Pantheon Report

Generated at 2018-08-31 09:22:17 (UTC).

Data path: GCE Tokyo on `ens4` (*local*) →GCE London 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.
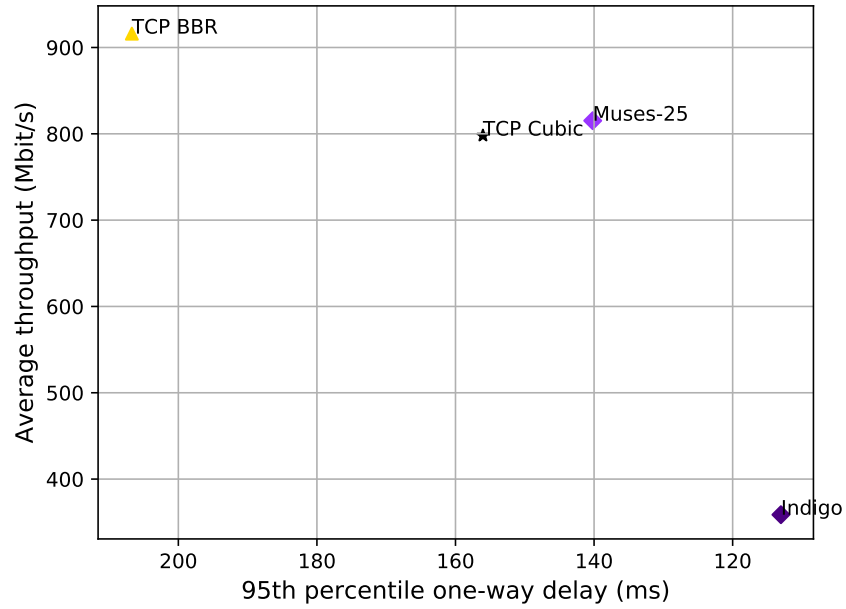
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
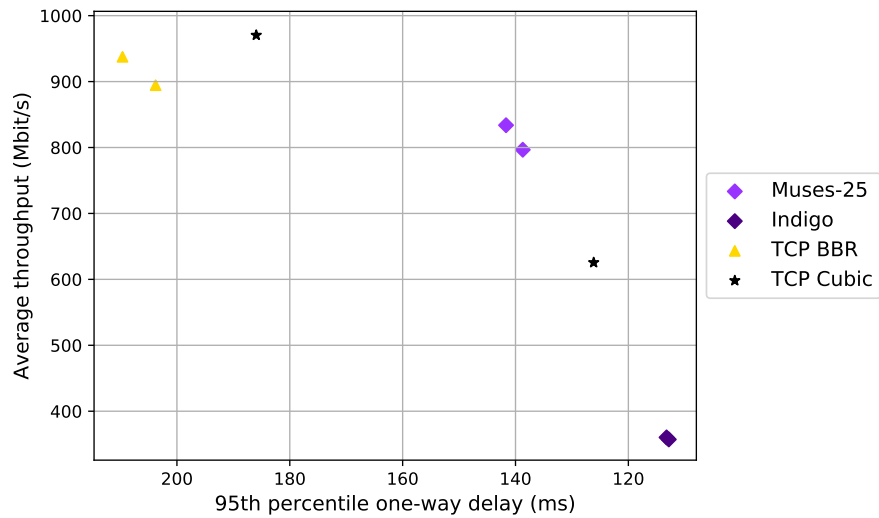
```
Git summary:
branch: muses @ e3c5aa19ca94c3066828fb83f16a8fb6b2731e7a
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
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 Tokyo to GCE London, 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 London, 2 runs of 30s each per scheme
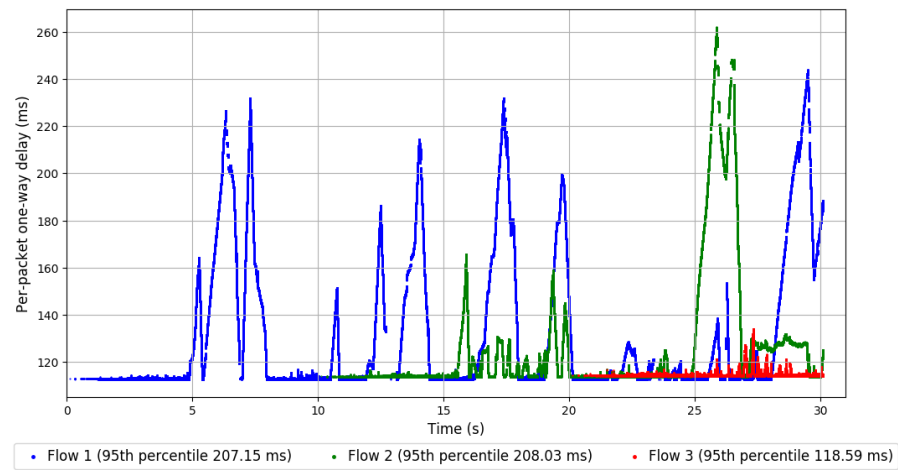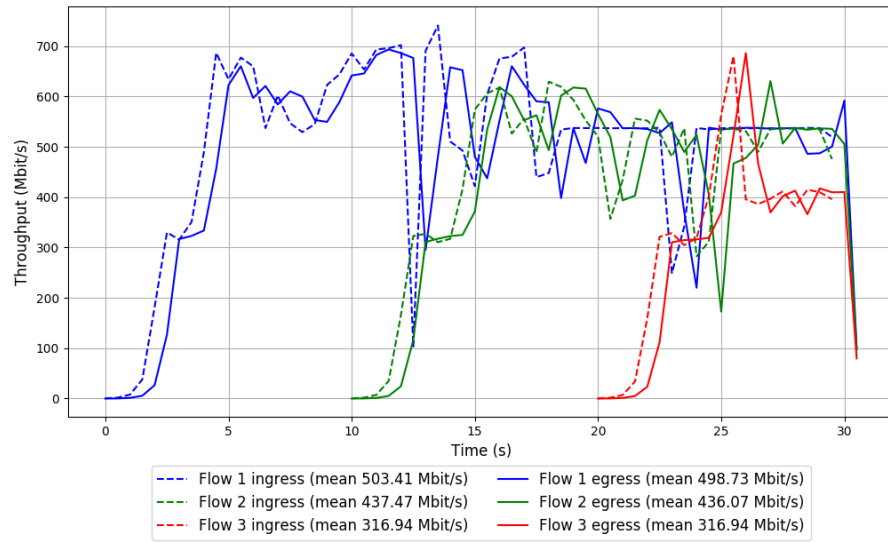3 flows with 10s interval between flows

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	510.74	436.63	344.34	204.91	216.65	142.92	0.96	1.71	0.00
TCP Cubic	2	425.62	374.11	370.40	151.08	151.50	135.00	0.06	0.06	0.55
Indigo	2	186.50	180.56	163.50	112.51	113.04	115.57	0.00	0.00	0.00
Muses-25	2	439.71	359.92	422.65	141.90	136.83	139.30	0.02	0.08	0.00

