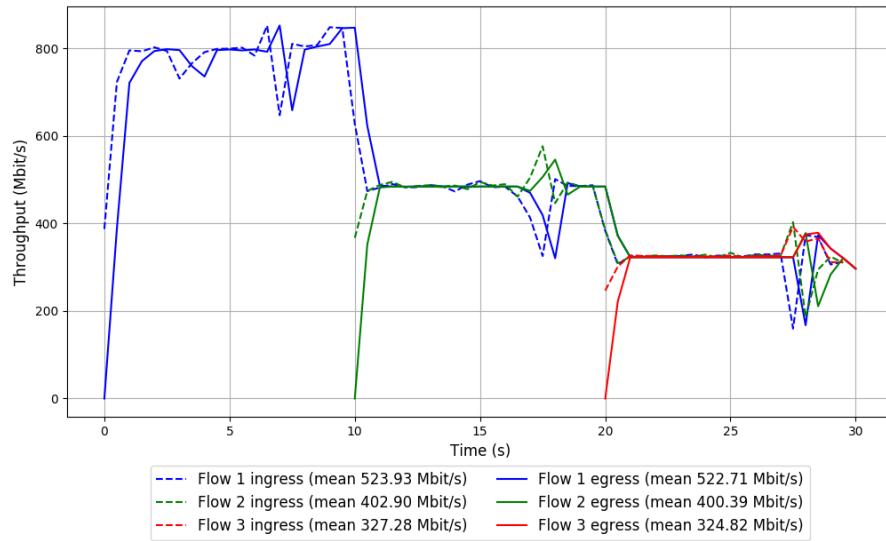
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	509.88	399.92	325.34	23.96	35.82	54.88	0.37	0.86	1.02
TCP Cubic	3	514.73	381.88	301.05	7.64	6.53	6.64	0.06	0.11	0.27
Indigo	3	164.55	154.65	78.72	0.45	0.34	0.22	0.05	0.09	0.20
Muses-23	3	319.52	436.44	231.65	5.90	14.93	7.87	0.07	0.11	0.23

Run 1: Statistics of TCP BBR

```
Start at: 2018-08-28 10:09:13
End at: 2018-08-28 10:09:43
Local clock offset: -25.44 ms
Remote clock offset: -1.272 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 897.04 Mbit/s
95th percentile per-packet one-way delay: 38.726 ms
Loss rate: 0.51%
-- Flow 1:
Average throughput: 522.71 Mbit/s
95th percentile per-packet one-way delay: 22.956 ms
Loss rate: 0.30%
-- Flow 2:
Average throughput: 400.39 Mbit/s
95th percentile per-packet one-way delay: 39.263 ms
Loss rate: 0.73%
-- Flow 3:
Average throughput: 324.82 Mbit/s
95th percentile per-packet one-way delay: 44.117 ms
Loss rate: 0.96%
```

Run 1: Report of TCP BBR — Data Link

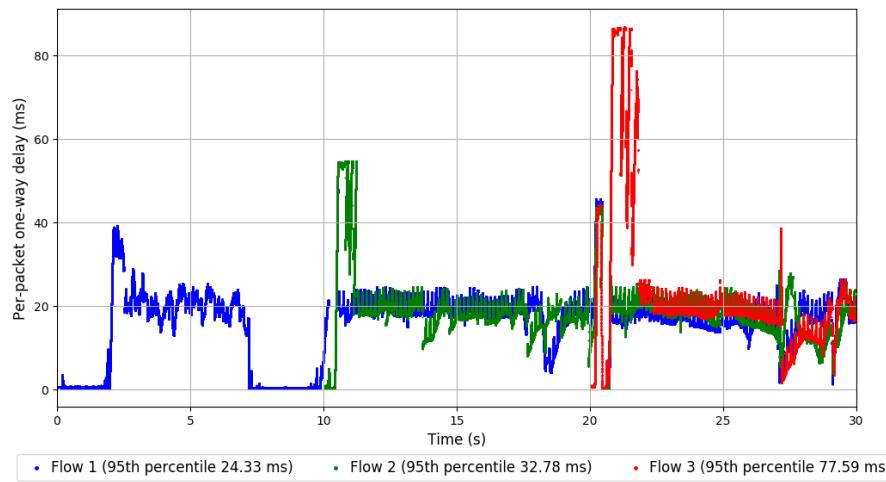
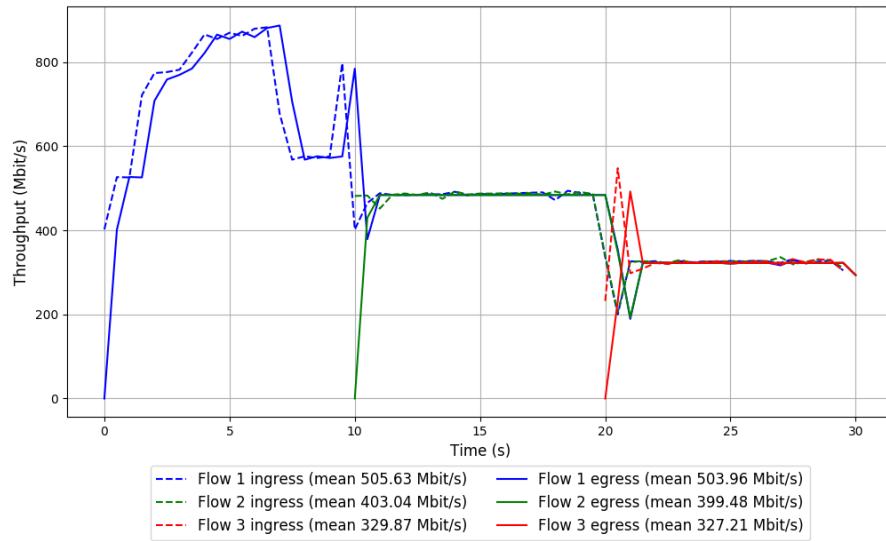


