Pantheon Report

Generated at 2018-08-31 12:18:44 (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.
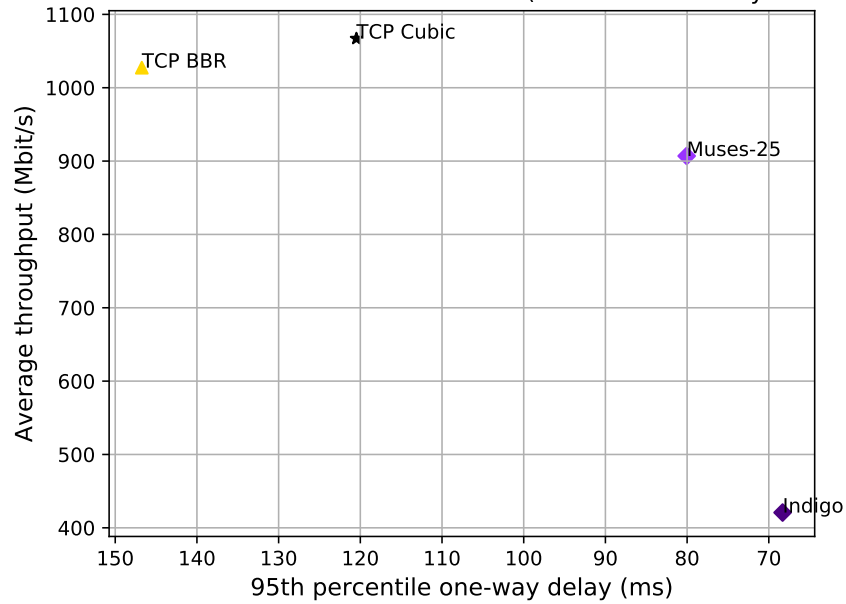
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
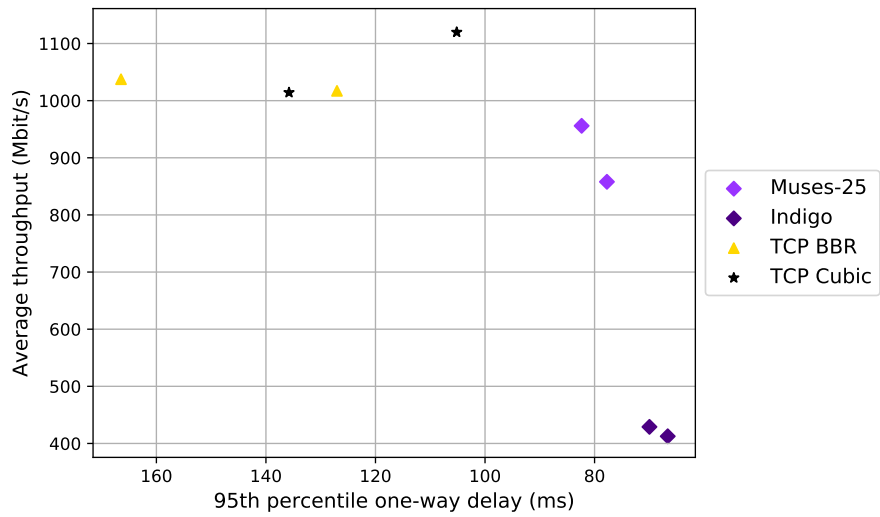
```
Git summary:
branch: muses @ e3c5aa19ca94c3066828fb83f16a8fb6b2731e7a
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
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 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	545.05	495.83	463.93	152.75	139.41	124.17	1.65	1.60	2.08
TCP Cubic	2	566.86	520.45	467.84	135.80	99.60	106.46	0.40	0.80	1.76
Indigo	2	221.16	211.14	184.38	63.55	66.63	67.15	0.40	0.64	1.49
Muses-25	2	497.18	424.30	392.36	79.69	80.72	78.53	0.34	0.61	1.63

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 11:47:02
End at: 2018-08-31 11:47:32
Local clock offset: -6.835 ms
Remote clock offset: 0.62 ms


# Below is generated by plot.py at 2018-08-31 12:17:32
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1017.19 Mbit/s
95th percentile per-packet one-way delay: 127.029 ms
