Pantheon Report

Generated at 2018-08-28 06:27:21 (UTC).

Data path: India on `em1` (*remote*) →AWS India 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.

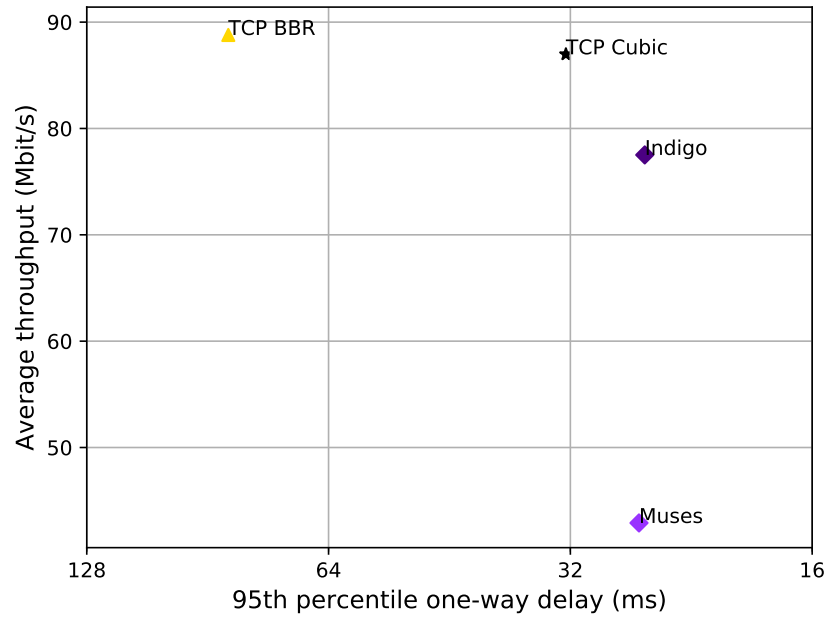NTP offsets were measured against `nets.org.sg` and have been applied to correct the timestamps in logs.

```
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 @ d0153f8e594aa89e93b032143cedbdfe58e562f4
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
```
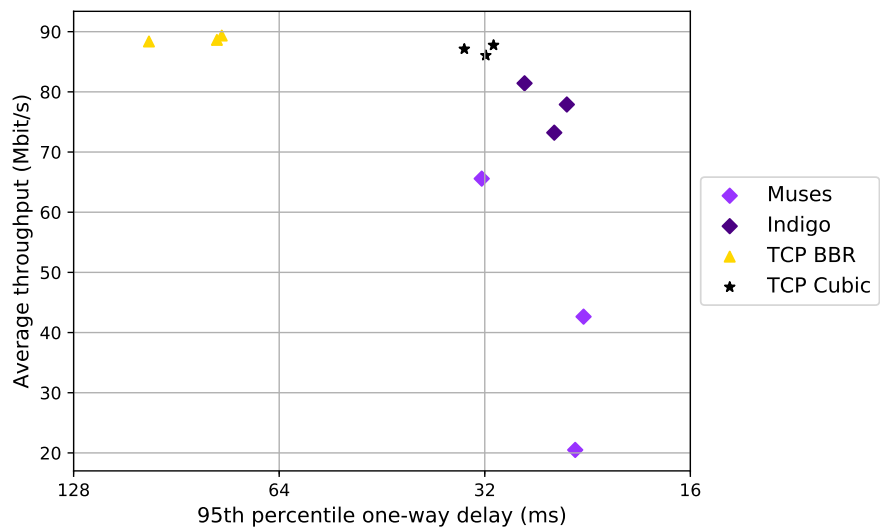
test from India to AWS India 1, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

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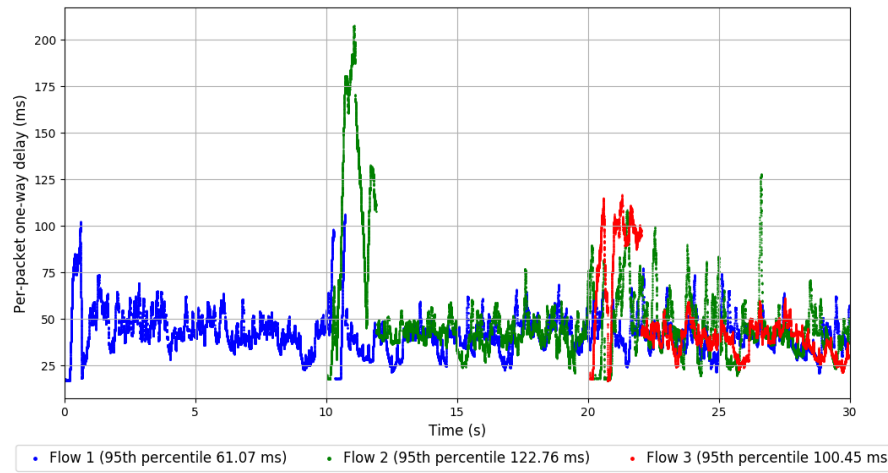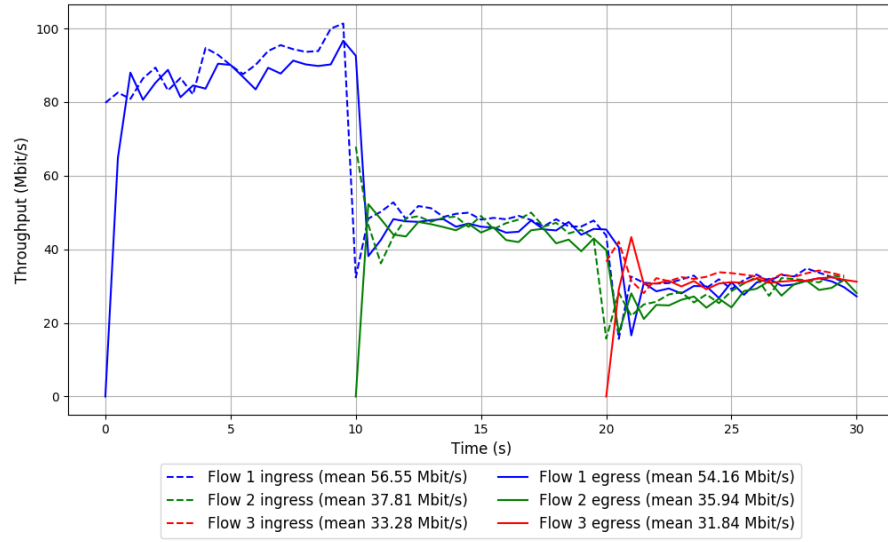3 flows with 10s interval between flows

