Pantheon Report

Generated at 2018-08-31 13:19:27 (UTC).

Data path: GCE London on **ens4** (*local*) →GCE Iowa on **ens4** (*remote*).

Repeated the test of 4 congestion control schemes twice.

Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `time.google.com` and have been applied to correct the timestamps in logs.
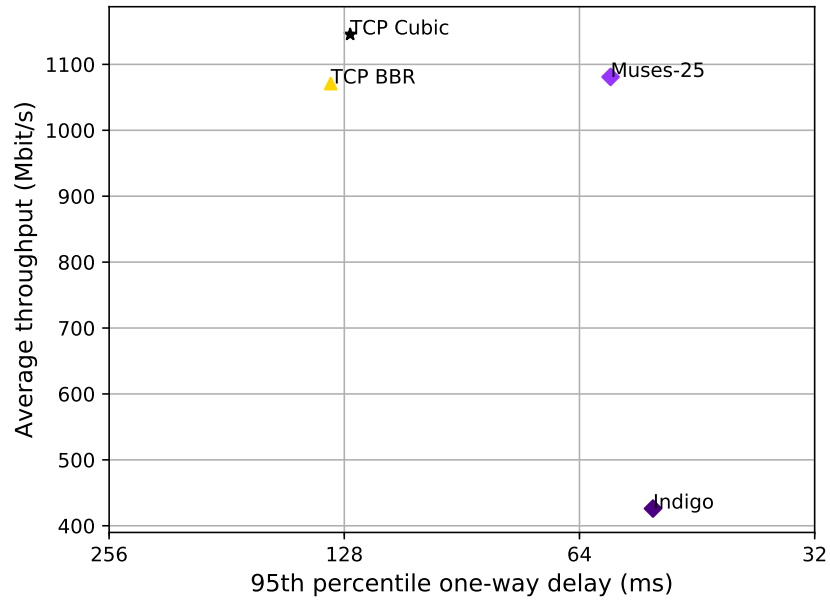
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
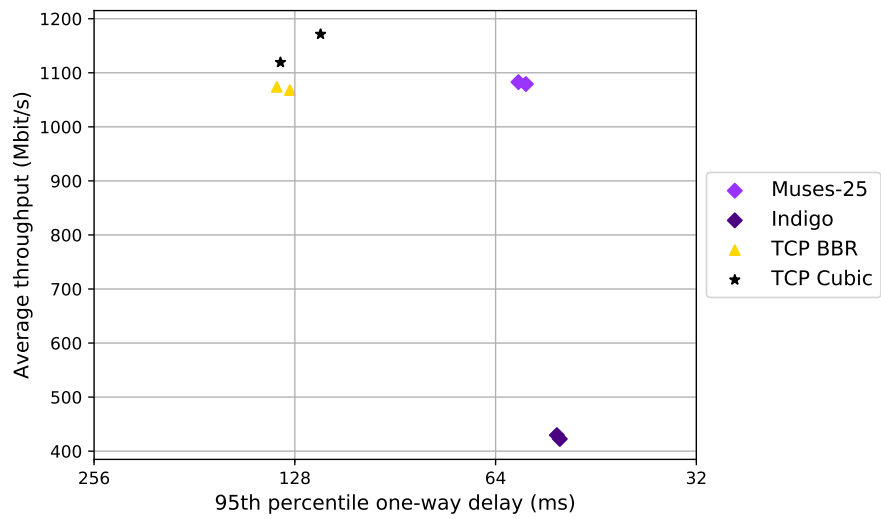
```
Git summary:
branch: muses @ e3c5aa19ca94c3066828fb83f16a8fb6b2731e7a
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
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 GCE London to GCE Iowa, 2 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

test from GCE London to GCE Iowa, 2 runs of 30s each per scheme
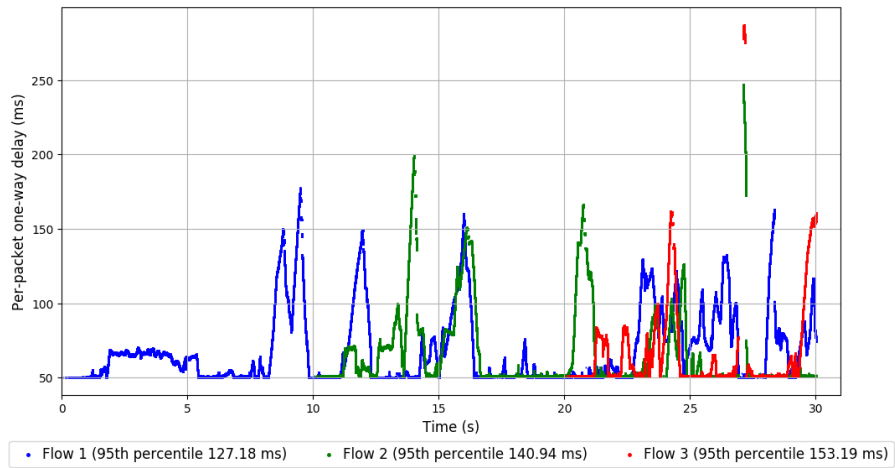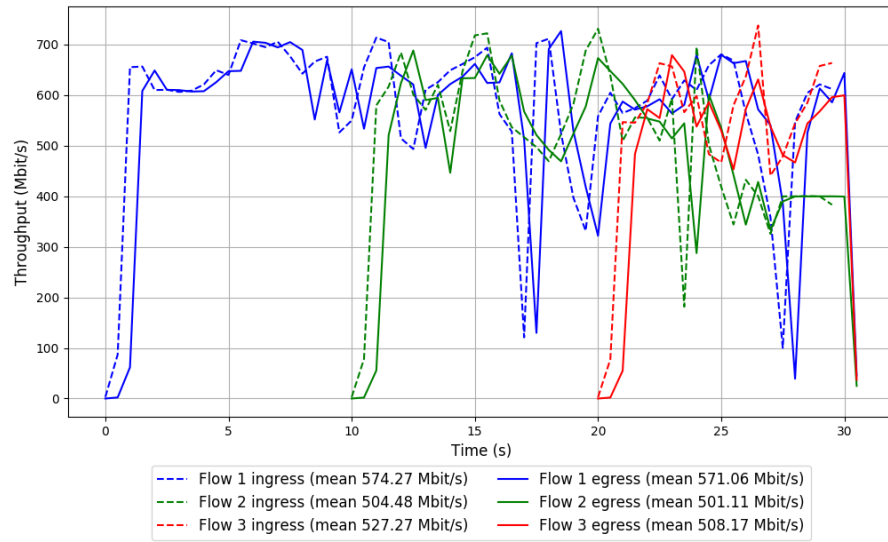3 flows with 10s interval between flows

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	2	562.94	507.35	511.27	130.77	131.91	145.43	0.74	0.55	1.88
TCP Cubic	2	613.19	529.06	540.63	129.65	72.15	126.67	0.09	0.03	0.21
Indigo	2	224.50	212.57	185.99	51.22	51.82	51.27	0.00	0.00	0.00
