Pantheon Report

Generated at 2018-09-03 09:19:35 (UTC).

Data path: GCE Sydney 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.
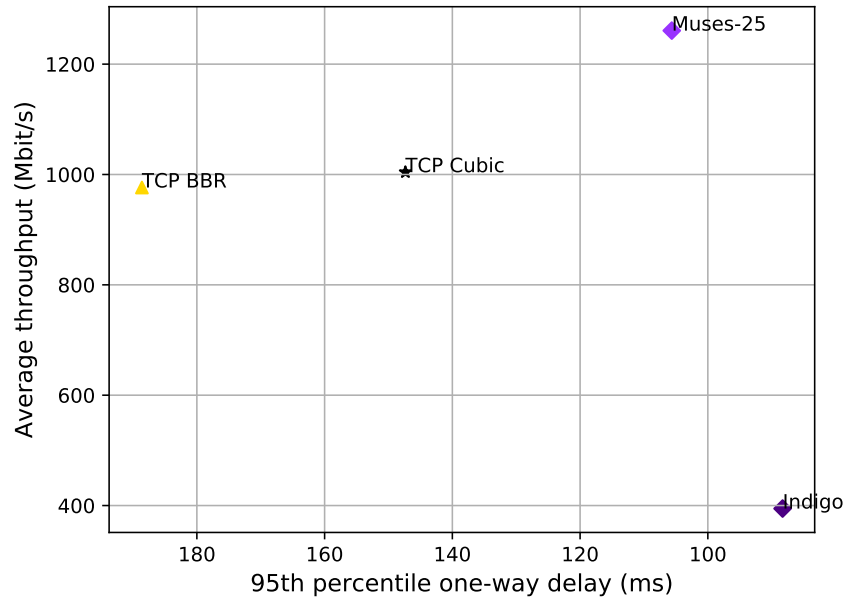
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912

Git summary:
branch: muses @ f309f5459e2c5237279a184e52ece7a2b47ef1c9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b8d5019b83a3a678804d830fcfe1da7b3a63421b
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
```
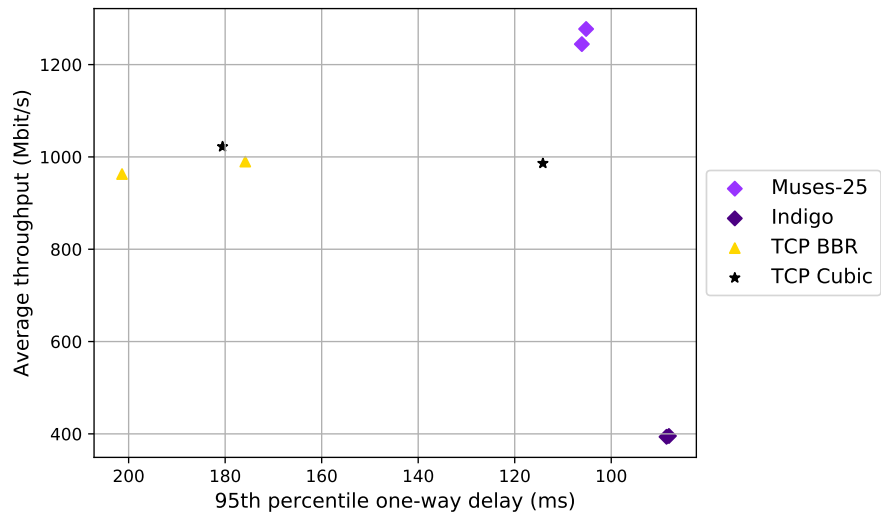
test from GCE Sydney to GCE Iowa, 2 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

Muses-25

TCP Cubic

TCP BBR

Indigo

Average throughput (Mbit/s)

95th percentile one-way delay (ms)

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

Average throughput (Mbit/s)

95th percentile one-way delay (ms)

◆ Muses-25
◆ Indigo
▲ TCP BBR
★ TCP Cubic

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	512.17	493.73	409.92	180.88	190.70	183.94	0.83	1.61	2.94
TCP Cubic	2	554.15	492.46	367.10	146.87	145.86	177.93	0.08	0.09	0.77
Indigo	2	209.14	198.21	167.81	88.04	88.37	88.67	0.00	0.00	0.00
Muses-25	2	714.74	548.55	559.72	106.29	103.71	106.63	0.01	0.01	0.01