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	55.50	36.00	28.11	59.35	114.64	189.04	4.40	4.62	5.16
TCP Cubic	3	52.18	38.52	27.56	32.93	30.77	33.92	0.07	0.15	0.35
Indigo	3	47.79	32.07	25.58	24.26	28.36	28.92	0.07	0.10	0.29
Muses	3	28.70	14.24	14.32	25.60	25.89	32.35	0.04	0.09	0.30

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-28 06:11:44
End at: 2018-08-28 06:12:14
Local clock offset: 0.332 ms
Remote clock offset: -3.873 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.64 Mbit/s
95th percentile per-packet one-way delay: 78.953 ms
Loss rate: 4.55%
-- Flow 1:
Average throughput: 54.16 Mbit/s
95th percentile per-packet one-way delay: 61.068 ms
Loss rate: 4.31%
-- Flow 2:
Average throughput: 35.94 Mbit/s
95th percentile per-packet one-way delay: 122.757 ms
Loss rate: 5.06%
-- Flow 3:
Average throughput: 31.84 Mbit/s
95th percentile per-packet one-way delay: 100.452 ms
Loss rate: 4.59%
```

Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 56.55 Mbit/s) --- Flow 1 egress (mean 54.16 Mbit/s) ---
Flow 2 ingress (mean 37.81 Mbit/s) --- Flow 2 egress (mean 35.94 Mbit/s) ---
Flow 3 ingress (mean 33.28 Mbit/s) --- Flow 3 egress (mean 31.84 Mbit/s) ---

Flow 1 (95th percentile 61.07 ms) • Flow 2 (95th percentile 122.76 ms) • Flow 3 (95th percentile 100.45 ms)

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```
Run 2: Statistics of TCP BBR

Start at: 2018-08-28 06:16:24
End at: 2018-08-28 06:16:54
Local clock offset: 0.216 ms
Remote clock offset: -3.7 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.36 Mbit/s
95th percentile per-packet one-way delay: 77.684 ms
Loss rate: 4.25%
-- Flow 1:
Average throughput: 54.23 Mbit/s
95th percentile per-packet one-way delay: 58.095 ms
Loss rate: 4.22%
-- Flow 2:
Average throughput: 38.31 Mbit/s
95th percentile per-packet one-way delay: 112.559 ms
Loss rate: 4.01%
-- Flow 3:
Average throughput: 28.96 Mbit/s
95th percentile per-packet one-way delay: 89.018 ms
Loss rate: 5.04%
```
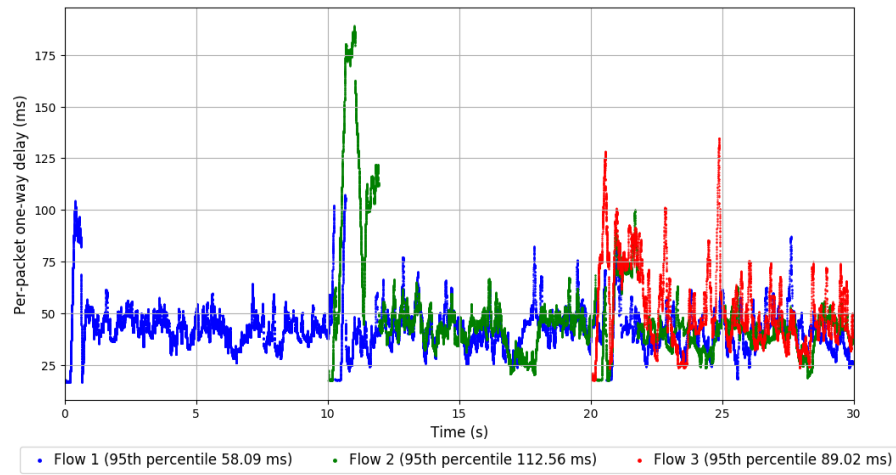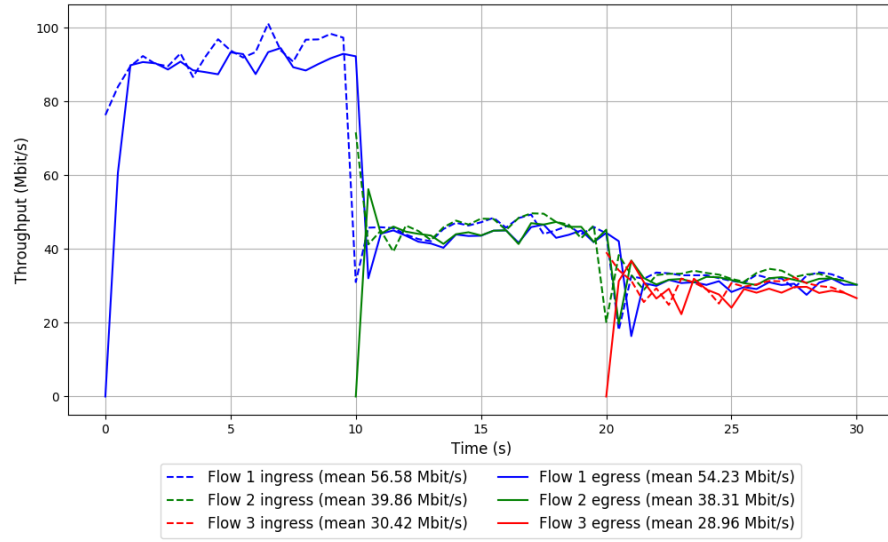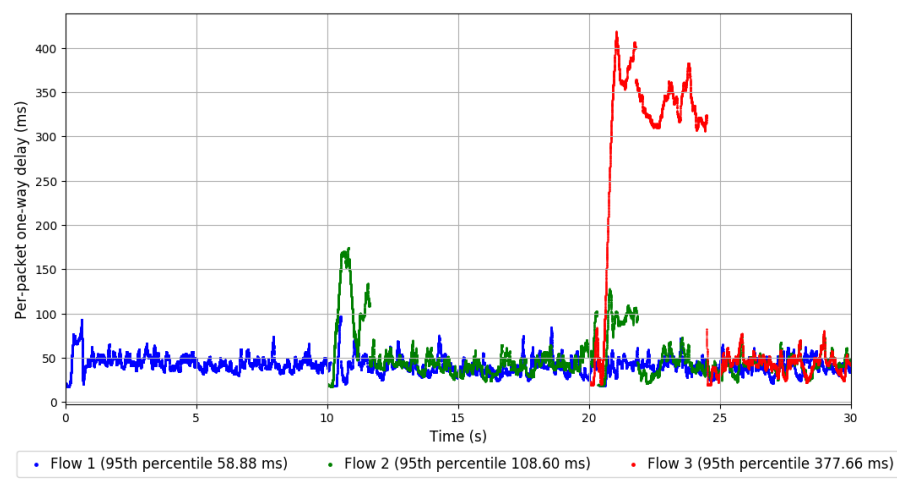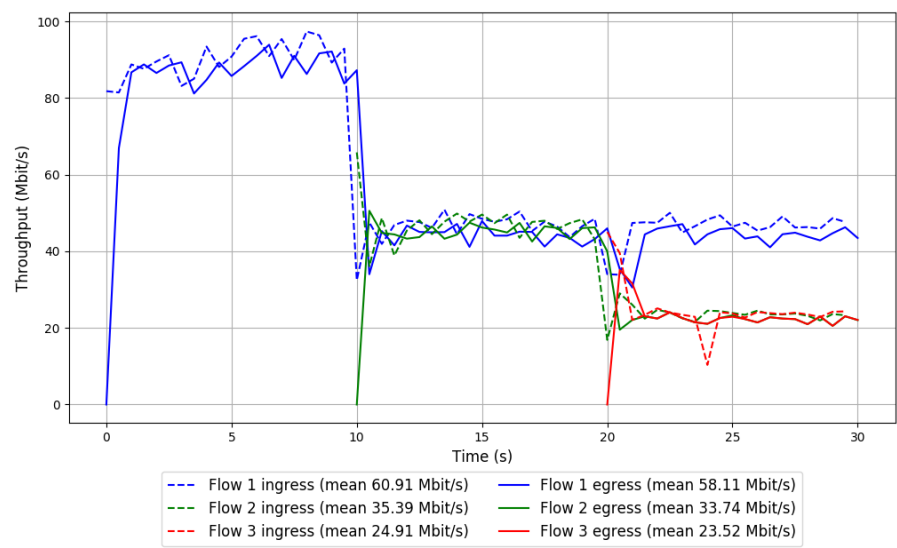
Run 2: Report of TCP BBR — Data Link