Muses-25	2	593.97	497.17	478.09	59.39	57.43	57.16	0.00	0.00	0.00

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 12:44:11
End at: 2018-08-31 12:44:41
Local clock offset: 0.043 ms
Remote clock offset: -1.085 ms


# Below is generated by plot.py at 2018-08-31 13:16:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1073.91 Mbit/s
95th percentile per-packet one-way delay: 136.224 ms
Loss rate: 1.08%
-- Flow 1:
Average throughput: 571.06 Mbit/s
95th percentile per-packet one-way delay: 127.180 ms
Loss rate: 0.55%
-- Flow 2:
Average throughput: 501.11 Mbit/s
95th percentile per-packet one-way delay: 140.937 ms
Loss rate: 0.67%
-- Flow 3:
Average throughput: 508.17 Mbit/s
95th percentile per-packet one-way delay: 153.189 ms
Loss rate: 3.62%
```

Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 574.27 Mbit/s)   Flow 1 egress (mean 571.06 Mbit/s)
Flow 2 ingress (mean 504.48 Mbit/s)   Flow 2 egress (mean 501.11 Mbit/s)
Flow 3 ingress (mean 527.27 Mbit/s)   Flow 3 egress (mean 508.17 Mbit/s)

Flow 1 (95th percentile 127.18 ms)   Flow 2 (95th percentile 140.94 ms)   Flow 3 (95th percentile 153.19 ms)