```
Run 1: Statistics of TCP BBR

Start at: 2018-09-03 08:52:02
End at: 2018-09-03 08:52:32
Local clock offset: 21.363 ms
Remote clock offset: 17.082 ms


# Below is generated by plot.py at 2018-09-03 09:18:28
# Datalink statistics
-- Total of 3 flows:
Average throughput: 989.86 Mbit/s
95th percentile per-packet one-way delay: 175.832 ms
Loss rate: 0.71%
-- Flow 1:
Average throughput: 534.39 Mbit/s
95th percentile per-packet one-way delay: 175.582 ms
Loss rate: 0.34%
-- Flow 2:
Average throughput: 477.50 Mbit/s
95th percentile per-packet one-way delay: 187.282 ms
Loss rate: 1.64%
-- Flow 3:
Average throughput: 419.36 Mbit/s
95th percentile per-packet one-way delay: 152.119 ms
Loss rate: 0.00%
```

Run 1: Report of TCP BBR — Data Link

- - - Flow 1 ingress (mean 536.23 Mbit/s) —— Flow 1 egress (mean 534.39 Mbit/s)
- - - Flow 2 ingress (mean 485.47 Mbit/s) —— Flow 2 egress (mean 477.50 Mbit/s)
- - - Flow 3 ingress (mean 412.33 Mbit/s) —— Flow 3 egress (mean 419.36 Mbit/s)

• Flow 1 (95th percentile 175.58 ms)　• Flow 2 (95th percentile 187.28 ms)　• Flow 3 (95th percentile 152.12 ms)
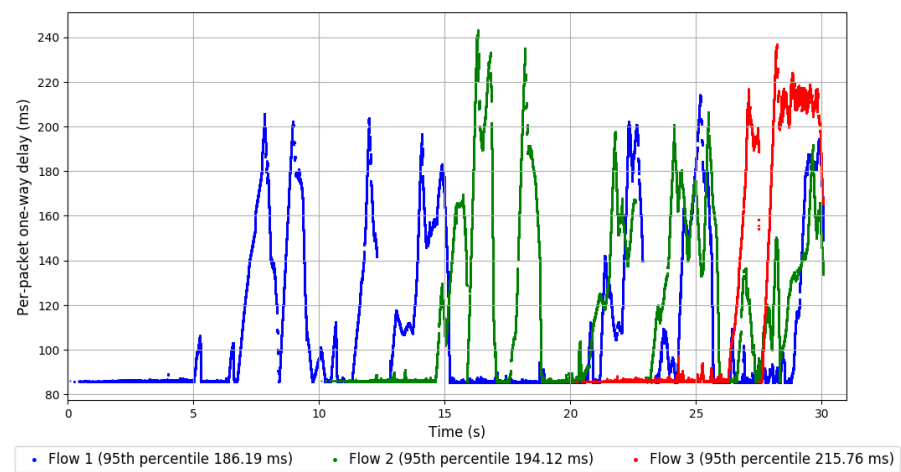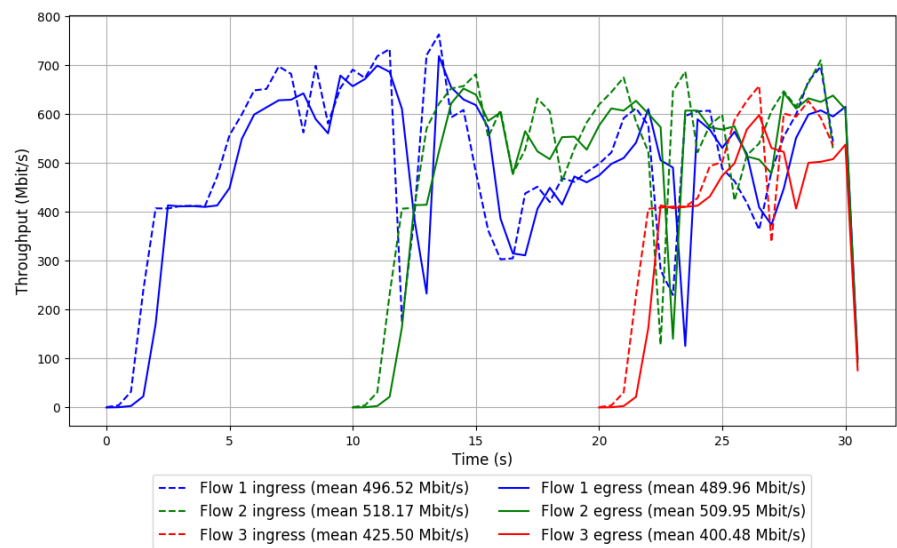
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-03 09:00:08
End at: 2018-09-03 09:00:38
Local clock offset: 19.902 ms
Remote clock offset: 18.487 ms


# Below is generated by plot.py at 2018-09-03 09:18:28
# Datalink statistics
-- Total of 3 flows:
Average throughput: 962.95 Mbit/s
95th percentile per-packet one-way delay: 201.371 ms
Loss rate: 2.07%
-- Flow 1:
Average throughput: 489.96 Mbit/s
95th percentile per-packet one-way delay: 186.187 ms
Loss rate: 1.32%
-- Flow 2:
Average throughput: 509.95 Mbit/s
95th percentile per-packet one-way delay: 194.124 ms
Loss rate: 1.59%
-- Flow 3:
Average throughput: 400.48 Mbit/s
95th percentile per-packet one-way delay: 215.763 ms
Loss rate: 5.88%
```

