Pantheon Report

Generated at 2018-09-05 05:52:19 (UTC).

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

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.
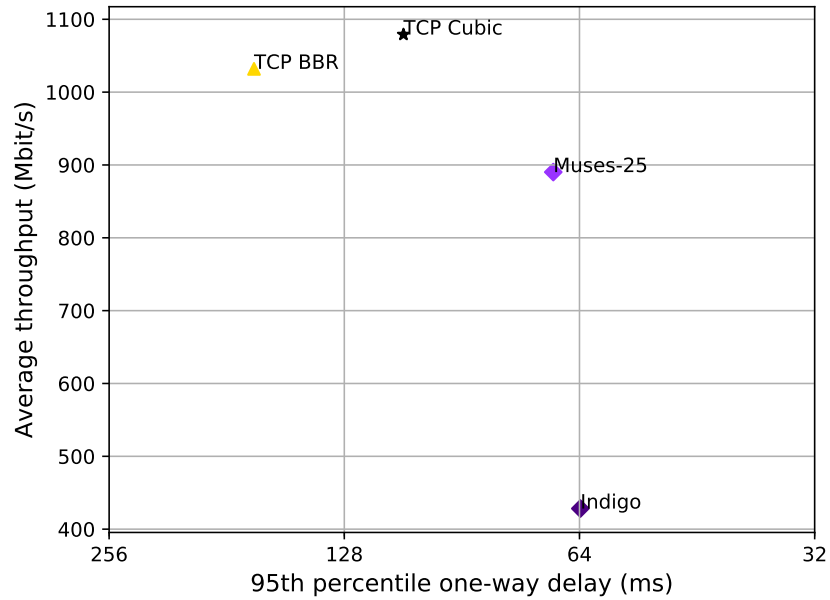
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
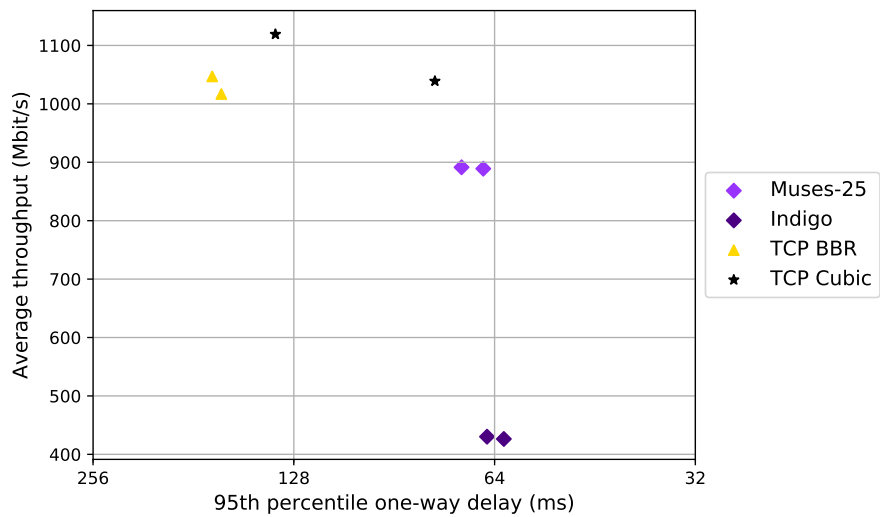
```
Git summary:
branch: muses @ 71e71e9a55b945431a7dea72180c1c9381097db9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
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 Tokyo 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 Tokyo to GCE Iowa, 2 runs of 30s each per scheme
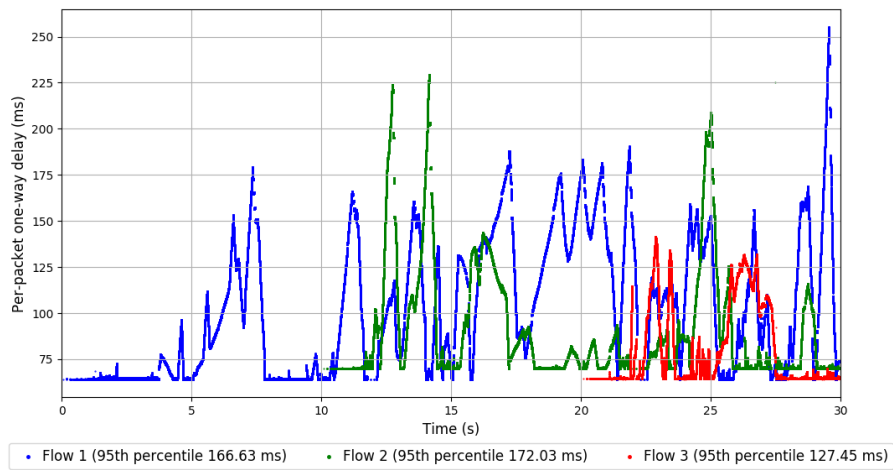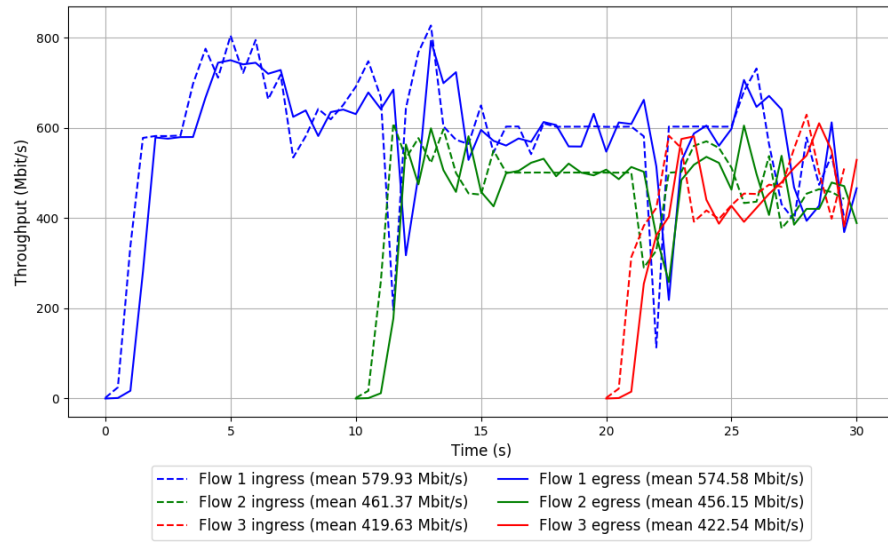### 3 flows with 10s interval between flows

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	561.59	487.87	443.25	168.24	142.37	164.94	1.72	1.21	2.40
TCP Cubic	2	576.07	522.38	471.94	99.80	109.98	86.51	0.49	0.90	1.53
Indigo	2	223.62	220.75	179.88	63.12	64.40	64.38	0.41	0.62	1.45
