Pantheon Report

Generated at 2018-09-05 03:01:26 (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.
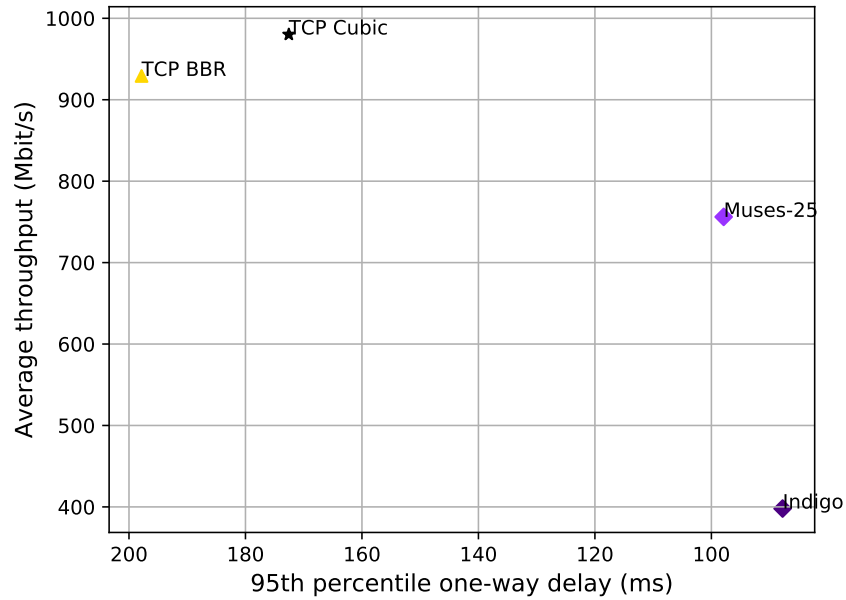
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
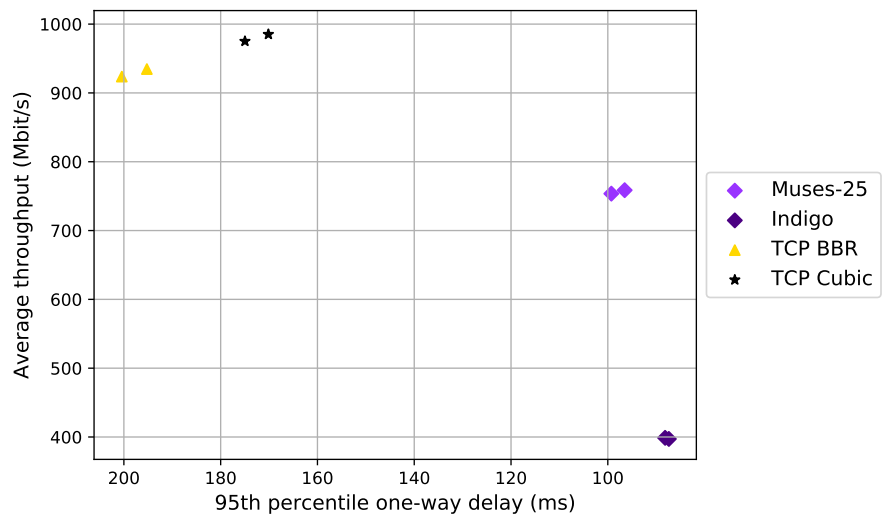
```
Git summary:
branch: muses @ 71e71e9a55b945431a7dea72180c1c9381097db9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ 96fbc95fb38373d71fbc80c5a105e62e7636623b
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)

test from GCE Sydney 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	517.95	441.51	352.86	164.27	197.18	232.93	0.86	1.22	4.77
TCP Cubic	2	532.81	476.76	390.59	175.14	133.62	129.53	0.17	0.03	0.26
Indigo	2	210.13	200.01	172.31	87.39	88.14	87.67	0.00	0.00	0.00
Muses-25	2	388.41	391.93	331.19	99.52	96.78	94.94	0.00	0.00	0.00

```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 02:35:33
End at: 2018-09-05 02:36:03
Local clock offset: 14.276 ms
Remote clock offset: 4.411 ms