Flow 1 ingress (mean 56.58 Mbit/s)   Flow 1 egress (mean 54.23 Mbit/s)
Flow 2 ingress (mean 39.86 Mbit/s)   Flow 2 egress (mean 38.31 Mbit/s)
Flow 3 ingress (mean 30.42 Mbit/s)   Flow 3 egress (mean 28.96 Mbit/s)

Flow 1 (95th percentile 58.09 ms)   Flow 2 (95th percentile 112.56 ms)   Flow 3 (95th percentile 89.02 ms)

```
Run 3: Statistics of TCP BBR

Start at: 2018-08-28 06:21:20
End at: 2018-08-28 06:21:50
Local clock offset: 1.155 ms
Remote clock offset: -3.561 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.38 Mbit/s
95th percentile per-packet one-way delay: 99.288 ms
Loss rate: 4.81%
-- Flow 1:
Average throughput: 58.11 Mbit/s
95th percentile per-packet one-way delay: 58.884 ms
Loss rate: 4.68%
-- Flow 2:
Average throughput: 33.74 Mbit/s
95th percentile per-packet one-way delay: 108.598 ms
Loss rate: 4.79%
-- Flow 3:
Average throughput: 23.52 Mbit/s
95th percentile per-packet one-way delay: 377.656 ms
Loss rate: 5.85%
```
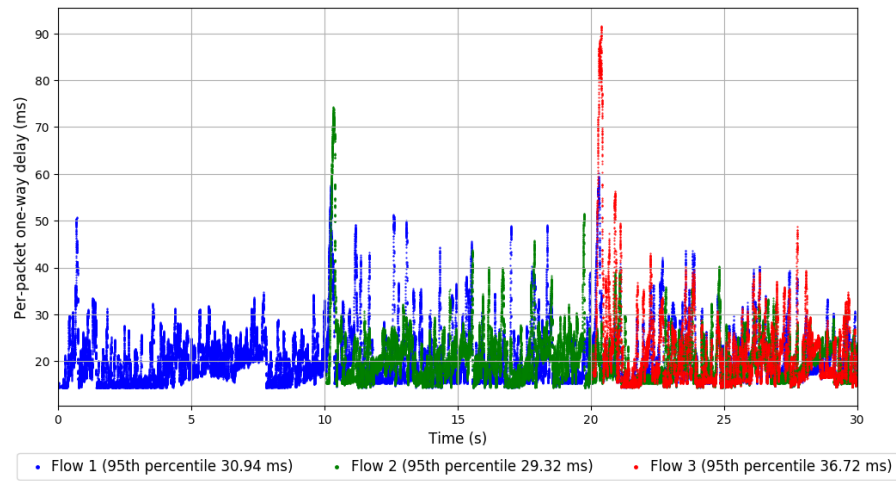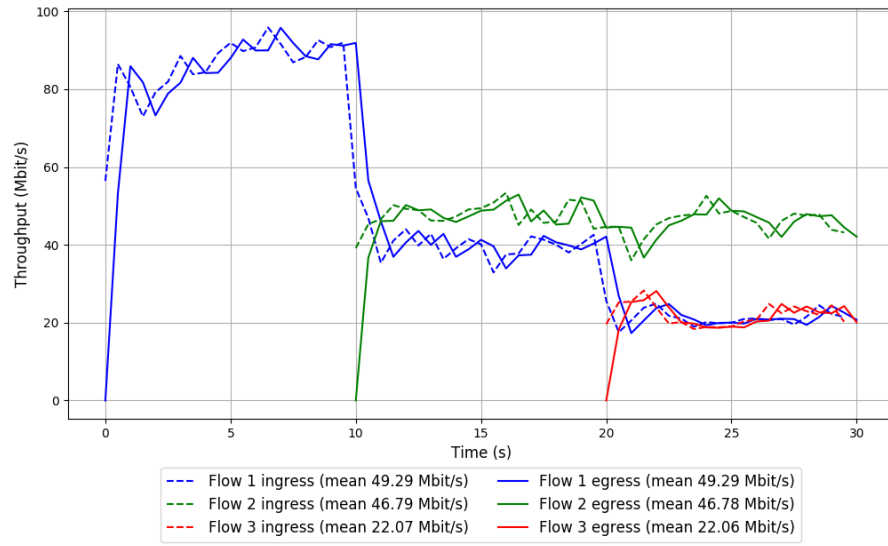
Run 3: Report of TCP BBR — Data Link

