Pantheon Report

Generated at 2018-08-28 06:28:07 (UTC).

Data path: Colombia on `p4p1` (*remote*) →AWS Brazil 2 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.

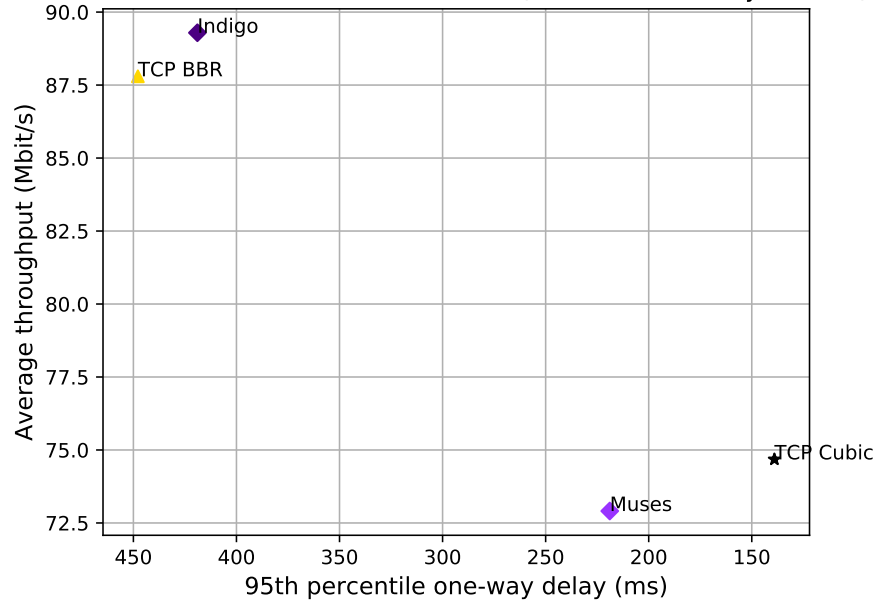NTP offsets were measured against `gps.ntp.br` and have been applied to correct the timestamps in logs.

```
System info:
Linux 4.15.0-1019-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
```
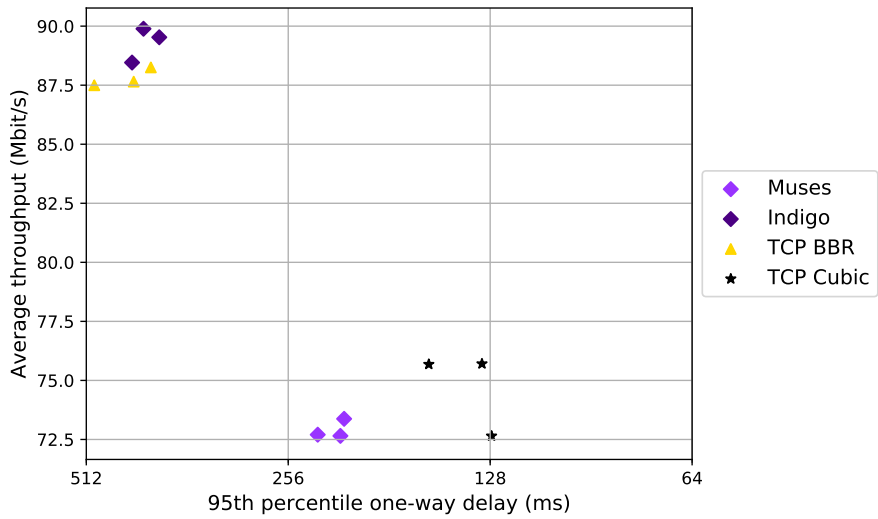
test from Colombia to AWS Brazil 2, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

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

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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	53.57	36.78	29.82	419.87	465.25	538.78	3.33	5.17	8.21
TCP Cubic	3	43.57	30.73	32.54	144.61	129.72	135.09	0.35	0.70	1.64
Indigo	3	56.05	36.74	27.96	451.82	136.47	136.84	4.79	1.28	2.62
Muses	3	48.41	28.73	16.56	207.39	227.78	241.97	1.07	2.17	5.91

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-28 06:14:16
End at: 2018-08-28 06:14:46
Local clock offset: 3.31 ms
Remote clock offset: 4.841 ms


# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.25 Mbit/s
95th percentile per-packet one-way delay: 410.233 ms
Loss rate: 4.64%
-- Flow 1:
Average throughput: 54.13 Mbit/s
95th percentile per-packet one-way delay: 394.480 ms
Loss rate: 3.70%
-- Flow 2:
Average throughput: 37.01 Mbit/s
95th percentile per-packet one-way delay: 383.564 ms
Loss rate: 5.30%
-- Flow 3:
Average throughput: 29.06 Mbit/s
95th percentile per-packet one-way delay: 629.745 ms
Loss rate: 8.07%
```
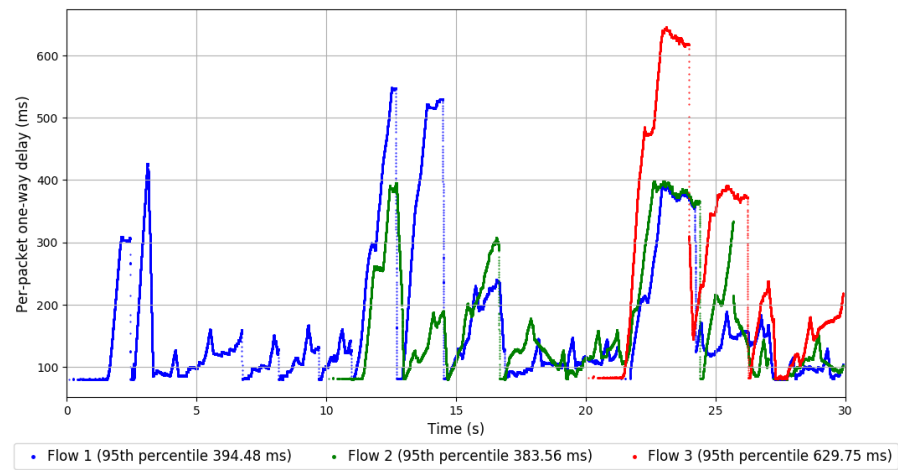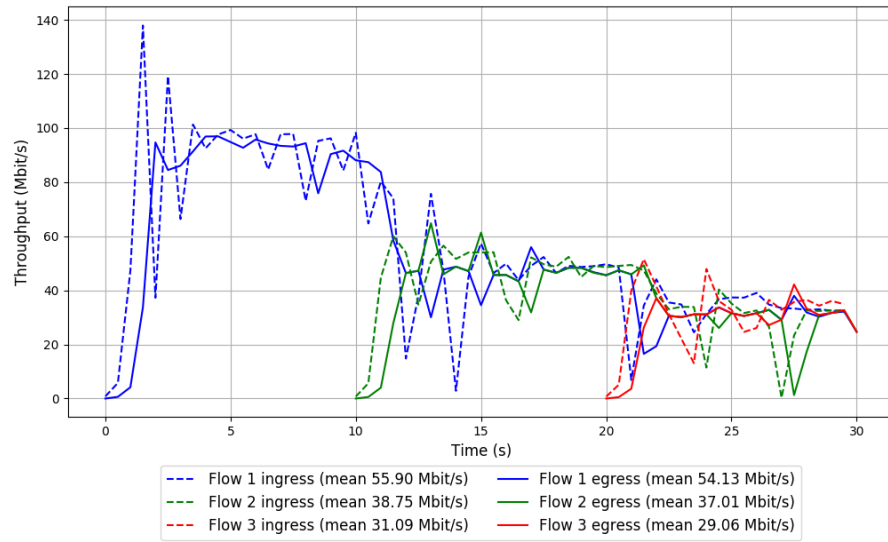
Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 55.90 Mbit/s) — — — Flow 1 egress (mean 54.13 Mbit/s)
Flow 2 ingress (mean 38.75 Mbit/s) — — — Flow 2 egress (mean 37.01 Mbit/s)
Flow 3 ingress (mean 31.09 Mbit/s) — — — Flow 3 egress (mean 29.06 Mbit/s)

Flow 1 (95th percentile 394.48 ms) • Flow 2 (95th percentile 383.56 ms) • Flow 3 (95th percentile 629.75 ms)

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```
Run 2: Statistics of TCP BBR

Start at: 2018-08-28 06:19:18
End at: 2018-08-28 06:19:48
Local clock offset: 2.403 ms
Remote clock offset: 7.038 ms


# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.65 Mbit/s
95th percentile per-packet one-way delay: 435.114 ms
Loss rate: 3.80%
-- Flow 1:
Average throughput: 53.76 Mbit/s
95th percentile per-packet one-way delay: 400.598 ms
Loss rate: 2.84%
-- Flow 2:
Average throughput: 36.02 Mbit/s
95th percentile per-packet one-way delay: 450.085 ms
Loss rate: 4.78%
-- Flow 3:
Average throughput: 30.35 Mbit/s
95th percentile per-packet one-way delay: 423.177 ms
Loss rate: 6.45%
```
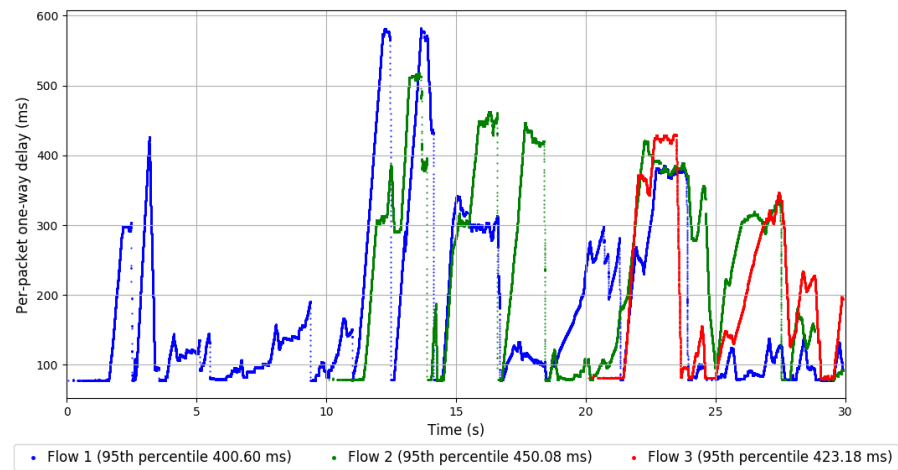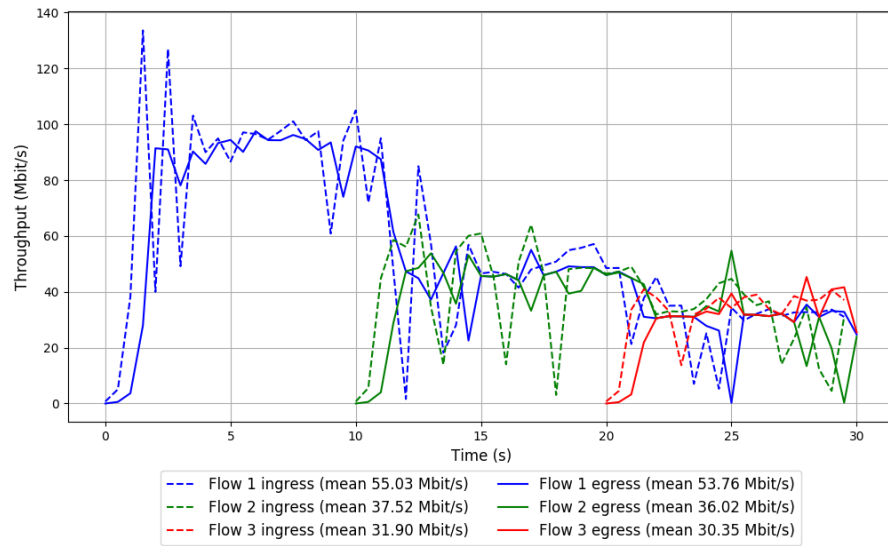
Run 2: Report of TCP BBR — Data Link

- Flow 1 ingress (mean 55.03 Mbit/s)
- Flow 1 egress (mean 53.76 Mbit/s)
- Flow 2 ingress (mean 37.52 Mbit/s)
- Flow 2 egress (mean 36.02 Mbit/s)
- Flow 3 ingress (mean 31.90 Mbit/s)
- Flow 3 egress (mean 30.35 Mbit/s)