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 08:53:30
End at: 2018-08-31 08:54:00
Local clock offset: 15.076 ms
Remote clock offset: 21.095 ms


# Below is generated by plot.py at 2018-08-31 09:21:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 894.54 Mbit/s
95th percentile per-packet one-way delay: 203.775 ms
Loss rate: 0.61%
-- Flow 1:
Average throughput: 498.73 Mbit/s
95th percentile per-packet one-way delay: 207.147 ms
Loss rate: 0.92%
-- Flow 2:
Average throughput: 436.07 Mbit/s
95th percentile per-packet one-way delay: 208.031 ms
Loss rate: 0.31%
-- Flow 3:
Average throughput: 316.94 Mbit/s
95th percentile per-packet one-way delay: 118.594 ms
Loss rate: 0.00%
```

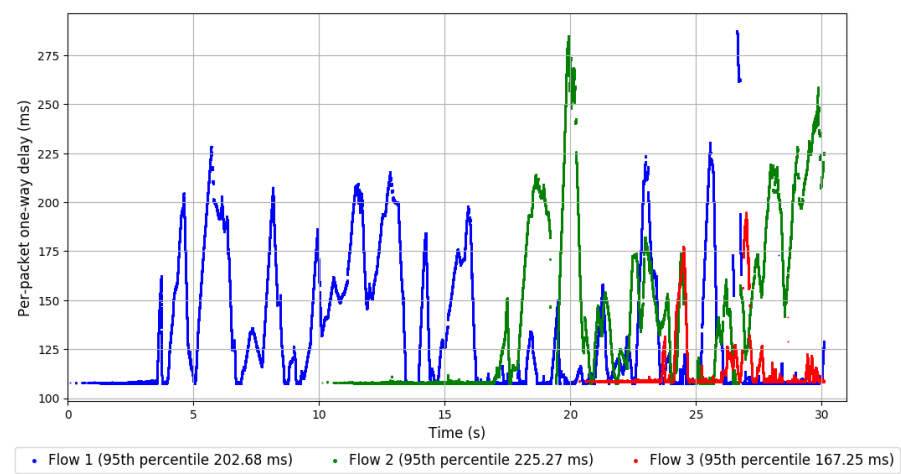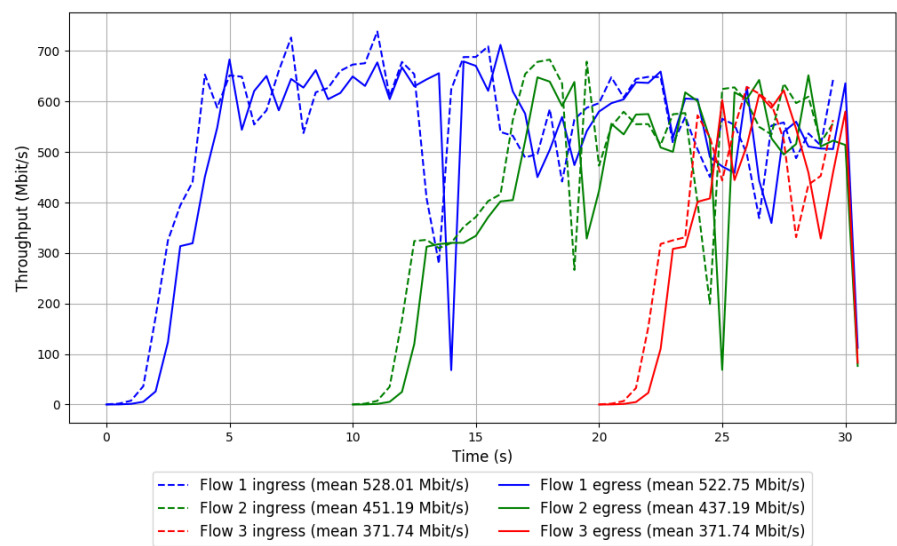Run 1: Report of TCP BBR — Data Link

```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 09:01:20
End at: 2018-08-31 09:01:50
Local clock offset: 22.593 ms
Remote clock offset: 22.616 ms