- - - Flow 1 ingress (mean 60.91 Mbit/s) —— Flow 1 egress (mean 58.11 Mbit/s)
- - - Flow 2 ingress (mean 35.39 Mbit/s) —— Flow 2 egress (mean 33.74 Mbit/s)
- - - Flow 3 ingress (mean 24.91 Mbit/s) —— Flow 3 egress (mean 23.52 Mbit/s)

• Flow 1 (95th percentile 58.88 ms)   • Flow 2 (95th percentile 108.60 ms)   • Flow 3 (95th percentile 377.66 ms)

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```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 06:15:13
End at: 2018-08-28 06:15:43
Local clock offset: -2.953 ms
Remote clock offset: -4.56 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.76 Mbit/s
95th percentile per-packet one-way delay: 31.067 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 49.29 Mbit/s
95th percentile per-packet one-way delay: 30.936 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 46.78 Mbit/s
95th percentile per-packet one-way delay: 29.316 ms
Loss rate: 0.16%
-- Flow 3:
Average throughput: 22.06 Mbit/s
95th percentile per-packet one-way delay: 36.716 ms
Loss rate: 0.33%
```
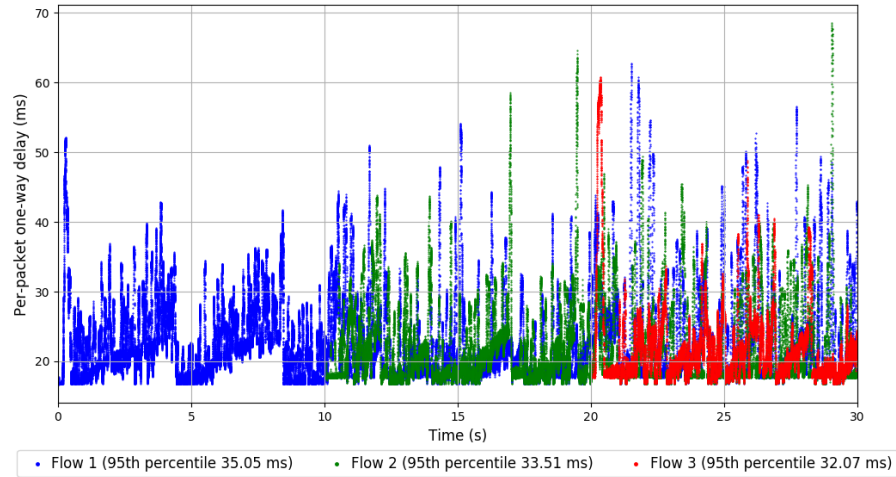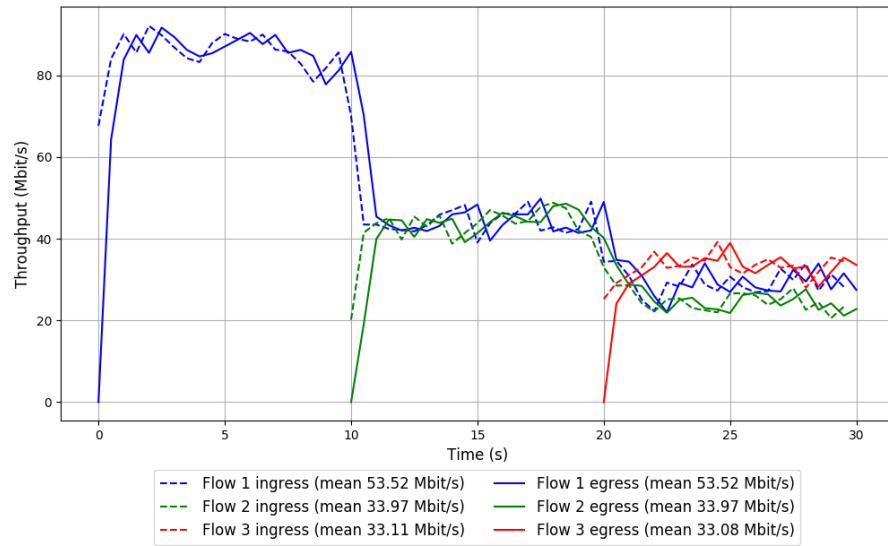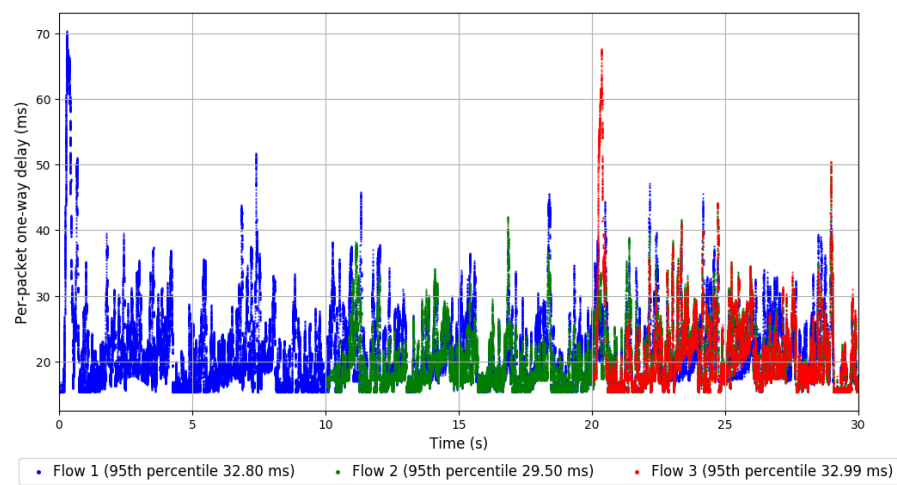
Run 1: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 49.29 Mbit/s) ---- Flow 1 egress (mean 49.29 Mbit/s)
Flow 2 ingress (mean 46.79 Mbit/s) ---- Flow 2 egress (mean 46.78 Mbit/s)
Flow 3 ingress (mean 22.07 Mbit/s) ---- Flow 3 egress (mean 22.06 Mbit/s)

Flow 1 (95th percentile 30.94 ms)   Flow 2 (95th percentile 29.32 ms)   Flow 3 (95th percentile 36.72 ms)

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```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 06:20:01
End at: 2018-08-28 06:20:31
Local clock offset: -5.58 ms
Remote clock offset: -9.452 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.12 Mbit/s
95th percentile per-packet one-way delay: 34.283 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 53.52 Mbit/s
95th percentile per-packet one-way delay: 35.049 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 33.97 Mbit/s
95th percentile per-packet one-way delay: 33.505 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 33.08 Mbit/s
95th percentile per-packet one-way delay: 32.070 ms
Loss rate: 0.36%
```

