Pantheon Report

Generated at 2018-08-31 04:55:59 (UTC).

Data path: AWS India 1 on `ens5` (*local*) →India 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.

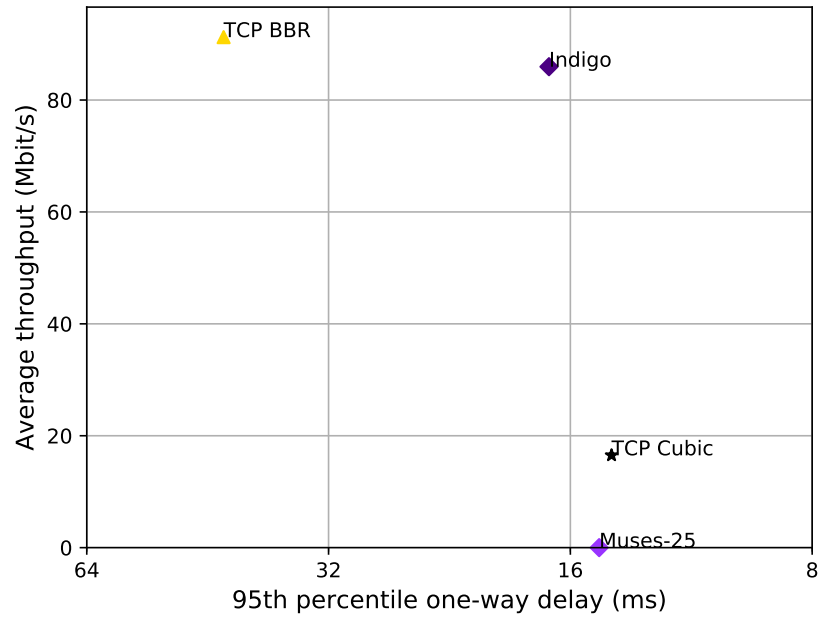NTP offsets were measured against `nets.org.sg` and have been applied to correct the timestamps in logs.

```
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 @ 2de97ca91a065473c29a25fffe63fb137c97a67c
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b59e0d118c50af3579569c462d33045741c85981
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
```
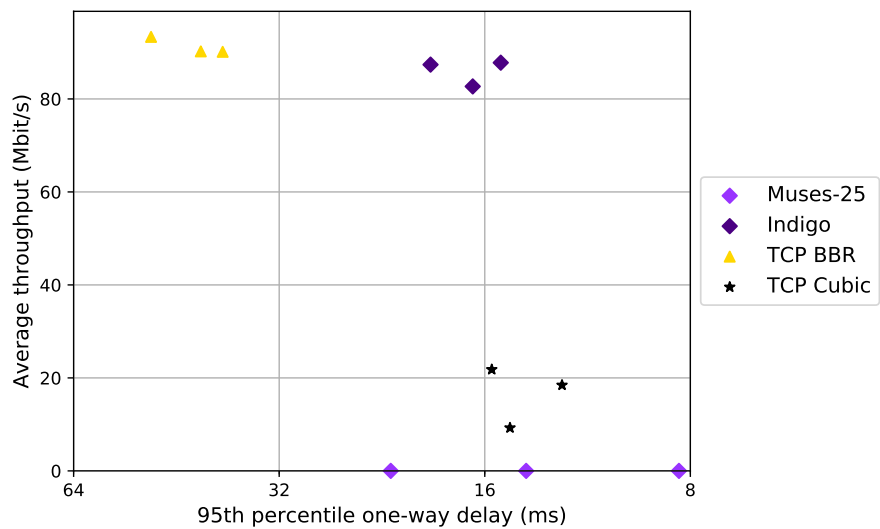
test from AWS India 1 to India, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

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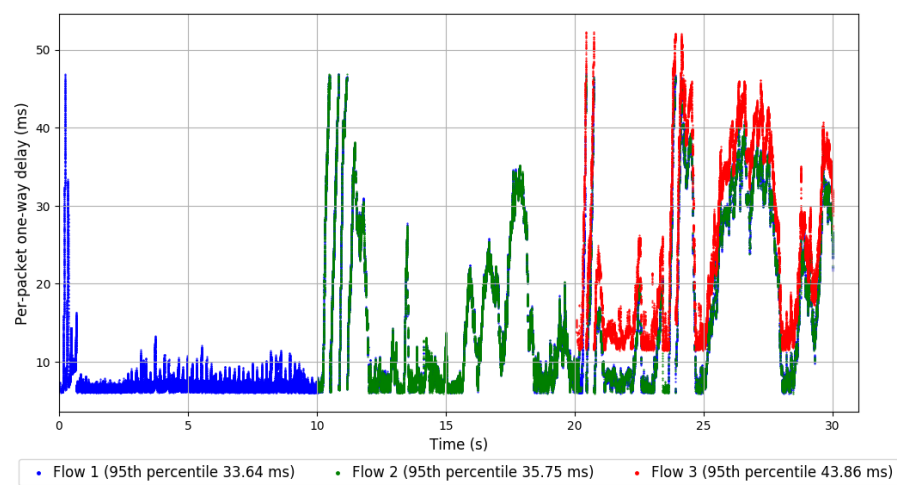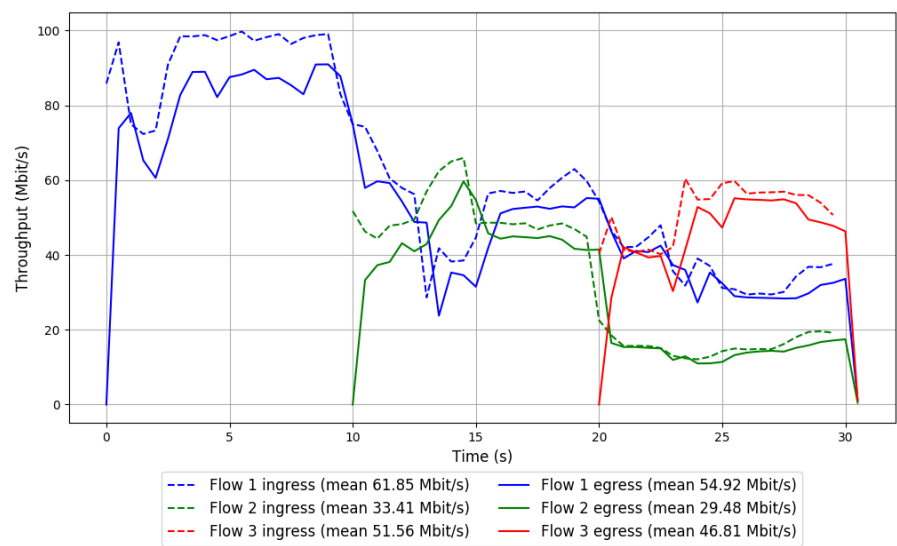3 flows with 10s interval between flows