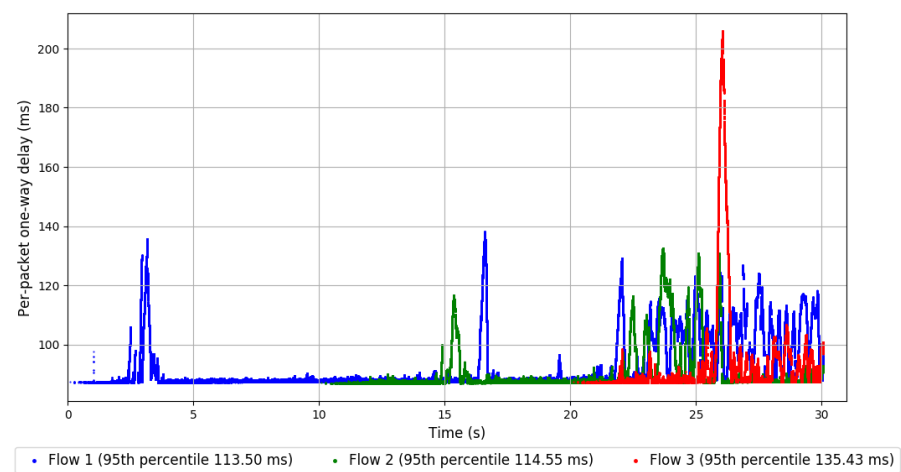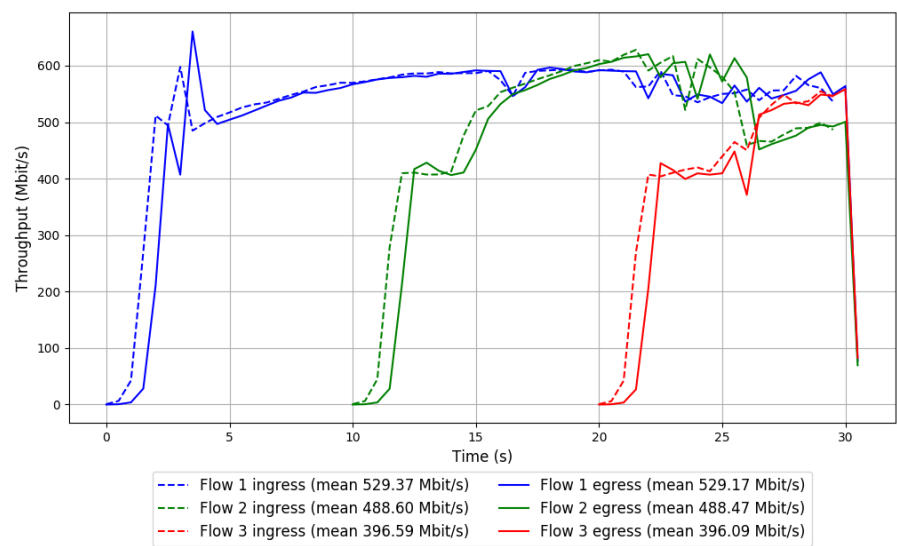Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-03 08:47:52
End at: 2018-09-03 08:48:22
Local clock offset: 16.085 ms
Remote clock offset: 18.462 ms