# Below is generated by plot.py at 2018-08-31 09:21:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 937.57 Mbit/s
95th percentile per-packet one-way delay: 209.642 ms
Loss rate: 1.53%
-- Flow 1:
Average throughput: 522.75 Mbit/s
95th percentile per-packet one-way delay: 202.680 ms
Loss rate: 0.99%
-- Flow 2:
Average throughput: 437.19 Mbit/s
95th percentile per-packet one-way delay: 225.267 ms
Loss rate: 3.10%
-- Flow 3:
Average throughput: 371.74 Mbit/s
95th percentile per-packet one-way delay: 167.254 ms
Loss rate: 0.00%
```
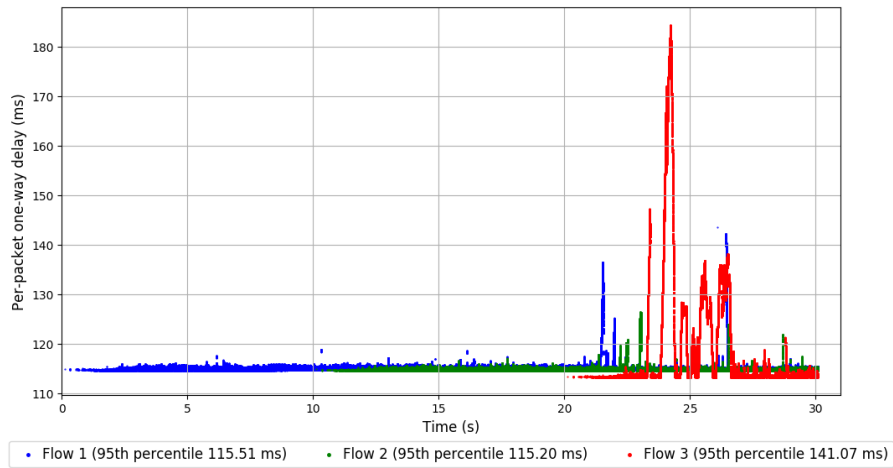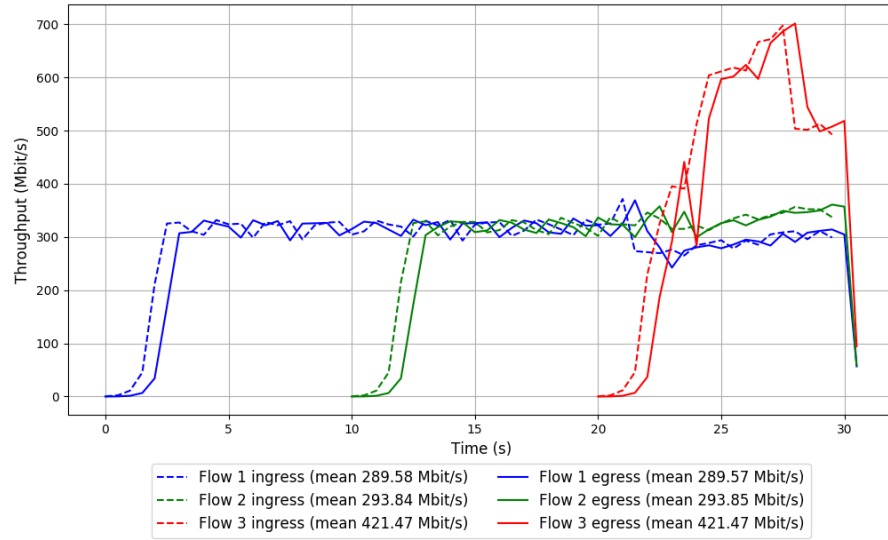
Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 08:57:29
End at: 2018-08-31 08:57:59
Local clock offset: 20.215 ms
Remote clock offset: 27.472 ms


# Below is generated by plot.py at 2018-08-31 09:21:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 625.49 Mbit/s
95th percentile per-packet one-way delay: 126.147 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 289.57 Mbit/s
95th percentile per-packet one-way delay: 115.514 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 293.85 Mbit/s