Run 2: Statistics of TCP BBR

```
Start at: 2018-08-28 10:16:08
End at: 2018-08-28 10:16:38
Local clock offset: -13.281 ms
Remote clock offset: -1.298 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 878.48 Mbit/s
95th percentile per-packet one-way delay: 28.013 ms
Loss rate: 0.65%
-- Flow 1:
Average throughput: 503.96 Mbit/s
95th percentile per-packet one-way delay: 24.334 ms
Loss rate: 0.40%
-- Flow 2:
Average throughput: 399.48 Mbit/s
95th percentile per-packet one-way delay: 32.785 ms
Loss rate: 0.98%
-- Flow 3:
Average throughput: 327.21 Mbit/s
95th percentile per-packet one-way delay: 77.595 ms
Loss rate: 1.00%
```

Run 2: Report of TCP BBR — Data Link

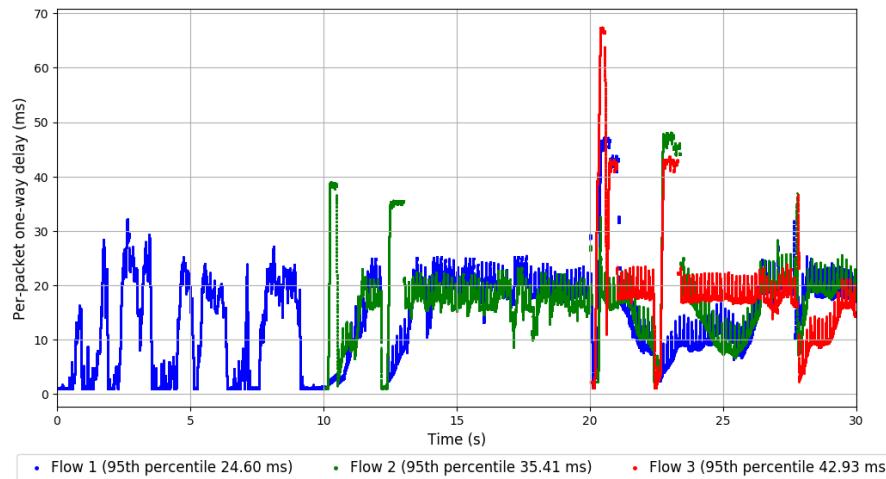
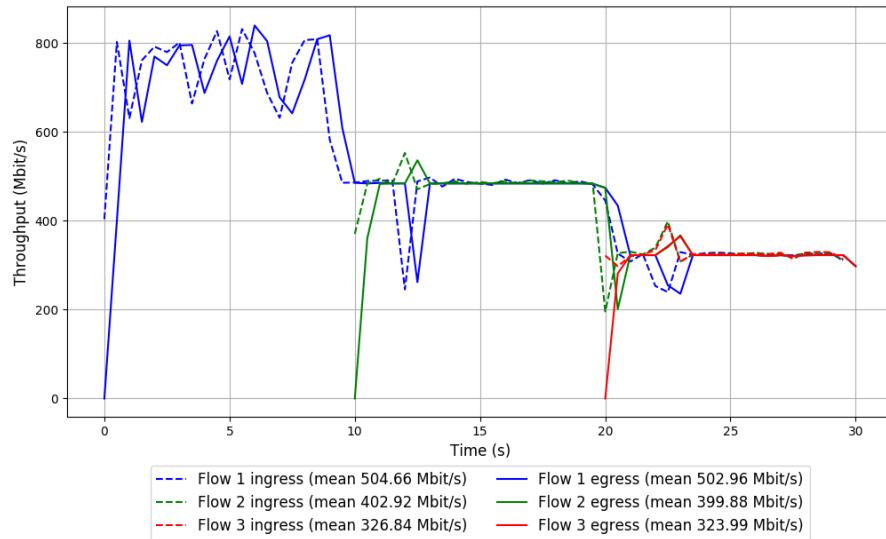


Run 3: Statistics of TCP BBR

```
Start at: 2018-08-28 10:23:00
End at: 2018-08-28 10:23:30
Local clock offset: -9.862 ms
Remote clock offset: 0.429 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 876.89 Mbit/s
95th percentile per-packet one-way delay: 29.360 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 502.96 Mbit/s
95th percentile per-packet one-way delay: 24.600 ms
Loss rate: 0.41%
-- Flow 2:
Average throughput: 399.88 Mbit/s
95th percentile per-packet one-way delay: 35.407 ms
Loss rate: 0.86%
-- Flow 3:
Average throughput: 323.99 Mbit/s
95th percentile per-packet one-way delay: 42.934 ms
Loss rate: 1.09%
```