# Below is generated by plot.py at 2018-09-03 09:18:30
# Datalink statistics
-- Total of 3 flows:
Average throughput: 986.16 Mbit/s
95th percentile per-packet one-way delay: 114.163 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 529.17 Mbit/s
95th percentile per-packet one-way delay: 113.497 ms
Loss rate: 0.03%
-- Flow 2:
Average throughput: 488.47 Mbit/s
95th percentile per-packet one-way delay: 114.547 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 396.09 Mbit/s
95th percentile per-packet one-way delay: 135.425 ms
Loss rate: 0.11%
```

Run 1: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 529.37 Mbit/s) — — — Flow 1 egress (mean 529.17 Mbit/s)
Flow 2 ingress (mean 488.60 Mbit/s) — — — Flow 2 egress (mean 488.47 Mbit/s)
Flow 3 ingress (mean 396.59 Mbit/s) — — — Flow 3 egress (mean 396.09 Mbit/s)

Flow 1 (95th percentile 113.50 ms)   Flow 2 (95th percentile 114.55 ms)   Flow 3 (95th percentile 135.43 ms)
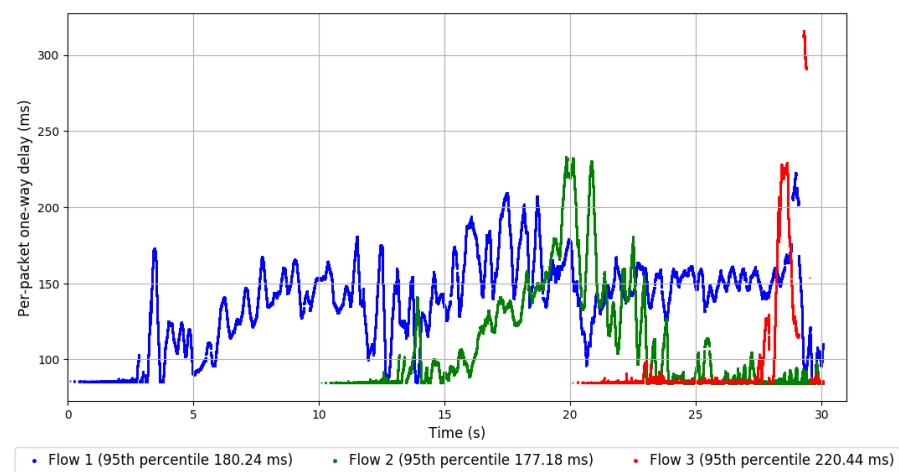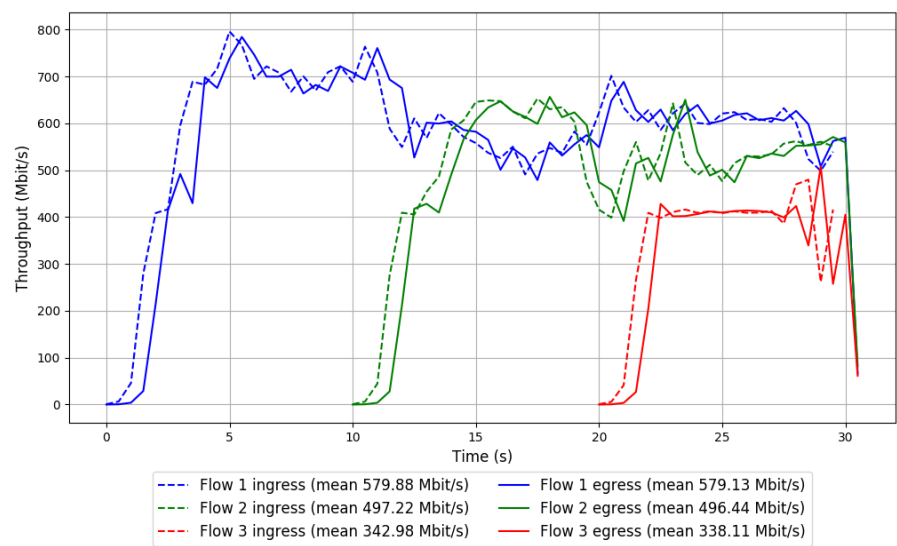
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```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-03 08:55:57
End at: 2018-09-03 08:56:27
Local clock offset: 24.509 ms
Remote clock offset: 17.304 ms


# Below is generated by plot.py at 2018-09-03 09:18:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1022.17 Mbit/s
95th percentile per-packet one-way delay: 180.539 ms
Loss rate: 0.29%
-- Flow 1:
Average throughput: 579.13 Mbit/s
95th percentile per-packet one-way delay: 180.238 ms
Loss rate: 0.13%
-- Flow 2:
Average throughput: 496.44 Mbit/s
95th percentile per-packet one-way delay: 177.182 ms
Loss rate: 0.16%
-- Flow 3:
Average throughput: 338.11 Mbit/s
95th percentile per-packet one-way delay: 220.439 ms
Loss rate: 1.42%
```

Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 579.88 Mbit/s) --- Flow 1 egress (mean 579.13 Mbit/s)
Flow 2 ingress (mean 497.22 Mbit/s) --- Flow 2 egress (mean 496.44 Mbit/s)
Flow 3 ingress (mean 342.98 Mbit/s) --- Flow 3 egress (mean 338.11 Mbit/s)

Flow 1 (95th percentile 180.24 ms)   Flow 2 (95th percentile 177.18 ms)   Flow 3 (95th percentile 220.44 ms)
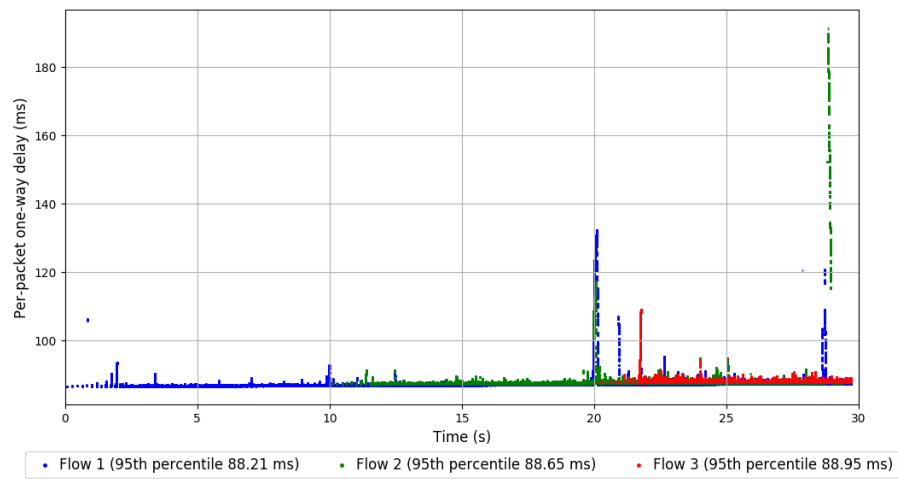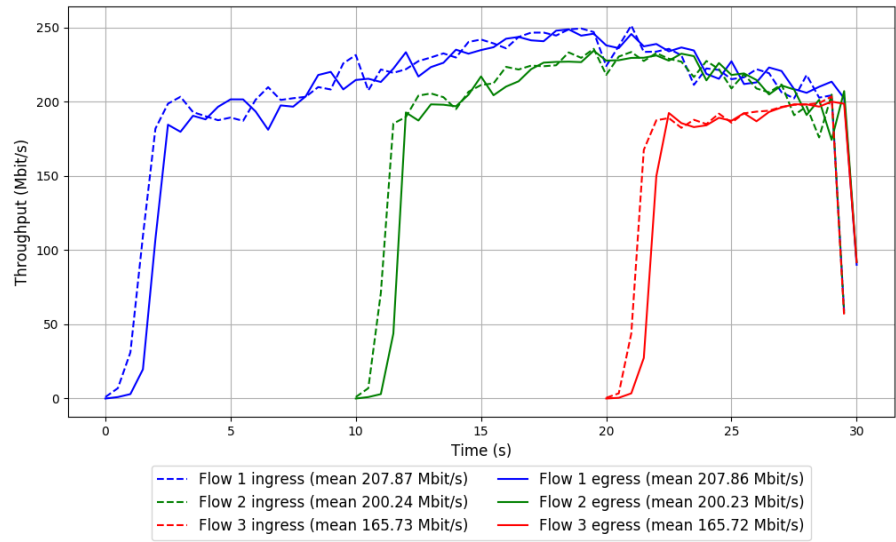
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```
Run 1: Statistics of Indigo

Start at: 2018-09-03 08:46:02
End at: 2018-09-03 08:46:33
Local clock offset: 14.226 ms
Remote clock offset: 19.722 ms