Loss rate: 1.18%
-- Flow 1:
Average throughput: 547.52 Mbit/s
95th percentile per-packet one-way delay: 136.457 ms
Loss rate: 0.94%
-- Flow 2:
Average throughput: 479.58 Mbit/s
95th percentile per-packet one-way delay: 108.890 ms
Loss rate: 1.30%
-- Flow 3:
Average throughput: 458.33 Mbit/s
95th percentile per-packet one-way delay: 126.042 ms
Loss rate: 1.81%
```
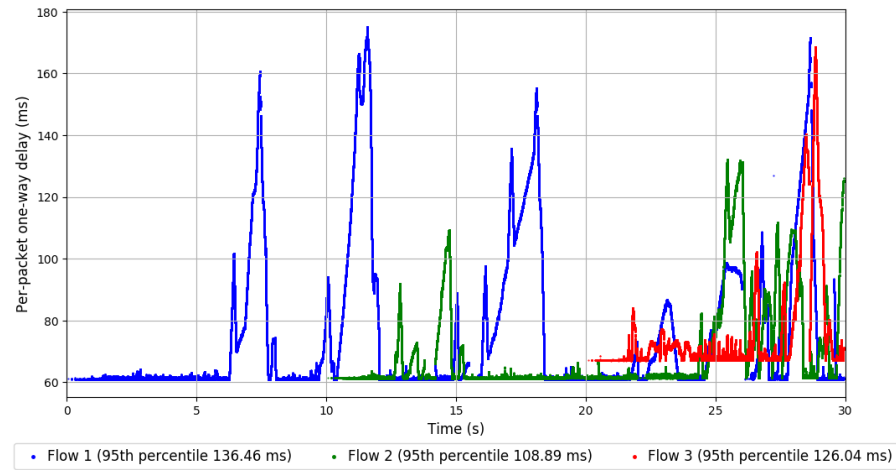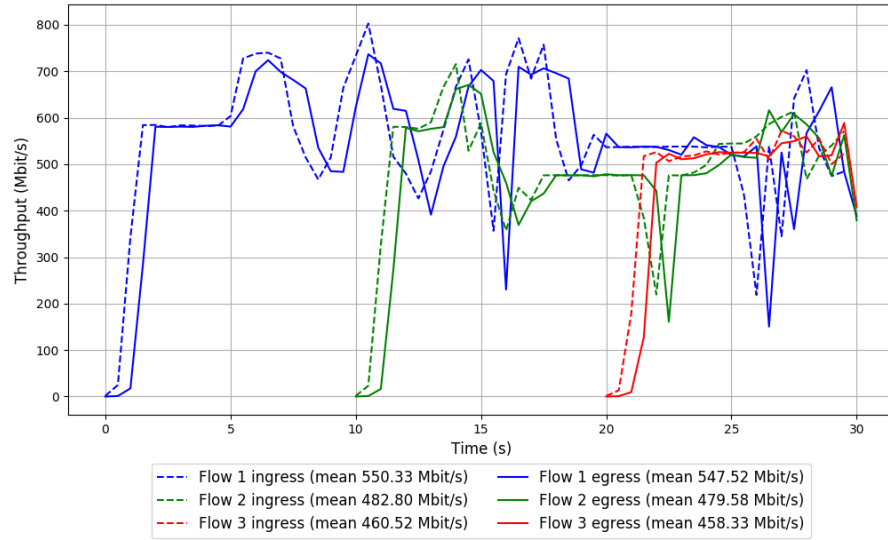
Run 1: Report of TCP BBR — Data Link

- - - Flow 1 ingress (mean 550.33 Mbit/s) ——— Flow 1 egress (mean 547.52 Mbit/s)
- - - Flow 2 ingress (mean 482.80 Mbit/s) ——— Flow 2 egress (mean 479.58 Mbit/s)
- - - Flow 3 ingress (mean 460.52 Mbit/s) ——— Flow 3 egress (mean 458.33 Mbit/s)

• Flow 1 (95th percentile 136.46 ms)   • Flow 2 (95th percentile 108.89 ms)   • Flow 3 (95th percentile 126.04 ms)
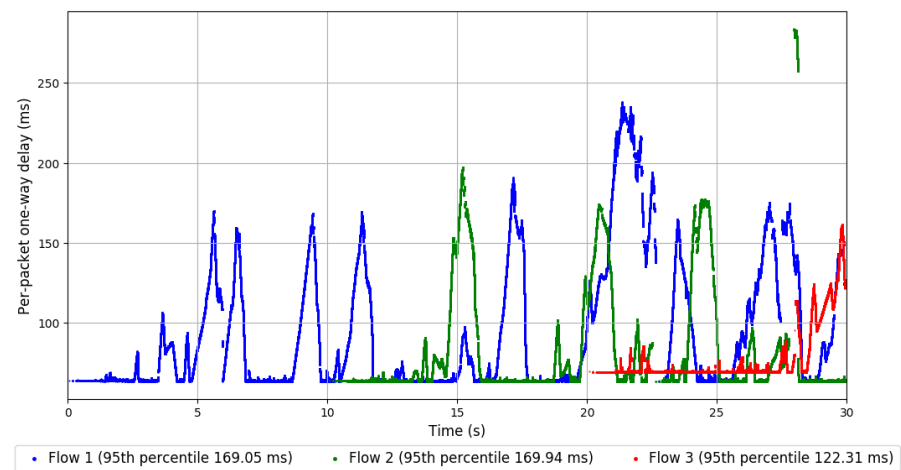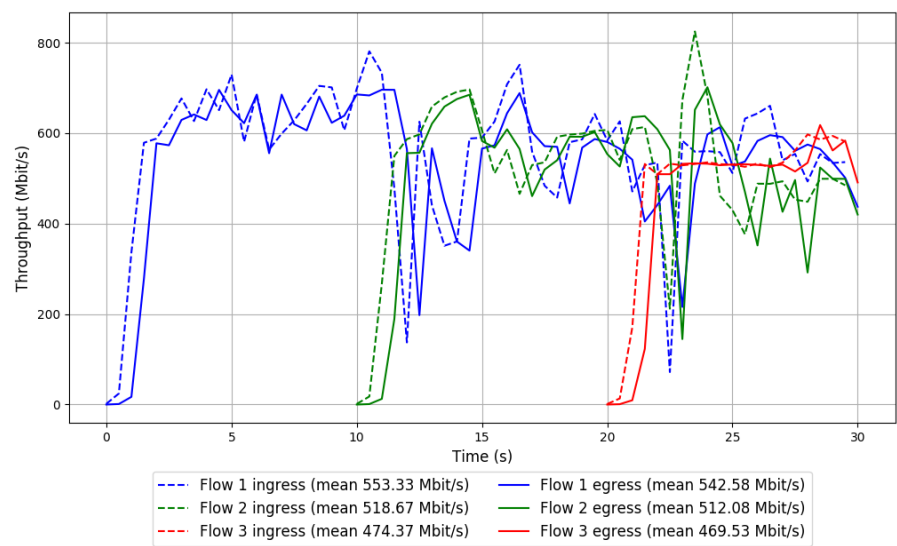
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```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 11:54:50
End at: 2018-08-31 11:55:20
