Pantheon Report

Generated at 2018-09-03 11:16:29 (UTC).

Data path: GCE Iowa on **ens4** (*local*) →GCE Tokyo 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.
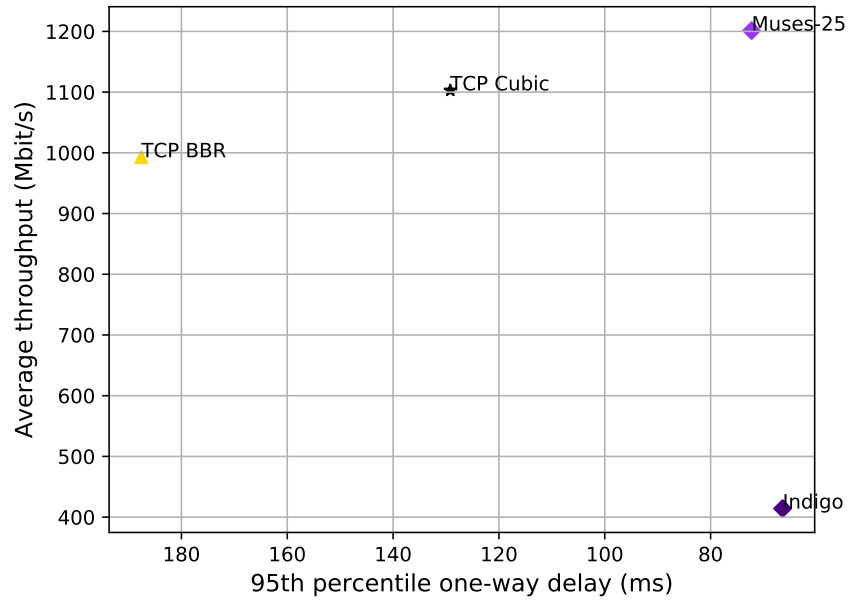
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
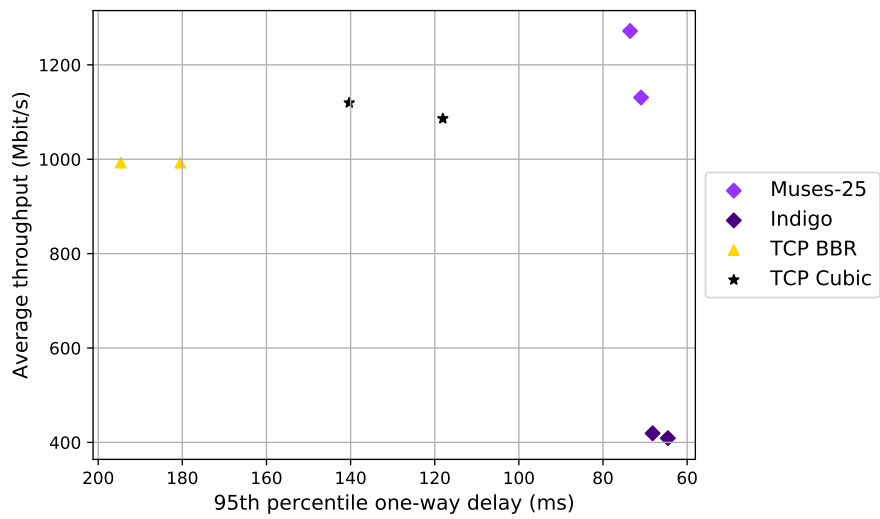
```
Git summary:
branch: muses @ f309f5459e2c5237279a184e52ece7a2b47ef1c9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
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 Iowa to GCE Tokyo, 2 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

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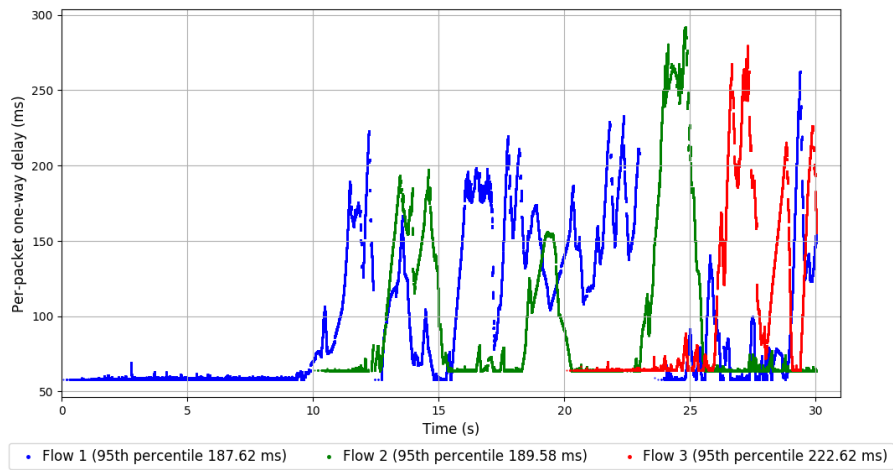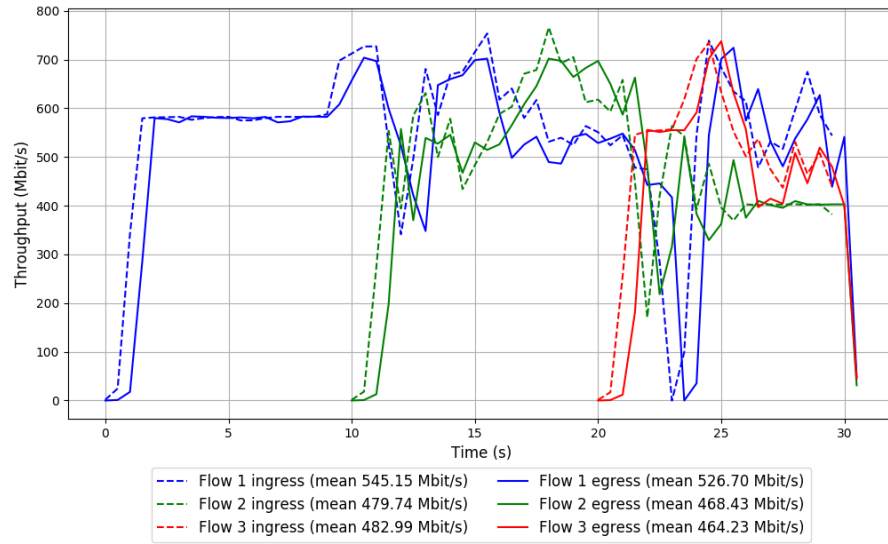3 flows with 10s interval between flows

2

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	513.67	483.40	473.03	157.86	195.94	202.12	1.90	2.33	4.47
TCP Cubic	2	599.71	528.88	453.11	132.59	123.78	134.95	0.12	0.19	0.70
Indigo	2	221.72	198.68	188.24	63.52	67.07	64.49	0.00	0.00	0.00