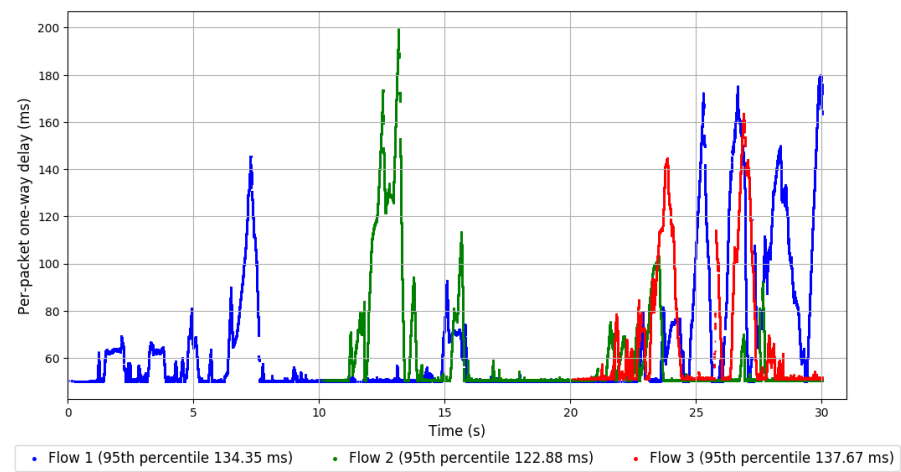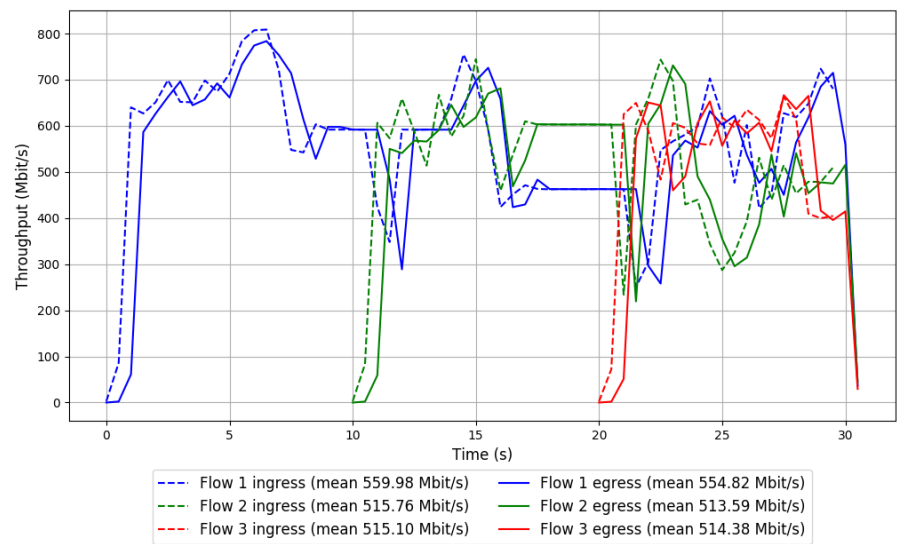
5

```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 12:52:10
End at: 2018-08-31 12:52:40
Local clock offset: 0.371 ms
Remote clock offset: -1.261 ms


# Below is generated by plot.py at 2018-08-31 13:16:37
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1068.03 Mbit/s
95th percentile per-packet one-way delay: 130.203 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 554.82 Mbit/s
95th percentile per-packet one-way delay: 134.351 ms
Loss rate: 0.92%
-- Flow 2:
Average throughput: 513.59 Mbit/s
95th percentile per-packet one-way delay: 122.881 ms
Loss rate: 0.42%
-- Flow 3:
Average throughput: 514.38 Mbit/s
95th percentile per-packet one-way delay: 137.669 ms
Loss rate: 0.14%
```
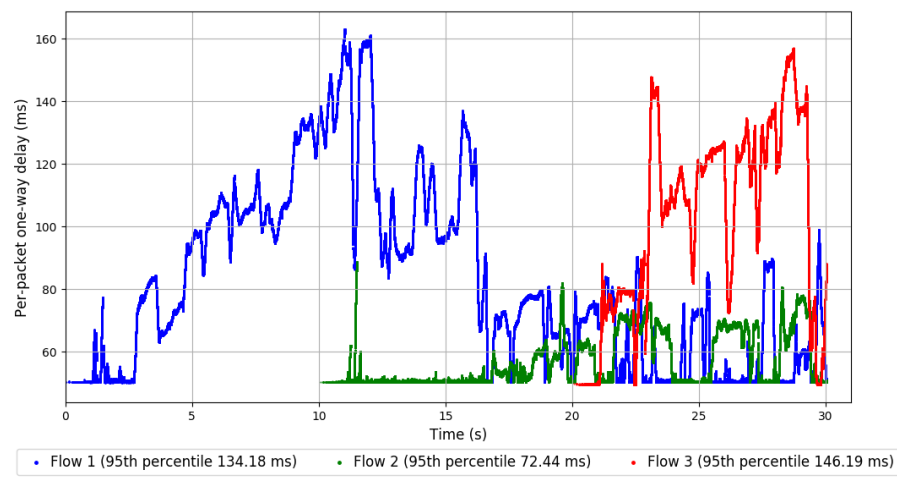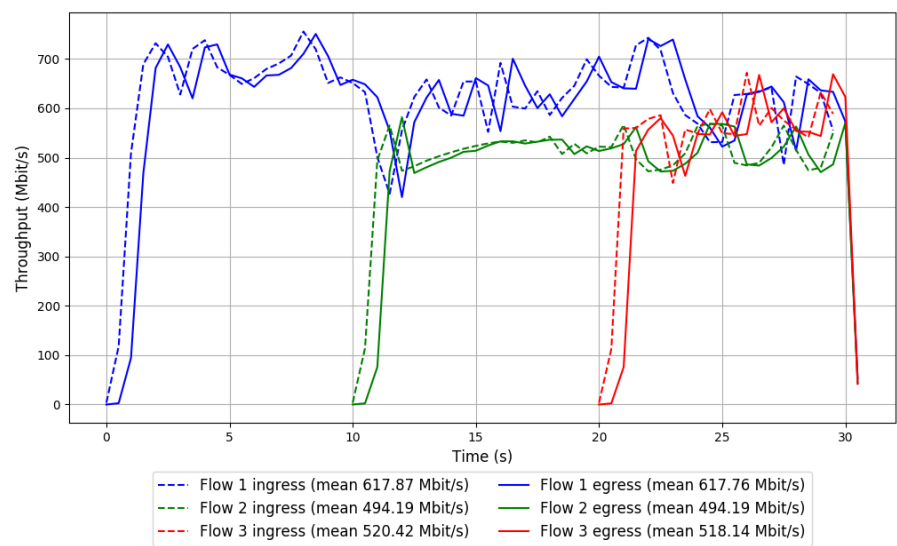
Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 12:48:20
End at: 2018-08-31 12:48:50
Local clock offset: 0.482 ms
Remote clock offset: -1.156 ms


# Below is generated by plot.py at 2018-08-31 13:18:03
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1119.34 Mbit/s