Local clock offset: -4.242 ms
Remote clock offset: -2.492 ms


# Below is generated by plot.py at 2018-08-31 12:17:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1037.52 Mbit/s
95th percentile per-packet one-way delay: 166.460 ms
Loss rate: 2.21%
-- Flow 1:
Average throughput: 542.58 Mbit/s
95th percentile per-packet one-way delay: 169.050 ms
Loss rate: 2.36%
-- Flow 2:
Average throughput: 512.08 Mbit/s
95th percentile per-packet one-way delay: 169.938 ms
Loss rate: 1.91%
-- Flow 3:
Average throughput: 469.53 Mbit/s
95th percentile per-packet one-way delay: 122.307 ms
Loss rate: 2.36%
```
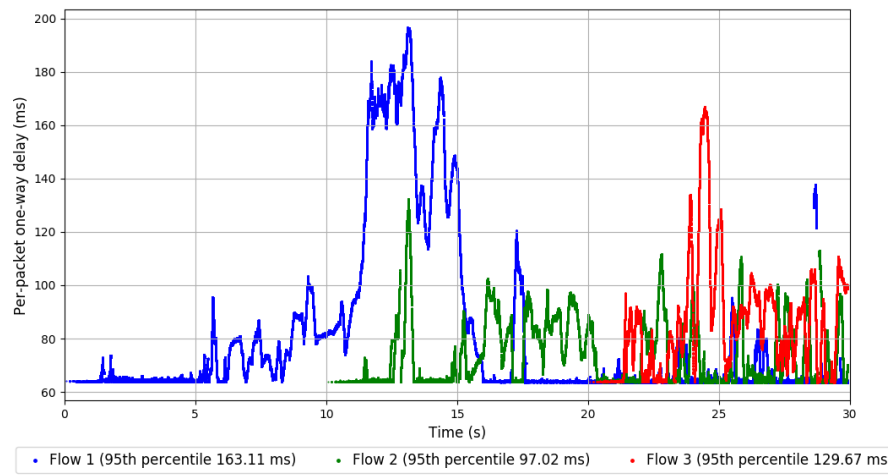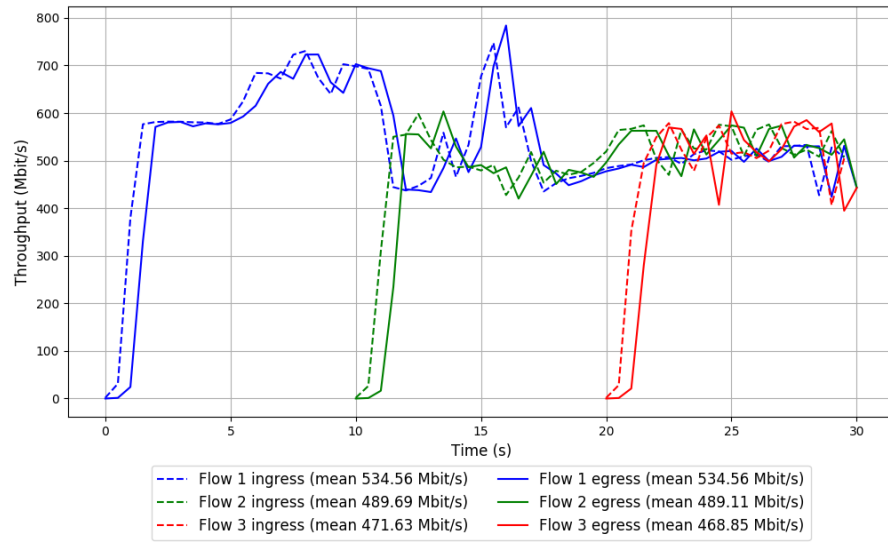
Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 11:50:54
End at: 2018-08-31 11:51:24
Local clock offset: -6.03 ms
Remote clock offset: -2.326 ms


# Below is generated by plot.py at 2018-08-31 12:17:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1014.16 Mbit/s
95th percentile per-packet one-way delay: 135.788 ms
Loss rate: 0.74%
-- Flow 1:
Average throughput: 534.56 Mbit/s