- Flow 1 (95th percentile 400.60 ms)
- Flow 2 (95th percentile 450.08 ms)
- Flow 3 (95th percentile 423.18 ms)

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```
Run 3: Statistics of TCP BBR

Start at: 2018-08-28 06:24:21
End at: 2018-08-28 06:24:51
Local clock offset: 1.517 ms
Remote clock offset: 2.078 ms


# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.50 Mbit/s
95th percentile per-packet one-way delay: 498.139 ms
Loss rate: 4.81%
-- Flow 1:
Average throughput: 52.82 Mbit/s
95th percentile per-packet one-way delay: 464.530 ms
Loss rate: 3.44%
-- Flow 2:
Average throughput: 37.31 Mbit/s
95th percentile per-packet one-way delay: 562.115 ms
Loss rate: 5.43%
-- Flow 3:
Average throughput: 30.05 Mbit/s
95th percentile per-packet one-way delay: 563.420 ms
Loss rate: 10.12%
```
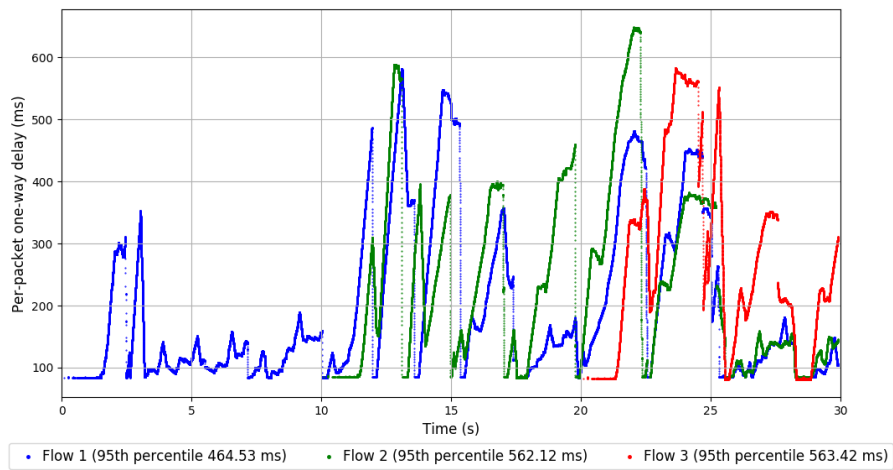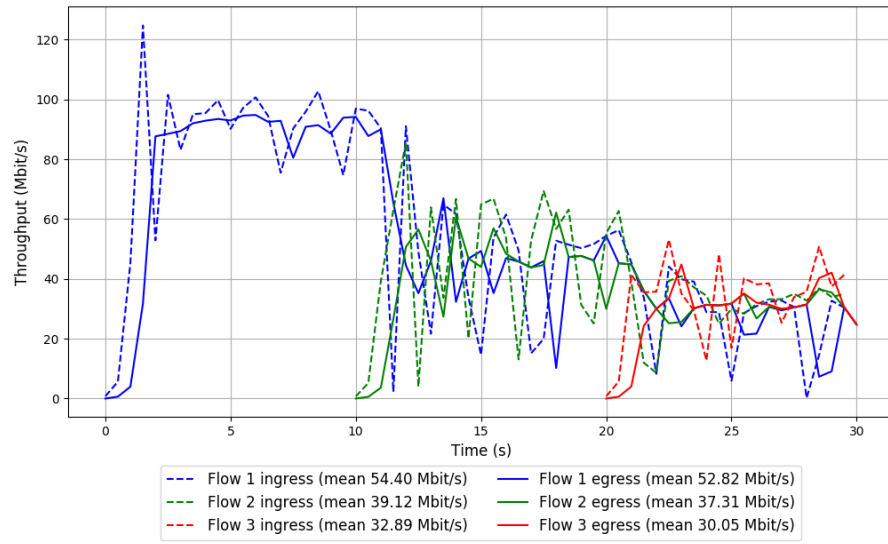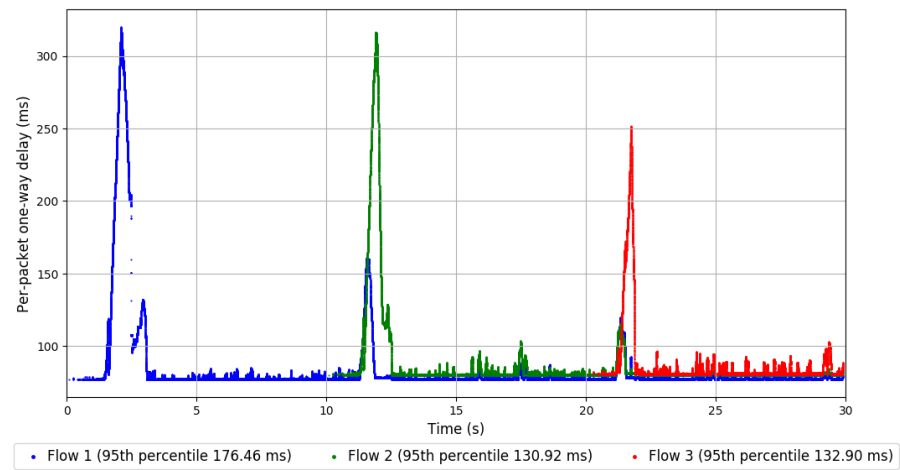
Run 3: Report of TCP BBR — Data Link

Flow 1 ingress (mean 54.40 Mbit/s) ---- Flow 1 egress (mean 52.82 Mbit/s)
Flow 2 ingress (mean 39.12 Mbit/s) ---- Flow 2 egress (mean 37.31 Mbit/s)
Flow 3 ingress (mean 32.89 Mbit/s) ---- Flow 3 egress (mean 30.05 Mbit/s)

Flow 1 (95th percentile 464.53 ms)   Flow 2 (95th percentile 562.12 ms)   Flow 3 (95th percentile 563.42 ms)

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 06:15:33
End at: 2018-08-28 06:16:03
Local clock offset: 1.661 ms
Remote clock offset: 4.862 ms


# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 75.68 Mbit/s
95th percentile per-packet one-way delay: 158.017 ms
Loss rate: 0.64%
-- Flow 1:
Average throughput: 42.95 Mbit/s
95th percentile per-packet one-way delay: 176.459 ms
Loss rate: 0.38%
-- Flow 2:
Average throughput: 31.77 Mbit/s
95th percentile per-packet one-way delay: 130.923 ms
Loss rate: 0.70%
-- Flow 3:
Average throughput: 35.42 Mbit/s
95th percentile per-packet one-way delay: 132.895 ms
Loss rate: 1.49%
```
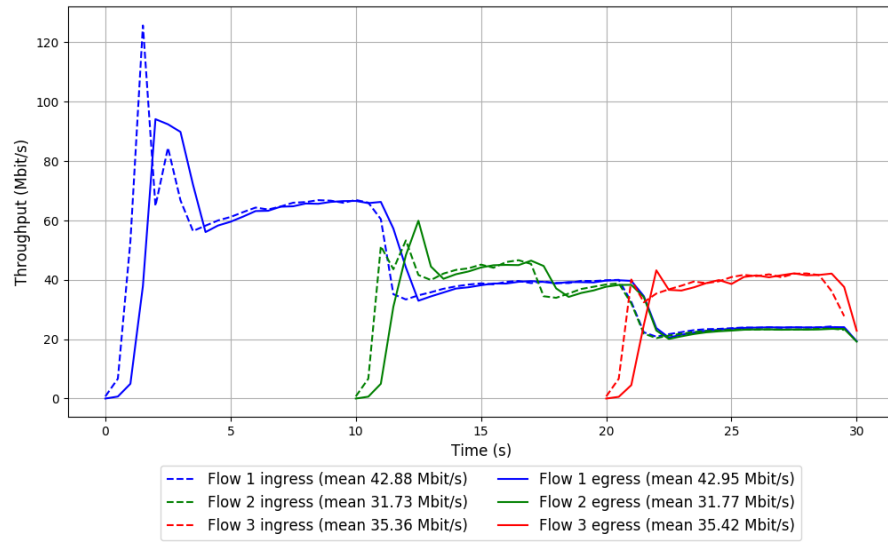
Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 06:20:35
End at: 2018-08-28 06:21:05
Local clock offset: 2.392 ms
Remote clock offset: 6.01 ms


# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 75.70 Mbit/s
95th percentile per-packet one-way delay: 131.654 ms
Loss rate: 0.59%
-- Flow 1:
Average throughput: 44.83 Mbit/s
95th percentile per-packet one-way delay: 129.974 ms
Loss rate: 0.32%
-- Flow 2:
Average throughput: 31.93 Mbit/s
95th percentile per-packet one-way delay: 132.144 ms
Loss rate: 0.69%
-- Flow 3:
Average throughput: 29.35 Mbit/s
95th percentile per-packet one-way delay: 138.896 ms
Loss rate: 1.59%
```
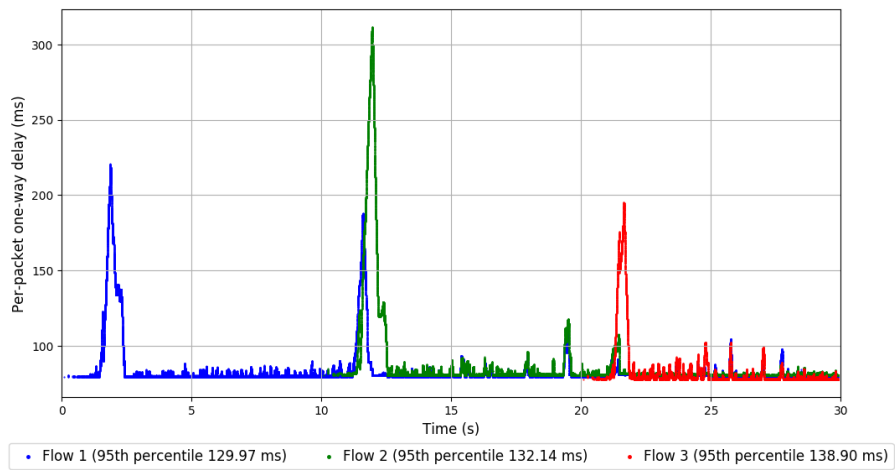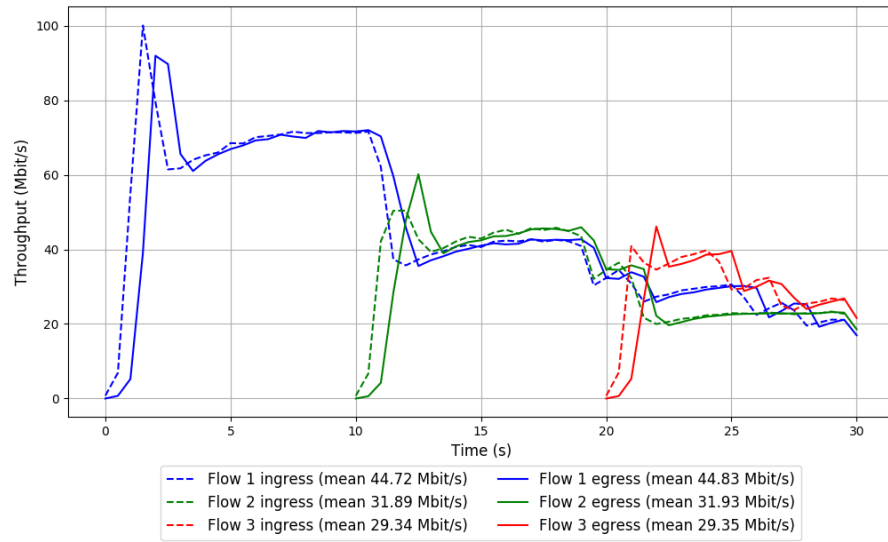
Run 2: Report of TCP Cubic — Data Link

```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-28 06:25:37
End at: 2018-08-28 06:26:07
Local clock offset: 3.093 ms
Remote clock offset: 0.968 ms


# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 72.65 Mbit/s
95th percentile per-packet one-way delay: 127.400 ms
Loss rate: 0.67%
-- Flow 1:
Average throughput: 42.92 Mbit/s
95th percentile per-packet one-way delay: 127.384 ms
Loss rate: 0.35%
-- Flow 2:
Average throughput: 28.50 Mbit/s
95th percentile per-packet one-way delay: 126.099 ms
Loss rate: 0.72%
-- Flow 3:
Average throughput: 32.86 Mbit/s
95th percentile per-packet one-way delay: 133.474 ms
Loss rate: 1.83%
```
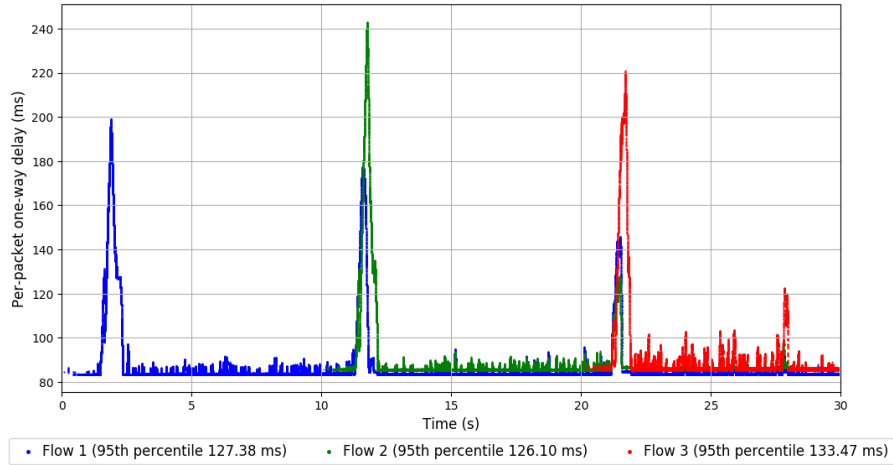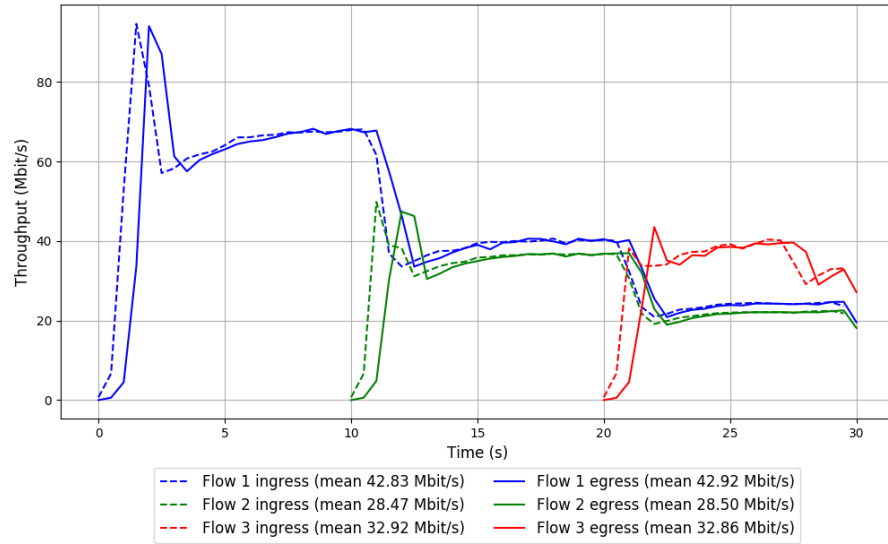
Run 3: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 42.83 Mbit/s)   Flow 1 egress (mean 42.92 Mbit/s)
Flow 2 ingress (mean 28.47 Mbit/s)   Flow 2 egress (mean 28.50 Mbit/s)
Flow 3 ingress (mean 32.92 Mbit/s)   Flow 3 egress (mean 32.86 Mbit/s)

Flow 1 (95th percentile 127.38 ms)   Flow 2 (95th percentile 126.10 ms)   Flow 3 (95th percentile 133.47 ms)

```
Run 1: Statistics of Indigo

Start at: 2018-08-28 06:11:45
End at: 2018-08-28 06:12:15
Local clock offset: 2.643 ms
Remote clock offset: 2.076 ms

# Below is generated by plot.py at 2018-08-28 06:27:35
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.46 Mbit/s
95th percentile per-packet one-way delay: 437.562 ms
Loss rate: 3.19%
-- Flow 1:
Average throughput: 55.65 Mbit/s
95th percentile per-packet one-way delay: 476.612 ms
Loss rate: 4.11%
-- Flow 2:
Average throughput: 36.51 Mbit/s
95th percentile per-packet one-way delay: 132.450 ms
Loss rate: 1.38%
-- Flow 3:
Average throughput: 28.39 Mbit/s
95th percentile per-packet one-way delay: 119.558 ms
Loss rate: 2.18%
```
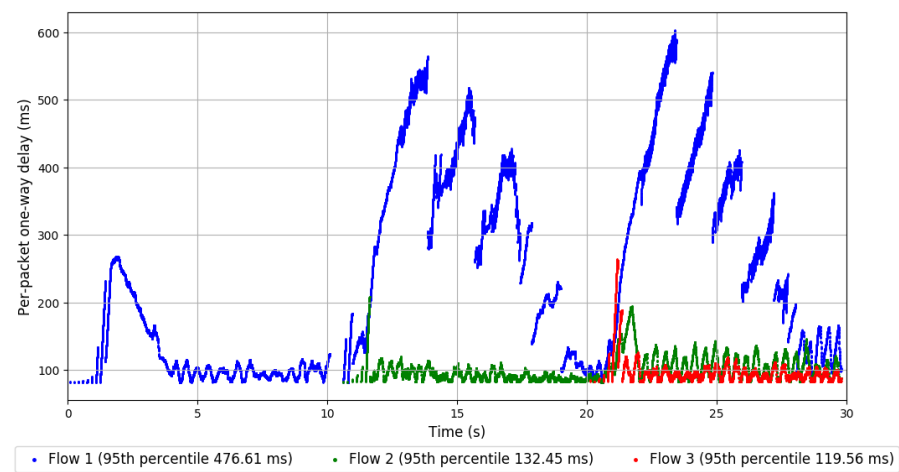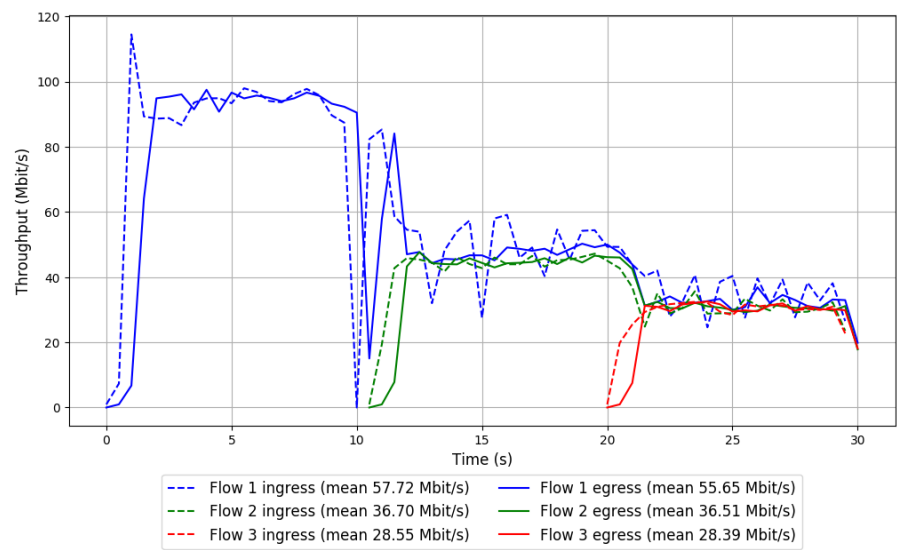
Run 1: Report of Indigo — Data Link

Flow 1 ingress (mean 57.72 Mbit/s) --- Flow 1 egress (mean 55.65 Mbit/s)
Flow 2 ingress (mean 36.70 Mbit/s) --- Flow 2 egress (mean 36.51 Mbit/s)
Flow 3 ingress (mean 28.55 Mbit/s) --- Flow 3 egress (mean 28.39 Mbit/s)

Flow 1 (95th percentile 476.61 ms)   Flow 2 (95th percentile 132.45 ms)   Flow 3 (95th percentile 119.56 ms)