# Below is generated by plot.py at 2018-09-03 09:18:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 393.66 Mbit/s
95th percentile per-packet one-way delay: 88.545 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 207.86 Mbit/s
95th percentile per-packet one-way delay: 88.206 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 200.23 Mbit/s
95th percentile per-packet one-way delay: 88.649 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 165.72 Mbit/s
95th percentile per-packet one-way delay: 88.949 ms
Loss rate: 0.00%
```
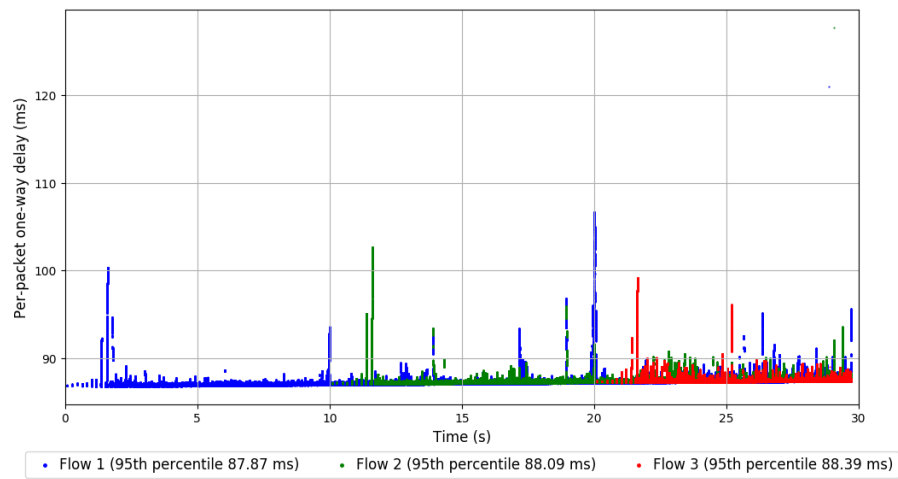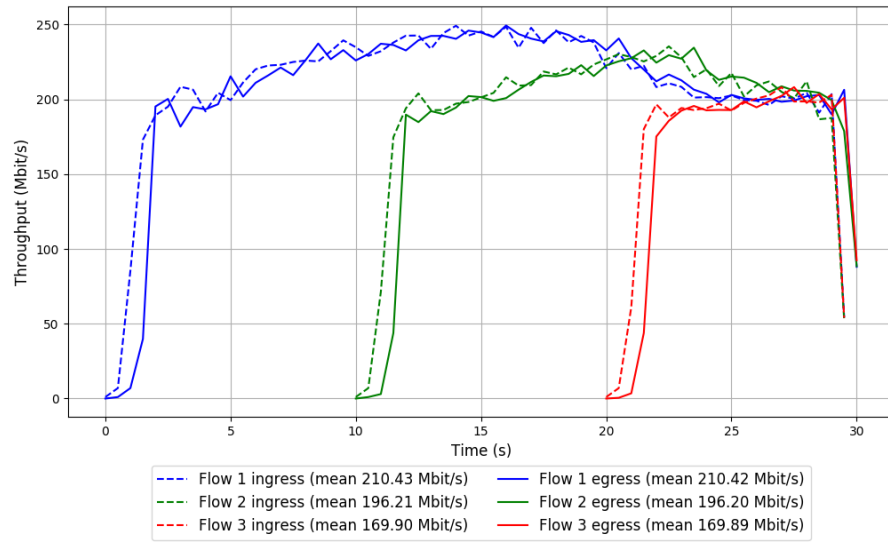
Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2018-09-03 08:54:08
End at: 2018-09-03 08:54:38
Local clock offset: 24.079 ms
Remote clock offset: 17.047 ms