95th percentile per-packet one-way delay: 134.496 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 617.76 Mbit/s
95th percentile per-packet one-way delay: 134.183 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 494.19 Mbit/s
95th percentile per-packet one-way delay: 72.440 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 518.14 Mbit/s
95th percentile per-packet one-way delay: 146.191 ms
Loss rate: 0.42%
```

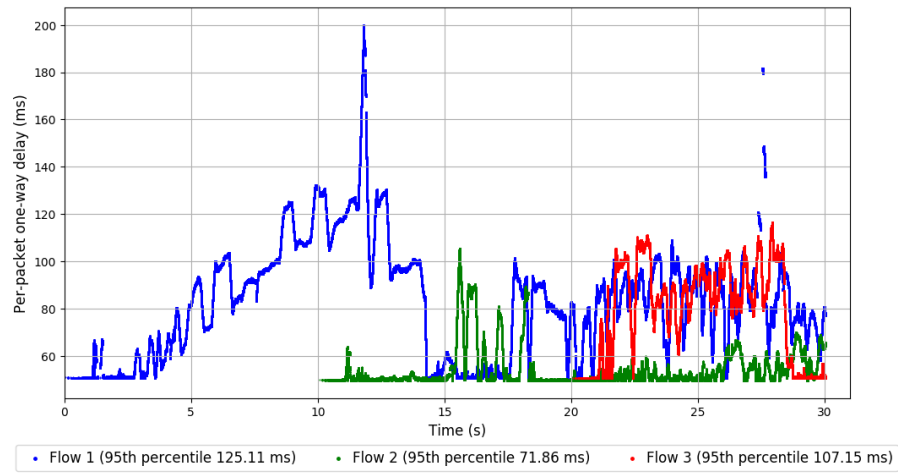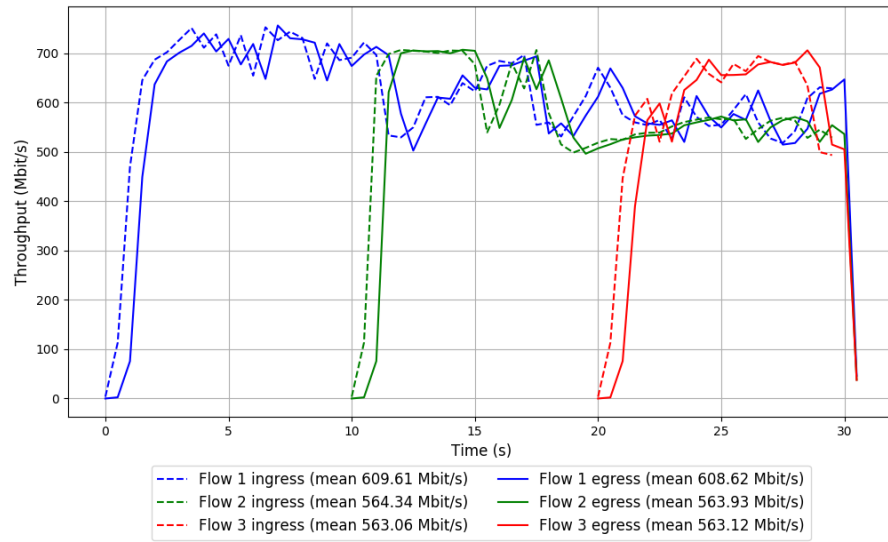Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 12:56:17
End at: 2018-08-31 12:56:47
Local clock offset: 0.603 ms
Remote clock offset: -1.381 ms


# Below is generated by plot.py at 2018-08-31 13:18:13
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1171.45 Mbit/s
95th percentile per-packet one-way delay: 117.123 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 608.62 Mbit/s
95th percentile per-packet one-way delay: 125.115 ms
Loss rate: 0.16%
-- Flow 2:
Average throughput: 563.93 Mbit/s
95th percentile per-packet one-way delay: 71.857 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 563.12 Mbit/s
95th percentile per-packet one-way delay: 107.152 ms