```
Run 2: Statistics of Indigo

Start at: 2018-08-28 06:16:47
End at: 2018-08-28 06:17:17
Local clock offset: 2.473 ms
Remote clock offset: 0.836 ms


# Below is generated by plot.py at 2018-08-28 06:27:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.89 Mbit/s
95th percentile per-packet one-way delay: 420.733 ms
Loss rate: 3.19%
-- Flow 1:
Average throughput: 56.38 Mbit/s
95th percentile per-packet one-way delay: 441.885 ms
Loss rate: 4.15%
-- Flow 2:
Average throughput: 36.86 Mbit/s
95th percentile per-packet one-way delay: 135.591 ms
Loss rate: 0.99%
-- Flow 3:
Average throughput: 27.84 Mbit/s
95th percentile per-packet one-way delay: 140.043 ms
Loss rate: 2.93%
```
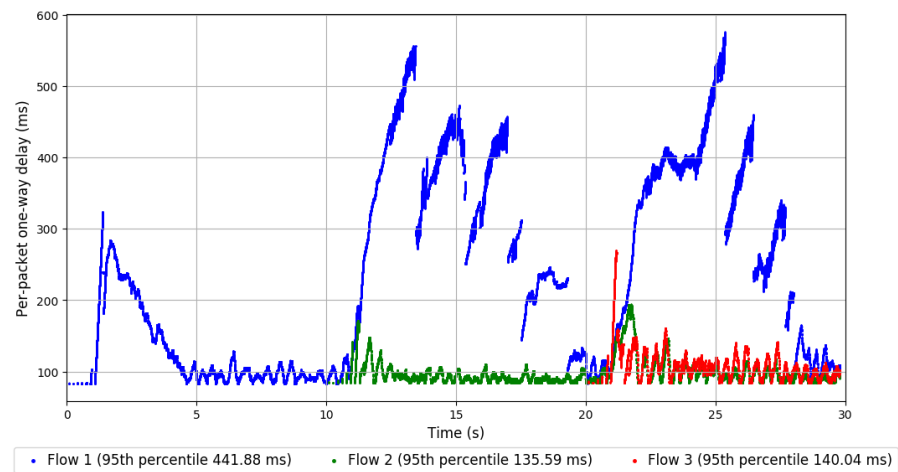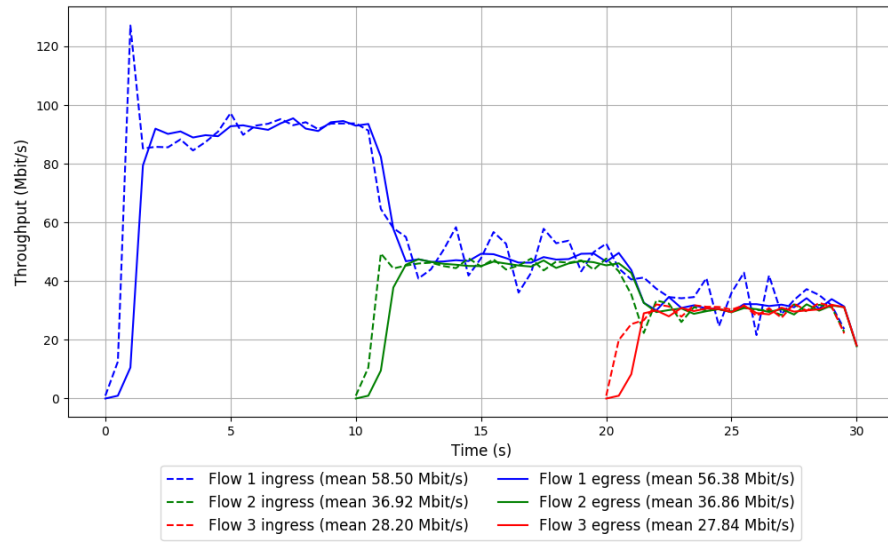
Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-08-28 06:21:49
End at: 2018-08-28 06:22:19
Local clock offset: 2.384 ms
Remote clock offset: 1.989 ms

# Below is generated by plot.py at 2018-08-28 06:27:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.53 Mbit/s
95th percentile per-packet one-way delay: 398.555 ms
Loss rate: 4.56%
-- Flow 1:
Average throughput: 56.11 Mbit/s
95th percentile per-packet one-way delay: 436.951 ms
Loss rate: 6.12%
-- Flow 2:
Average throughput: 36.84 Mbit/s
95th percentile per-packet one-way delay: 141.364 ms
Loss rate: 1.47%
-- Flow 3:
Average throughput: 27.66 Mbit/s
95th percentile per-packet one-way delay: 150.923 ms
Loss rate: 2.74%
```
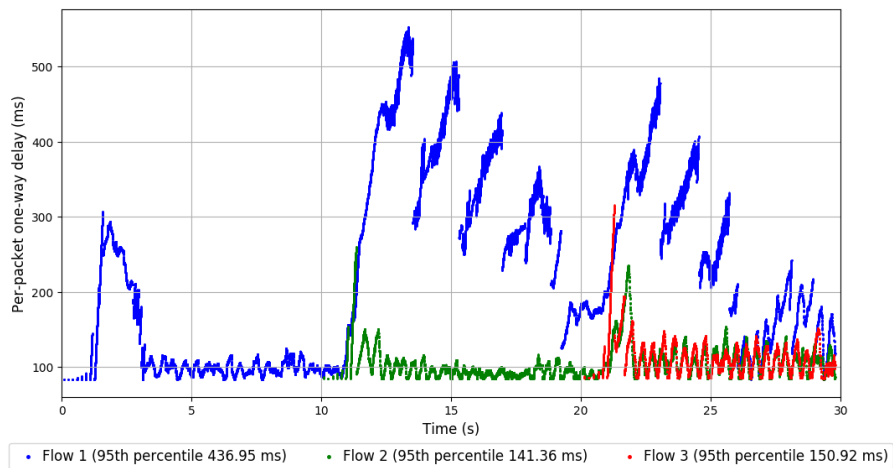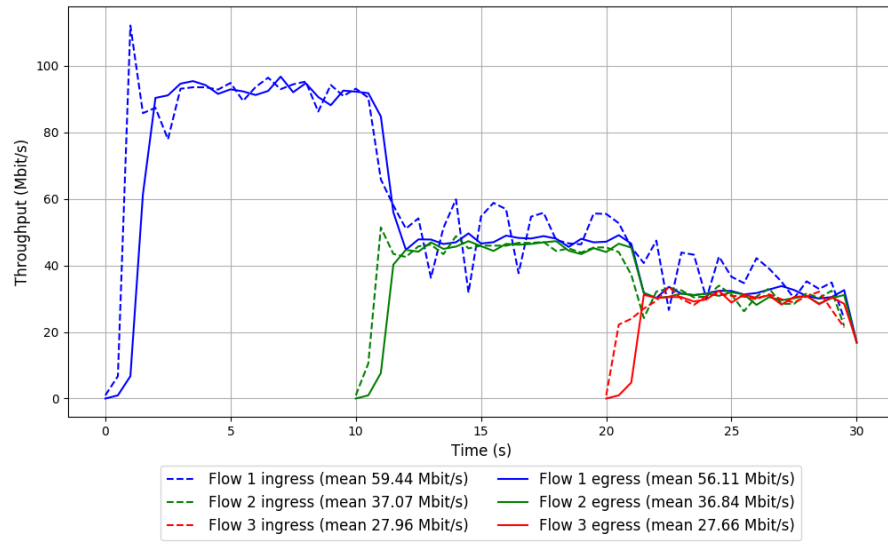
Run 3: Report of Indigo — Data Link