Run 3: Report of TCP BBR — Data Link

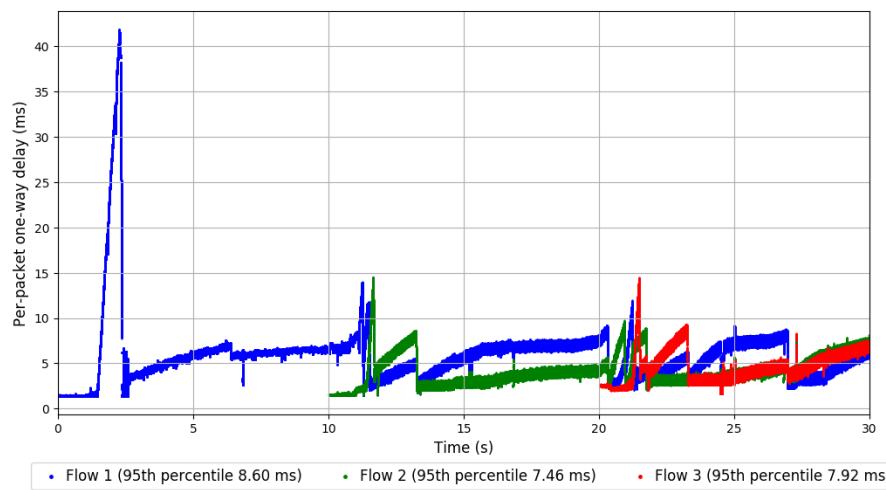
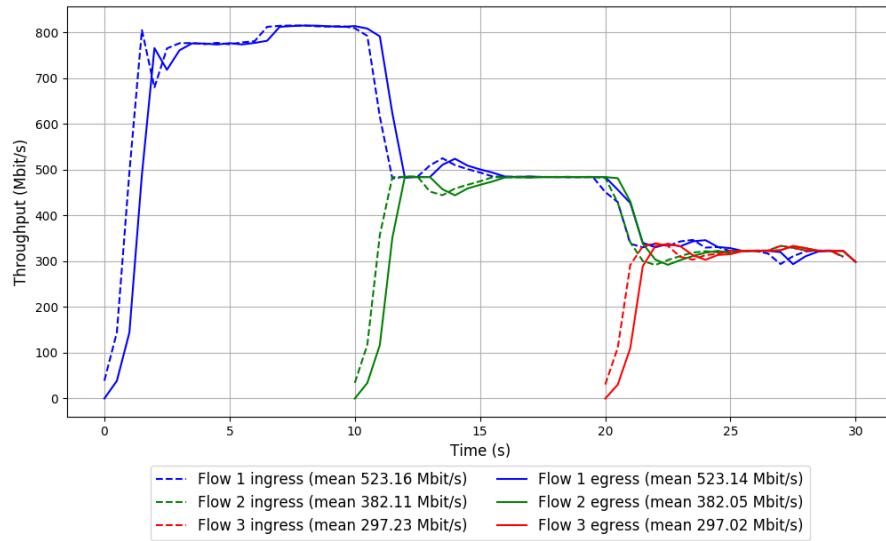


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-08-28 10:05:43
End at: 2018-08-28 10:06:13
Local clock offset: -24.836 ms
Remote clock offset: -1.118 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 876.06 Mbit/s
95th percentile per-packet one-way delay: 8.017 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 523.14 Mbit/s
95th percentile per-packet one-way delay: 8.603 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 382.05 Mbit/s
95th percentile per-packet one-way delay: 7.461 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 297.02 Mbit/s
95th percentile per-packet one-way delay: 7.921 ms
Loss rate: 0.27%
```

Run 1: Report of TCP Cubic — Data Link

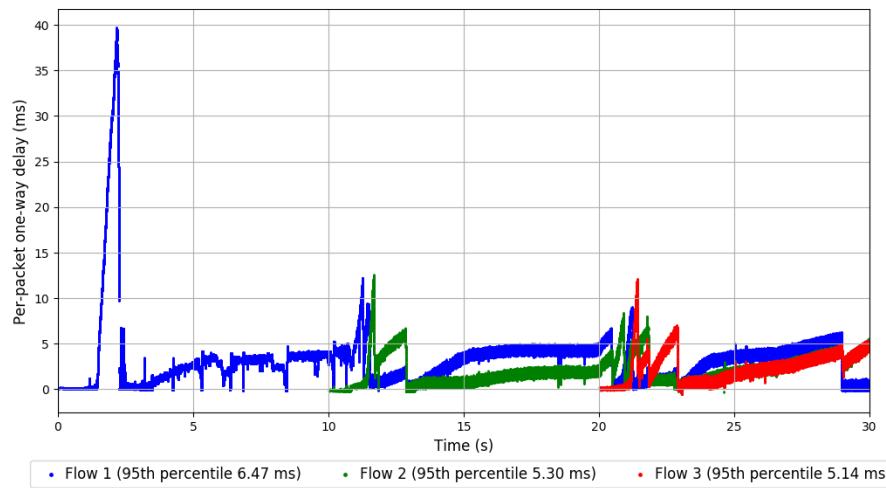
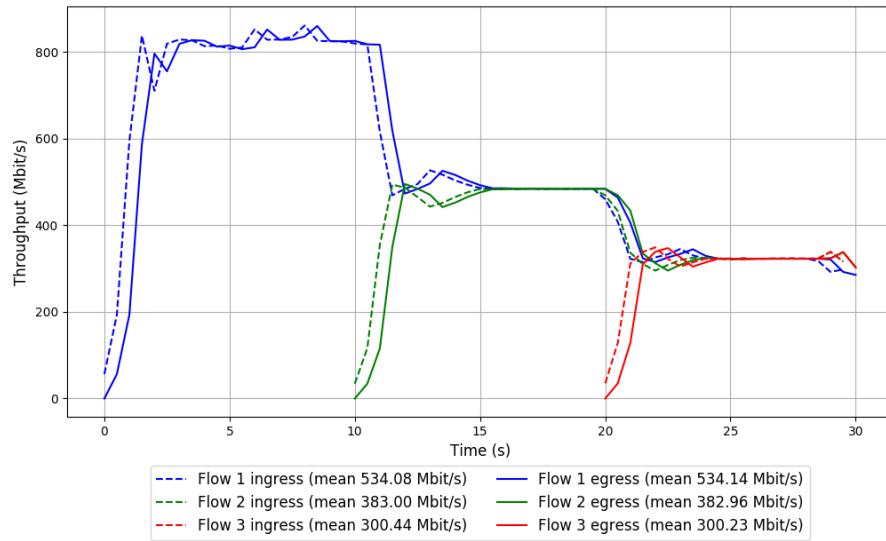


Run 2: Statistics of TCP Cubic