Loss rate: 0.00%
```

Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 609.61 Mbit/s) --- Flow 1 egress (mean 608.62 Mbit/s)
Flow 2 ingress (mean 564.34 Mbit/s) --- Flow 2 egress (mean 563.93 Mbit/s)
Flow 3 ingress (mean 563.06 Mbit/s) --- Flow 3 egress (mean 563.12 Mbit/s)

Flow 1 (95th percentile 125.11 ms)   Flow 2 (95th percentile 71.86 ms)   Flow 3 (95th percentile 107.15 ms)
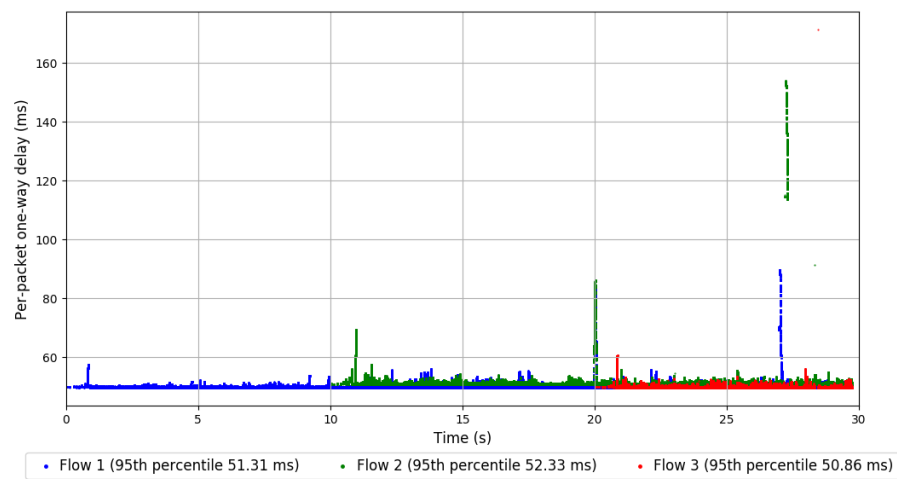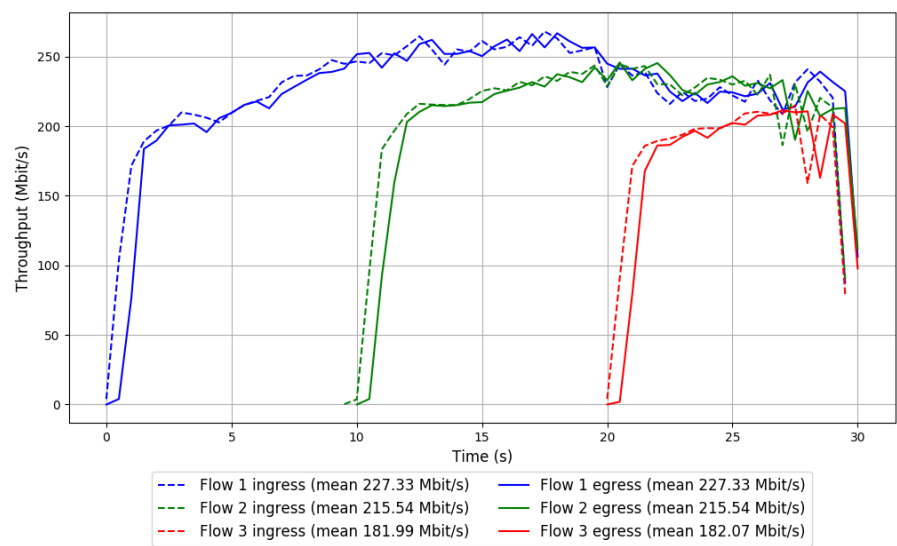
```
Run 1: Statistics of Indigo

Start at: 2018-08-31 12:50:23
End at: 2018-08-31 12:50:53
Local clock offset: 0.505 ms
Remote clock offset: -1.219 ms


# Below is generated by plot.py at 2018-08-31 13:18:13
# Datalink statistics
-- Total of 3 flows:
Average throughput: 429.67 Mbit/s
95th percentile per-packet one-way delay: 51.801 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 227.33 Mbit/s
95th percentile per-packet one-way delay: 51.308 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 215.54 Mbit/s
95th percentile per-packet one-way delay: 52.334 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 182.07 Mbit/s
