Pantheon Report

Generated at 2018-08-31 13:18:03 (UTC).

Data path: GCE Sydney 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.
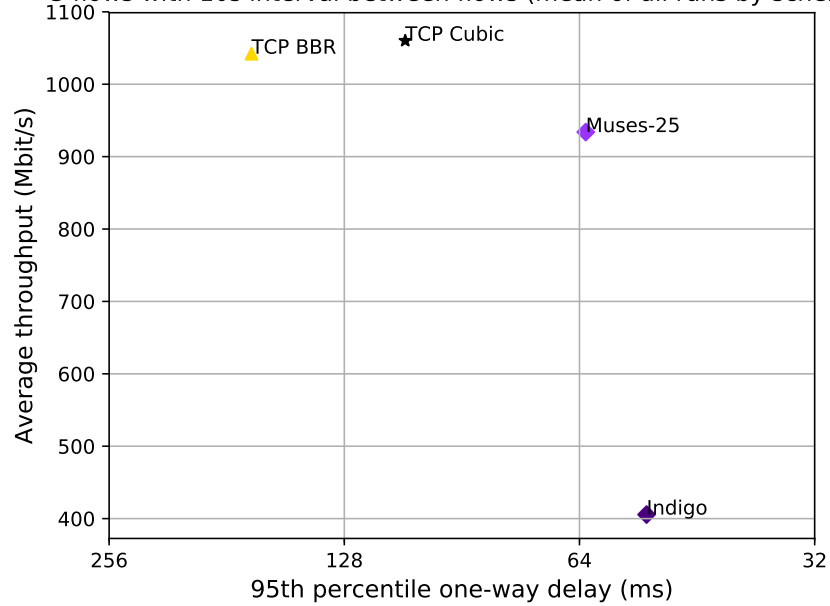
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
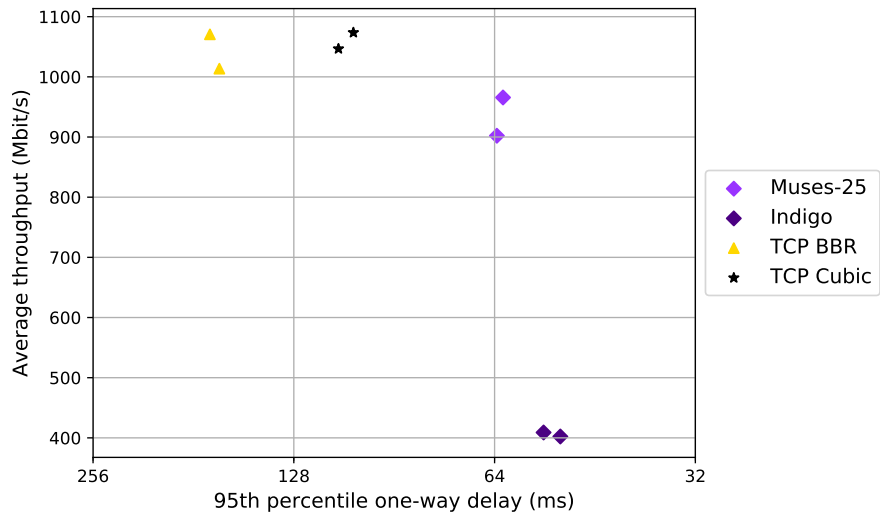
```
Git summary:
branch: muses @ e3c5aa19ca94c3066828fb83f16a8fb6b2731e7a
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
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 Sydney 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 Sydney to GCE Tokyo, 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	547.85	529.26	426.38	167.70	118.88	166.94	1.48	0.42	2.13
TCP Cubic	2	555.89	526.86	461.19	73.99	102.79	105.28	0.00	0.10	0.14
Indigo	2	215.05	202.94	173.37	51.30	52.00	51.28	0.00	0.00	0.43
Muses-25	2	509.52	434.31	415.85	62.83	63.70	61.50	0.00	0.01	0.11

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 12:49:56
End at: 2018-08-31 12:50:26
Local clock offset: 0.853 ms
Remote clock offset: 0.644 ms