# Below is generated by plot.py at 2018-09-05 03:01:04
# Datalink statistics
-- Total of 3 flows:
Average throughput: 923.74 Mbit/s
95th percentile per-packet one-way delay: 200.426 ms
Loss rate: 1.57%
-- Flow 1:
Average throughput: 509.08 Mbit/s
95th percentile per-packet one-way delay: 178.533 ms
Loss rate: 1.02%
-- Flow 2:
Average throughput: 454.99 Mbit/s
95th percentile per-packet one-way delay: 208.199 ms
Loss rate: 1.93%
-- Flow 3:
Average throughput: 335.82 Mbit/s
95th percentile per-packet one-way delay: 226.912 ms
Loss rate: 3.07%
```
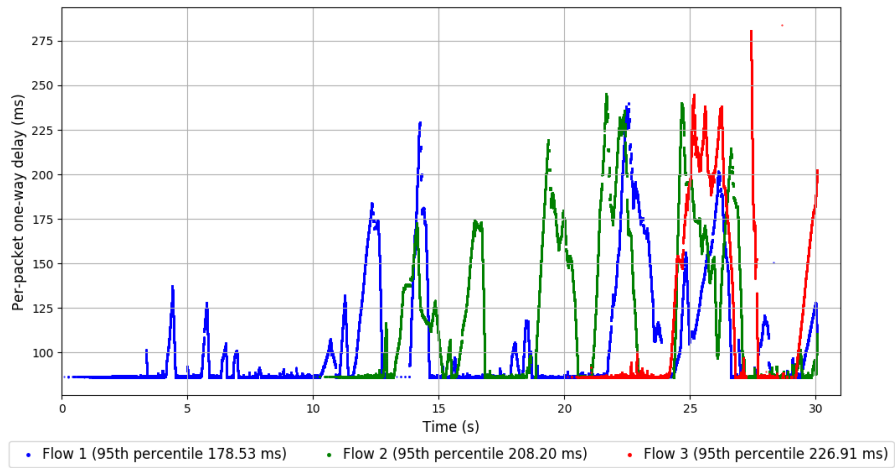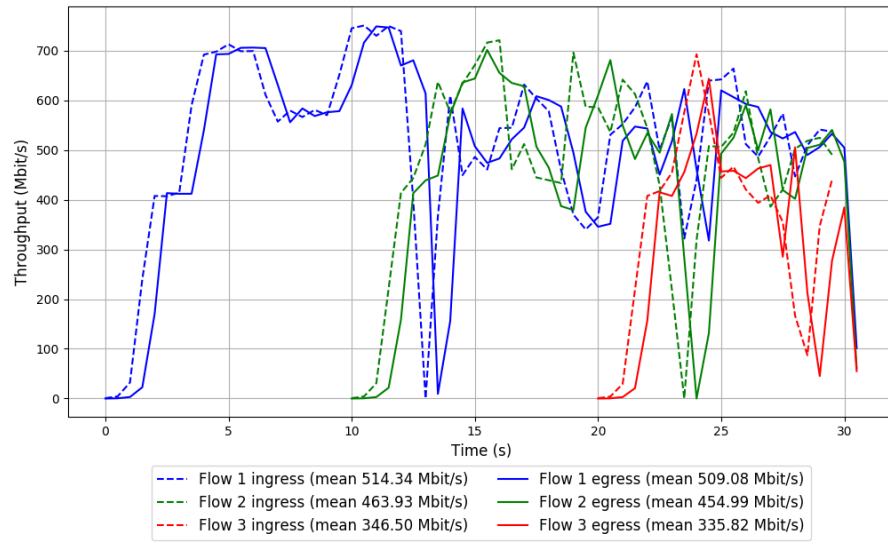
Run 1: Report of TCP BBR — Data Link

```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 02:43:40
End at: 2018-09-05 02:44:10
Local clock offset: 13.498 ms
Remote clock offset: 4.161 ms


# Below is generated by plot.py at 2018-09-05 03:01:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 934.70 Mbit/s
95th percentile per-packet one-way delay: 195.248 ms
Loss rate: 1.45%