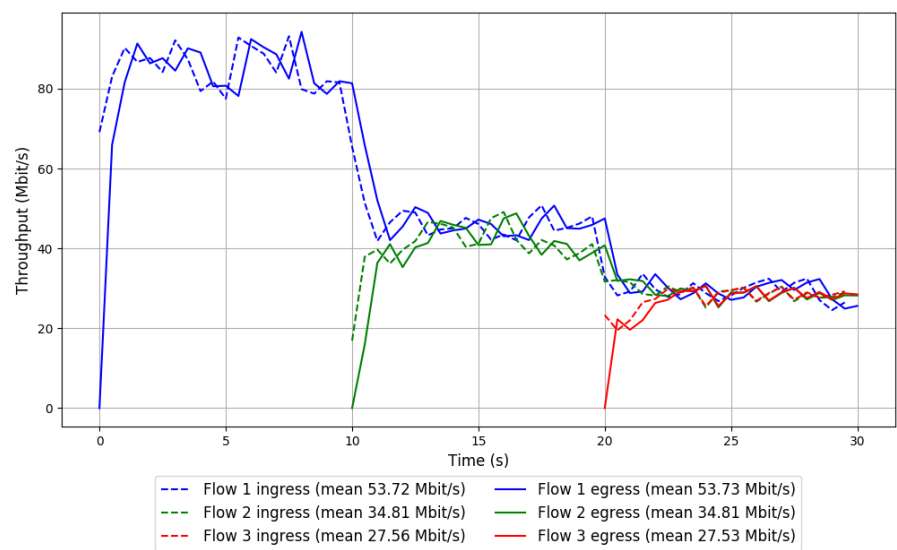Run 2: Report of TCP Cubic — Data Link

```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-28 06:25:02
End at: 2018-08-28 06:25:32
Local clock offset: -2.246 ms
Remote clock offset: -4.733 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 86.05 Mbit/s
95th percentile per-packet one-way delay: 31.886 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 53.73 Mbit/s
95th percentile per-packet one-way delay: 32.796 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 34.81 Mbit/s
95th percentile per-packet one-way delay: 29.499 ms
Loss rate: 0.15%
-- Flow 3:
Average throughput: 27.53 Mbit/s
95th percentile per-packet one-way delay: 32.988 ms
Loss rate: 0.36%
```