```
Start at: 2018-08-28 10:12:37
End at: 2018-08-28 10:13:07
Local clock offset: -18.066 ms
Remote clock offset: -1.355 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 888.86 Mbit/s
95th percentile per-packet one-way delay: 5.698 ms
Loss rate: 0.09%
-- Flow 1:
Average throughput: 534.14 Mbit/s
95th percentile per-packet one-way delay: 6.469 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 382.96 Mbit/s
95th percentile per-packet one-way delay: 5.302 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 300.23 Mbit/s
95th percentile per-packet one-way delay: 5.139 ms
Loss rate: 0.27%
```

Run 2: Report of TCP Cubic — Data Link

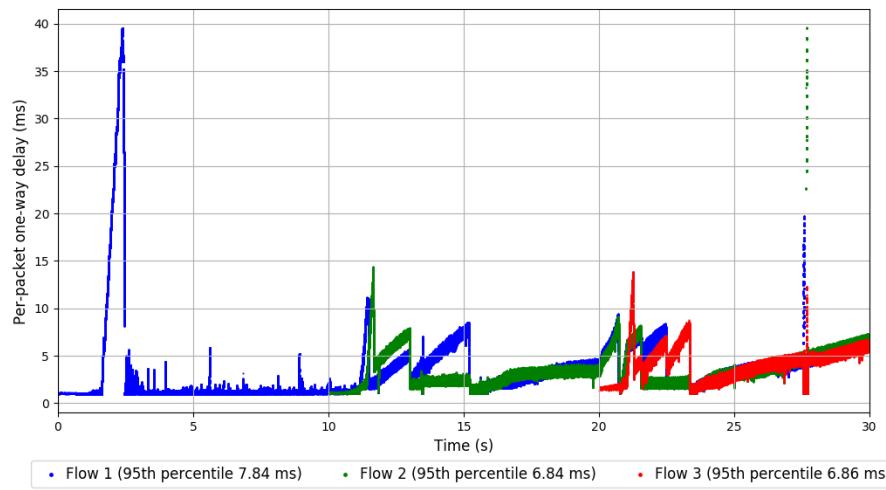
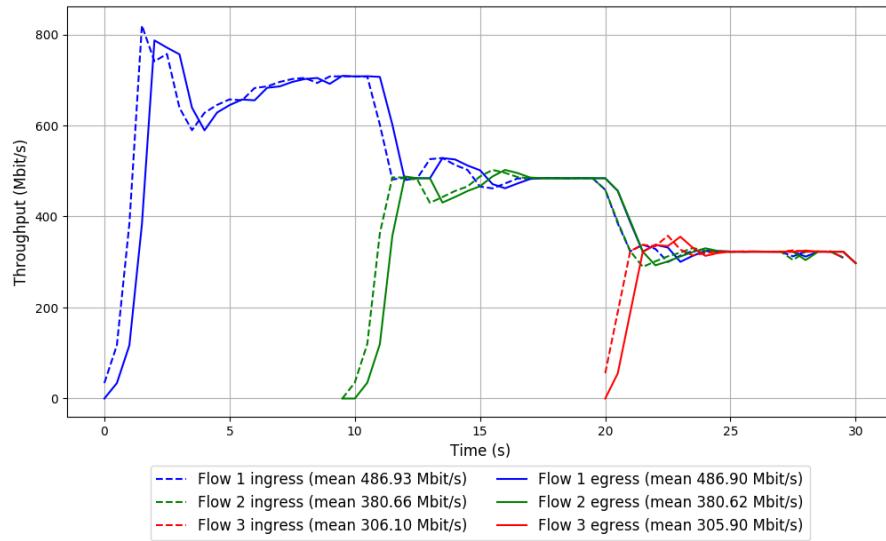


Run 3: Statistics of TCP Cubic