# Below is generated by plot.py at 2018-08-31 13:17:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1070.67 Mbit/s
95th percentile per-packet one-way delay: 171.013 ms
Loss rate: 1.31%
-- Flow 1:
Average throughput: 545.72 Mbit/s
95th percentile per-packet one-way delay: 161.330 ms
Loss rate: 1.41%
-- Flow 2:
Average throughput: 573.38 Mbit/s
95th percentile per-packet one-way delay: 90.215 ms
Loss rate: 0.17%
-- Flow 3:
Average throughput: 430.37 Mbit/s
95th percentile per-packet one-way delay: 236.504 ms
Loss rate: 3.86%
```
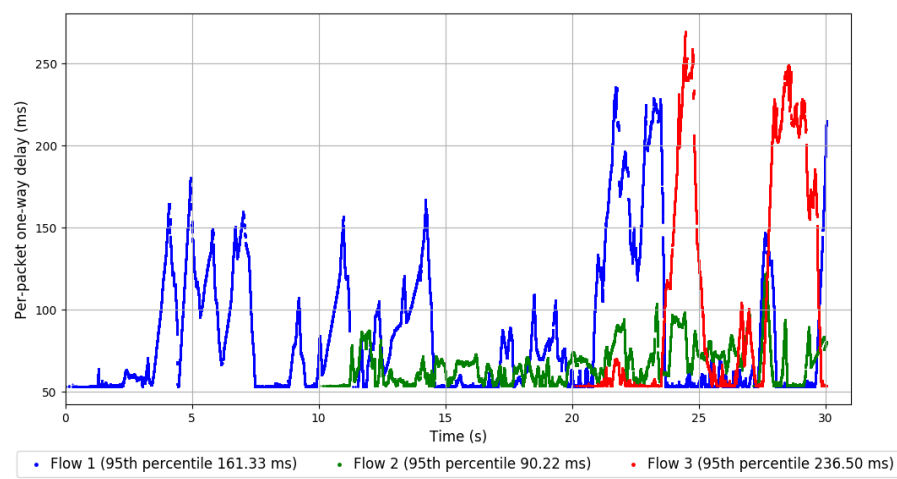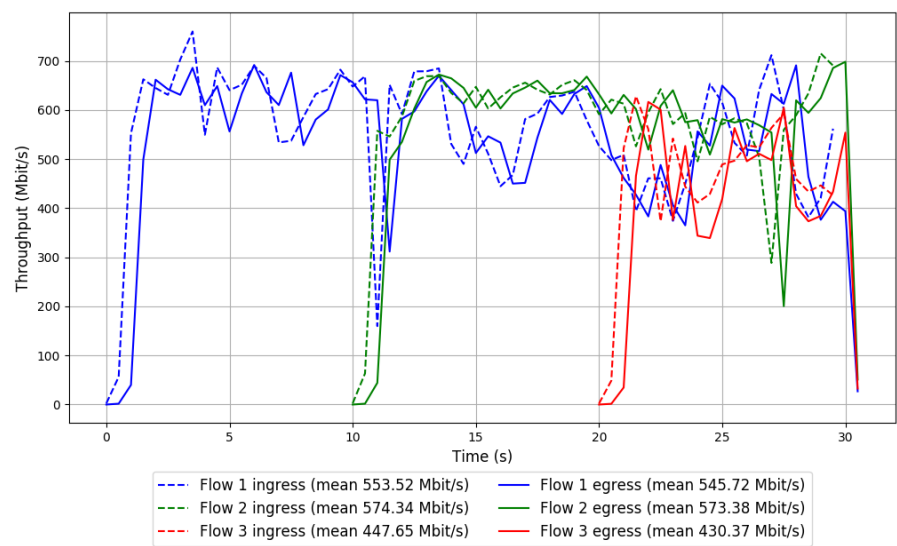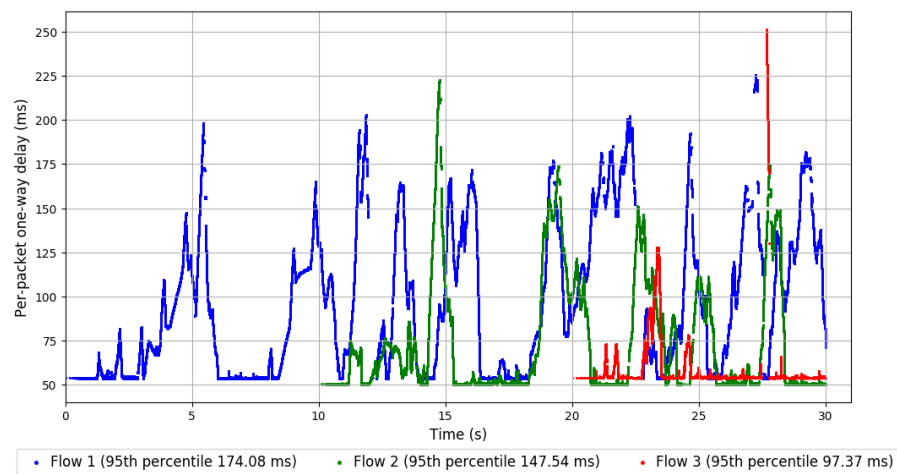
Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 553.52 Mbit/s) --- Flow 1 egress (mean 545.72 Mbit/s)
Flow 2 ingress (mean 574.34 Mbit/s) --- Flow 2 egress (mean 573.38 Mbit/s)
Flow 3 ingress (mean 447.65 Mbit/s) --- Flow 3 egress (mean 430.37 Mbit/s)

Flow 1 (95th percentile 161.33 ms) • Flow 2 (95th percentile 90.22 ms) • Flow 3 (95th percentile 236.50 ms)