-- Flow 1:
Average throughput: 526.82 Mbit/s
95th percentile per-packet one-way delay: 150.013 ms
Loss rate: 0.71%
-- Flow 2:
Average throughput: 428.04 Mbit/s
95th percentile per-packet one-way delay: 186.156 ms
Loss rate: 0.51%
-- Flow 3:
Average throughput: 369.90 Mbit/s
95th percentile per-packet one-way delay: 238.957 ms
Loss rate: 6.47%
```
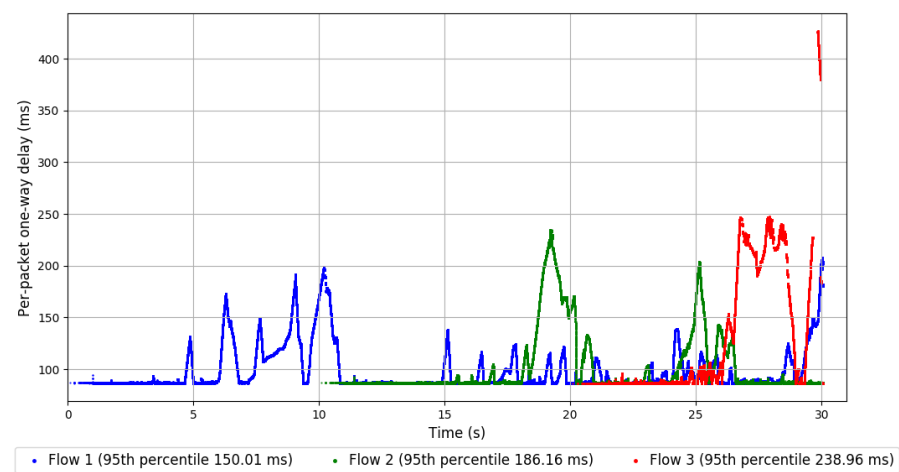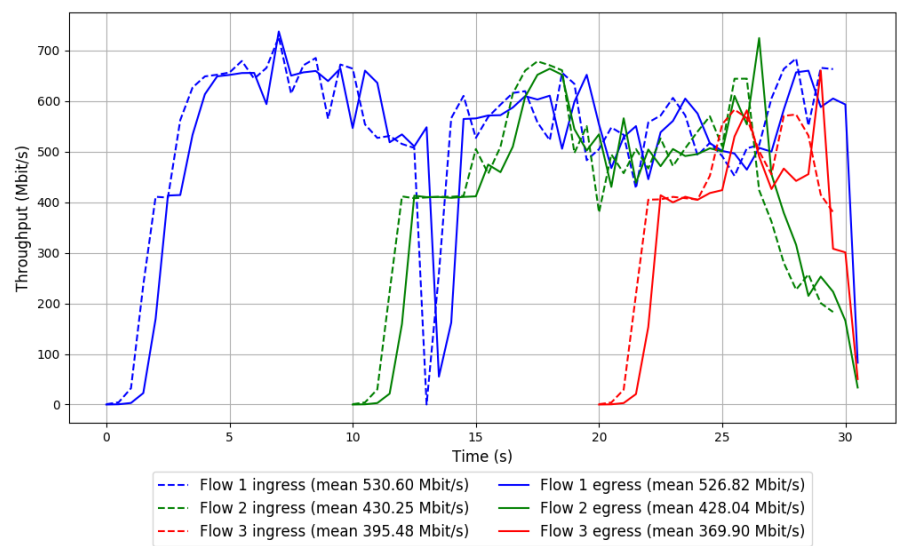
Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 02:29:39
End at: 2018-09-05 02:30:09
Local clock offset: 18.999 ms
Remote clock offset: 5.824 ms


# Below is generated by plot.py at 2018-09-05 03:01:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 975.07 Mbit/s
95th percentile per-packet one-way delay: 174.983 ms
Loss rate: 0.25%
-- Flow 1:
Average throughput: 534.48 Mbit/s
95th percentile per-packet one-way delay: 180.245 ms
Loss rate: 0.33%
-- Flow 2:
Average throughput: 469.50 Mbit/s
95th percentile per-packet one-way delay: 93.479 ms