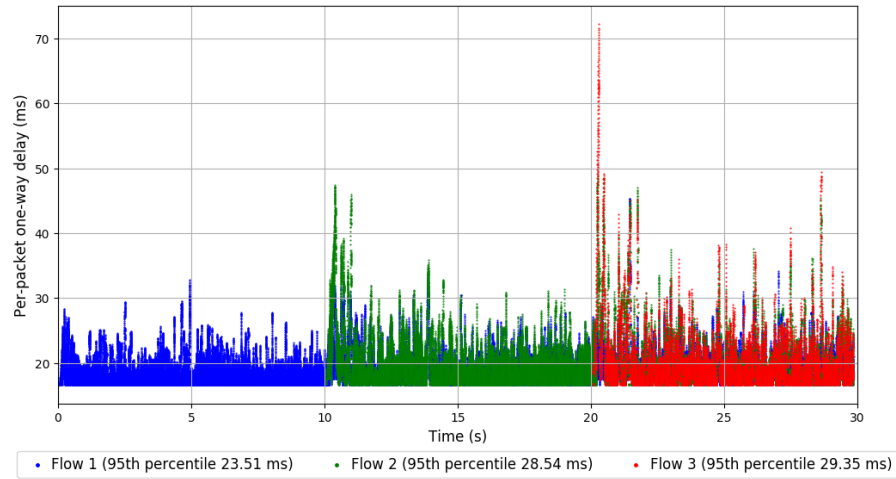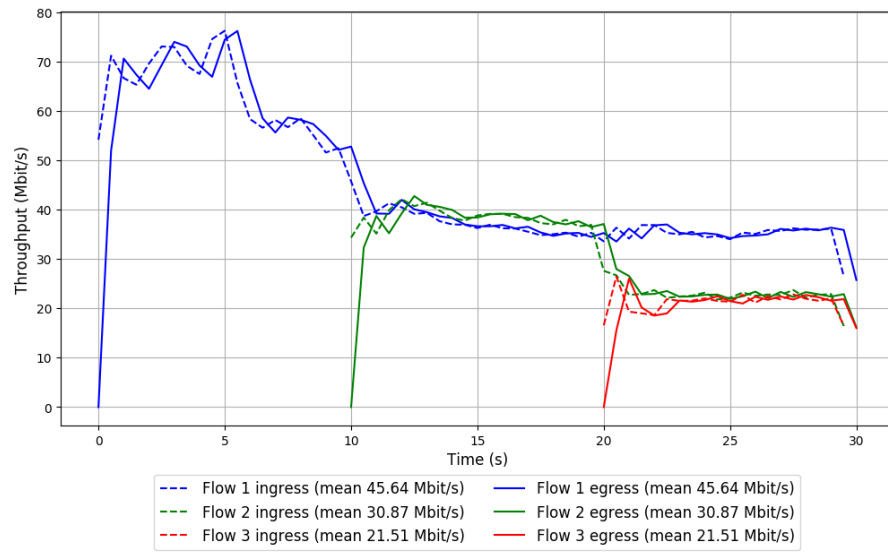Run 3: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-08-28 06:14:00
End at: 2018-08-28 06:14:30
Local clock offset: -0.818 ms
Remote clock offset: -4.622 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 73.22 Mbit/s
95th percentile per-packet one-way delay: 25.315 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 45.64 Mbit/s
95th percentile per-packet one-way delay: 23.510 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 30.87 Mbit/s
95th percentile per-packet one-way delay: 28.540 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 21.51 Mbit/s
95th percentile per-packet one-way delay: 29.351 ms
Loss rate: 0.31%
```
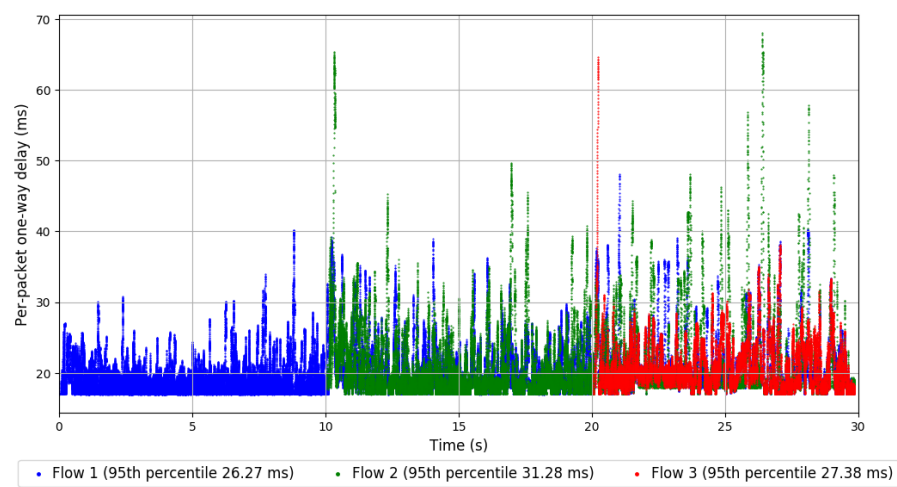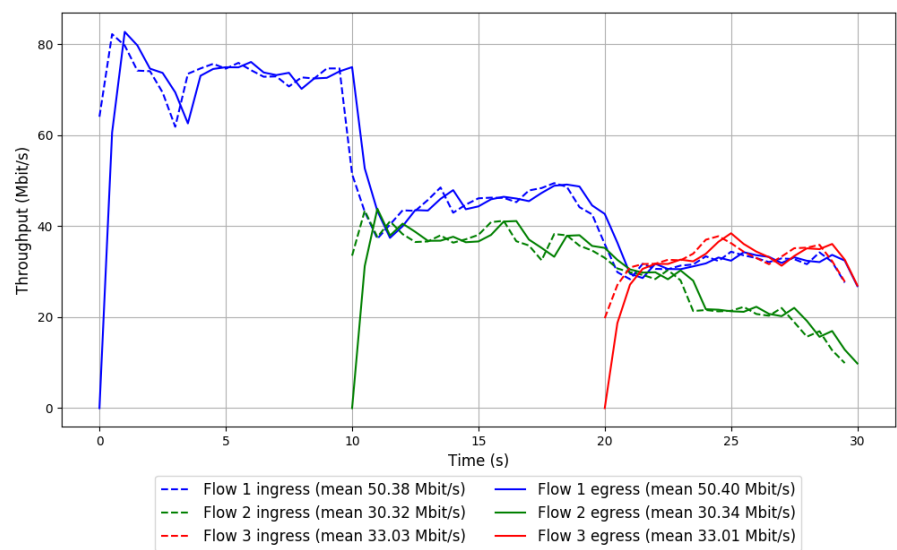
Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2018-08-28 06:18:49
End at: 2018-08-28 06:19:19
Local clock offset: -0.024 ms
Remote clock offset: -4.133 ms


# Below is generated by plot.py at 2018-08-28 06:27:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 81.42 Mbit/s
95th percentile per-packet one-way delay: 27.983 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 50.40 Mbit/s
95th percentile per-packet one-way delay: 26.268 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 30.34 Mbit/s
95th percentile per-packet one-way delay: 31.276 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 33.01 Mbit/s
95th percentile per-packet one-way delay: 27.378 ms
Loss rate: 0.33%
```

Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-08-28 06:23:43
End at: 2018-08-28 06:24:13
Local clock offset: -2.837 ms
Remote clock offset: -4.124 ms