95th percentile per-packet one-way delay: 115.196 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 421.47 Mbit/s
95th percentile per-packet one-way delay: 141.072 ms
Loss rate: 0.00%
```

Run 1: Report of TCP Cubic — Data Link

- - - - Flow 1 ingress (mean 289.58 Mbit/s) —— Flow 1 egress (mean 289.57 Mbit/s)
- - - - Flow 2 ingress (mean 293.84 Mbit/s) —— Flow 2 egress (mean 293.85 Mbit/s)
- - - - Flow 3 ingress (mean 421.47 Mbit/s) —— Flow 3 egress (mean 421.47 Mbit/s)

• Flow 1 (95th percentile 115.51 ms)   • Flow 2 (95th percentile 115.20 ms)   • Flow 3 (95th percentile 141.07 ms)
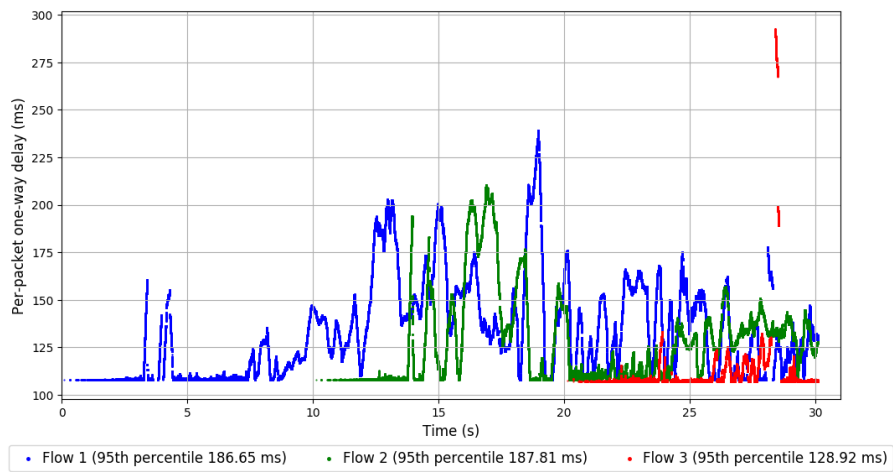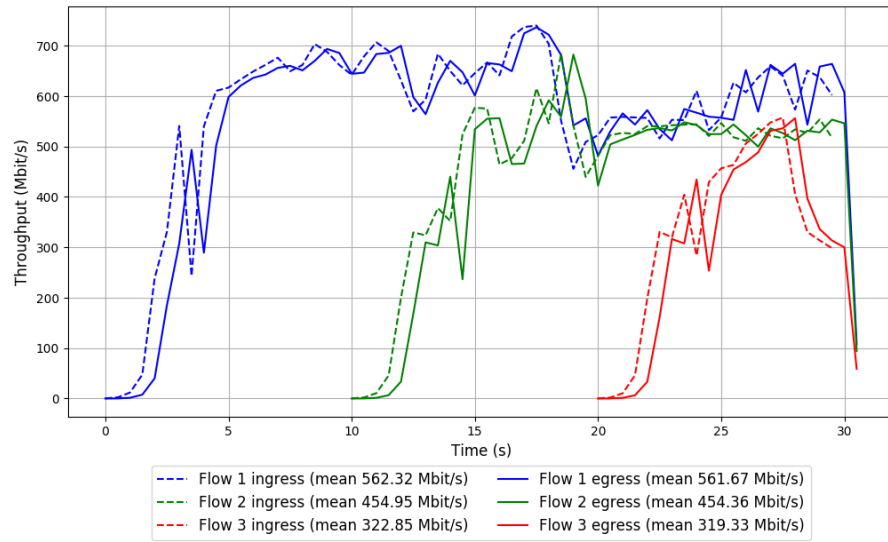
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 09:05:25
End at: 2018-08-31 09:05:55
Local clock offset: 20.502 ms
Remote clock offset: 20.504 ms


# Below is generated by plot.py at 2018-08-31 09:21:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 970.38 Mbit/s
95th percentile per-packet one-way delay: 185.937 ms
Loss rate: 0.22%
-- Flow 1:
Average throughput: 561.67 Mbit/s
95th percentile per-packet one-way delay: 186.650 ms
Loss rate: 0.11%
-- Flow 2:
Average throughput: 454.36 Mbit/s
95th percentile per-packet one-way delay: 187.810 ms
Loss rate: 0.12%
-- Flow 3:
Average throughput: 319.33 Mbit/s
95th percentile per-packet one-way delay: 128.921 ms
Loss rate: 1.09%
```

Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 562.32 Mbit/s)   Flow 1 egress (mean 561.67 Mbit/s)
Flow 2 ingress (mean 454.95 Mbit/s)   Flow 2 egress (mean 454.36 Mbit/s)
Flow 3 ingress (mean 322.85 Mbit/s)   Flow 3 egress (mean 319.33 Mbit/s)

Flow 1 (95th percentile 186.65 ms)   Flow 2 (95th percentile 187.81 ms)   Flow 3 (95th percentile 128.92 ms)
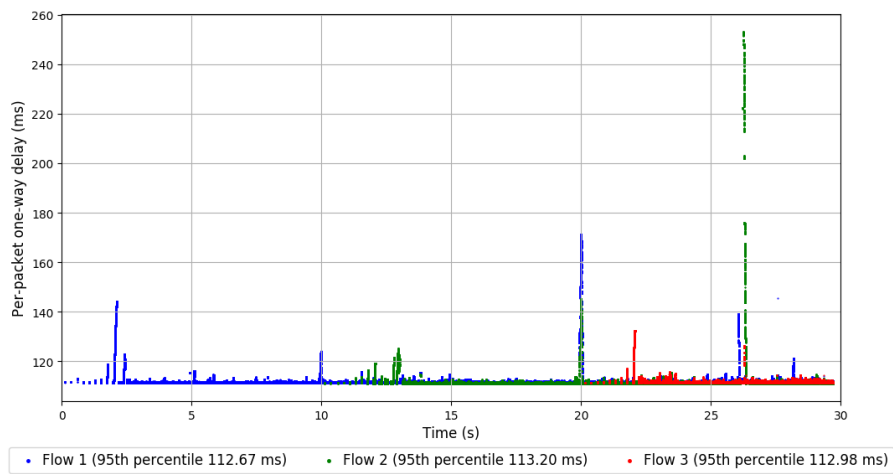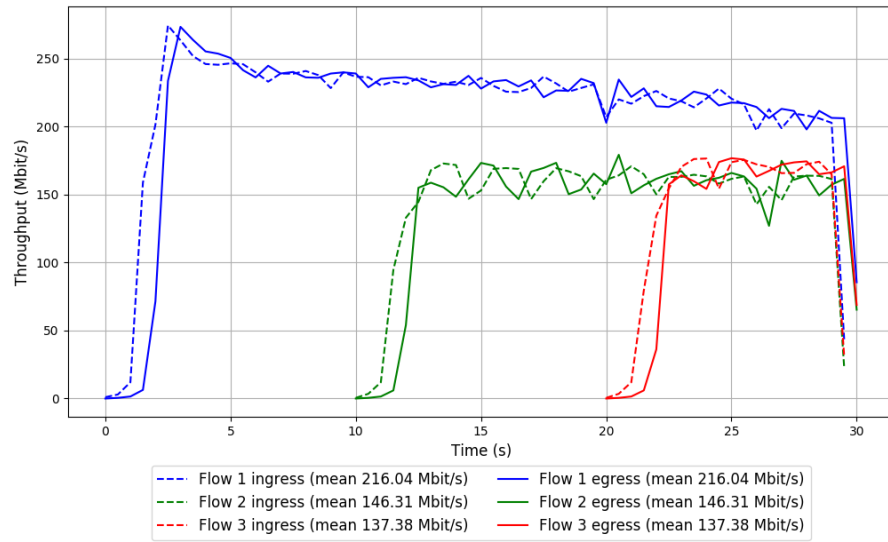
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```
Run 1: Statistics of Indigo

Start at: 2018-08-31 08:55:38
End at: 2018-08-31 08:56:08
Local clock offset: 20.591 ms
Remote clock offset: 24.147 ms