95th percentile per-packet one-way delay: 163.112 ms
Loss rate: 0.41%
-- Flow 2:
Average throughput: 489.11 Mbit/s
95th percentile per-packet one-way delay: 97.020 ms
Loss rate: 0.76%
-- Flow 3:
Average throughput: 468.85 Mbit/s
95th percentile per-packet one-way delay: 129.671 ms
Loss rate: 1.81%
```

Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 11:58:47
End at: 2018-08-31 11:59:17
Local clock offset: -3.199 ms
Remote clock offset: 0.323 ms


# Below is generated by plot.py at 2018-08-31 12:18:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1119.81 Mbit/s
95th percentile per-packet one-way delay: 105.173 ms
Loss rate: 0.72%
-- Flow 1:
Average throughput: 599.16 Mbit/s
95th percentile per-packet one-way delay: 108.480 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 551.80 Mbit/s
95th percentile per-packet one-way delay: 102.177 ms
Loss rate: 0.84%
-- Flow 3:
Average throughput: 466.82 Mbit/s
95th percentile per-packet one-way delay: 83.257 ms
Loss rate: 1.71%
```
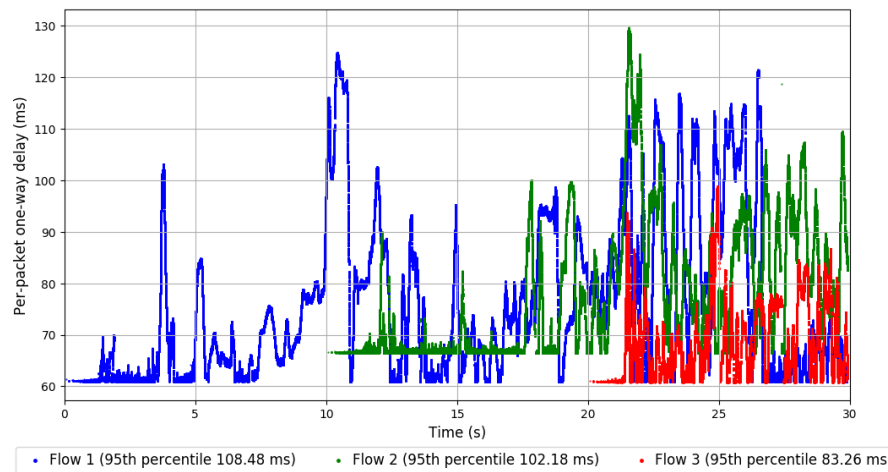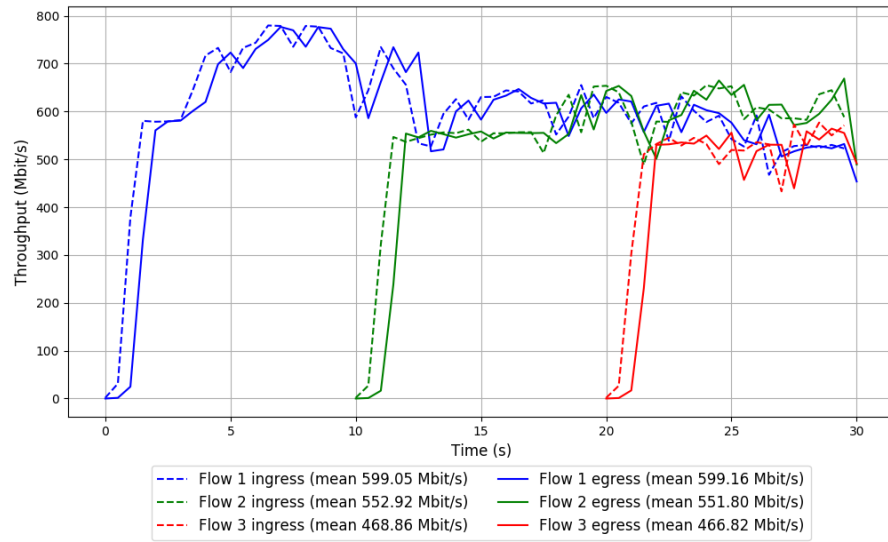