Muses-25	2	464.49	429.95	427.42	70.71	68.75	66.66	0.33	0.52	0.90

```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 05:24:58
End at: 2018-09-05 05:25:28
Local clock offset: 0.076 ms
Remote clock offset: -2.879 ms


# Below is generated by plot.py at 2018-09-05 05:52:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1016.87 Mbit/s
95th percentile per-packet one-way delay: 164.395 ms
Loss rate: 1.35%
-- Flow 1:
Average throughput: 574.58 Mbit/s
95th percentile per-packet one-way delay: 166.627 ms
Loss rate: 1.33%
-- Flow 2:
Average throughput: 456.15 Mbit/s
95th percentile per-packet one-way delay: 172.029 ms
Loss rate: 1.77%
-- Flow 3:
Average throughput: 422.54 Mbit/s
95th percentile per-packet one-way delay: 127.452 ms
Loss rate: 0.55%
```
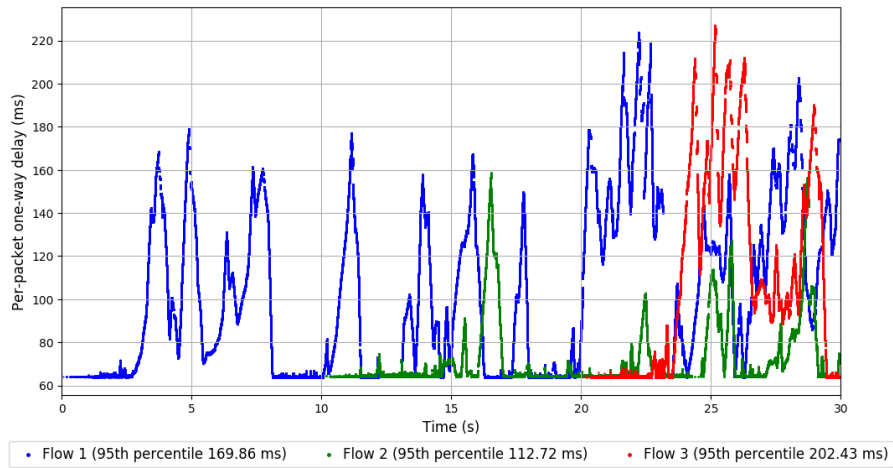
Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 579.93 Mbit/s)   Flow 1 egress (mean 574.58 Mbit/s)
Flow 2 ingress (mean 461.37 Mbit/s)   Flow 2 egress (mean 456.15 Mbit/s)