Loss rate: 0.05%
-- Flow 3:
Average throughput: 384.75 Mbit/s
95th percentile per-packet one-way delay: 142.277 ms
Loss rate: 0.39%
```
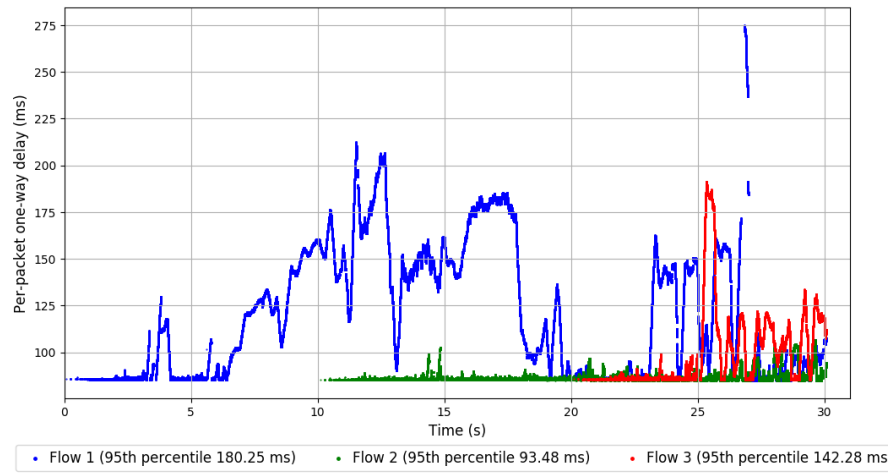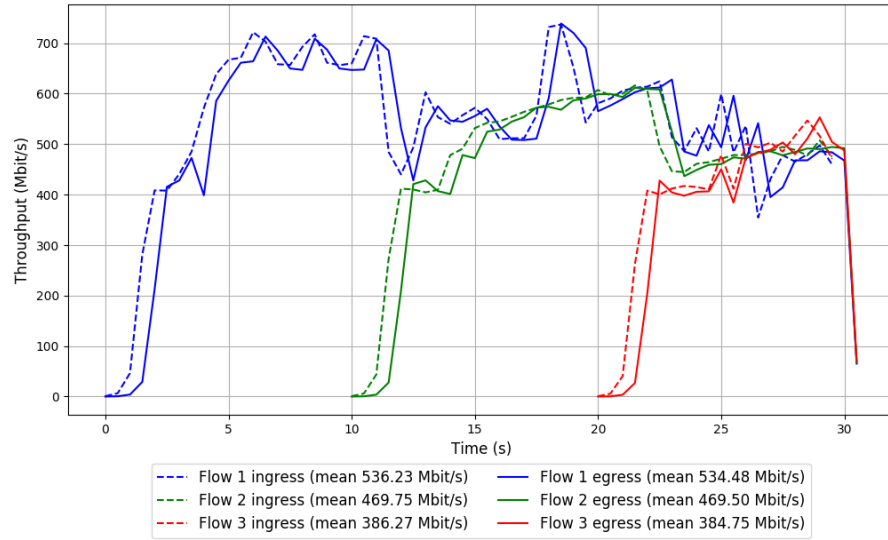
Run 1: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 536.23 Mbit/s) --- Flow 1 egress (mean 534.48 Mbit/s)
Flow 2 ingress (mean 469.75 Mbit/s) --- Flow 2 egress (mean 469.50 Mbit/s)
Flow 3 ingress (mean 386.27 Mbit/s) --- Flow 3 egress (mean 384.75 Mbit/s)

Flow 1 (95th percentile 180.25 ms)   Flow 2 (95th percentile 93.48 ms)   Flow 3 (95th percentile 142.28 ms)

9

```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 02:37:44
End at: 2018-09-05 02:38:14
Local clock offset: 13.648 ms
Remote clock offset: 4.22 ms


# Below is generated by plot.py at 2018-09-05 03:01:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 985.19 Mbit/s
95th percentile per-packet one-way delay: 170.134 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 531.14 Mbit/s