Muses-25	2	643.07	581.51	527.81	69.29	76.91	72.07	0.00	0.00	0.00

```
Run 1: Statistics of TCP BBR

Start at: 2018-09-03 10:44:57
End at: 2018-09-03 10:45:27
Local clock offset: 0.92 ms
Remote clock offset: -0.574 ms


# Below is generated by plot.py at 2018-09-03 11:15:14
# Datalink statistics
-- Total of 3 flows:
Average throughput: 992.80 Mbit/s
95th percentile per-packet one-way delay: 194.655 ms
Loss rate: 3.13%
-- Flow 1:
Average throughput: 526.70 Mbit/s
95th percentile per-packet one-way delay: 187.616 ms
Loss rate: 3.37%
-- Flow 2:
Average throughput: 468.43 Mbit/s
95th percentile per-packet one-way delay: 189.576 ms
Loss rate: 2.36%
-- Flow 3:
Average throughput: 464.23 Mbit/s
95th percentile per-packet one-way delay: 222.624 ms
Loss rate: 3.88%
```

Run 1: Report of TCP BBR — Data Link

```
Run 2: Statistics of TCP BBR

Start at: 2018-09-03 10:52:59
End at: 2018-09-03 10:53:29
Local clock offset: 1.023 ms
Remote clock offset: 1.506 ms


# Below is generated by plot.py at 2018-09-03 11:15:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 992.51 Mbit/s
95th percentile per-packet one-way delay: 180.480 ms
Loss rate: 1.83%
-- Flow 1:
Average throughput: 500.65 Mbit/s
95th percentile per-packet one-way delay: 128.103 ms
Loss rate: 0.43%
-- Flow 2:
Average throughput: 498.38 Mbit/s
95th percentile per-packet one-way delay: 202.311 ms
Loss rate: 2.29%
-- Flow 3:
Average throughput: 481.83 Mbit/s
95th percentile per-packet one-way delay: 181.616 ms
Loss rate: 5.06%
```
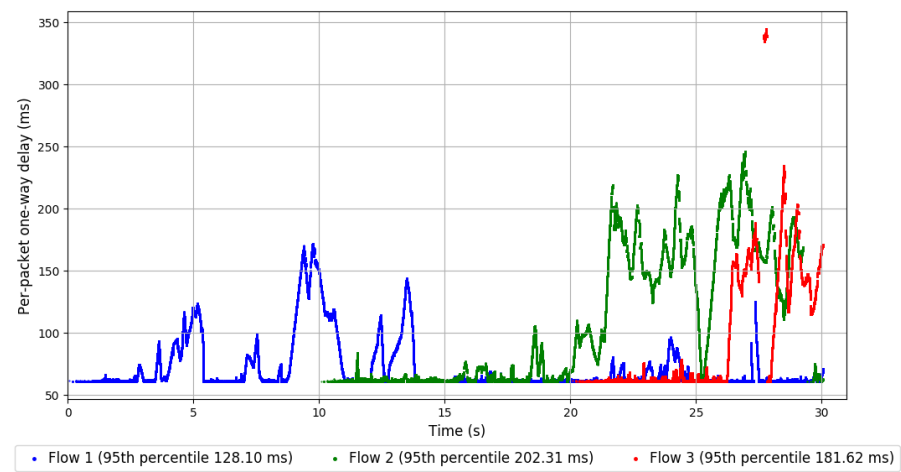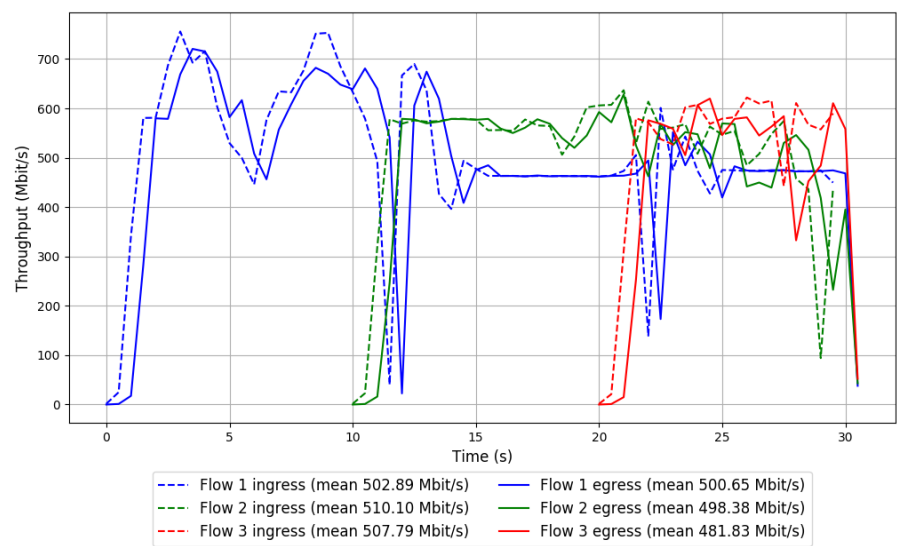
Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-03 10:48:51
End at: 2018-09-03 10:49:21
Local clock offset: 1.045 ms
Remote clock offset: 4.444 ms


# Below is generated by plot.py at 2018-09-03 11:16:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1119.56 Mbit/s
95th percentile per-packet one-way delay: 140.328 ms