Flow 3 ingress (mean 419.63 Mbit/s)   Flow 3 egress (mean 422.54 Mbit/s)

Flow 1 (95th percentile 166.63 ms)   Flow 2 (95th percentile 172.03 ms)   Flow 3 (95th percentile 127.45 ms)

```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 05:32:58
End at: 2018-09-05 05:33:28
Local clock offset: 0.084 ms
Remote clock offset: -2.88 ms


# Below is generated by plot.py at 2018-09-05 05:52:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1047.01 Mbit/s
95th percentile per-packet one-way delay: 169.656 ms
Loss rate: 1.95%
-- Flow 1:
Average throughput: 548.59 Mbit/s
95th percentile per-packet one-way delay: 169.856 ms
Loss rate: 2.10%
-- Flow 2:
Average throughput: 519.58 Mbit/s
95th percentile per-packet one-way delay: 112.719 ms
Loss rate: 0.65%
-- Flow 3:
Average throughput: 463.96 Mbit/s
95th percentile per-packet one-way delay: 202.434 ms
Loss rate: 4.24%
```
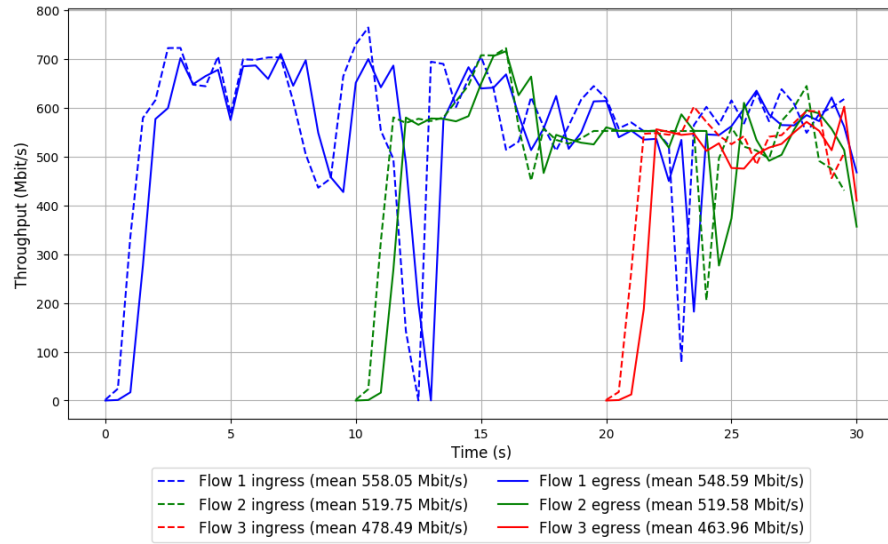
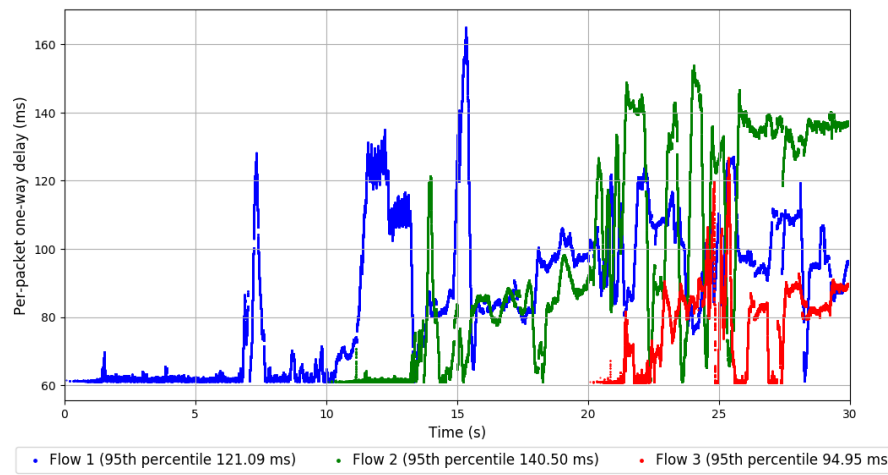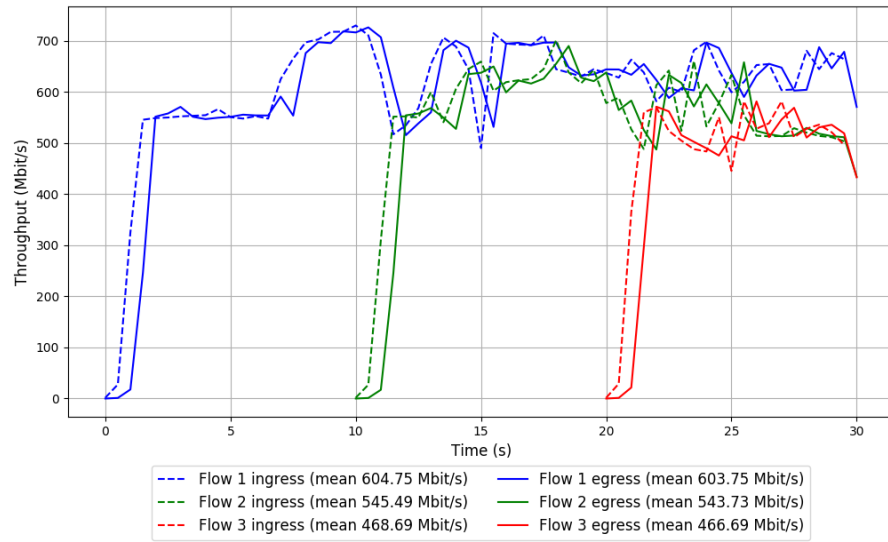Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 05:19:02