Run 2: Report of TCP Cubic — Data Link

- - - Flow 1 ingress (mean 599.05 Mbit/s)   —— Flow 1 egress (mean 599.16 Mbit/s)
- - - Flow 2 ingress (mean 552.92 Mbit/s)   —— Flow 2 egress (mean 551.80 Mbit/s)
- - - Flow 3 ingress (mean 468.86 Mbit/s)   —— Flow 3 egress (mean 466.82 Mbit/s)

• Flow 1 (95th percentile 108.48 ms)   • Flow 2 (95th percentile 102.18 ms)   • Flow 3 (95th percentile 83.26 ms)
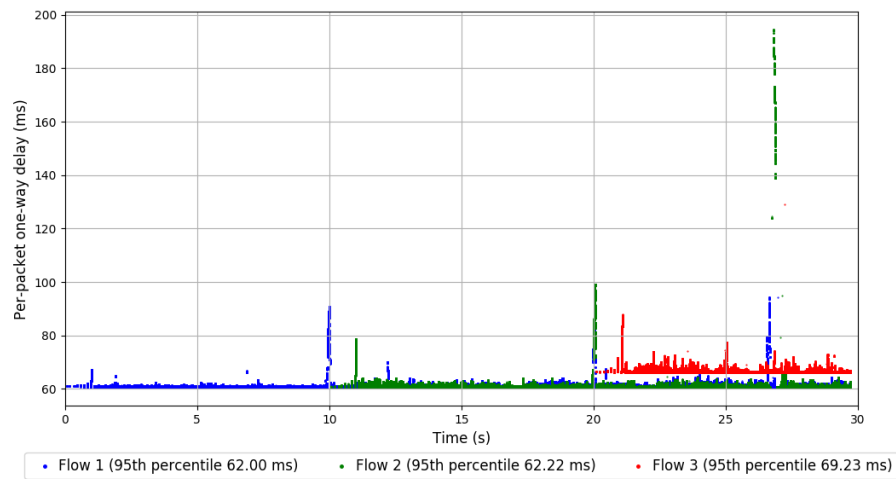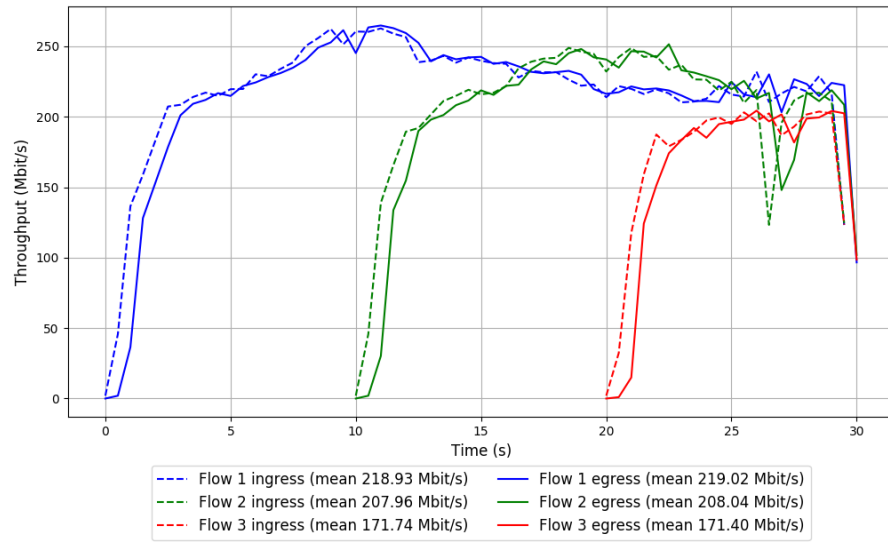
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```
Run 1: Statistics of Indigo

Start at: 2018-08-31 11:49:06
End at: 2018-08-31 11:49:36
Local clock offset: -7.182 ms
Remote clock offset: 0.596 ms


# Below is generated by plot.py at 2018-08-31 12:18:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 412.57 Mbit/s
95th percentile per-packet one-way delay: 66.642 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 219.02 Mbit/s
95th percentile per-packet one-way delay: 62.002 ms
Loss rate: 0.40%
-- Flow 2:
Average throughput: 208.04 Mbit/s