```
Start at: 2018-08-28 10:19:33
End at: 2018-08-28 10:20:03
Local clock offset: -10.906 ms
Remote clock offset: -1.263 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 842.06 Mbit/s
95th percentile per-packet one-way delay: 7.290 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 486.90 Mbit/s
95th percentile per-packet one-way delay: 7.845 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 380.62 Mbit/s
95th percentile per-packet one-way delay: 6.841 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 305.90 Mbit/s
95th percentile per-packet one-way delay: 6.861 ms
Loss rate: 0.27%
```

Run 3: Report of TCP Cubic — Data Link

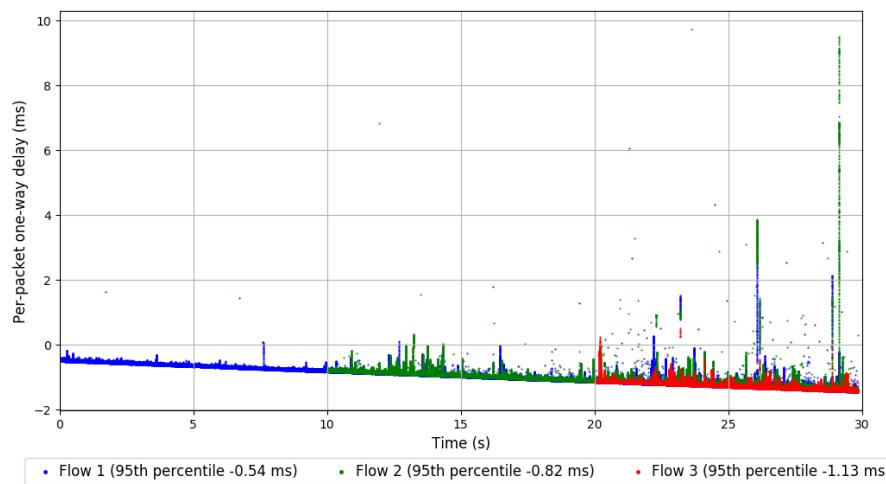
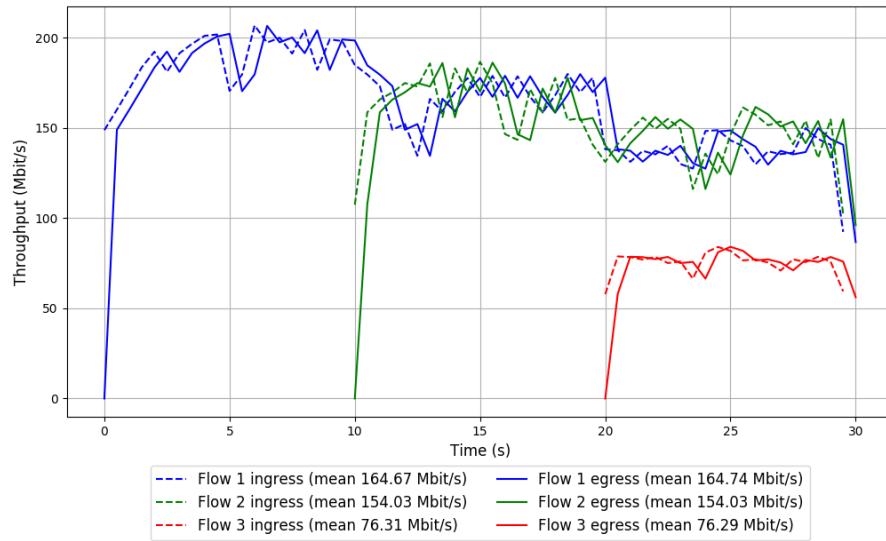


Run 1: Statistics of Indigo