End at: 2018-09-05 05:19:32
Local clock offset: 0.003 ms
Remote clock offset: -0.136 ms


# Below is generated by plot.py at 2018-09-05 05:52:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1119.17 Mbit/s
95th percentile per-packet one-way delay: 136.393 ms
Loss rate: 0.86%
-- Flow 1:
Average throughput: 603.75 Mbit/s
95th percentile per-packet one-way delay: 121.086 ms
Loss rate: 0.59%
-- Flow 2:
Average throughput: 543.73 Mbit/s
95th percentile per-packet one-way delay: 140.504 ms
Loss rate: 0.96%
-- Flow 3:
Average throughput: 466.69 Mbit/s
95th percentile per-packet one-way delay: 94.953 ms
Loss rate: 1.65%
```

Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 05:27:06
End at: 2018-09-05 05:27:36
Local clock offset: 0.015 ms
Remote clock offset: 0.018 ms


# Below is generated by plot.py at 2018-09-05 05:52:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1038.92 Mbit/s
95th percentile per-packet one-way delay: 78.650 ms
Loss rate: 0.69%
-- Flow 1:
Average throughput: 548.39 Mbit/s
95th percentile per-packet one-way delay: 78.512 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 501.02 Mbit/s
95th percentile per-packet one-way delay: 79.459 ms
Loss rate: 0.84%
-- Flow 3:
Average throughput: 477.18 Mbit/s
95th percentile per-packet one-way delay: 78.076 ms
Loss rate: 1.41%
```
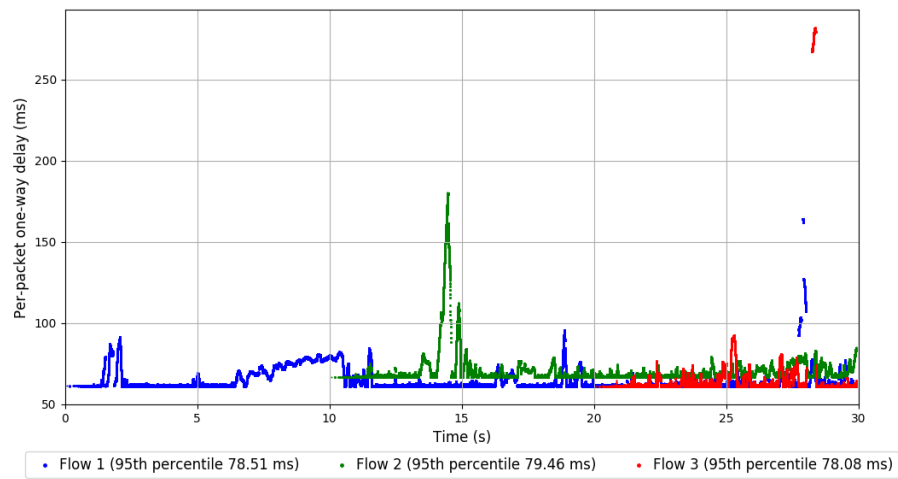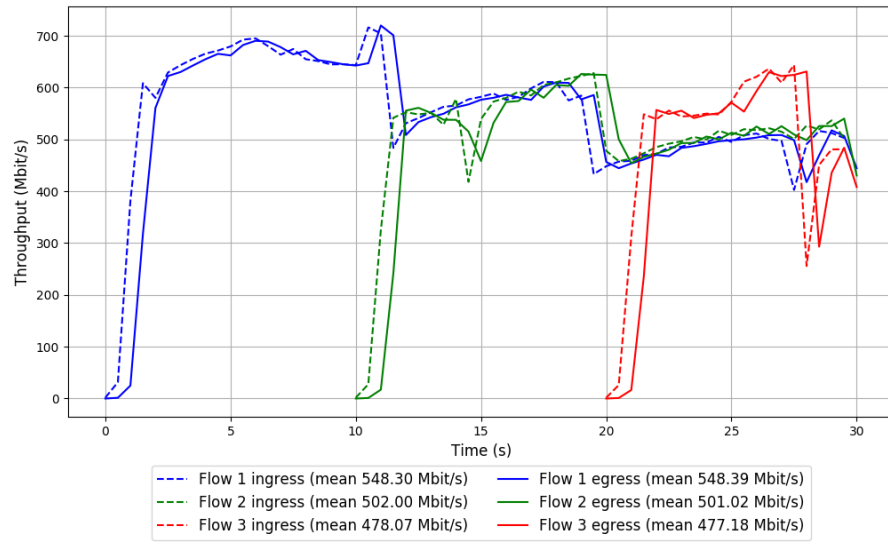
Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 548.30 Mbit/s) — — — — Flow 1 egress (mean 548.39 Mbit/s)
Flow 2 ingress (mean 502.00 Mbit/s) — — — — Flow 2 egress (mean 501.02 Mbit/s)
Flow 3 ingress (mean 478.07 Mbit/s) — — — — Flow 3 egress (mean 477.18 Mbit/s)

Flow 1 (95th percentile 78.51 ms)   Flow 2 (95th percentile 79.46 ms)   Flow 3 (95th percentile 78.08 ms)
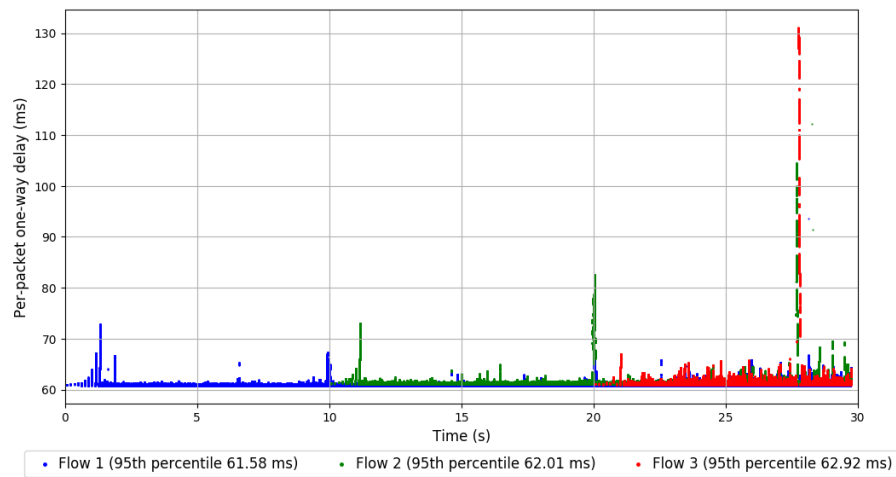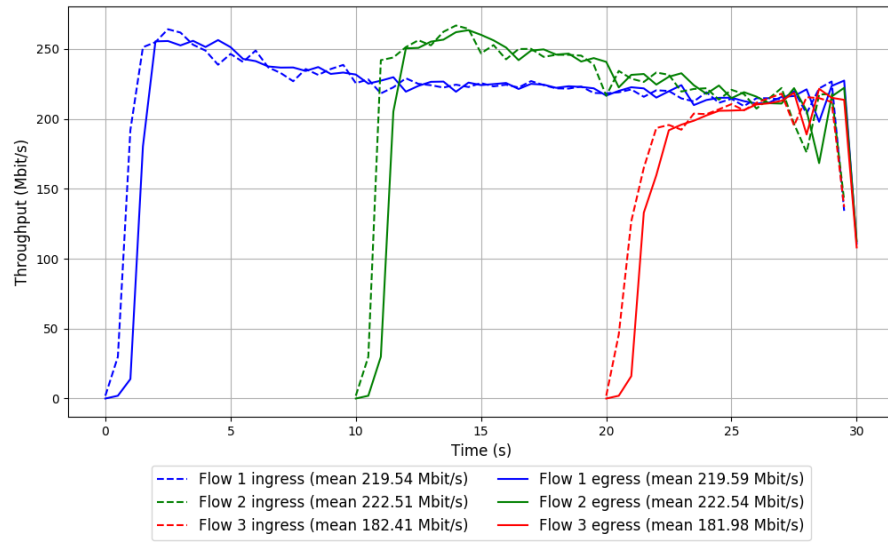
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 05:23:06