Loss rate: 0.20%
-- Flow 1:
Average throughput: 605.47 Mbit/s
95th percentile per-packet one-way delay: 147.119 ms
Loss rate: 0.18%
-- Flow 2:
Average throughput: 543.64 Mbit/s
95th percentile per-packet one-way delay: 137.245 ms
Loss rate: 0.16%
-- Flow 3:
Average throughput: 456.65 Mbit/s
95th percentile per-packet one-way delay: 119.232 ms
Loss rate: 0.33%
```
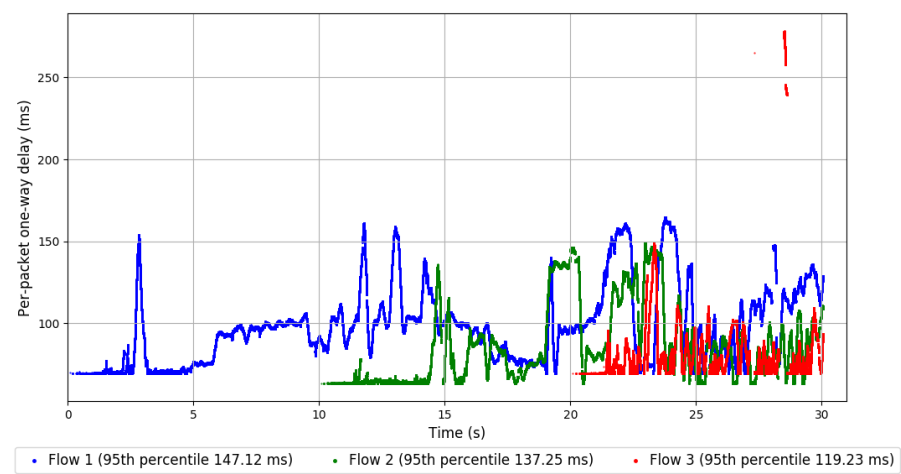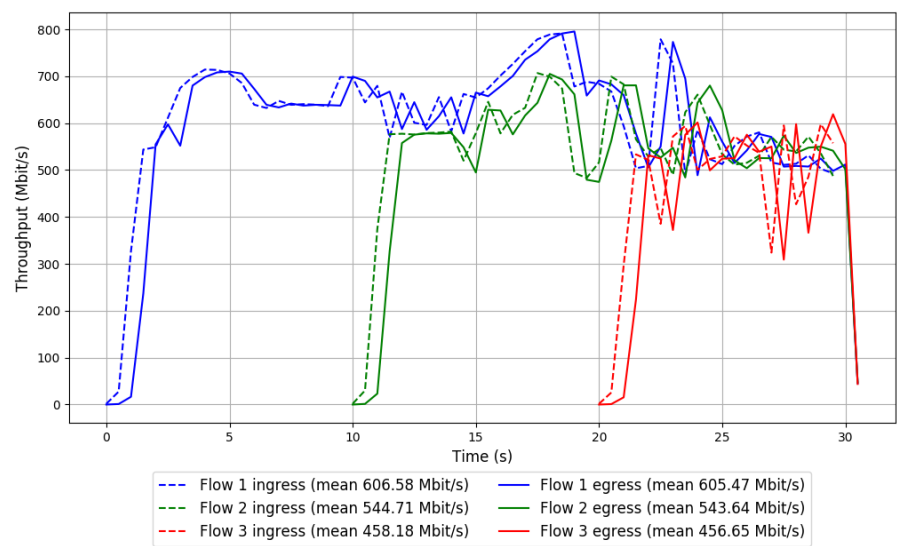
Run 1: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 606.58 Mbit/s) --- Flow 1 egress (mean 605.47 Mbit/s)
Flow 2 ingress (mean 544.71 Mbit/s) --- Flow 2 egress (mean 543.64 Mbit/s)
Flow 3 ingress (mean 458.18 Mbit/s) --- Flow 3 egress (mean 456.65 Mbit/s)

Flow 1 (95th percentile 147.12 ms) · Flow 2 (95th percentile 137.25 ms) · Flow 3 (95th percentile 119.23 ms)
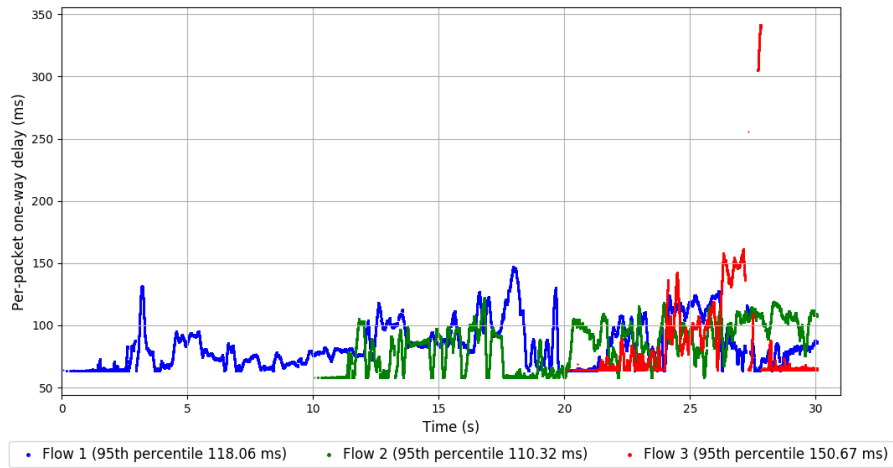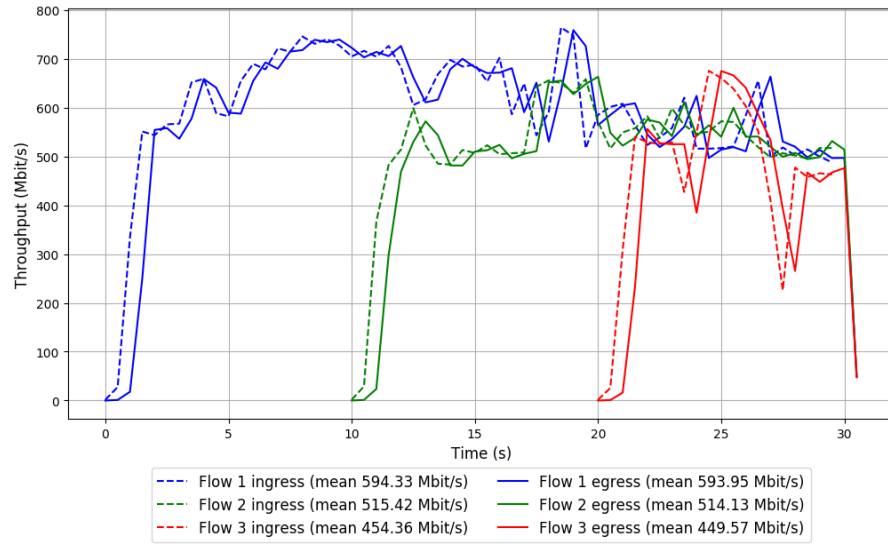