95th percentile per-packet one-way delay: 170.029 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 484.03 Mbit/s
95th percentile per-packet one-way delay: 173.751 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 396.43 Mbit/s
95th percentile per-packet one-way delay: 116.779 ms
Loss rate: 0.13%
```
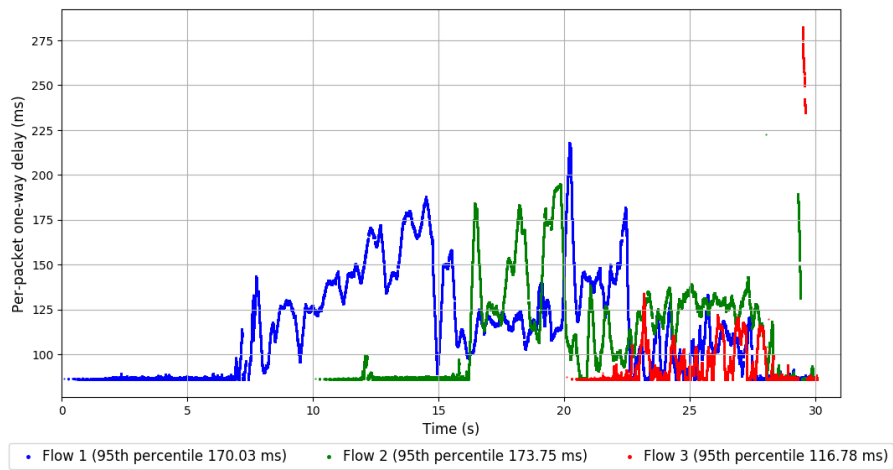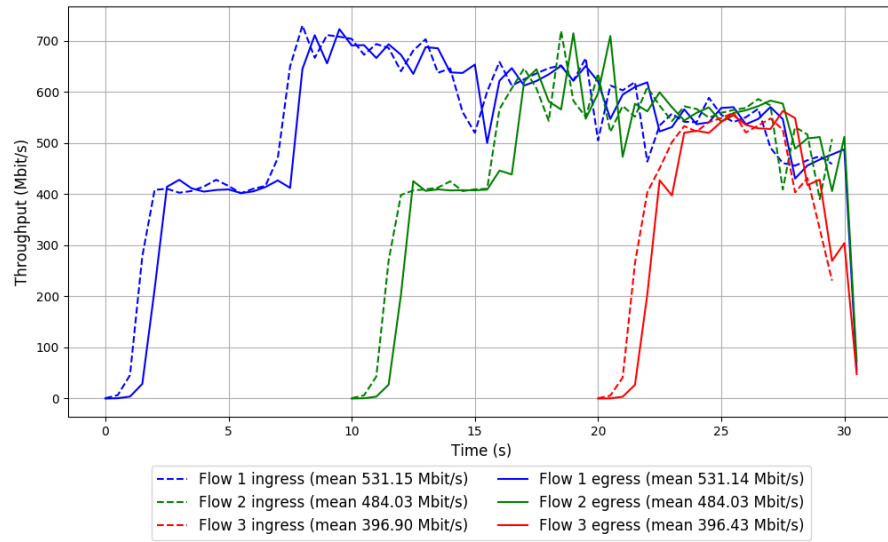
Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 531.15 Mbit/s)   Flow 1 egress (mean 531.14 Mbit/s)
Flow 2 ingress (mean 484.03 Mbit/s)   Flow 2 egress (mean 484.03 Mbit/s)
Flow 3 ingress (mean 396.90 Mbit/s)   Flow 3 egress (mean 396.43 Mbit/s)

Flow 1 (95th percentile 170.03 ms)   Flow 2 (95th percentile 173.75 ms)   Flow 3 (95th percentile 116.78 ms)
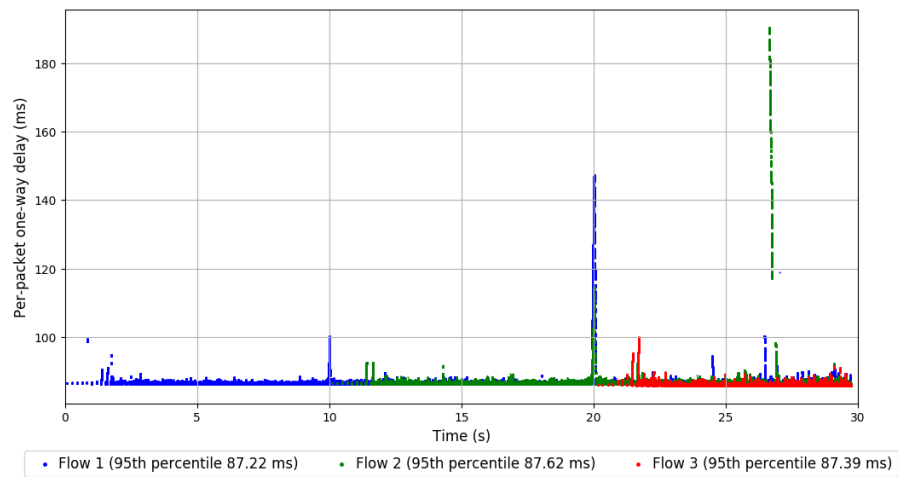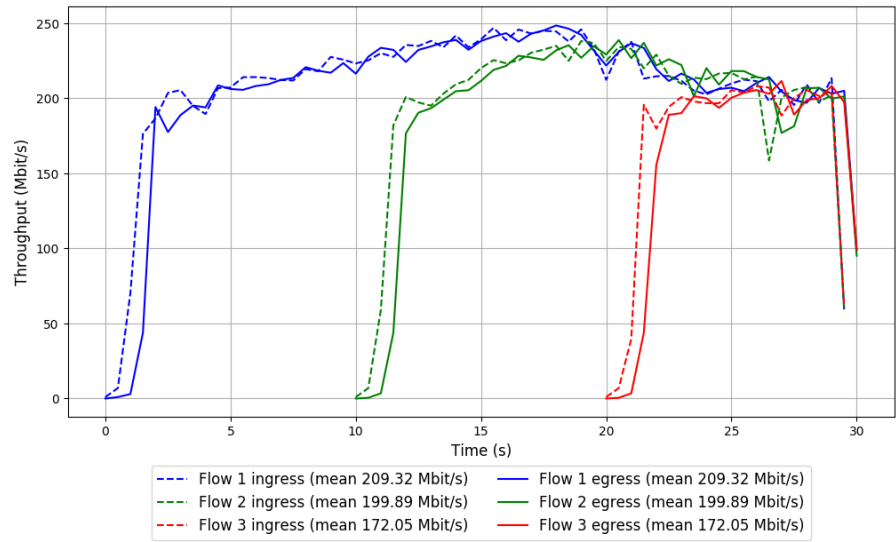
11

```
Run 1: Statistics of Indigo

Start at: 2018-09-05 02:33:40
End at: 2018-09-05 02:34:10
Local clock offset: 15.105 ms
Remote clock offset: 4.737 ms