End at: 2018-09-05 05:23:36
Local clock offset: 0.048 ms
Remote clock offset: -0.066 ms


# Below is generated by plot.py at 2018-09-05 05:52:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 426.32 Mbit/s
95th percentile per-packet one-way delay: 61.987 ms
Loss rate: 0.62%
-- Flow 1:
Average throughput: 219.59 Mbit/s
95th percentile per-packet one-way delay: 61.577 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 222.54 Mbit/s
95th percentile per-packet one-way delay: 62.014 ms
Loss rate: 0.60%
-- Flow 3:
Average throughput: 181.98 Mbit/s
95th percentile per-packet one-way delay: 62.922 ms
Loss rate: 1.49%
```

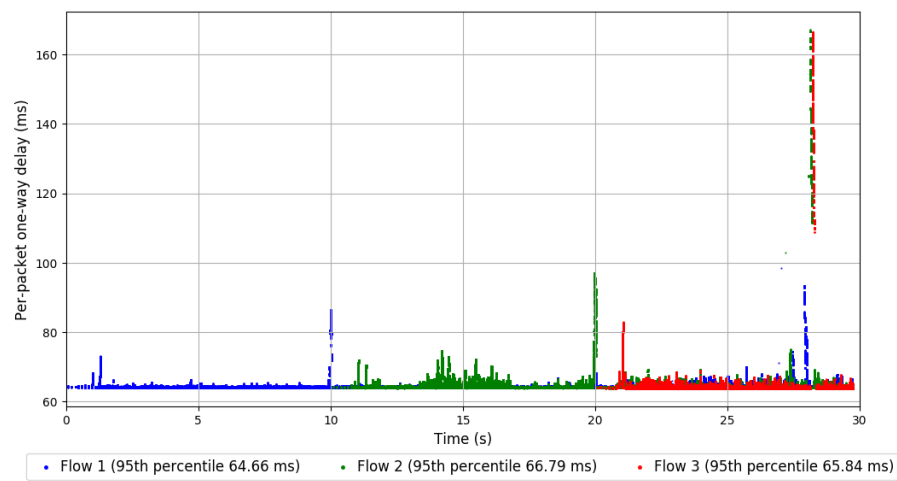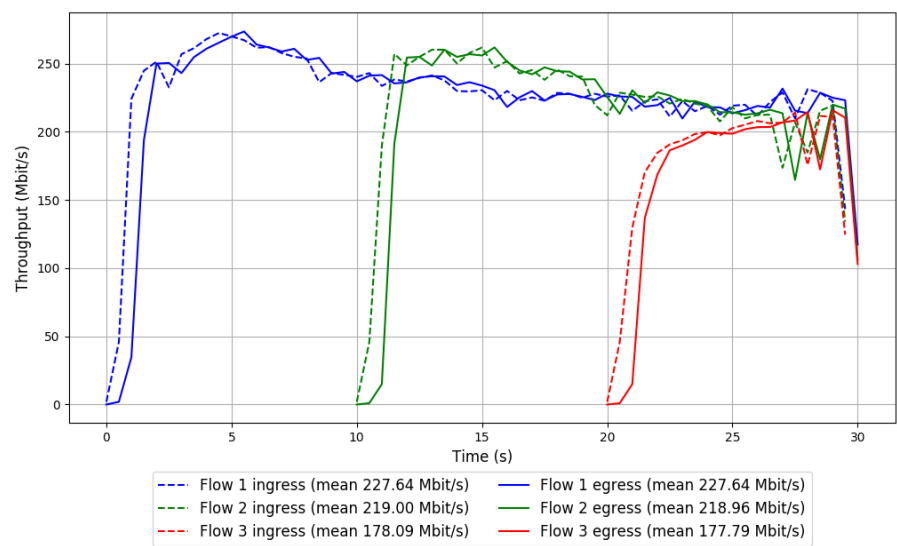Run 1: Report of Indigo — Data Link

13

```
Run 2: Statistics of Indigo

Start at: 2018-09-05 05:31:06
End at: 2018-09-05 05:31:36
Local clock offset: 0.086 ms
Remote clock offset: -2.983 ms