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```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-03 10:56:54
End at: 2018-09-03 10:57:24
Local clock offset: 0.658 ms
Remote clock offset: -1.571 ms


# Below is generated by plot.py at 2018-09-03 11:16:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1086.04 Mbit/s
95th percentile per-packet one-way delay: 118.072 ms
Loss rate: 0.25%
-- Flow 1:
Average throughput: 593.95 Mbit/s
95th percentile per-packet one-way delay: 118.065 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 514.13 Mbit/s
95th percentile per-packet one-way delay: 110.319 ms
Loss rate: 0.22%
-- Flow 3:
Average throughput: 449.57 Mbit/s
95th percentile per-packet one-way delay: 150.669 ms
Loss rate: 1.06%
```

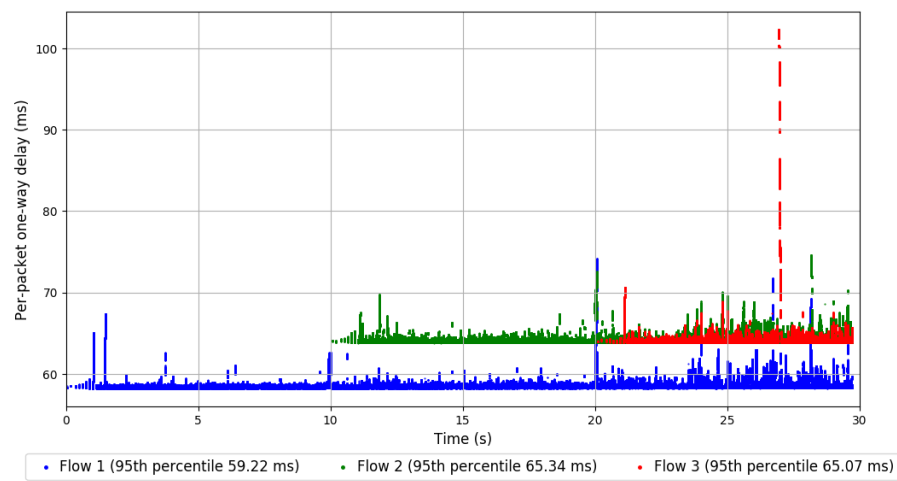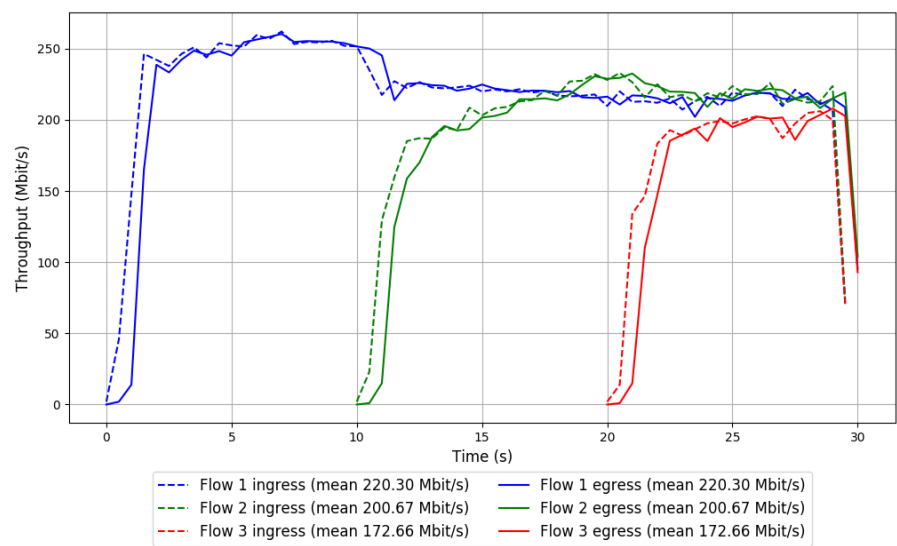Run 2: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-09-03 10:47:03
End at: 2018-09-03 10:47:33
Local clock offset: 0.95 ms