# Below is generated by plot.py at 2018-09-05 03:01:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 397.17 Mbit/s
95th percentile per-packet one-way delay: 87.386 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 209.32 Mbit/s
95th percentile per-packet one-way delay: 87.222 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 199.89 Mbit/s
95th percentile per-packet one-way delay: 87.619 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 172.05 Mbit/s
95th percentile per-packet one-way delay: 87.393 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

13

```
Run 2: Statistics of Indigo

Start at: 2018-09-05 02:41:46
End at: 2018-09-05 02:42:16
Local clock offset: 13.159 ms
Remote clock offset: 4.106 ms


# Below is generated by plot.py at 2018-09-05 03:01:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 398.77 Mbit/s
95th percentile per-packet one-way delay: 88.161 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 210.95 Mbit/s
95th percentile per-packet one-way delay: 87.554 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 200.14 Mbit/s
95th percentile per-packet one-way delay: 88.667 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 172.57 Mbit/s
95th percentile per-packet one-way delay: 87.940 ms
Loss rate: 0.00%
```
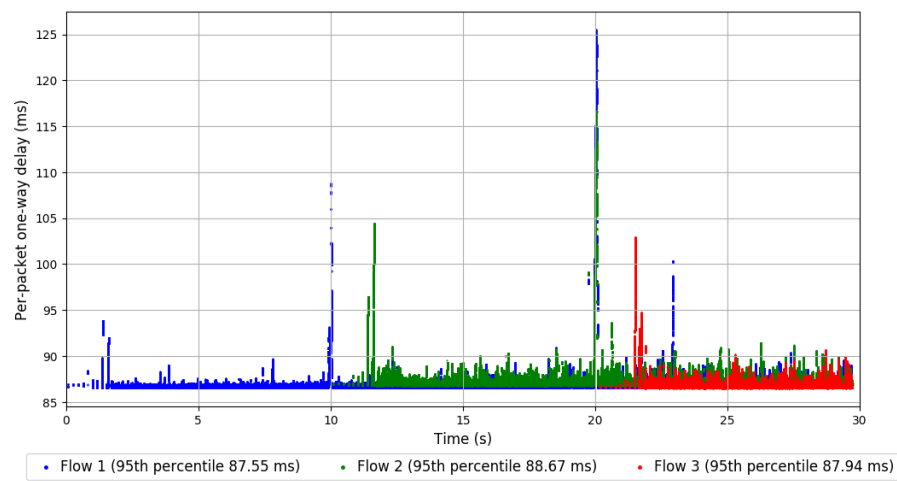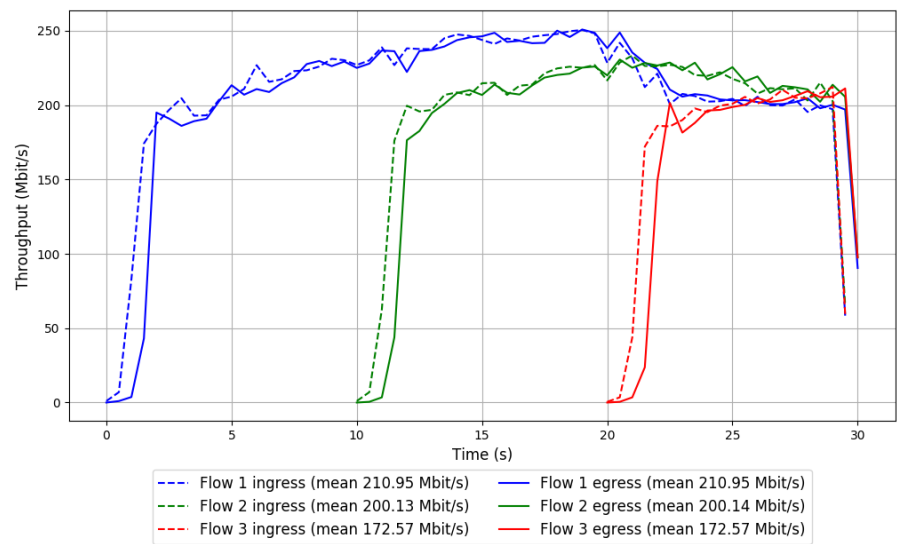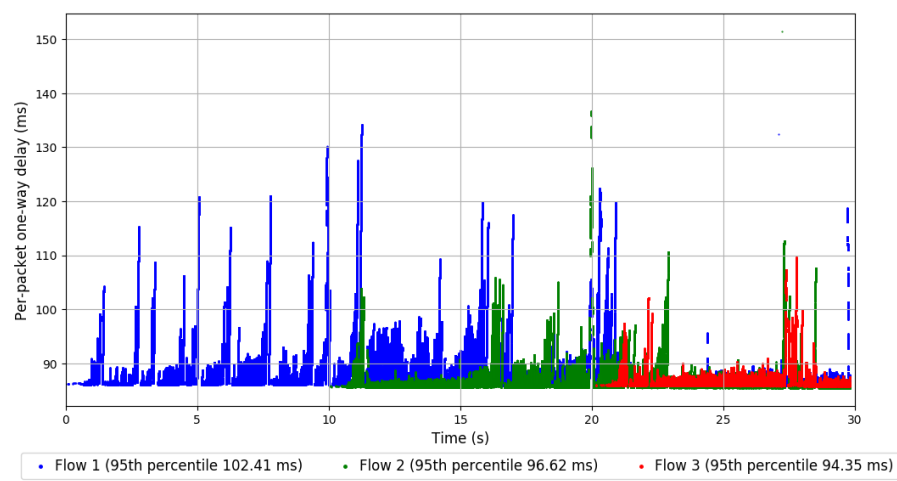
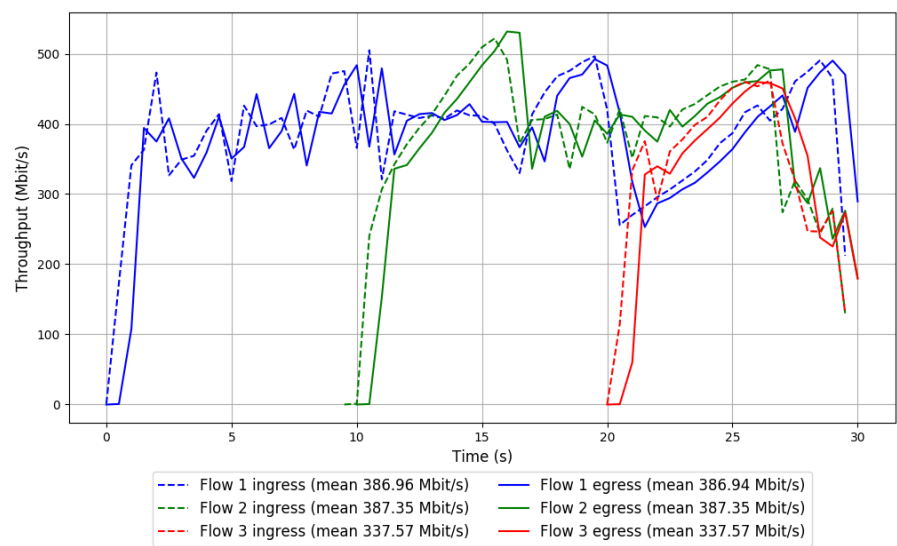Run 2: Report of Indigo — Data Link

15

```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 02:31:45
End at: 2018-09-05 02:32:15
Local clock offset: 16.467 ms
Remote clock offset: 5.156 ms

# Below is generated by plot.py at 2018-09-05 03:01:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 753.63 Mbit/s
95th percentile per-packet one-way delay: 99.267 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 386.94 Mbit/s
95th percentile per-packet one-way delay: 102.413 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 387.35 Mbit/s
95th percentile per-packet one-way delay: 96.619 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 337.57 Mbit/s
95th percentile per-packet one-way delay: 94.350 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link

17

```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 02:39:52
End at: 2018-09-05 02:40:22
Local clock offset: 13.23 ms
Remote clock offset: 4.153 ms


# Below is generated by plot.py at 2018-09-05 03:01:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 758.65 Mbit/s
95th percentile per-packet one-way delay: 96.517 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 389.89 Mbit/s
95th percentile per-packet one-way delay: 96.617 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 396.50 Mbit/s
95th percentile per-packet one-way delay: 96.943 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 324.80 Mbit/s
95th percentile per-packet one-way delay: 95.539 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link