```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 12:57:42
End at: 2018-08-31 12:58:12
Local clock offset: 0.56 ms
Remote clock offset: 0.773 ms


# Below is generated by plot.py at 2018-08-31 13:17:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1013.61 Mbit/s
95th percentile per-packet one-way delay: 165.521 ms
Loss rate: 1.12%
-- Flow 1:
Average throughput: 549.98 Mbit/s
95th percentile per-packet one-way delay: 174.077 ms
Loss rate: 1.56%
-- Flow 2:
Average throughput: 485.15 Mbit/s
95th percentile per-packet one-way delay: 147.543 ms
Loss rate: 0.67%
-- Flow 3:
Average throughput: 422.39 Mbit/s
95th percentile per-packet one-way delay: 97.368 ms
Loss rate: 0.41%
```
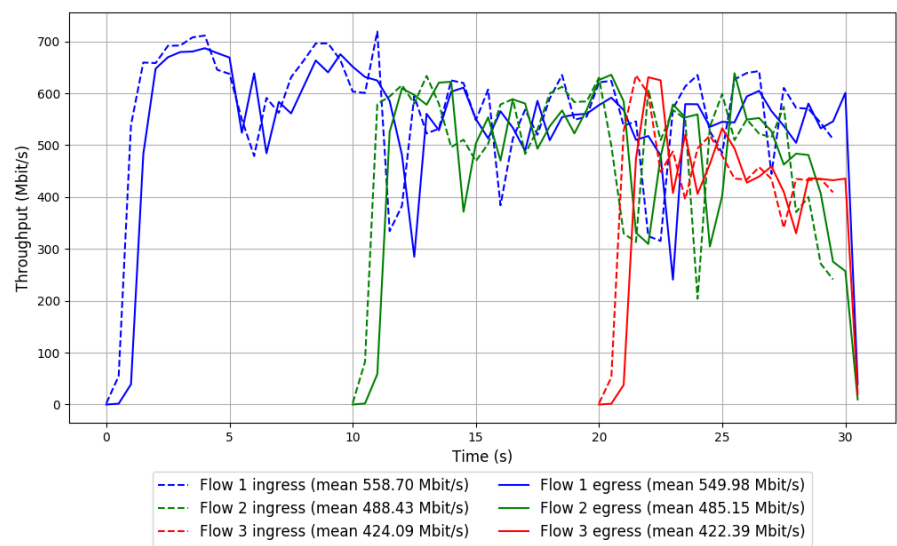
Run 2: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 12:47:56
End at: 2018-08-31 12:48:26
Local clock offset: 0.751 ms
Remote clock offset: 0.696 ms