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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	57.02	32.05	38.76	39.81	43.56	46.33	8.41	9.61	8.35
TCP Cubic	3	8.59	7.83	8.14	12.26	14.17	13.58	1.33	1.15	0.99
Indigo	3	50.41	39.22	29.19	14.94	15.74	16.19	11.64	12.61	10.44
Muses-25	3	0.00	0.00	0.00	15.18	12.98	12.07	0.00	0.00	0.00

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 04:42:53
End at: 2018-08-31 04:43:23
Local clock offset: -4.491 ms
Remote clock offset: -4.599 ms


# Below is generated by plot.py at 2018-08-31 04:55:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.14 Mbit/s
95th percentile per-packet one-way delay: 38.717 ms
Loss rate: 10.94%
-- Flow 1:
Average throughput: 54.92 Mbit/s
95th percentile per-packet one-way delay: 33.641 ms
Loss rate: 11.15%
-- Flow 2:
Average throughput: 29.48 Mbit/s
95th percentile per-packet one-way delay: 35.748 ms
Loss rate: 11.71%
-- Flow 3:
Average throughput: 46.81 Mbit/s
95th percentile per-packet one-way delay: 43.863 ms
Loss rate: 9.14%
```

Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 61.85 Mbit/s) --- Flow 1 egress (mean 54.92 Mbit/s)
Flow 2 ingress (mean 33.41 Mbit/s) --- Flow 2 egress (mean 29.48 Mbit/s)
Flow 3 ingress (mean 51.56 Mbit/s) --- Flow 3 egress (mean 46.81 Mbit/s)

Flow 1 (95th percentile 33.64 ms) • Flow 2 (95th percentile 35.75 ms) • Flow 3 (95th percentile 43.86 ms)

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```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 04:47:30
End at: 2018-08-31 04:48:00
Local clock offset: -7.865 ms
Remote clock offset: -4.6 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.35 Mbit/s
95th percentile per-packet one-way delay: 49.294 ms
Loss rate: 6.27%
-- Flow 1:
Average throughput: 56.10 Mbit/s
95th percentile per-packet one-way delay: 48.222 ms
Loss rate: 6.37%
-- Flow 2:
Average throughput: 35.65 Mbit/s
95th percentile per-packet one-way delay: 50.027 ms
Loss rate: 6.88%
-- Flow 3:
Average throughput: 40.81 Mbit/s
95th percentile per-packet one-way delay: 50.505 ms
Loss rate: 4.78%
```
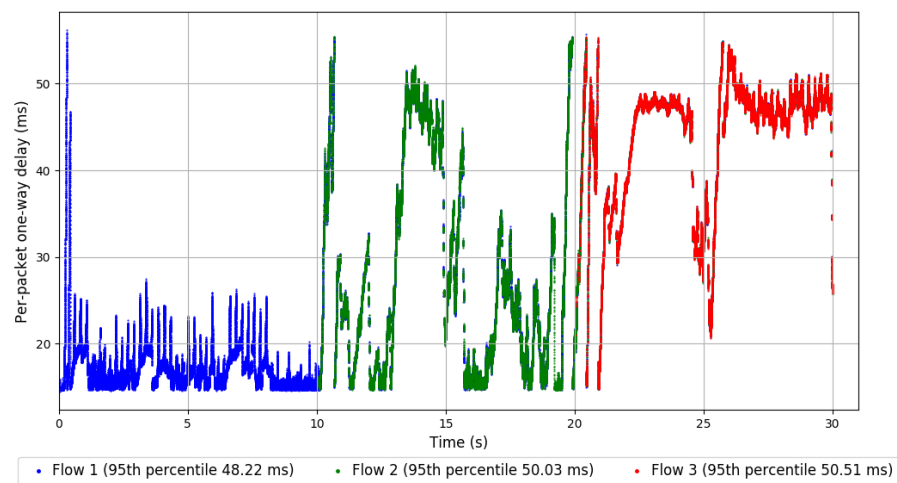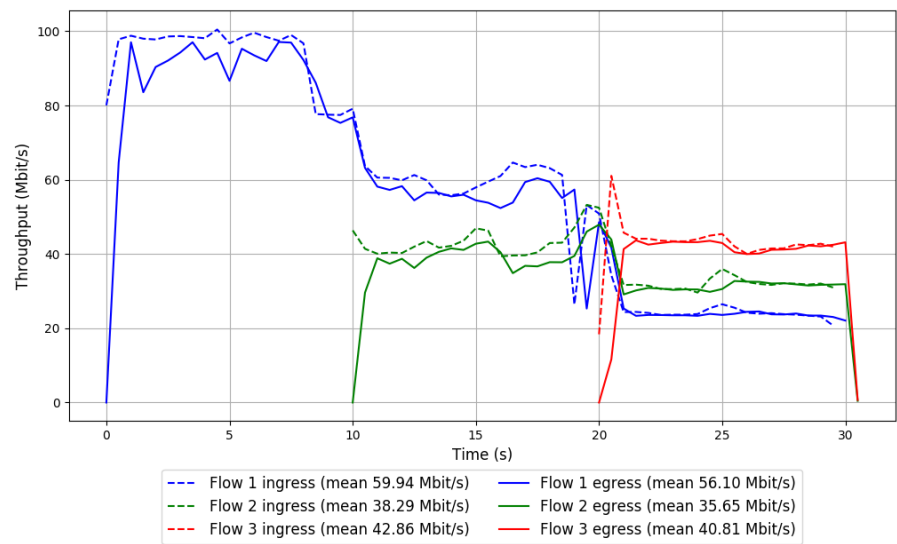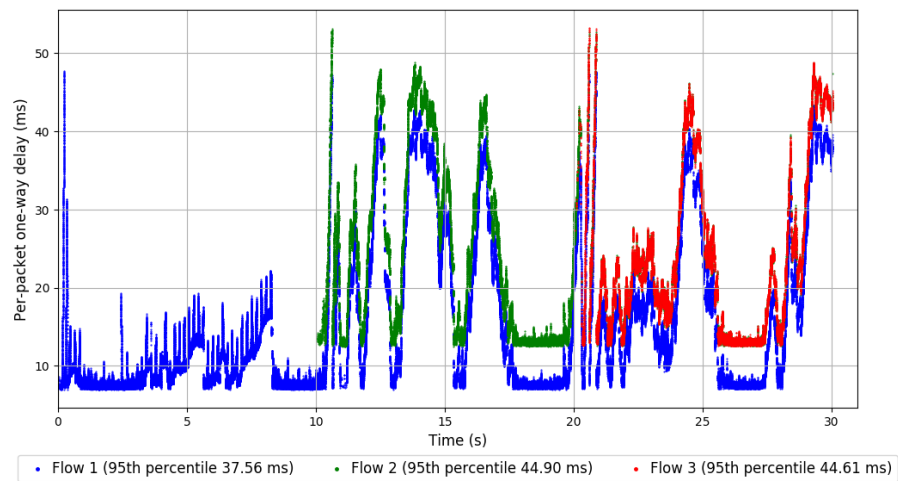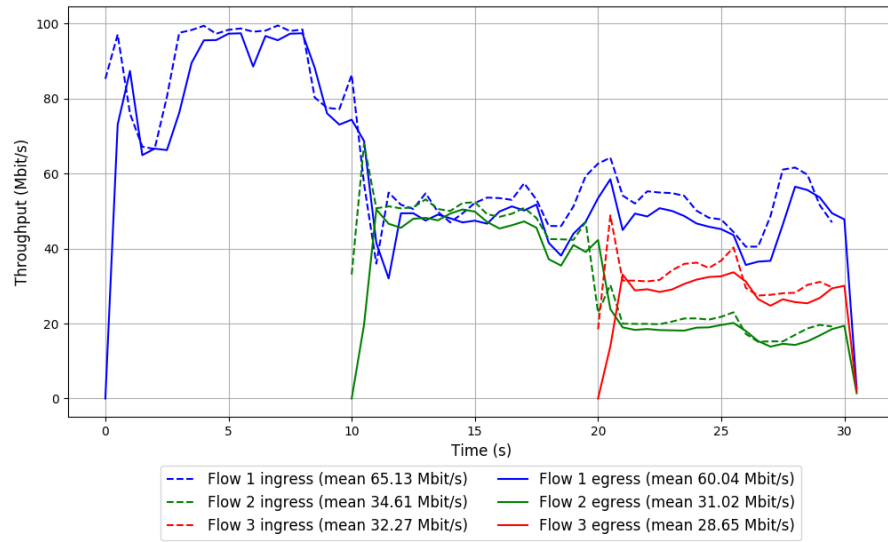
Run 2: Report of TCP BBR — Data Link