95th percentile per-packet one-way delay: 50.864 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

Flow 1 ingress (mean 227.33 Mbit/s) --- Flow 1 egress (mean 227.33 Mbit/s)
Flow 2 ingress (mean 215.54 Mbit/s) --- Flow 2 egress (mean 215.54 Mbit/s)
Flow 3 ingress (mean 181.99 Mbit/s) --- Flow 3 egress (mean 182.07 Mbit/s)

Flow 1 (95th percentile 51.31 ms)   Flow 2 (95th percentile 52.33 ms)   Flow 3 (95th percentile 50.86 ms)
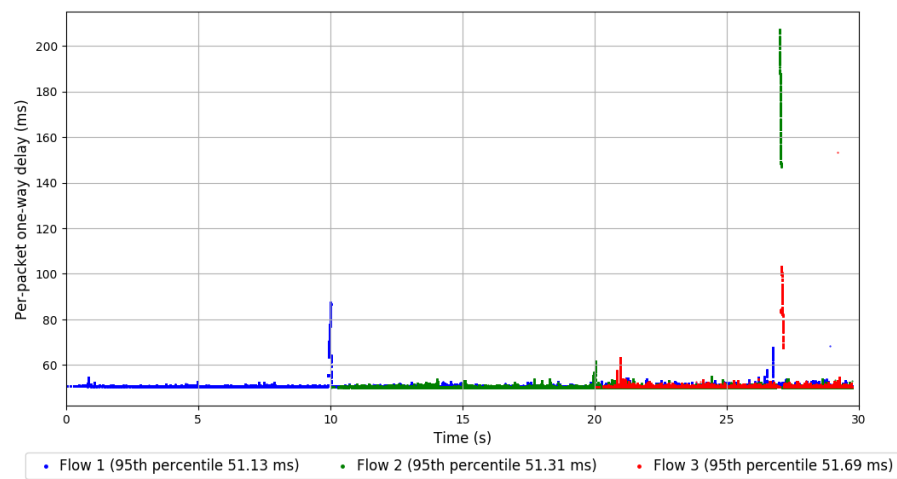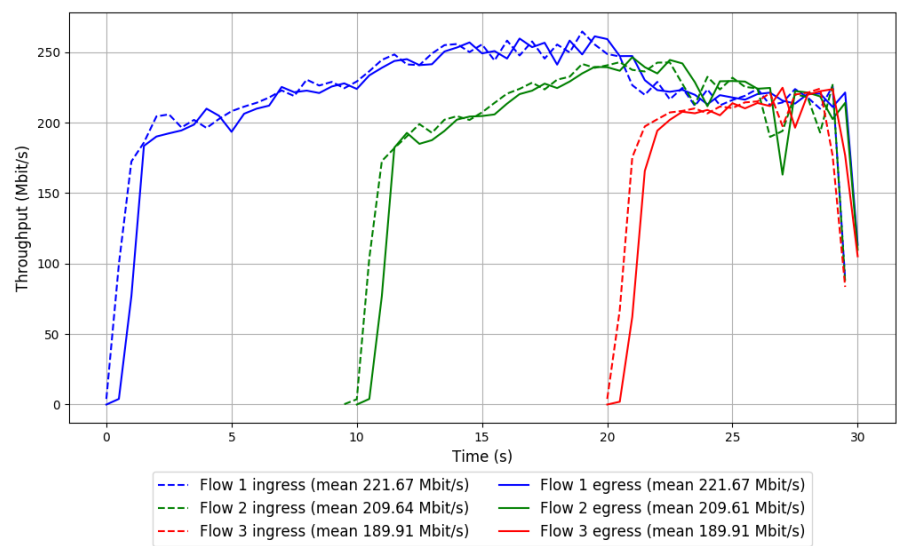
13

```
Run 2: Statistics of Indigo

Start at: 2018-08-31 12:58:21
End at: 2018-08-31 12:58:51
Local clock offset: 0.465 ms
Remote clock offset: -1.217 ms


# Below is generated by plot.py at 2018-08-31 13:18:13
# Datalink statistics
-- Total of 3 flows:
Average throughput: 422.57 Mbit/s
95th percentile per-packet one-way delay: 51.268 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 221.67 Mbit/s
95th percentile per-packet one-way delay: 51.131 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 209.61 Mbit/s
95th percentile per-packet one-way delay: 51.308 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 189.91 Mbit/s