# Below is generated by plot.py at 2018-08-31 13:17:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1046.60 Mbit/s
95th percentile per-packet one-way delay: 109.720 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 557.68 Mbit/s
95th percentile per-packet one-way delay: 61.106 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 532.07 Mbit/s
95th percentile per-packet one-way delay: 118.747 ms
Loss rate: 0.18%
-- Flow 3:
Average throughput: 405.34 Mbit/s
95th percentile per-packet one-way delay: 89.958 ms
Loss rate: 0.00%
```
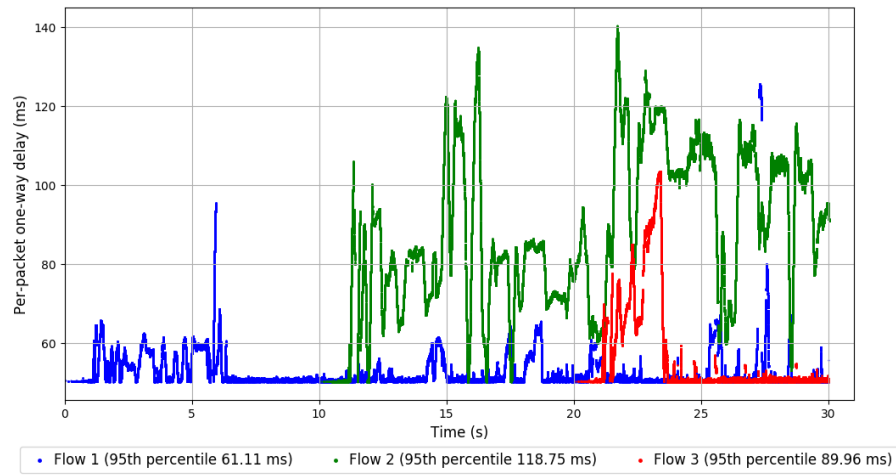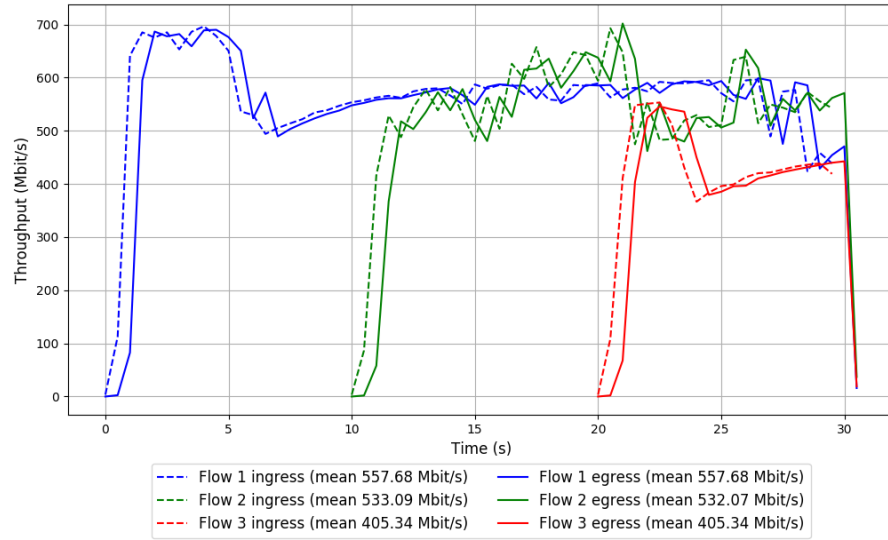
Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 12:55:41
End at: 2018-08-31 12:56:11
Local clock offset: 0.822 ms
Remote clock offset: 3.849 ms


# Below is generated by plot.py at 2018-08-31 13:17:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1073.54 Mbit/s
95th percentile per-packet one-way delay: 104.202 ms
Loss rate: 0.05%
-- Flow 1:
Average throughput: 554.10 Mbit/s