```
Start at: 2018-08-28 10:11:06
End at: 2018-08-28 10:11:36
Local clock offset: -21.266 ms
Remote clock offset: -1.333 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 292.16 Mbit/s
95th percentile per-packet one-way delay: -0.565 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 164.74 Mbit/s
95th percentile per-packet one-way delay: -0.535 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 154.03 Mbit/s
95th percentile per-packet one-way delay: -0.821 ms
Loss rate: 0.09%
-- Flow 3:
Average throughput: 76.29 Mbit/s
95th percentile per-packet one-way delay: -1.132 ms
Loss rate: 0.21%
```

Run 1: Report of Indigo — Data Link

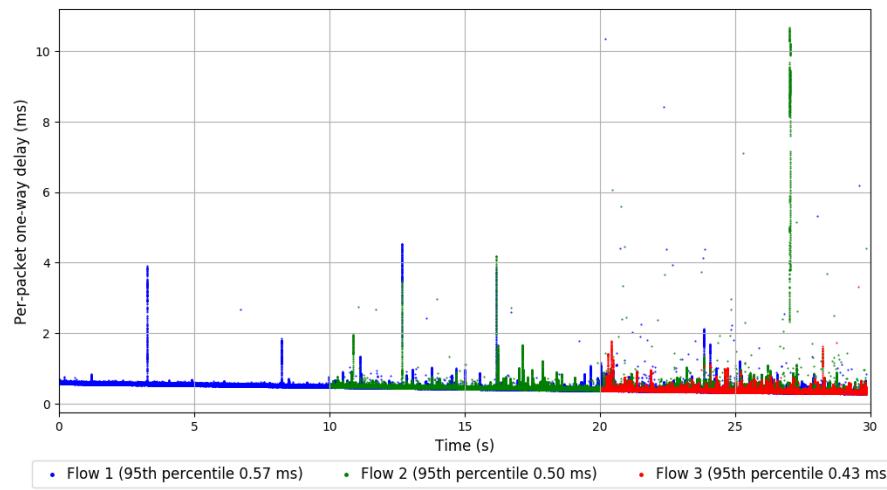
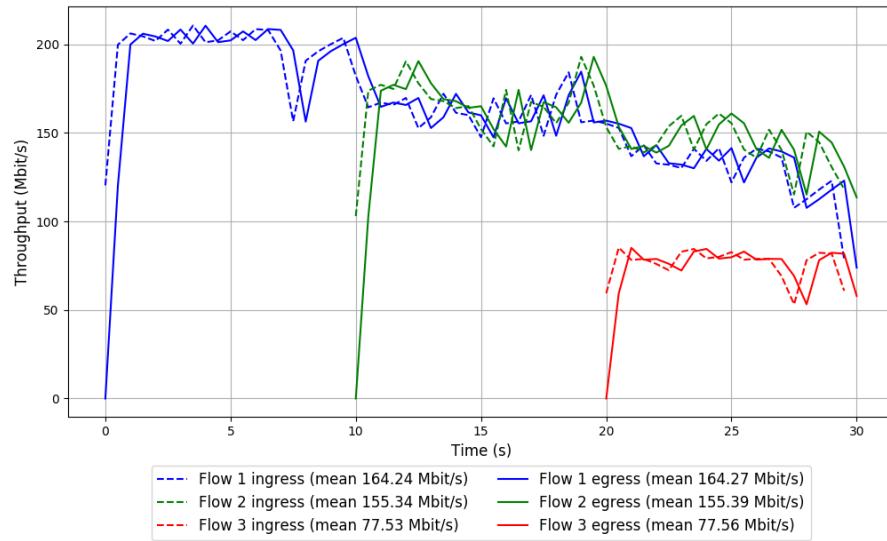


Run 2: Statistics of Indigo

```
Start at: 2018-08-28 10:18:02
End at: 2018-08-28 10:18:32
Local clock offset: -11.9 ms
Remote clock offset: -1.414 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 292.96 Mbit/s
95th percentile per-packet one-way delay: 0.568 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 164.27 Mbit/s
95th percentile per-packet one-way delay: 0.575 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 155.39 Mbit/s
95th percentile per-packet one-way delay: 0.501 ms
Loss rate: 0.08%
-- Flow 3:
Average throughput: 77.56 Mbit/s
95th percentile per-packet one-way delay: 0.435 ms
Loss rate: 0.20%
```

Run 2: Report of Indigo — Data Link

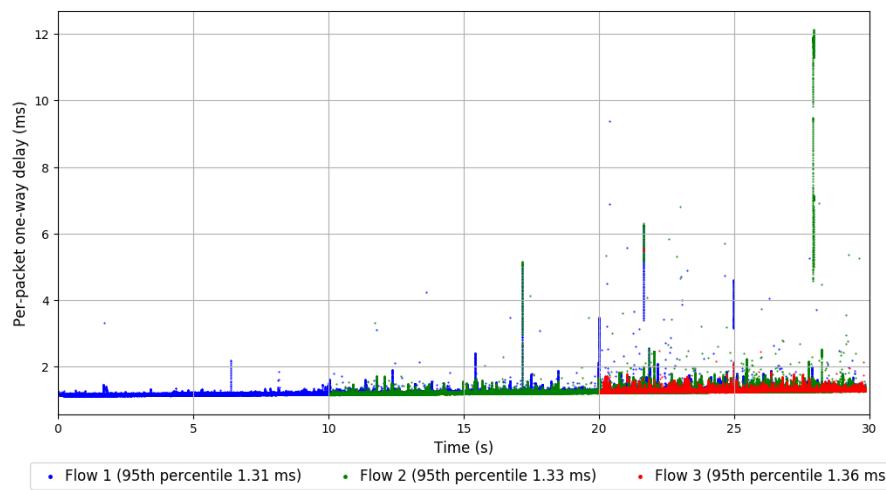
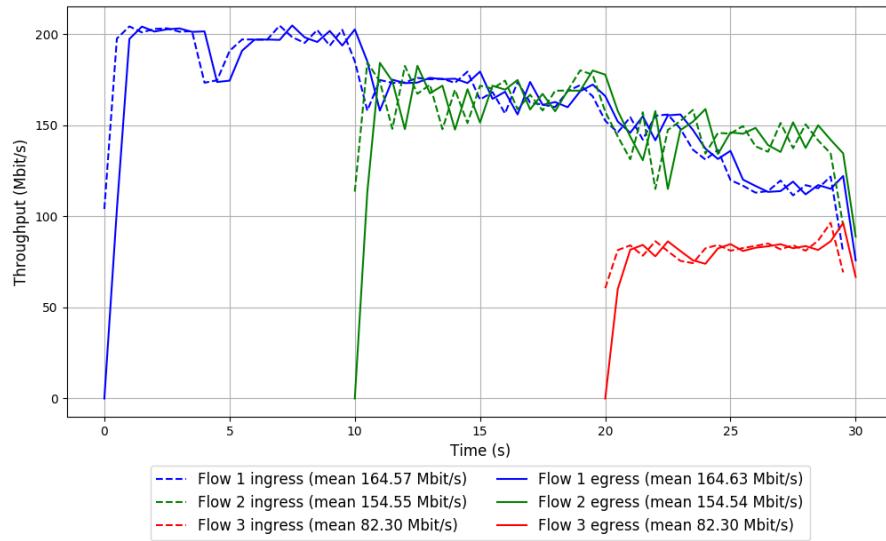


Run 3: Statistics of Indigo