# Below is generated by plot.py at 2018-08-28 06:27:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 77.90 Mbit/s
95th percentile per-packet one-way delay: 24.265 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 47.34 Mbit/s
95th percentile per-packet one-way delay: 23.014 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 35.01 Mbit/s
95th percentile per-packet one-way delay: 25.277 ms
Loss rate: 0.14%
-- Flow 3:
Average throughput: 22.21 Mbit/s
95th percentile per-packet one-way delay: 30.039 ms
Loss rate: 0.24%
```
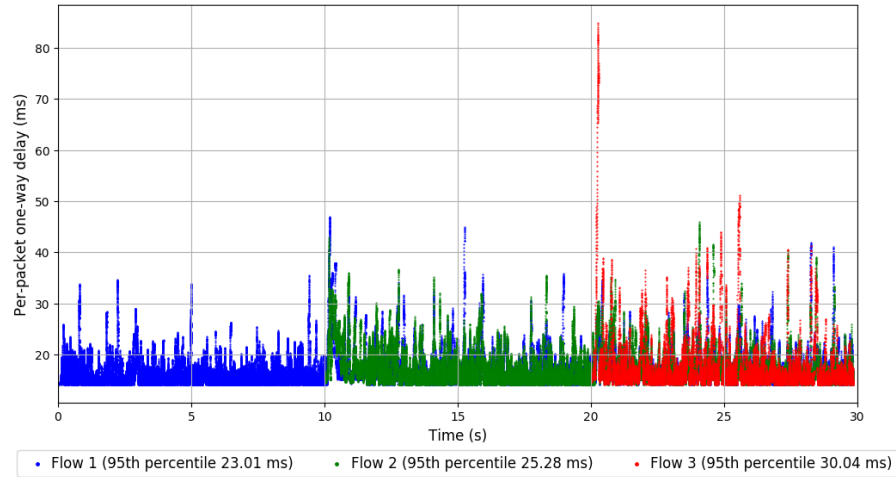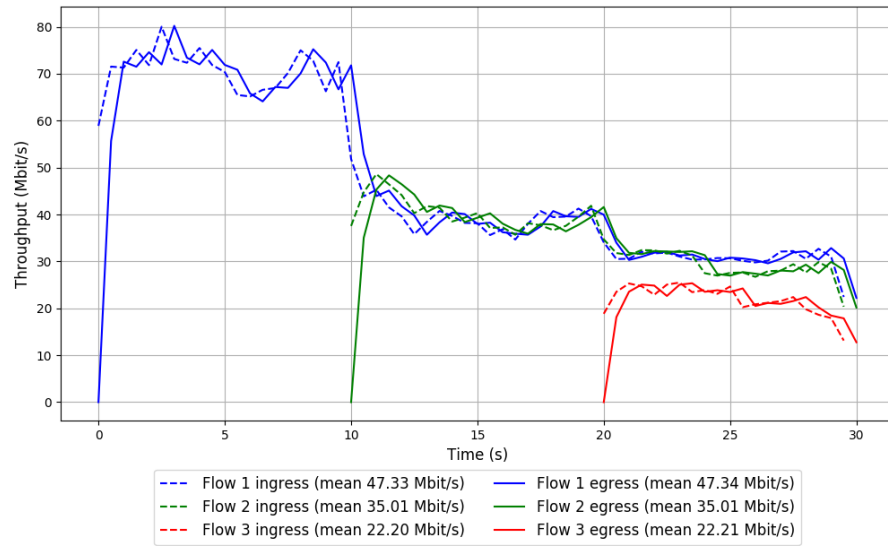
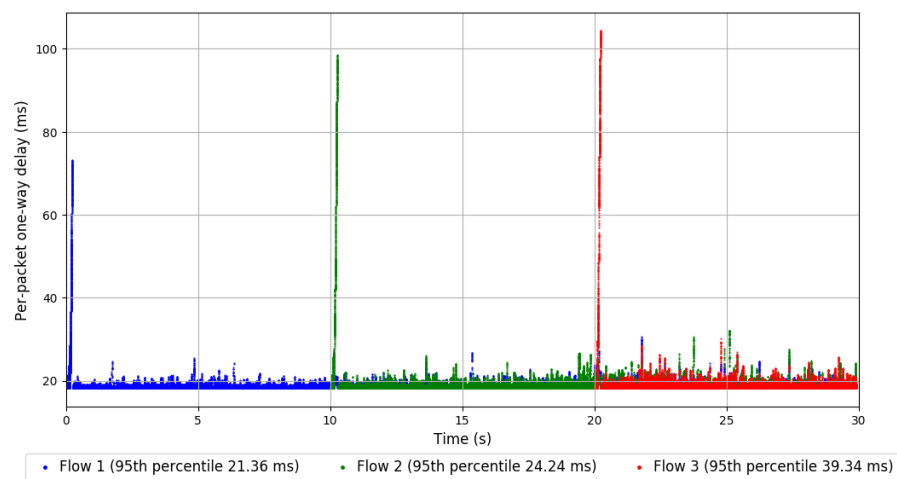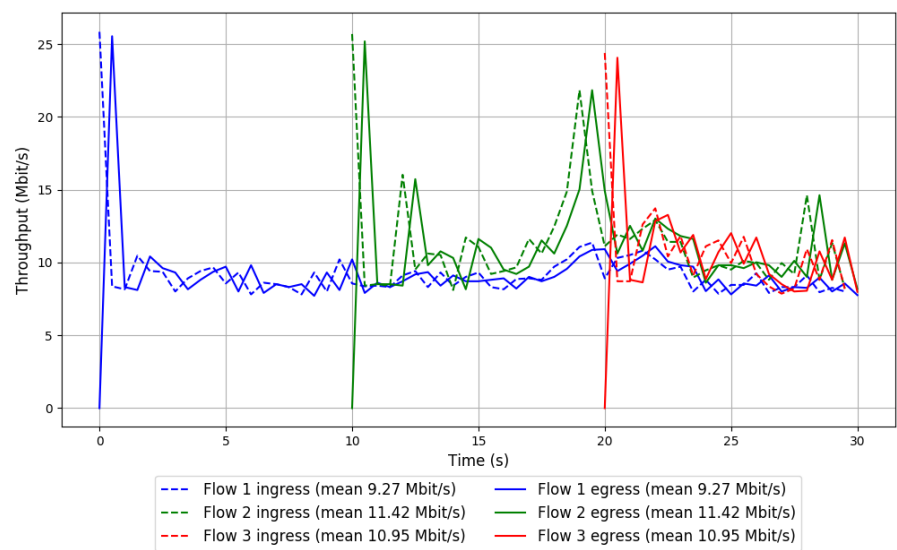Run 3: Report of Indigo — Data Link