95th percentile per-packet one-way delay: 86.880 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 521.65 Mbit/s
95th percentile per-packet one-way delay: 86.834 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 517.04 Mbit/s
95th percentile per-packet one-way delay: 120.609 ms
Loss rate: 0.28%
```
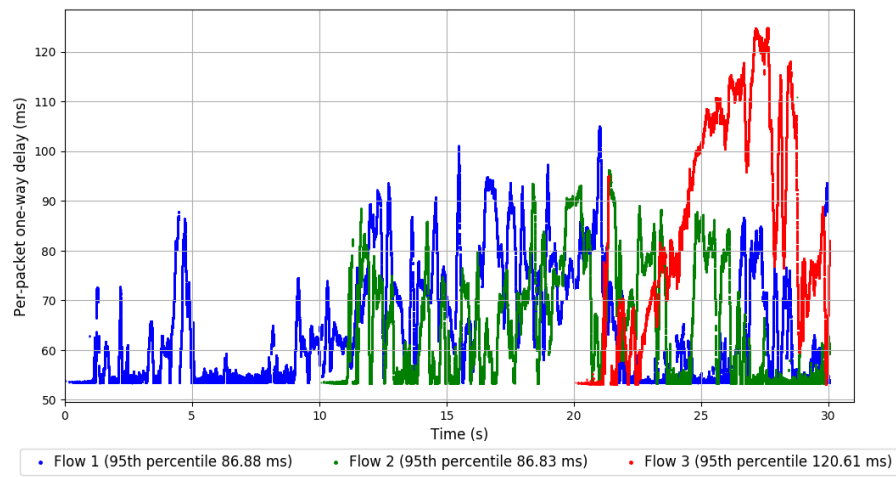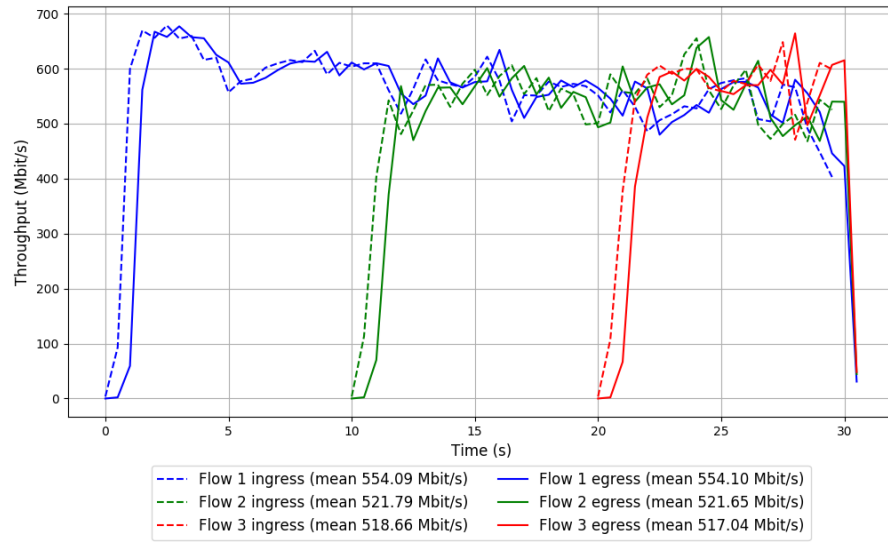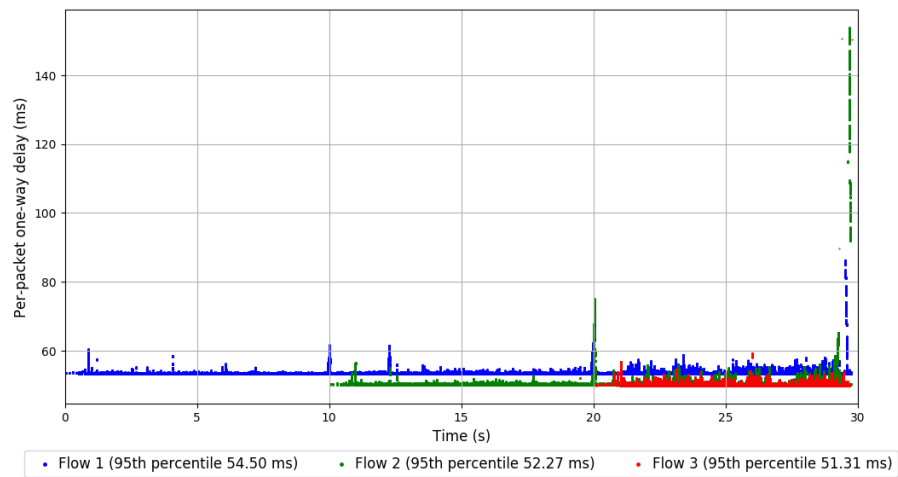
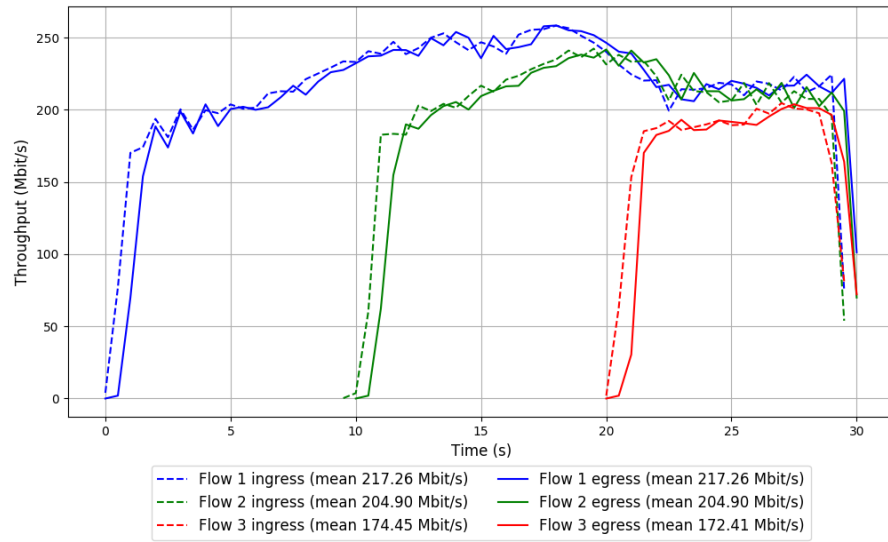Run 2: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-08-31 12:44:12
End at: 2018-08-31 12:44:42
Local clock offset: 0.796 ms
Remote clock offset: 0.607 ms


# Below is generated by plot.py at 2018-08-31 13:17:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 408.93 Mbit/s
95th percentile per-packet one-way delay: 54.041 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 217.26 Mbit/s
95th percentile per-packet one-way delay: 54.498 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 204.90 Mbit/s