Remote clock offset: -0.859 ms

# Below is generated by plot.py at 2018-09-03 11:16:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 409.00 Mbit/s
95th percentile per-packet one-way delay: 64.579 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 220.30 Mbit/s
95th percentile per-packet one-way delay: 59.224 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 200.67 Mbit/s
95th percentile per-packet one-way delay: 65.342 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 172.66 Mbit/s
95th percentile per-packet one-way delay: 65.066 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2018-09-03 10:55:05
End at: 2018-09-03 10:55:35
Local clock offset: 0.702 ms
Remote clock offset: 1.478 ms


# Below is generated by plot.py at 2018-09-03 11:16:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 419.23 Mbit/s
95th percentile per-packet one-way delay: 68.206 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 223.14 Mbit/s
95th percentile per-packet one-way delay: 67.822 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 196.69 Mbit/s
95th percentile per-packet one-way delay: 68.802 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 203.81 Mbit/s
95th percentile per-packet one-way delay: 63.913 ms
Loss rate: 0.00%
```
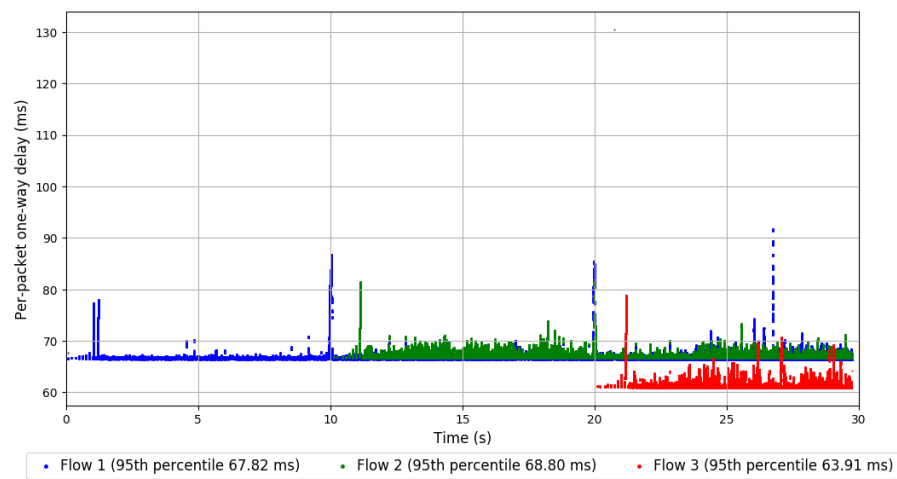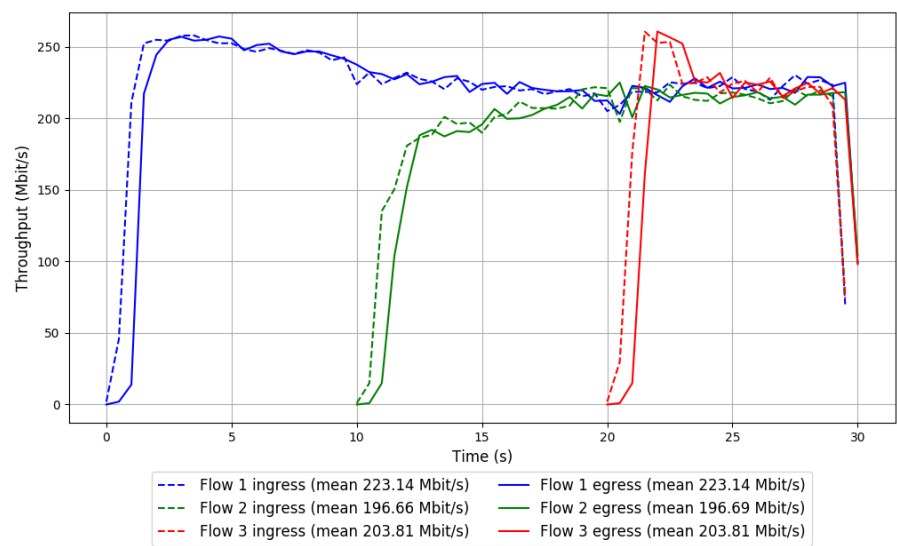
Run 2: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-09-03 10:43:00
End at: 2018-09-03 10:43:30
Local clock offset: 0.918 ms
Remote clock offset: 2.686 ms


# Below is generated by plot.py at 2018-09-03 11:16:09
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1130.80 Mbit/s
95th percentile per-packet one-way delay: 70.947 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 618.41 Mbit/s
95th percentile per-packet one-way delay: 68.309 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 534.19 Mbit/s