```
Run 1: Statistics of Muses

Start at: 2018-08-28 06:12:54
End at: 2018-08-28 06:13:24
Local clock offset: 1.13 ms
Remote clock offset: -4.339 ms


# Below is generated by plot.py at 2018-08-28 06:27:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 20.49 Mbit/s
95th percentile per-packet one-way delay: 23.590 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 9.27 Mbit/s
95th percentile per-packet one-way delay: 21.358 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 11.42 Mbit/s
95th percentile per-packet one-way delay: 24.244 ms
Loss rate: 0.08%
-- Flow 3:
Average throughput: 10.95 Mbit/s
95th percentile per-packet one-way delay: 39.335 ms
Loss rate: 0.21%
```
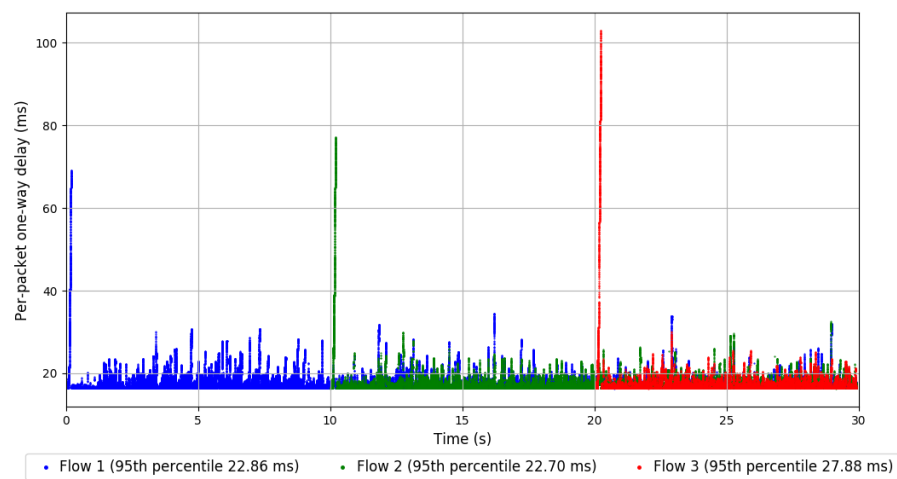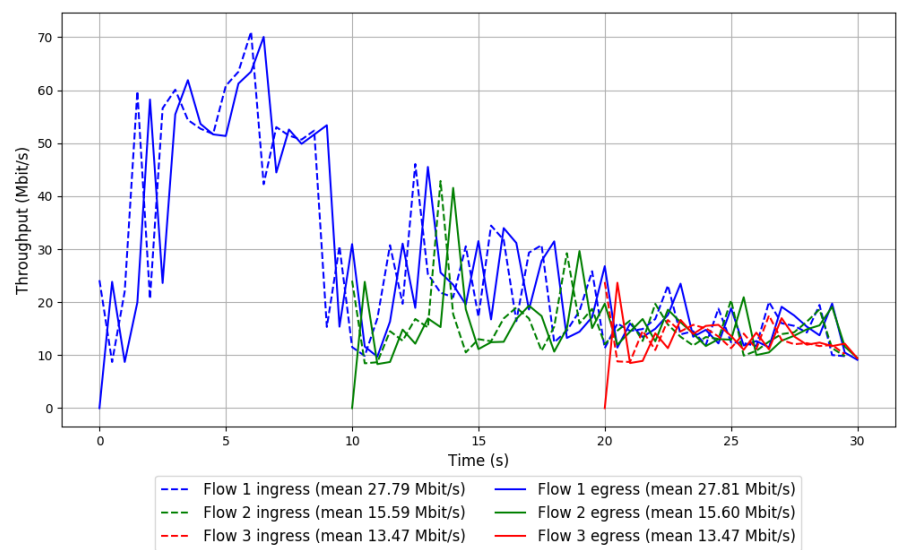
Run 1: Report of Muses — Data Link

```
Run 2: Statistics of Muses

Start at: 2018-08-28 06:17:39
End at: 2018-08-28 06:18:09
Local clock offset: -0.362 ms
Remote clock offset: -3.815 ms


# Below is generated by plot.py at 2018-08-28 06:27:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 42.64 Mbit/s
95th percentile per-packet one-way delay: 22.935 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 27.81 Mbit/s
95th percentile per-packet one-way delay: 22.864 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 15.60 Mbit/s
95th percentile per-packet one-way delay: 22.699 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 13.47 Mbit/s
95th percentile per-packet one-way delay: 27.882 ms
Loss rate: 0.30%
```

Run 2: Report of Muses — Data Link

```
Run 3: Statistics of Muses

Start at: 2018-08-28 06:22:33
End at: 2018-08-28 06:23:03
Local clock offset: 1.055 ms
Remote clock offset: -4.421 ms


# Below is generated by plot.py at 2018-08-28 06:27:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 65.58 Mbit/s
95th percentile per-packet one-way delay: 32.330 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 49.01 Mbit/s
95th percentile per-packet one-way delay: 32.572 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 15.70 Mbit/s
95th percentile per-packet one-way delay: 30.726 ms
Loss rate: 0.12%
-- Flow 3:
Average throughput: 18.53 Mbit/s
95th percentile per-packet one-way delay: 29.831 ms
Loss rate: 0.38%
```

Run 3: Report of Muses — Data Link