95th percentile per-packet one-way delay: 52.273 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 172.41 Mbit/s
95th percentile per-packet one-way delay: 51.313 ms
Loss rate: 0.86%
```
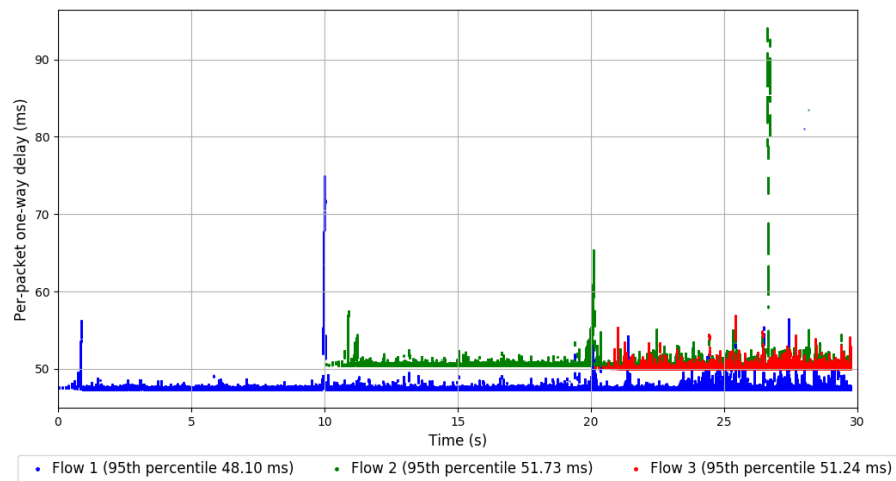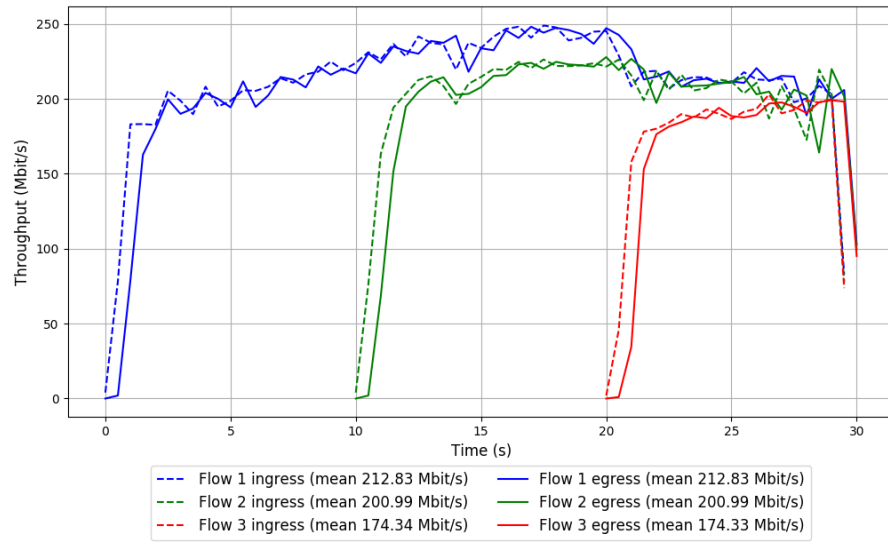
Run 1: Report of Indigo — Data Link

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Run 2: Statistics of Indigo

Start at: 2018-08-31 12:52:00
End at: 2018-08-31 12:52:30
Local clock offset: 0.944 ms
Remote clock offset: -2.139 ms


# Below is generated by plot.py at 2018-08-31 13:17:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 402.26 Mbit/s
95th percentile per-packet one-way delay: 51.001 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 212.83 Mbit/s
95th percentile per-packet one-way delay: 48.102 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 200.99 Mbit/s
95th percentile per-packet one-way delay: 51.733 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 174.33 Mbit/s