95th percentile per-packet one-way delay: 51.686 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link

Flow 1 ingress (mean 221.67 Mbit/s) — Flow 1 egress (mean 221.67 Mbit/s)
Flow 2 ingress (mean 209.64 Mbit/s) — Flow 2 egress (mean 209.61 Mbit/s)
Flow 3 ingress (mean 189.91 Mbit/s) — Flow 3 egress (mean 189.91 Mbit/s)

Flow 1 (95th percentile 51.13 ms)   Flow 2 (95th percentile 51.31 ms)   Flow 3 (95th percentile 51.69 ms)
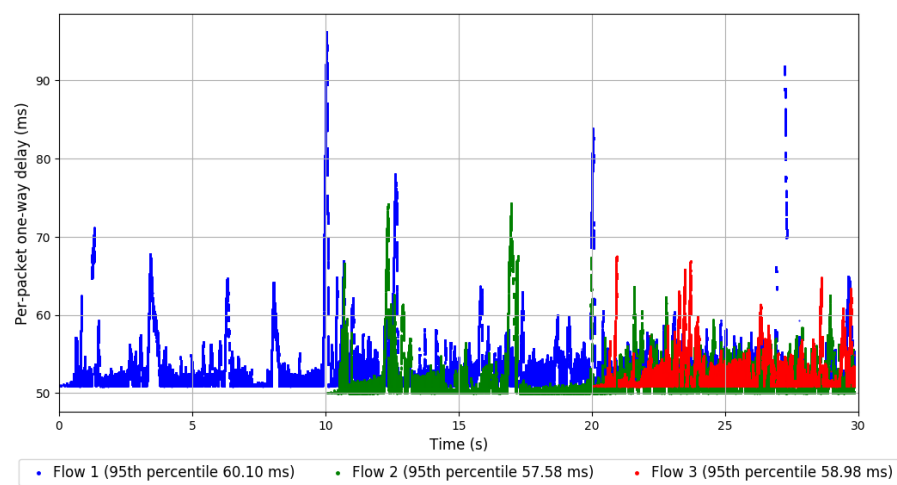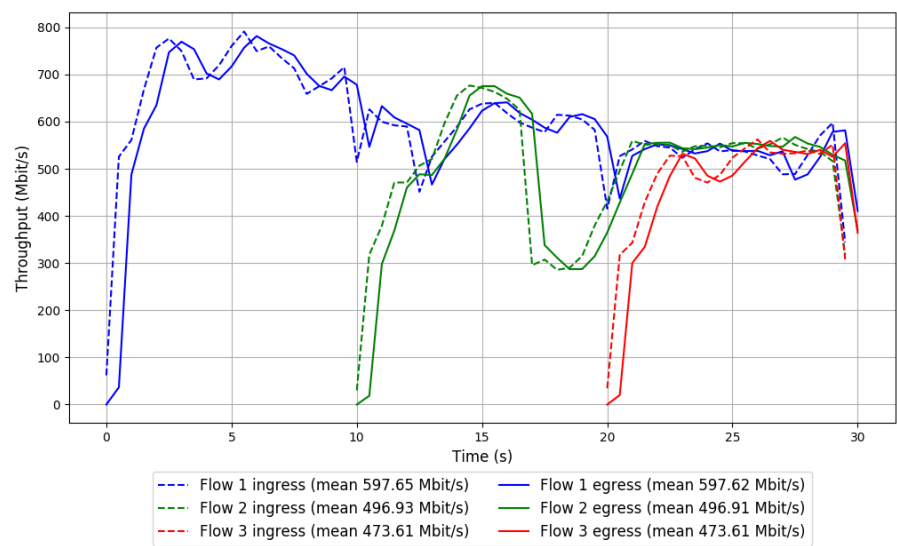
```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 12:46:16
End at: 2018-08-31 12:46:46
Local clock offset: 0.146 ms
Remote clock offset: -1.137 ms

# Below is generated by plot.py at 2018-08-31 13:19:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1082.73 Mbit/s
95th percentile per-packet one-way delay: 59.143 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 597.62 Mbit/s
95th percentile per-packet one-way delay: 60.098 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 496.91 Mbit/s
95th percentile per-packet one-way delay: 57.576 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 473.61 Mbit/s
95th percentile per-packet one-way delay: 58.978 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 12:54:13
End at: 2018-08-31 12:54:43
Local clock offset: 0.814 ms
Remote clock offset: -1.314 ms


# Below is generated by plot.py at 2018-08-31 13:19:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1079.15 Mbit/s
95th percentile per-packet one-way delay: 57.644 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 590.32 Mbit/s
95th percentile per-packet one-way delay: 58.680 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 497.43 Mbit/s
95th percentile per-packet one-way delay: 57.288 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 482.57 Mbit/s
95th percentile per-packet one-way delay: 55.343 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link

Flow 1 ingress (mean 590.33 Mbit/s) --- Flow 1 egress (mean 590.32 Mbit/s)
Flow 2 ingress (mean 497.43 Mbit/s) --- Flow 2 egress (mean 497.43 Mbit/s)
Flow 3 ingress (mean 482.60 Mbit/s) --- Flow 3 egress (mean 482.57 Mbit/s)

Flow 1 (95th percentile 58.68 ms)   Flow 2 (95th percentile 57.29 ms)   Flow 3 (95th percentile 55.34 ms)

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