95th percentile per-packet one-way delay: 71.529 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 481.55 Mbit/s
95th percentile per-packet one-way delay: 78.565 ms
Loss rate: 0.00%
```
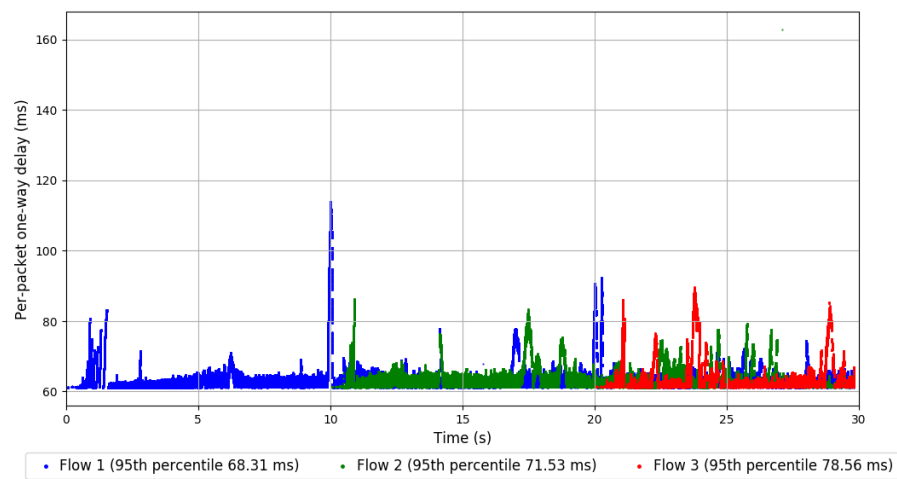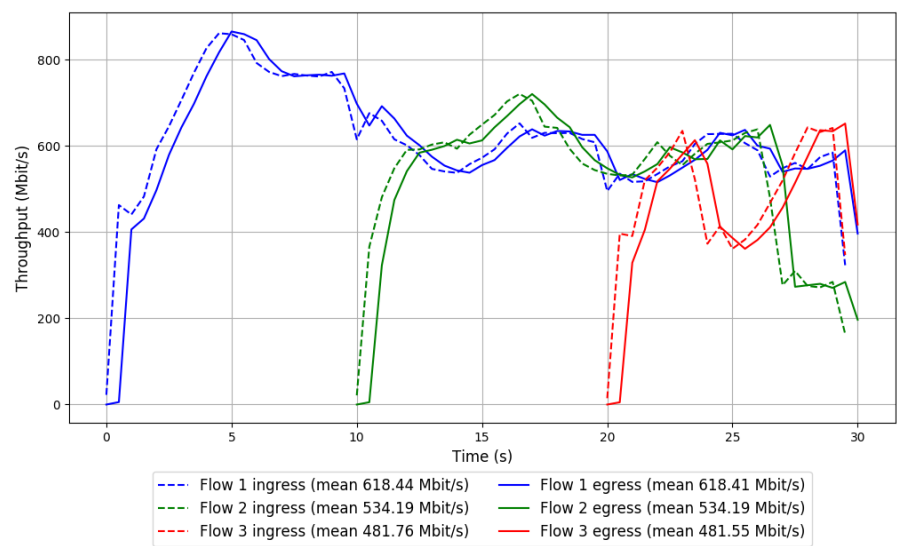
Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-09-03 10:50:58
End at: 2018-09-03 10:51:28
Local clock offset: 1.08 ms
Remote clock offset: -1.306 ms


# Below is generated by plot.py at 2018-09-03 11:16:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1271.78 Mbit/s
95th percentile per-packet one-way delay: 73.558 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 667.73 Mbit/s
95th percentile per-packet one-way delay: 70.276 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 628.82 Mbit/s
95th percentile per-packet one-way delay: 82.283 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 574.07 Mbit/s
95th percentile per-packet one-way delay: 65.572 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link