# Below is generated by plot.py at 2018-08-31 09:21:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 357.20 Mbit/s
95th percentile per-packet one-way delay: 112.831 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 216.04 Mbit/s
95th percentile per-packet one-way delay: 112.674 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 146.31 Mbit/s
95th percentile per-packet one-way delay: 113.197 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 137.38 Mbit/s
95th percentile per-packet one-way delay: 112.984 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

Flow 1 ingress (mean 216.04 Mbit/s)   Flow 1 egress (mean 216.04 Mbit/s)
Flow 2 ingress (mean 146.31 Mbit/s)   Flow 2 egress (mean 146.31 Mbit/s)
Flow 3 ingress (mean 137.38 Mbit/s)   Flow 3 egress (mean 137.38 Mbit/s)

Flow 1 (95th percentile 112.67 ms)   Flow 2 (95th percentile 113.20 ms)   Flow 3 (95th percentile 112.98 ms)
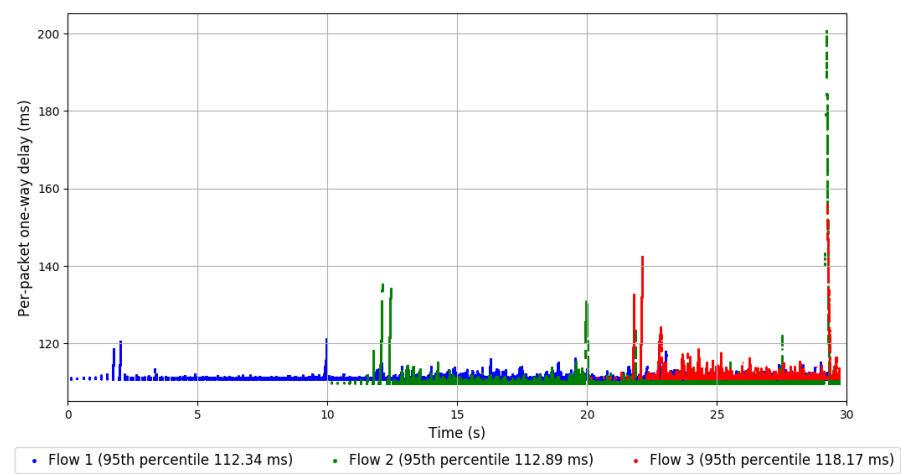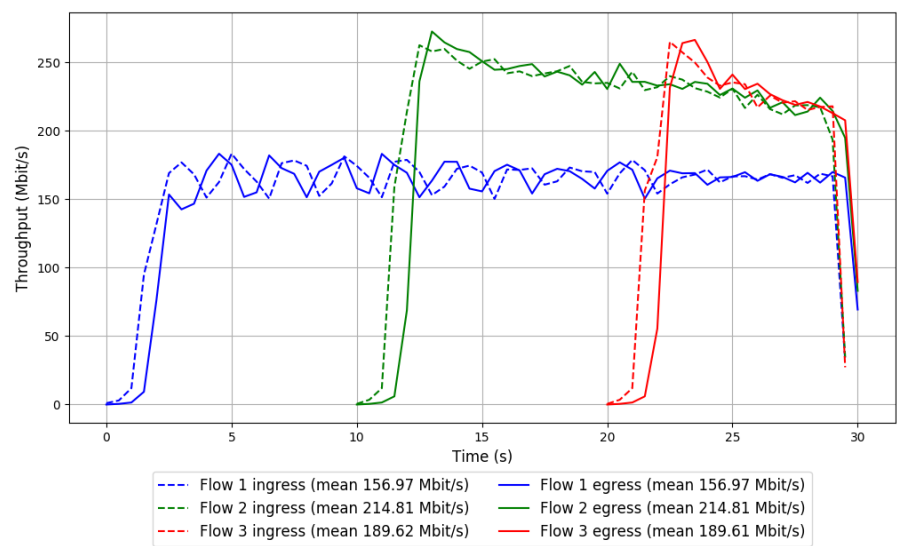
13

```
Run 2: Statistics of Indigo

Start at: 2018-08-31 09:03:34
End at: 2018-08-31 09:04:04
Local clock offset: 18.198 ms