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```
Run 3: Statistics of TCP BBR

Start at: 2018-08-31 04:52:03
End at: 2018-08-31 04:52:33
Local clock offset: -2.735 ms
Remote clock offset: -2.379 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.23 Mbit/s
95th percentile per-packet one-way delay: 41.681 ms
Loss rate: 8.67%
-- Flow 1:
Average throughput: 60.04 Mbit/s
95th percentile per-packet one-way delay: 37.560 ms
Loss rate: 7.72%
-- Flow 2:
Average throughput: 31.02 Mbit/s
95th percentile per-packet one-way delay: 44.901 ms
Loss rate: 10.23%
-- Flow 3:
Average throughput: 28.65 Mbit/s
95th percentile per-packet one-way delay: 44.608 ms
Loss rate: 11.14%
```
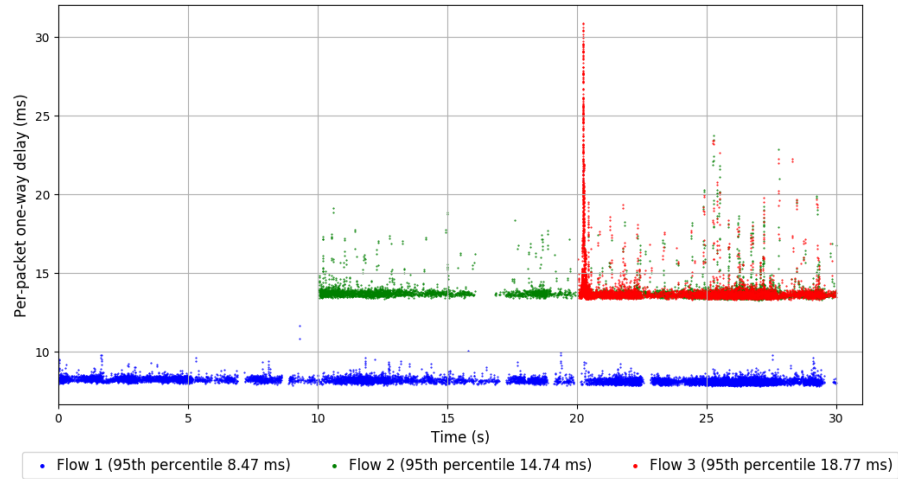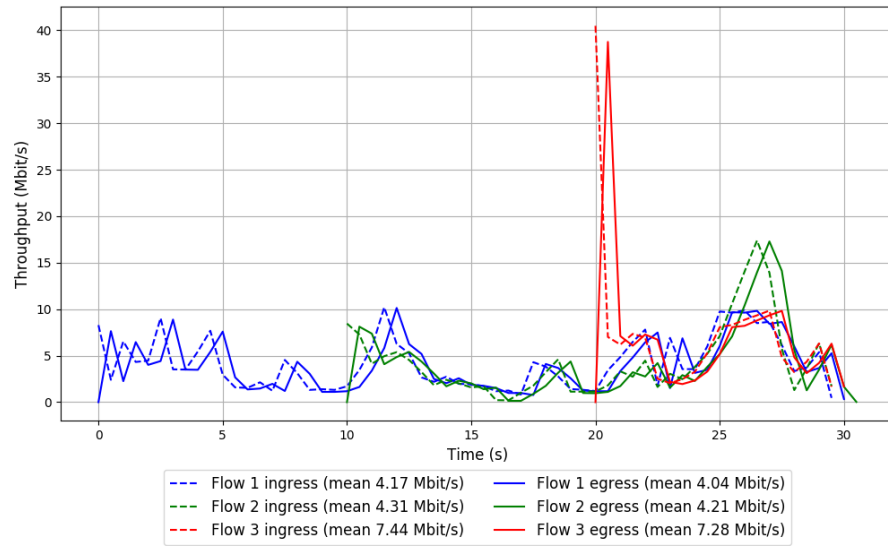
Run 3: Report of TCP BBR — Data Link

- - - Flow 1 ingress (mean 65.13 Mbit/s) —— Flow 1 egress (mean 60.04 Mbit/s)
- - - Flow 2 ingress (mean 34.61 Mbit/s) —— Flow 2 egress (mean 31.02 Mbit/s)
- - - Flow 3 ingress (mean 32.27 Mbit/s) —— Flow 3 egress (mean 28.65 Mbit/s)

• Flow 1 (95th percentile 37.56 ms)   • Flow 2 (95th percentile 44.90 ms)   • Flow 3 (95th percentile 44.61 ms)

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 04:45:13
End at: 2018-08-31 04:45:43
Local clock offset: -6.316 ms