```
Start at: 2018-08-28 10:24:53
End at: 2018-08-28 10:25:23
Local clock offset: -9.673 ms
Remote clock offset: 1.021 ms

# Below is generated by plot.py at 2018-08-28 10:37:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 294.34 Mbit/s
95th percentile per-packet one-way delay: 1.325 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 164.63 Mbit/s
95th percentile per-packet one-way delay: 1.314 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 154.54 Mbit/s
95th percentile per-packet one-way delay: 1.333 ms
Loss rate: 0.10%
-- Flow 3:
Average throughput: 82.30 Mbit/s
95th percentile per-packet one-way delay: 1.357 ms
Loss rate: 0.19%
```

Run 3: Report of Indigo — Data Link

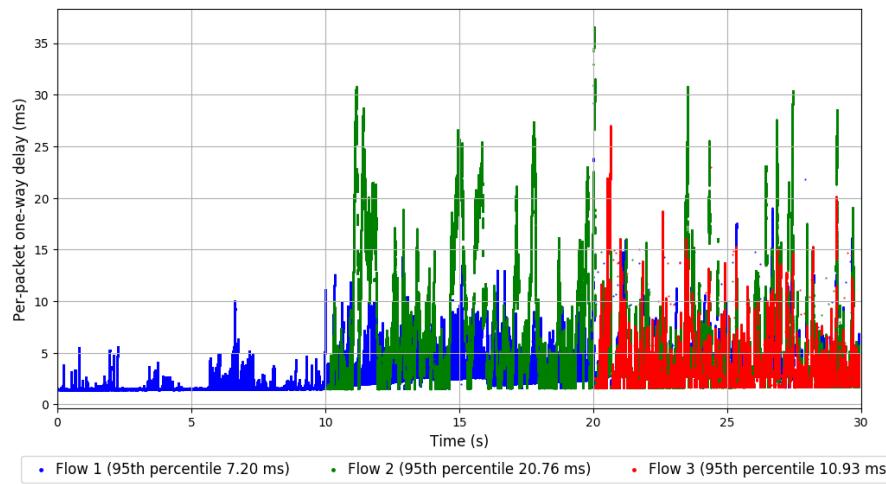
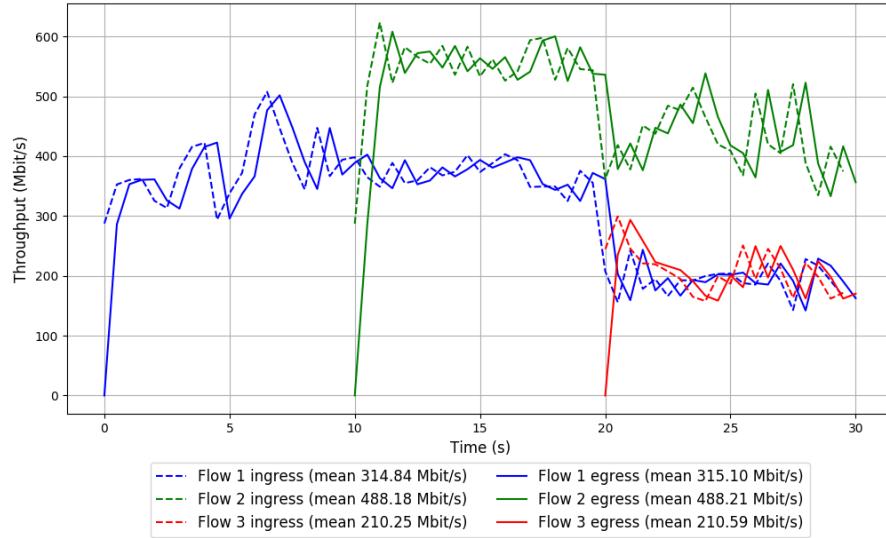


Run 1: Statistics of Muses-23

```
Start at: 2018-08-28 10:07:29
End at: 2018-08-28 10:07:59
Local clock offset: -26.08 ms
Remote clock offset: -1.186 ms