95th percentile per-packet one-way delay: 62.223 ms
Loss rate: 0.61%
-- Flow 3:
Average throughput: 171.40 Mbit/s
95th percentile per-packet one-way delay: 69.227 ms
Loss rate: 1.56%
```

Run 1: Report of Indigo — Data Link

Flow 1 ingress (mean 218.93 Mbit/s)   Flow 1 egress (mean 219.02 Mbit/s)
Flow 2 ingress (mean 207.96 Mbit/s)   Flow 2 egress (mean 208.04 Mbit/s)
Flow 3 ingress (mean 171.74 Mbit/s)   Flow 3 egress (mean 171.40 Mbit/s)

Flow 1 (95th percentile 62.00 ms)   Flow 2 (95th percentile 62.22 ms)   Flow 3 (95th percentile 69.23 ms)

```
Run 2: Statistics of Indigo

Start at: 2018-08-31 11:56:58
End at: 2018-08-31 11:57:28
Local clock offset: -3.616 ms
Remote clock offset: -2.43 ms


# Below is generated by plot.py at 2018-08-31 12:18:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 429.04 Mbit/s
95th percentile per-packet one-way delay: 69.980 ms
Loss rate: 0.64%
-- Flow 1:
Average throughput: 223.30 Mbit/s
95th percentile per-packet one-way delay: 65.107 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 214.24 Mbit/s