Remote clock offset: -3.942 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 9.26 Mbit/s
95th percentile per-packet one-way delay: 14.696 ms
Loss rate: 2.60%
-- Flow 1:
Average throughput: 4.04 Mbit/s
95th percentile per-packet one-way delay: 8.469 ms
Loss rate: 3.20%
-- Flow 2:
Average throughput: 4.21 Mbit/s
95th percentile per-packet one-way delay: 14.741 ms
Loss rate: 2.16%
-- Flow 3:
Average throughput: 7.28 Mbit/s
95th percentile per-packet one-way delay: 18.766 ms
Loss rate: 2.10%
```
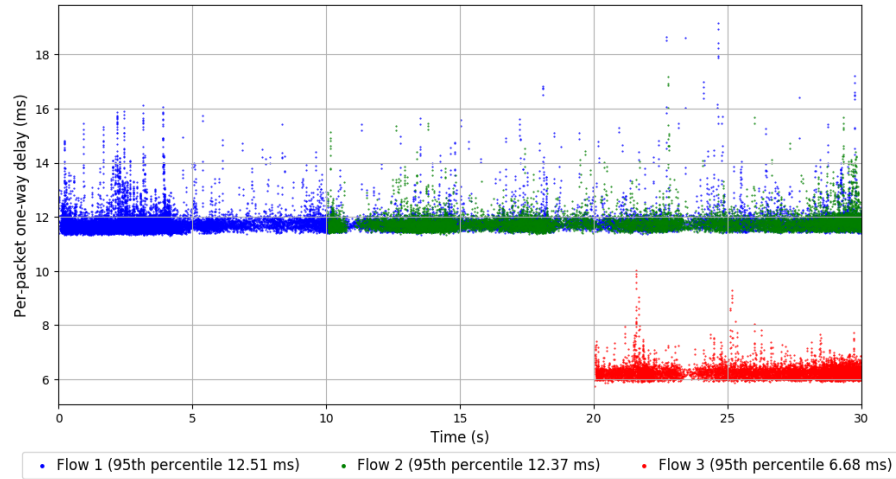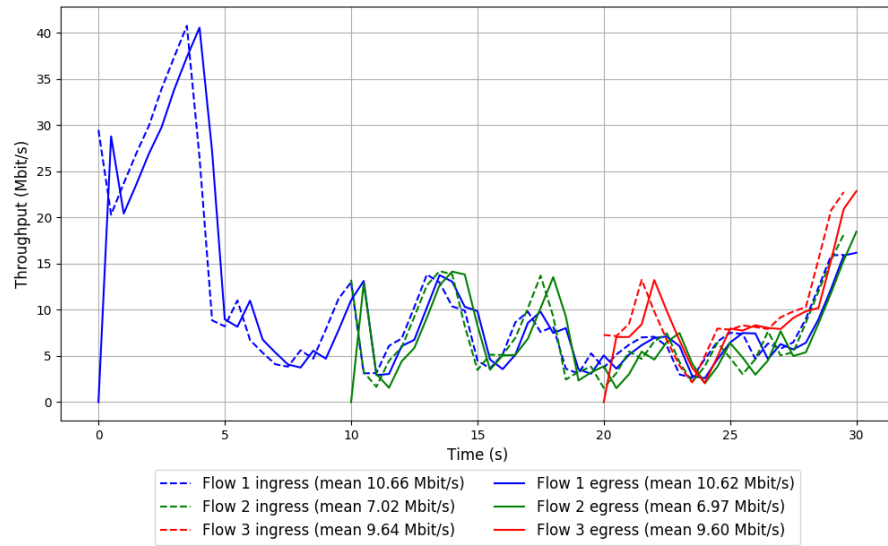
Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 04:49:47
End at: 2018-08-31 04:50:17
Local clock offset: -3.418 ms
Remote clock offset: -3.939 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 18.45 Mbit/s
95th percentile per-packet one-way delay: 12.331 ms
Loss rate: 0.50%
-- Flow 1:
Average throughput: 10.62 Mbit/s
95th percentile per-packet one-way delay: 12.507 ms
Loss rate: 0.40%
-- Flow 2:
Average throughput: 6.97 Mbit/s
95th percentile per-packet one-way delay: 12.368 ms
Loss rate: 0.75%
-- Flow 3:
Average throughput: 9.60 Mbit/s
95th percentile per-packet one-way delay: 6.682 ms
Loss rate: 0.46%
```

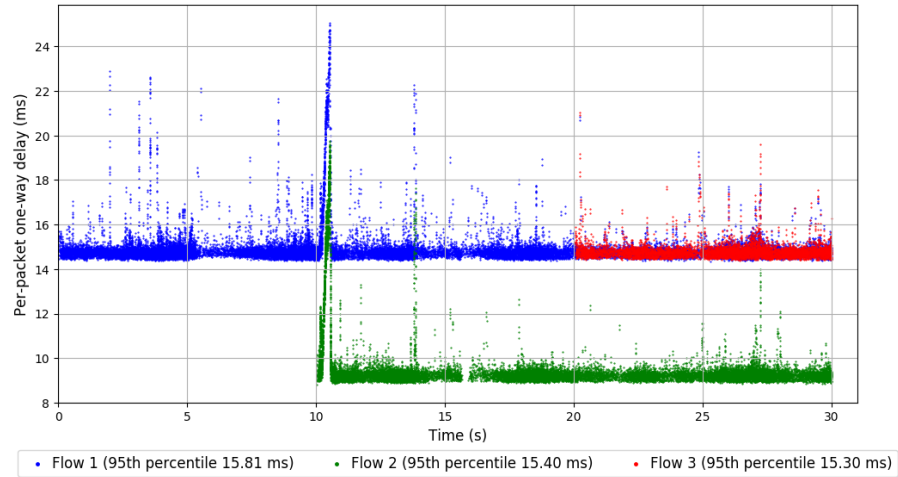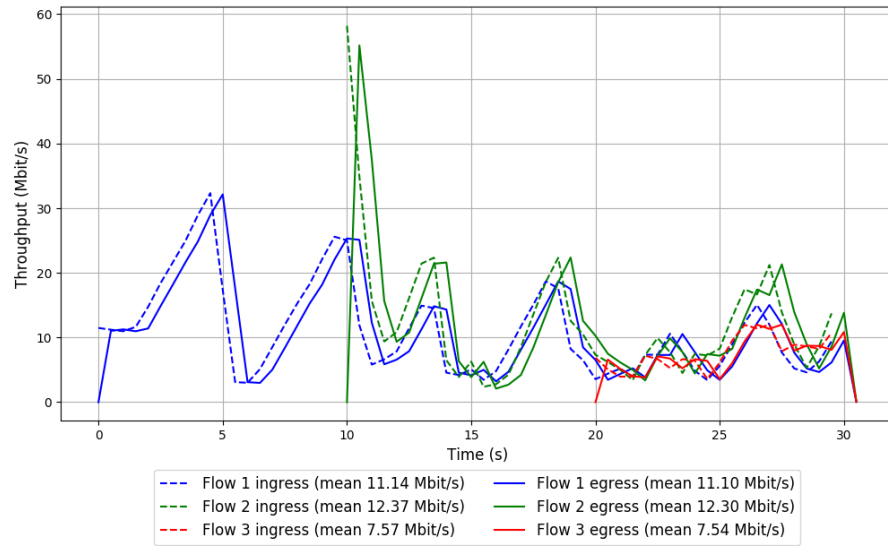Run 2: Report of TCP Cubic — Data Link