# Below is generated by plot.py at 2018-08-28 10:38:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 709.45 Mbit/s
95th percentile per-packet one-way delay: 16.050 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 315.10 Mbit/s
95th percentile per-packet one-way delay: 7.199 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 488.21 Mbit/s
95th percentile per-packet one-way delay: 20.757 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 210.59 Mbit/s
95th percentile per-packet one-way delay: 10.926 ms
Loss rate: 0.04%
```

Run 1: Report of Muses-23 — Data Link

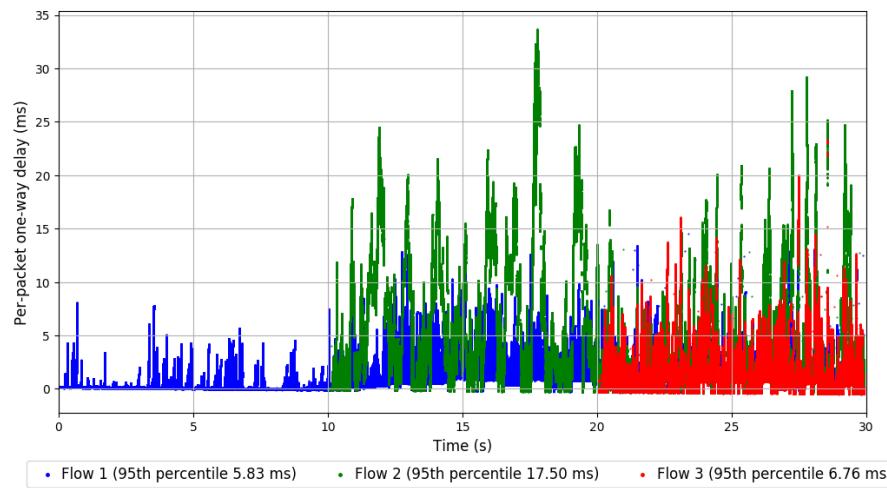
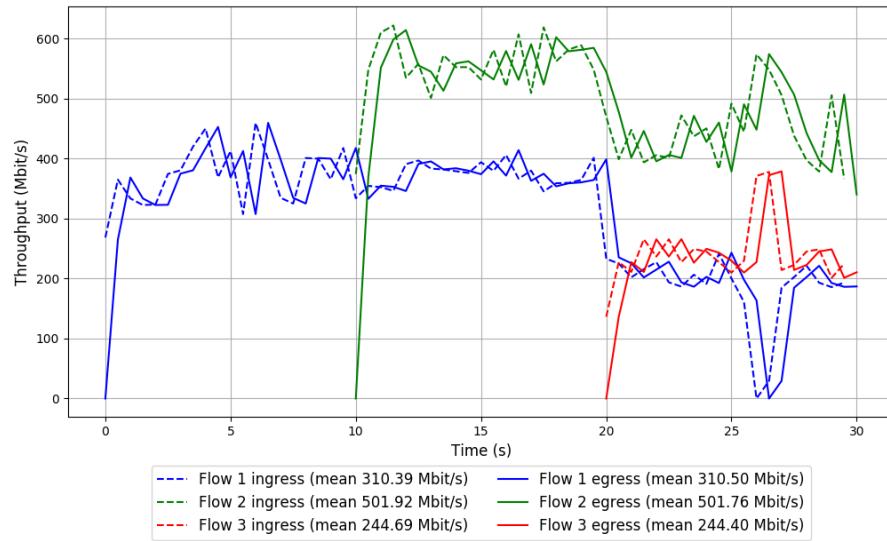


Run 2: Statistics of Muses-23

```
Start at: 2018-08-28 10:14:23
End at: 2018-08-28 10:14:53
Local clock offset: -15.47 ms
Remote clock offset: -1.319 ms

# Below is generated by plot.py at 2018-08-28 10:39:53
# Datalink statistics
-- Total of 3 flows:
Average throughput: 724.93 Mbit/s
95th percentile per-packet one-way delay: 14.220 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 310.50 Mbit/s
95th percentile per-packet one-way delay: 5.834 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 501.76 Mbit/s
95th percentile per-packet one-way delay: 17.503 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 244.40 Mbit/s
95th percentile per-packet one-way delay: 6.763 ms
Loss rate: 0.29%
```

Run 2: Report of Muses-23 — Data Link



Run 3: Statistics of Muses-23

```
Start at: 2018-08-28 10:21:19
End at: 2018-08-28 10:21:49
Local clock offset: -10.327 ms
Remote clock offset: -0.356 ms

# Below is generated by plot.py at 2018-08-28 10:39:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 624.56 Mbit/s
95th percentile per-packet one-way delay: 5.483 ms
Loss rate: 0.16%
-- Flow 1:
Average throughput: 332.96 Mbit/s
95th percentile per-packet one-way delay: 4.671 ms
Loss rate: 0.15%
-- Flow 2:
Average throughput: 319.35 Mbit/s
95th percentile per-packet one-way delay: 6.525 ms
Loss rate: 0.09%
-- Flow 3:
Average throughput: 239.95 Mbit/s
95th percentile per-packet one-way delay: 5.923 ms
Loss rate: 0.37%
```

Run 3: Report of Muses-23 — Data Link