95th percentile per-packet one-way delay: 51.238 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 12:45:57
End at: 2018-08-31 12:46:27
Local clock offset: 0.719 ms
Remote clock offset: 0.628 ms

# Below is generated by plot.py at 2018-08-31 13:18:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 965.70 Mbit/s
95th percentile per-packet one-way delay: 62.165 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 504.71 Mbit/s
95th percentile per-packet one-way delay: 62.200 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 462.10 Mbit/s
95th percentile per-packet one-way delay: 62.842 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 470.44 Mbit/s
95th percentile per-packet one-way delay: 60.970 ms
Loss rate: 0.01%
```
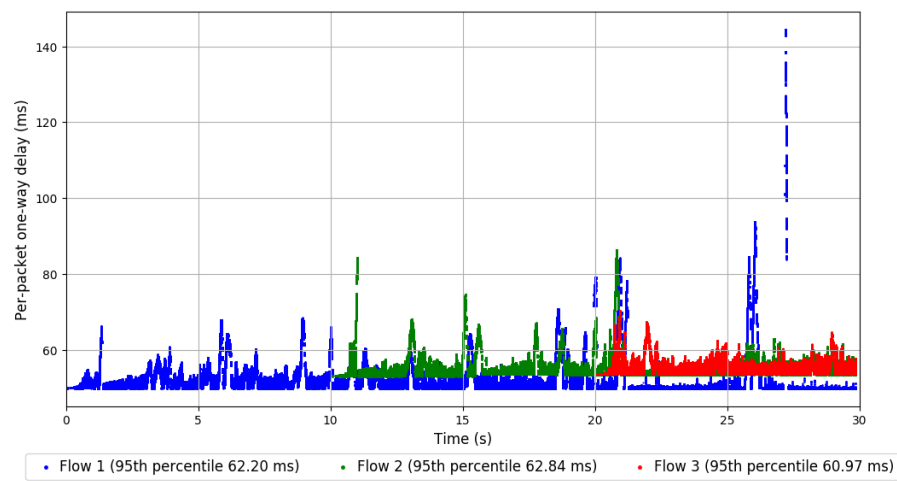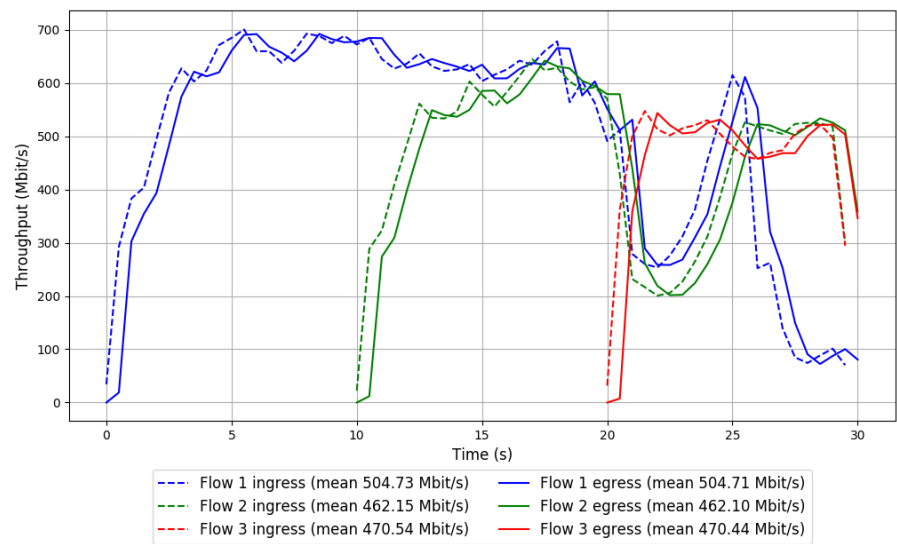
Run 1: Report of Muses-25 — Data Link

Flow 1 ingress (mean 504.73 Mbit/s) --- Flow 1 egress (mean 504.71 Mbit/s)
Flow 2 ingress (mean 462.15 Mbit/s) --- Flow 2 egress (mean 462.10 Mbit/s)
Flow 3 ingress (mean 470.54 Mbit/s) --- Flow 3 egress (mean 470.44 Mbit/s)

Flow 1 (95th percentile 62.20 ms)   Flow 2 (95th percentile 62.84 ms)   Flow 3 (95th percentile 60.97 ms)

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```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 12:53:45
End at: 2018-08-31 12:54:15
Local clock offset: 0.756 ms
Remote clock offset: 3.671 ms


# Below is generated by plot.py at 2018-08-31 13:18:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 902.11 Mbit/s
95th percentile per-packet one-way delay: 63.499 ms
Loss rate: 0.03%
-- Flow 1:
Average throughput: 514.34 Mbit/s
95th percentile per-packet one-way delay: 63.455 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 406.51 Mbit/s
95th percentile per-packet one-way delay: 64.563 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 361.25 Mbit/s
95th percentile per-packet one-way delay: 62.039 ms
Loss rate: 0.21%
```

Run 2: Report of Muses-25 — Data Link