- - - Flow 1 ingress (mean 59.44 Mbit/s)   —— Flow 1 egress (mean 56.11 Mbit/s)
- - - Flow 2 ingress (mean 37.07 Mbit/s)   —— Flow 2 egress (mean 36.84 Mbit/s)
- - - Flow 3 ingress (mean 27.96 Mbit/s)   —— Flow 3 egress (mean 27.66 Mbit/s)

• Flow 1 (95th percentile 436.95 ms)   • Flow 2 (95th percentile 141.36 ms)   • Flow 3 (95th percentile 150.92 ms)

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```
Run 1: Statistics of Muses

Start at: 2018-08-28 06:13:01
End at: 2018-08-28 06:13:31
Local clock offset: 2.576 ms
Remote clock offset: 5.965 ms

# Below is generated by plot.py at 2018-08-28 06:28:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 72.65 Mbit/s
95th percentile per-packet one-way delay: 214.027 ms
Loss rate: 1.87%
-- Flow 1:
Average throughput: 48.09 Mbit/s
95th percentile per-packet one-way delay: 202.044 ms
Loss rate: 1.15%
-- Flow 2:
Average throughput: 28.94 Mbit/s
95th percentile per-packet one-way delay: 224.068 ms
Loss rate: 2.22%
-- Flow 3:
Average throughput: 16.34 Mbit/s
95th percentile per-packet one-way delay: 237.051 ms
Loss rate: 6.81%
```
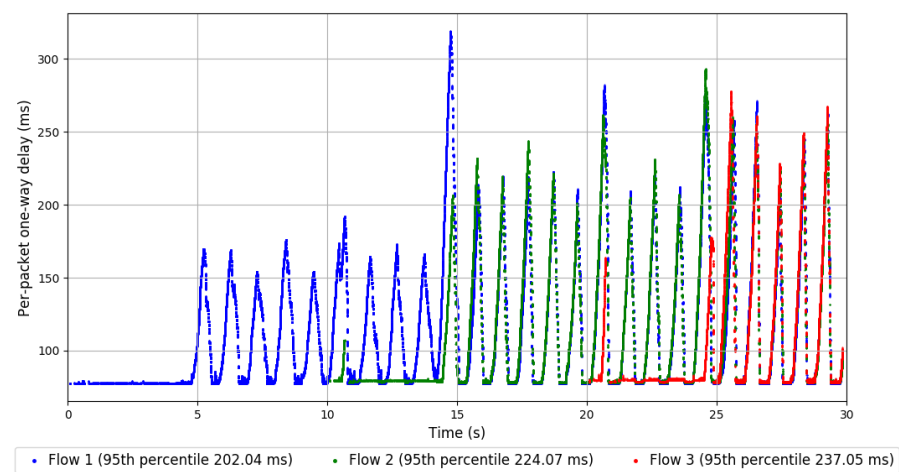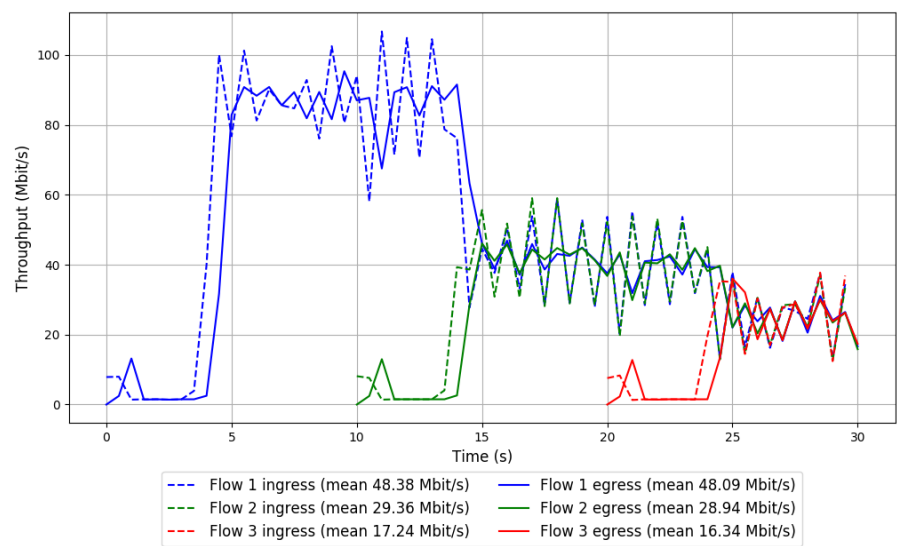
Run 1: Report of Muses — Data Link