# Below is generated by plot.py at 2018-09-05 05:52:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 430.23 Mbit/s
95th percentile per-packet one-way delay: 65.695 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 227.64 Mbit/s
95th percentile per-packet one-way delay: 64.660 ms
Loss rate: 0.42%
-- Flow 2:
Average throughput: 218.96 Mbit/s
95th percentile per-packet one-way delay: 66.792 ms
Loss rate: 0.64%
-- Flow 3:
Average throughput: 177.79 Mbit/s
95th percentile per-packet one-way delay: 65.841 ms
Loss rate: 1.41%
```
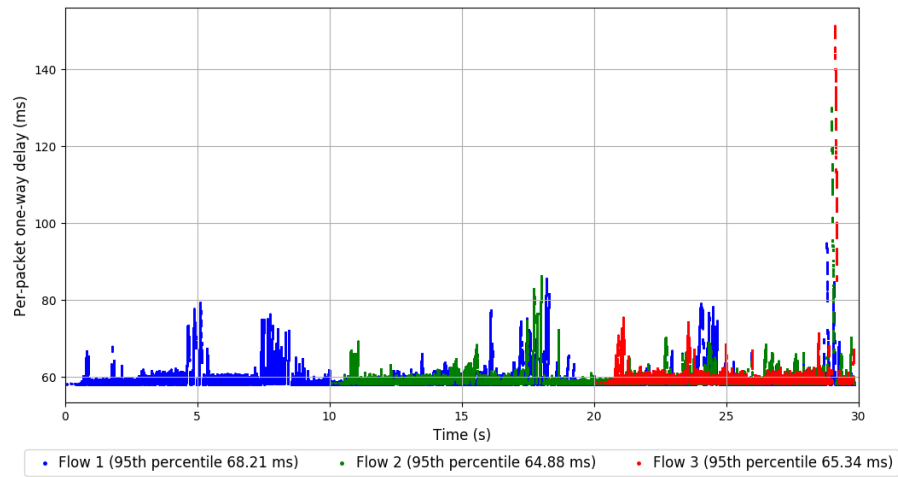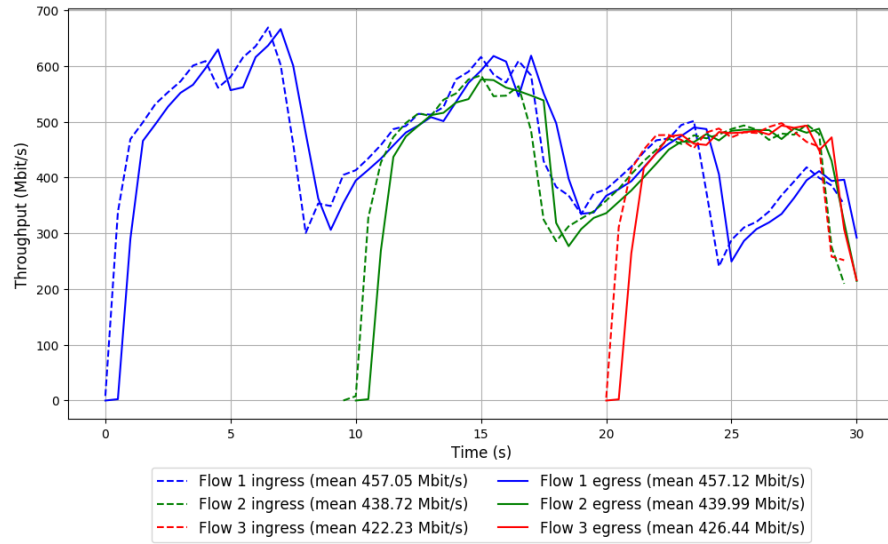
Run 2: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 05:21:10
End at: 2018-09-05 05:21:40
Local clock offset: 0.042 ms
Remote clock offset: 2.757 ms


# Below is generated by plot.py at 2018-09-05 05:52:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 889.03 Mbit/s
95th percentile per-packet one-way delay: 66.548 ms
Loss rate: 0.37%
-- Flow 1:
Average throughput: 457.12 Mbit/s
95th percentile per-packet one-way delay: 68.211 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 439.99 Mbit/s
95th percentile per-packet one-way delay: 64.880 ms
Loss rate: 0.31%
-- Flow 3:
Average throughput: 426.44 Mbit/s
95th percentile per-packet one-way delay: 65.338 ms
Loss rate: 0.44%
```

Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 05:29:10
End at: 2018-09-05 05:29:40
Local clock offset: 0.04 ms
Remote clock offset: -2.892 ms


# Below is generated by plot.py at 2018-09-05 05:52:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 891.41 Mbit/s
95th percentile per-packet one-way delay: 71.732 ms
Loss rate: 0.58%
-- Flow 1:
Average throughput: 471.85 Mbit/s
95th percentile per-packet one-way delay: 73.205 ms
Loss rate: 0.26%
-- Flow 2:
Average throughput: 419.91 Mbit/s
95th percentile per-packet one-way delay: 72.622 ms
Loss rate: 0.72%
-- Flow 3:
Average throughput: 428.40 Mbit/s
95th percentile per-packet one-way delay: 67.973 ms
Loss rate: 1.36%
```

Run 2: Report of Muses-25 — Data Link