95th percentile per-packet one-way delay: 71.039 ms
Loss rate: 0.67%
-- Flow 3:
Average throughput: 197.35 Mbit/s
95th percentile per-packet one-way delay: 65.072 ms
Loss rate: 1.42%
```
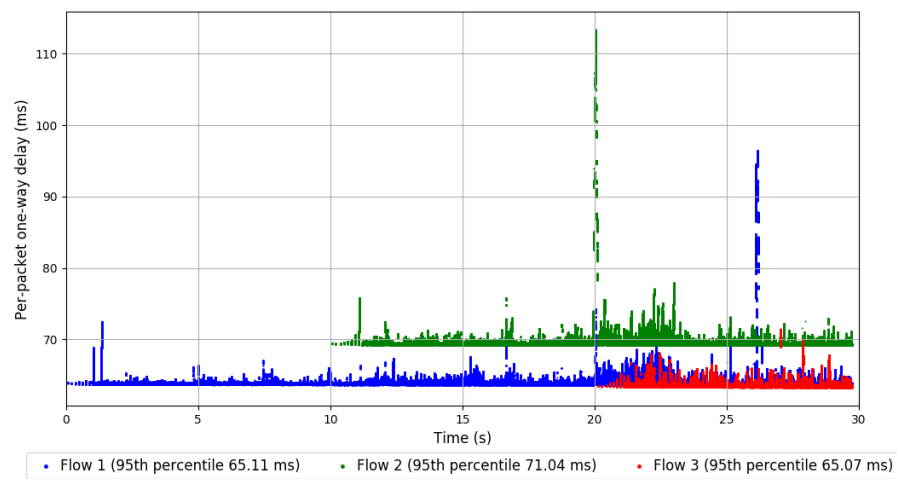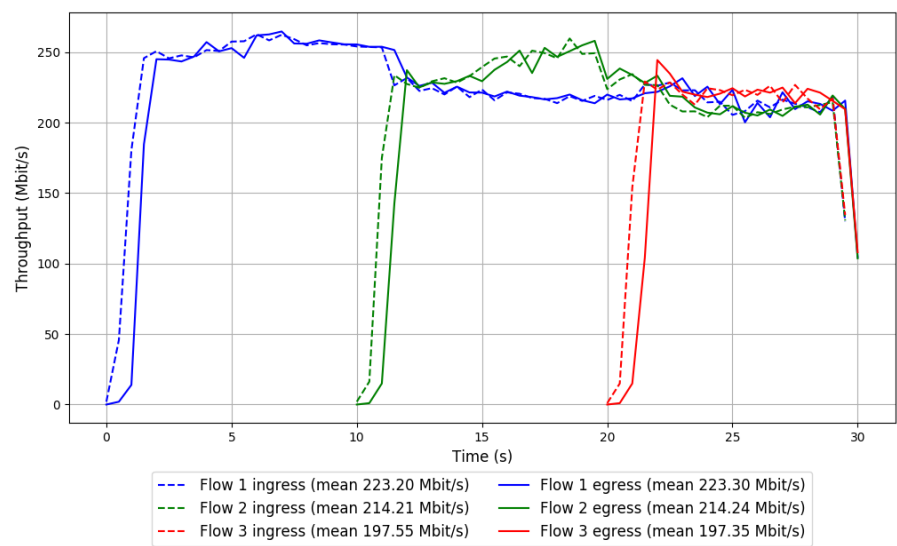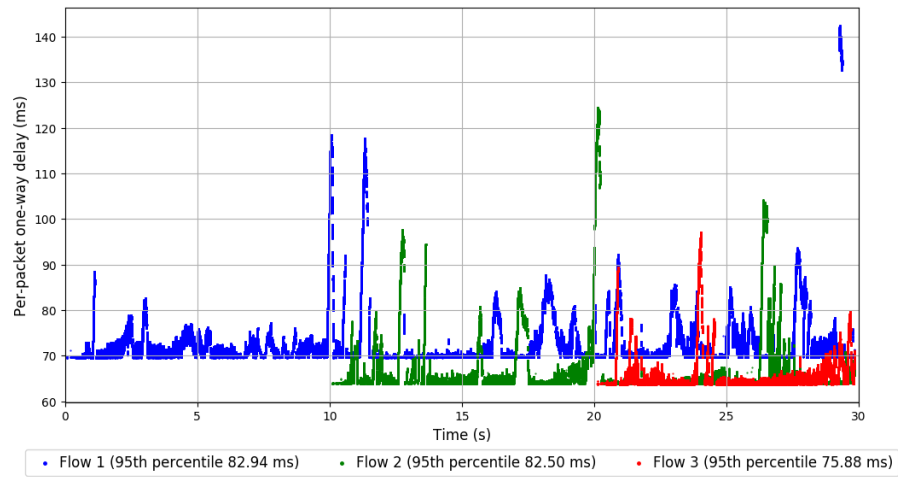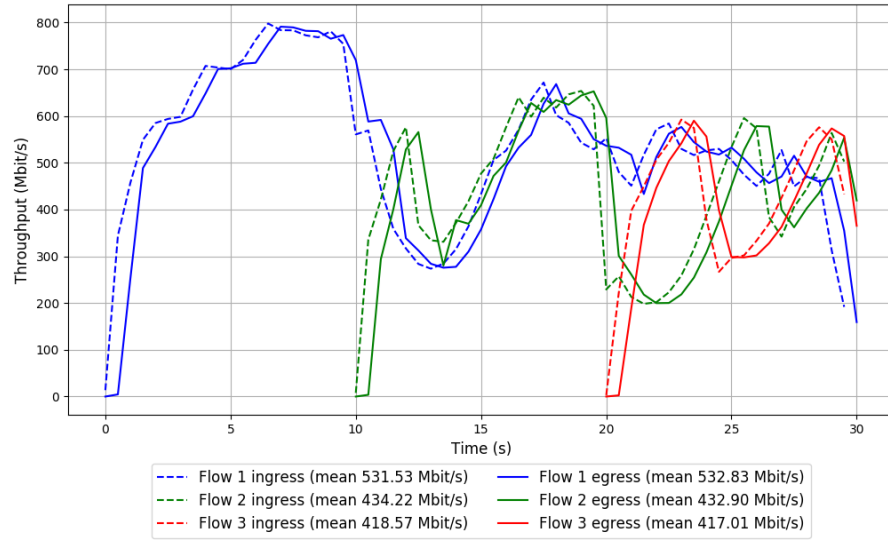
Run 2: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 11:45:02
End at: 2018-08-31 11:45:32
Local clock offset: -6.382 ms
Remote clock offset: -2.133 ms

# Below is generated by plot.py at 2018-08-31 12:18:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 955.94 Mbit/s
95th percentile per-packet one-way delay: 82.361 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 532.83 Mbit/s
95th percentile per-packet one-way delay: 82.935 ms
Loss rate: 0.19%
-- Flow 2:
Average throughput: 432.90 Mbit/s
95th percentile per-packet one-way delay: 82.501 ms
Loss rate: 0.95%
-- Flow 3:
Average throughput: 417.01 Mbit/s
95th percentile per-packet one-way delay: 75.884 ms
Loss rate: 1.65%
```

Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 11:52:54