```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-31 04:54:19
End at: 2018-08-31 04:54:49
Local clock offset: -5.092 ms
Remote clock offset: -2.828 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 21.80 Mbit/s
95th percentile per-packet one-way delay: 15.628 ms
Loss rate: 0.44%
-- Flow 1:
Average throughput: 11.10 Mbit/s
95th percentile per-packet one-way delay: 15.813 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 12.30 Mbit/s
95th percentile per-packet one-way delay: 15.405 ms
Loss rate: 0.53%
-- Flow 3:
Average throughput: 7.54 Mbit/s
95th percentile per-packet one-way delay: 15.297 ms
Loss rate: 0.41%
```

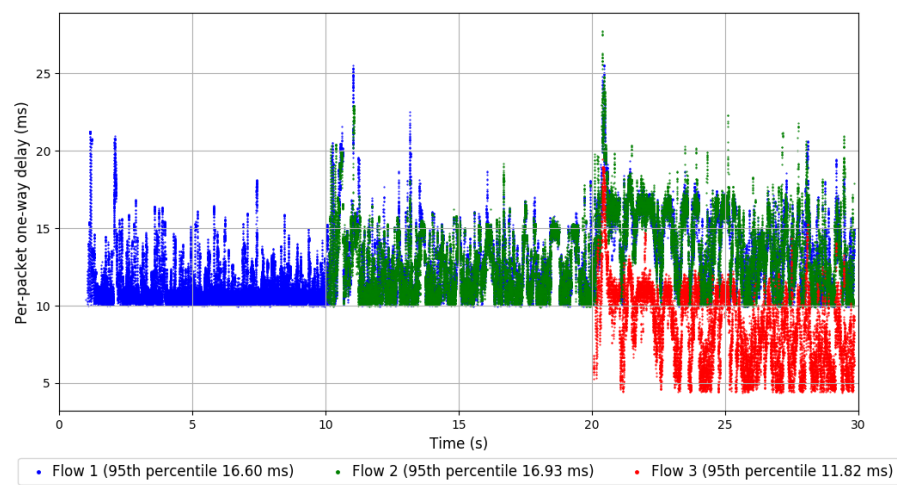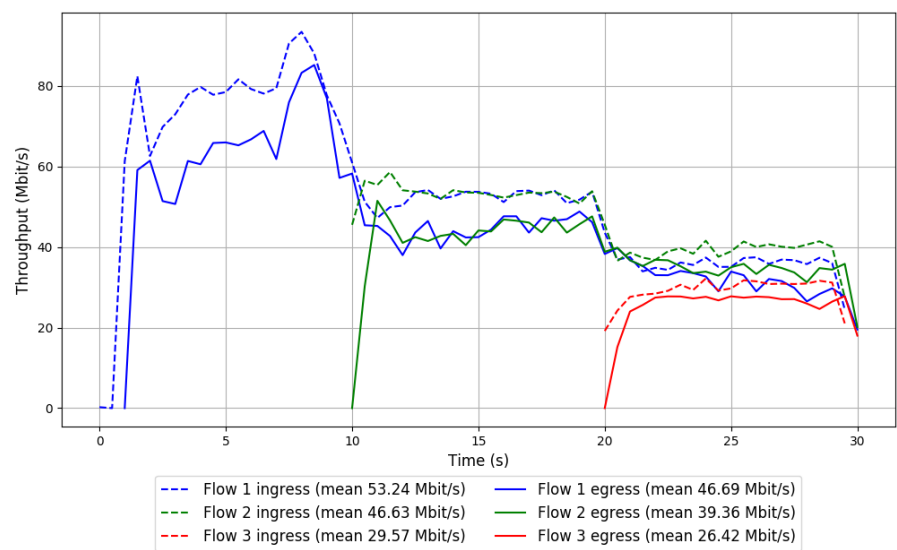Run 3: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-08-31 04:41:42
End at: 2018-08-31 04:42:12
Local clock offset: -2.205 ms
Remote clock offset: -4.209 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 82.69 Mbit/s
95th percentile per-packet one-way delay: 16.663 ms
Loss rate: 14.89%
-- Flow 1:
Average throughput: 46.69 Mbit/s
95th percentile per-packet one-way delay: 16.597 ms
Loss rate: 15.25%
-- Flow 2:
Average throughput: 39.36 Mbit/s
95th percentile per-packet one-way delay: 16.925 ms
Loss rate: 15.59%
-- Flow 3:
Average throughput: 26.42 Mbit/s
95th percentile per-packet one-way delay: 11.823 ms
Loss rate: 10.66%
```

Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2018-08-31 04:46:18
End at: 2018-08-31 04:46:48
Local clock offset: -6.081 ms
Remote clock offset: -4.44 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.38 Mbit/s
95th percentile per-packet one-way delay: 19.210 ms
Loss rate: 8.47%
-- Flow 1:
Average throughput: 51.86 Mbit/s
95th percentile per-packet one-way delay: 14.287 ms
Loss rate: 8.92%
-- Flow 2:
Average throughput: 39.86 Mbit/s
95th percentile per-packet one-way delay: 15.016 ms
Loss rate: 8.03%
-- Flow 3:
Average throughput: 27.68 Mbit/s
95th percentile per-packet one-way delay: 20.678 ms
Loss rate: 7.08%
```
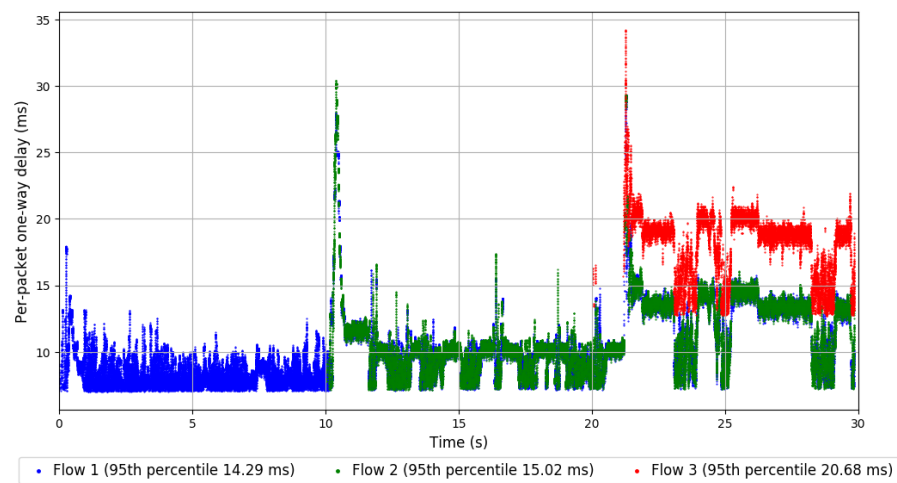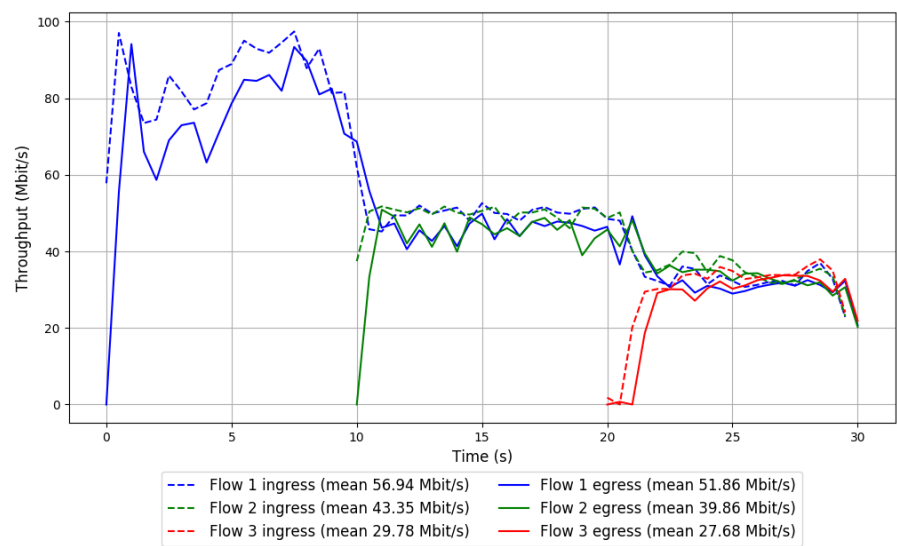
Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-08-31 04:50:53
End at: 2018-08-31 04:51:23
Local clock offset: -5.156 ms