# Below is generated by plot.py at 2018-09-03 09:18:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 395.41 Mbit/s
95th percentile per-packet one-way delay: 88.045 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 210.42 Mbit/s
95th percentile per-packet one-way delay: 87.873 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 196.20 Mbit/s
95th percentile per-packet one-way delay: 88.093 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 169.89 Mbit/s
95th percentile per-packet one-way delay: 88.387 ms
Loss rate: 0.00%
```
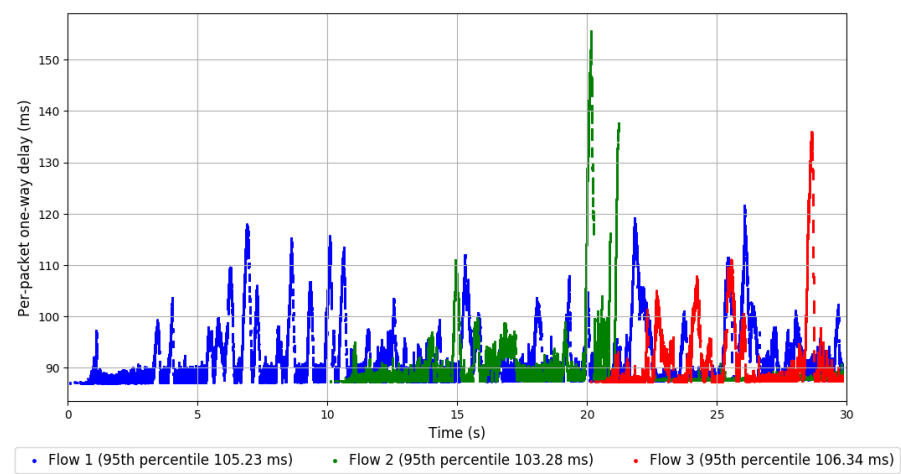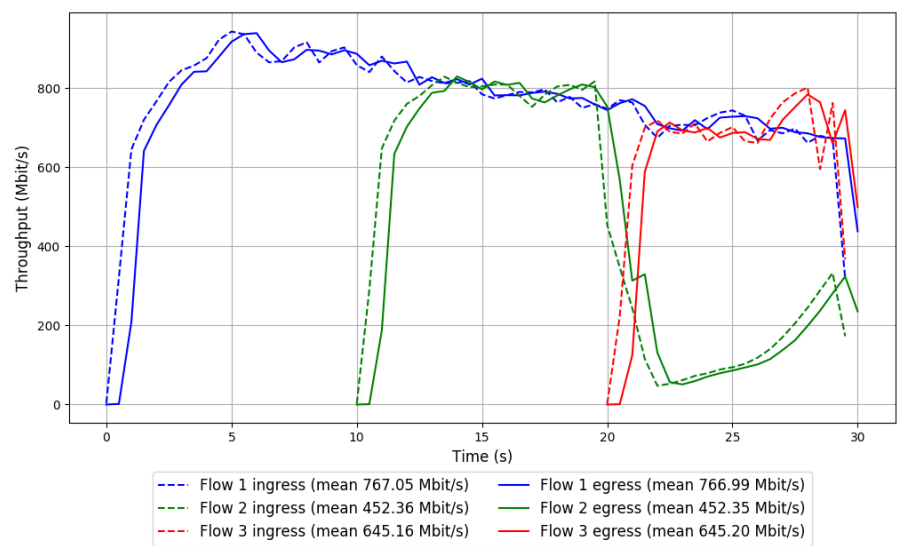
Run 2: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-09-03 08:49:55
End at: 2018-09-03 08:50:25
Local clock offset: 18.391 ms
Remote clock offset: 17.563 ms