End at: 2018-08-31 11:53:24
Local clock offset: -4.911 ms
Remote clock offset: 0.48 ms


# Below is generated by plot.py at 2018-08-31 12:18:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 857.97 Mbit/s
95th percentile per-packet one-way delay: 77.745 ms
Loss rate: 0.58%
-- Flow 1:
Average throughput: 461.53 Mbit/s
95th percentile per-packet one-way delay: 76.436 ms
Loss rate: 0.49%
-- Flow 2:
Average throughput: 415.71 Mbit/s
95th percentile per-packet one-way delay: 78.944 ms
Loss rate: 0.27%
-- Flow 3:
Average throughput: 367.71 Mbit/s
95th percentile per-packet one-way delay: 81.169 ms
Loss rate: 1.61%
```

Run 2: Report of Muses-25 — Data Link

Flow 1 ingress (mean 461.96 Mbit/s)   Flow 1 egress (mean 461.53 Mbit/s)
Flow 2 ingress (mean 414.25 Mbit/s)   Flow 2 egress (mean 415.71 Mbit/s)
Flow 3 ingress (mean 368.81 Mbit/s)   Flow 3 egress (mean 367.71 Mbit/s)

Flow 1 (95th percentile 76.44 ms)   Flow 2 (95th percentile 78.94 ms)   Flow 3 (95th percentile 81.17 ms)

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