Remote clock offset: -4.645 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.80 Mbit/s
95th percentile per-packet one-way delay: 15.160 ms
Loss rate: 12.10%
-- Flow 1:
Average throughput: 52.69 Mbit/s
95th percentile per-packet one-way delay: 13.928 ms
Loss rate: 10.76%
-- Flow 2:
Average throughput: 38.44 Mbit/s
95th percentile per-packet one-way delay: 15.269 ms
Loss rate: 14.20%
-- Flow 3:
Average throughput: 33.46 Mbit/s
95th percentile per-packet one-way delay: 16.059 ms
Loss rate: 13.57%
```
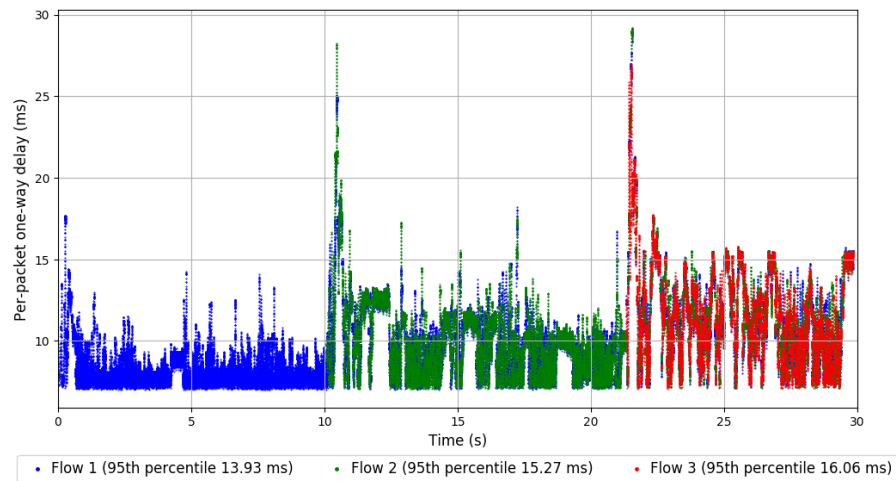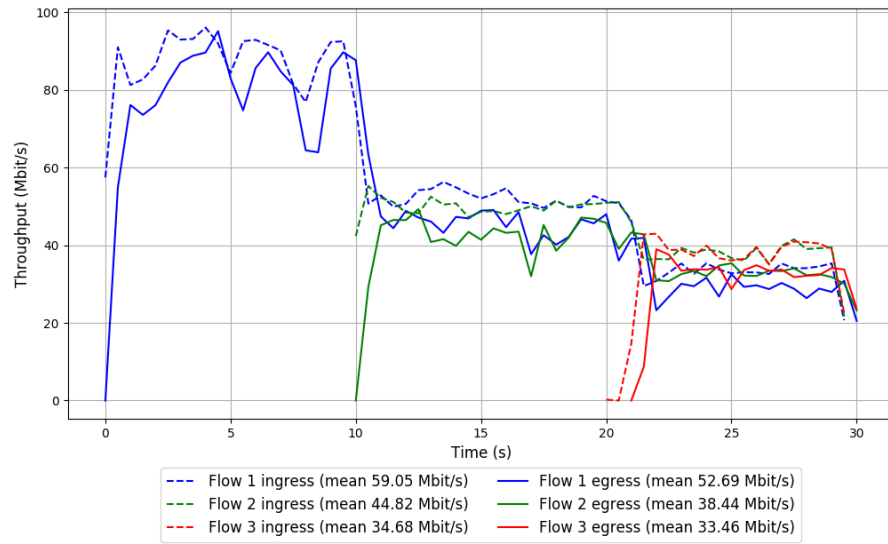
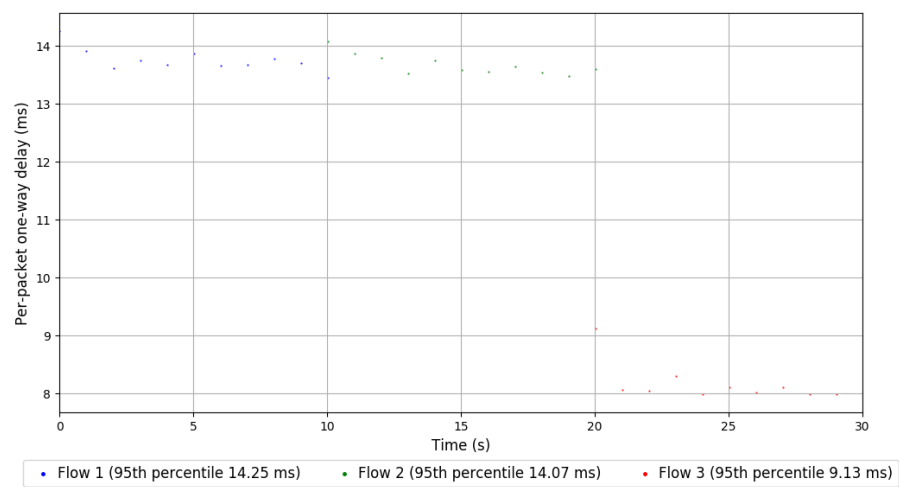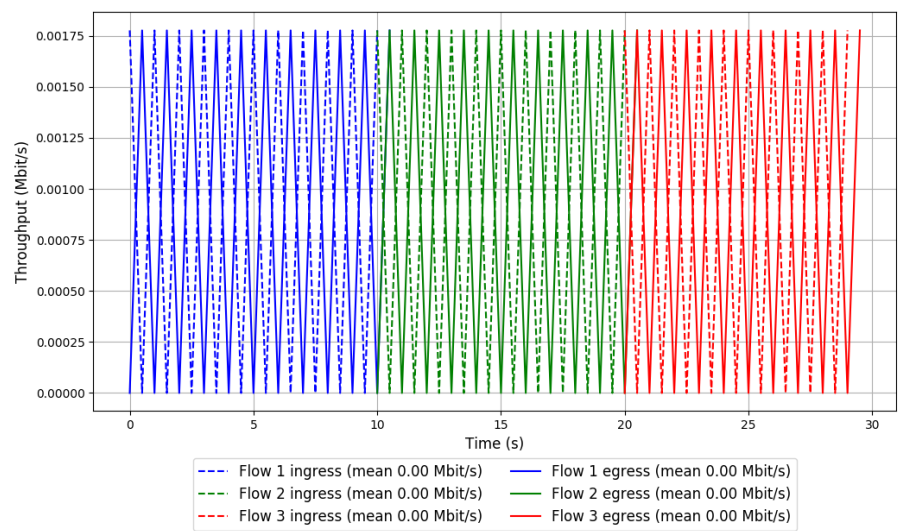Run 3: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 04:44:03
End at: 2018-08-31 04:44:33
Local clock offset: -5.743 ms
Remote clock offset: -3.404 ms

# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 13.916 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 14.252 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 14.071 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 9.126 ms
Loss rate: 0.00%
```

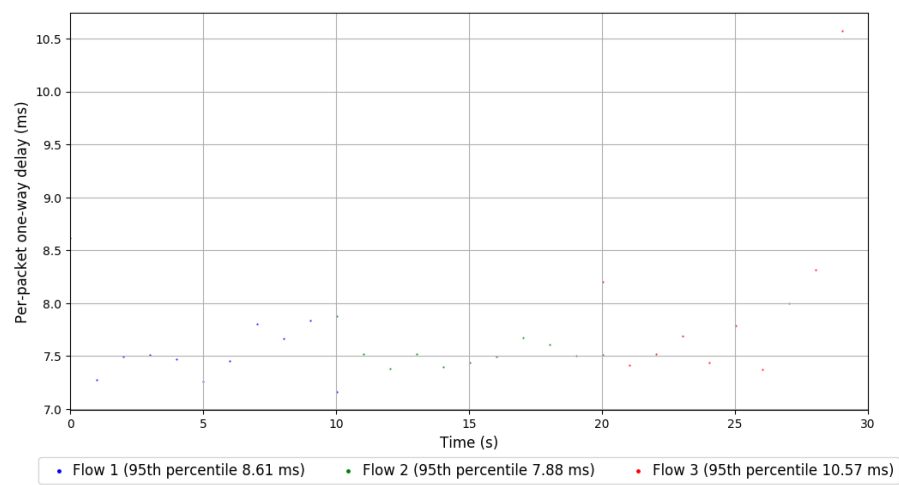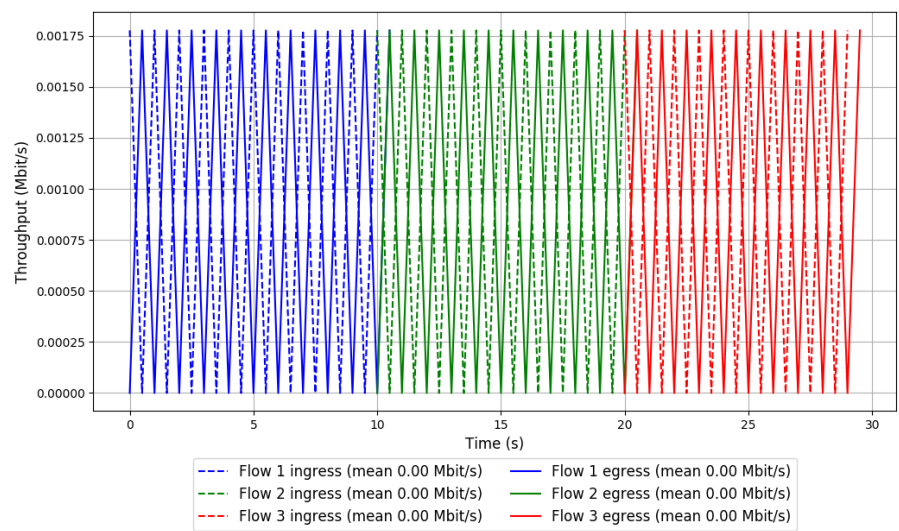# Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 04:48:42
End at: 2018-08-31 04:49:12
Local clock offset: -5.799 ms
Remote clock offset: -4.563 ms

# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 8.313 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 8.612 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 7.880 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 10.571 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link

```
Run 3: Statistics of Muses-25

Start at: 2018-08-31 04:53:14
End at: 2018-08-31 04:53:44
Local clock offset: -12.05 ms
Remote clock offset: -2.695 ms


# Below is generated by plot.py at 2018-08-31 04:55:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 21.968 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 22.684 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 17.001 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 16.519 ms
Loss rate: 0.00%
```

Run 3: Report of Muses-25 — Data Link