# Below is generated by plot.py at 2018-09-03 09:19:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1277.16 Mbit/s
95th percentile per-packet one-way delay: 105.205 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 766.99 Mbit/s
95th percentile per-packet one-way delay: 105.227 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 452.35 Mbit/s
95th percentile per-packet one-way delay: 103.275 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 645.20 Mbit/s
95th percentile per-packet one-way delay: 106.339 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link

Flow 1 ingress (mean 767.05 Mbit/s) — — — Flow 1 egress (mean 766.99 Mbit/s) ——
Flow 2 ingress (mean 452.36 Mbit/s) — — — Flow 2 egress (mean 452.35 Mbit/s) ——
Flow 3 ingress (mean 645.16 Mbit/s) — — — Flow 3 egress (mean 645.20 Mbit/s) ——

Flow 1 (95th percentile 105.23 ms) · Flow 2 (95th percentile 103.28 ms) · Flow 3 (95th percentile 106.34 ms)

```
Run 2: Statistics of Muses-25

Start at: 2018-09-03 08:58:03
End at: 2018-09-03 08:58:33
Local clock offset: 21.186 ms
Remote clock offset: 17.808 ms


# Below is generated by plot.py at 2018-09-03 09:19:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1244.38 Mbit/s
95th percentile per-packet one-way delay: 106.088 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 662.48 Mbit/s
95th percentile per-packet one-way delay: 107.352 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 644.75 Mbit/s
95th percentile per-packet one-way delay: 104.139 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 474.23 Mbit/s
95th percentile per-packet one-way delay: 106.924 ms
Loss rate: 0.01%
```

Run 2: Report of Muses-25 — Data Link

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