```
Run 2: Statistics of Muses

Start at: 2018-08-28 06:18:04
End at: 2018-08-28 06:18:34
Local clock offset: 1.688 ms
Remote clock offset: 7.105 ms

# Below is generated by plot.py at 2018-08-28 06:28:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 73.37 Mbit/s
95th percentile per-packet one-way delay: 211.317 ms
Loss rate: 1.51%
-- Flow 1:
Average throughput: 49.08 Mbit/s
95th percentile per-packet one-way delay: 198.324 ms
Loss rate: 0.96%
-- Flow 2:
Average throughput: 28.37 Mbit/s
95th percentile per-packet one-way delay: 221.978 ms
Loss rate: 1.97%
-- Flow 3:
Average throughput: 16.64 Mbit/s
95th percentile per-packet one-way delay: 241.516 ms
Loss rate: 4.75%
```
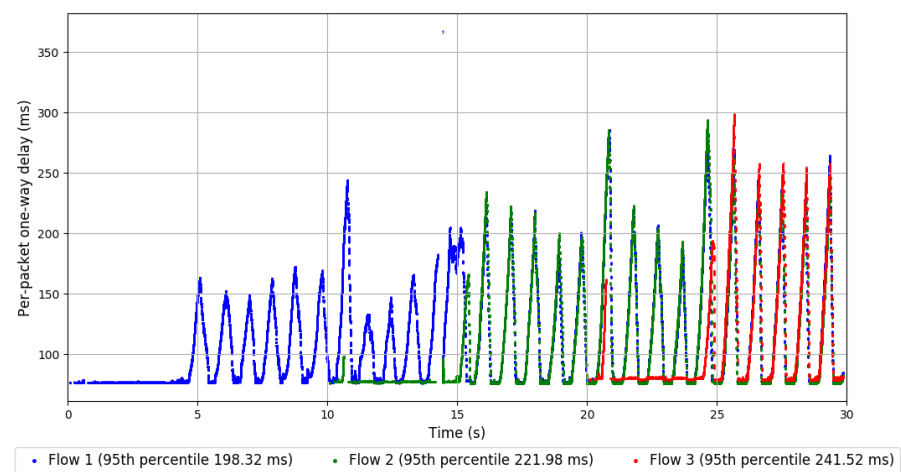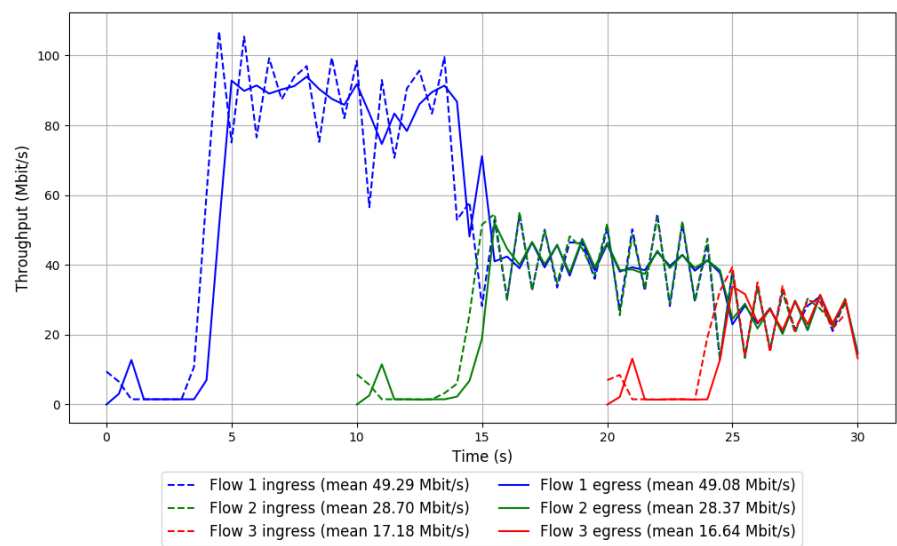
Run 2: Report of Muses — Data Link

```
Run 3: Statistics of Muses

Start at: 2018-08-28 06:23:06
End at: 2018-08-28 06:23:36
Local clock offset: 2.358 ms
Remote clock offset: 0.867 ms

# Below is generated by plot.py at 2018-08-28 06:28:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 72.70 Mbit/s
95th percentile per-packet one-way delay: 231.356 ms
Loss rate: 1.82%
-- Flow 1:
Average throughput: 48.05 Mbit/s
95th percentile per-packet one-way delay: 221.798 ms
Loss rate: 1.10%
-- Flow 2:
Average throughput: 28.88 Mbit/s
95th percentile per-packet one-way delay: 237.284 ms
Loss rate: 2.31%
-- Flow 3:
Average throughput: 16.71 Mbit/s
95th percentile per-packet one-way delay: 247.330 ms
Loss rate: 6.18%
```

Run 3: Report of Muses — Data Link