Remote clock offset: 20.807 ms


# Below is generated by plot.py at 2018-08-31 09:21:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 360.27 Mbit/s
95th percentile per-packet one-way delay: 113.234 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 156.97 Mbit/s
95th percentile per-packet one-way delay: 112.339 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 214.81 Mbit/s
95th percentile per-packet one-way delay: 112.889 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 189.61 Mbit/s
95th percentile per-packet one-way delay: 118.166 ms
Loss rate: 0.00%
```

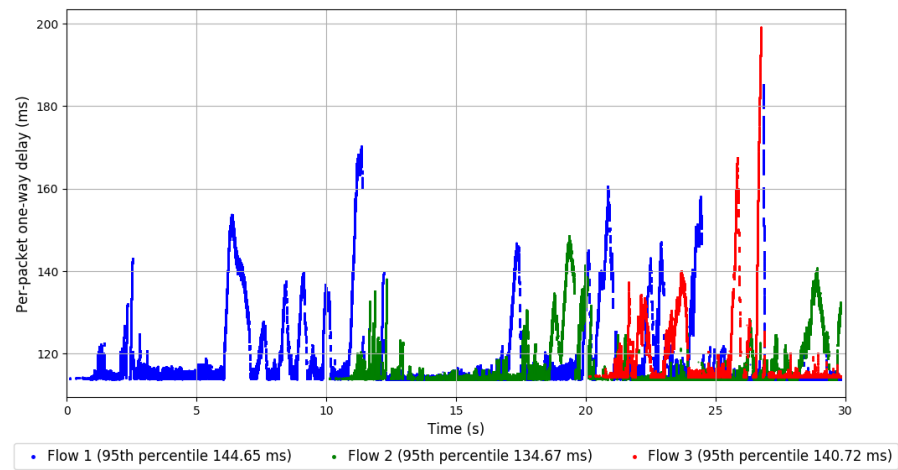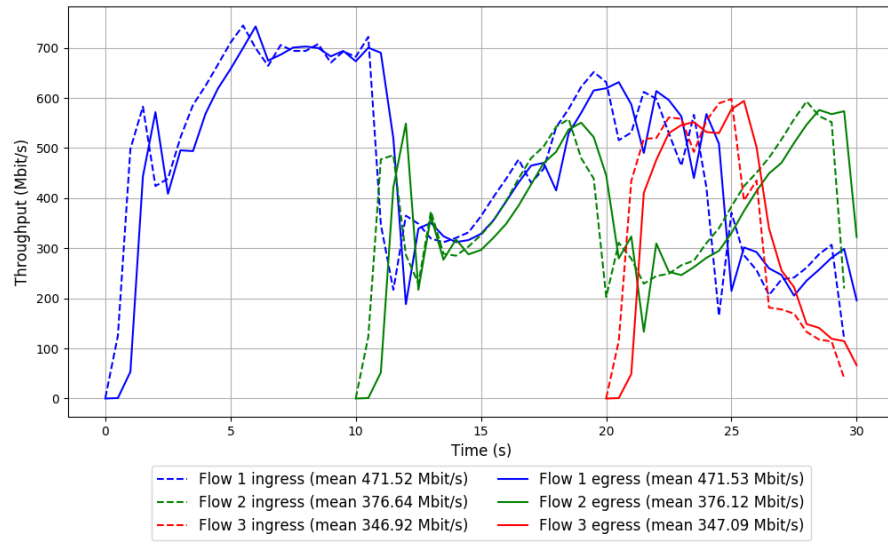Run 2: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 08:51:26
End at: 2018-08-31 08:51:56
Local clock offset: 12.936 ms
Remote clock offset: 18.776 ms


# Below is generated by plot.py at 2018-08-31 09:22:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 833.79 Mbit/s
95th percentile per-packet one-way delay: 141.678 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 471.53 Mbit/s
95th percentile per-packet one-way delay: 144.654 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 376.12 Mbit/s
95th percentile per-packet one-way delay: 134.674 ms
Loss rate: 0.14%
-- Flow 3:
Average throughput: 347.09 Mbit/s
95th percentile per-packet one-way delay: 140.723 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 08:59:19
End at: 2018-08-31 08:59:49
Local clock offset: 21.912 ms
Remote clock offset: 24.622 ms


# Below is generated by plot.py at 2018-08-31 09:22:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 796.61 Mbit/s
95th percentile per-packet one-way delay: 138.713 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 407.89 Mbit/s
95th percentile per-packet one-way delay: 139.149 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 343.72 Mbit/s
95th percentile per-packet one-way delay: 138.987 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 498.22 Mbit/s
95th percentile per-packet one-way delay: 137.880 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link