

Pantheon Report

Generated at 2018-08-28 06:45:11 (UTC).

Data path: Stanford on **eno1** (*remote*) → AWS California 1 on **ens5** (*local*).

Repeated the test of 4 congestion control schemes 3 times.

Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against **time.stanford.edu** and have been applied to correct the timestamps in logs.

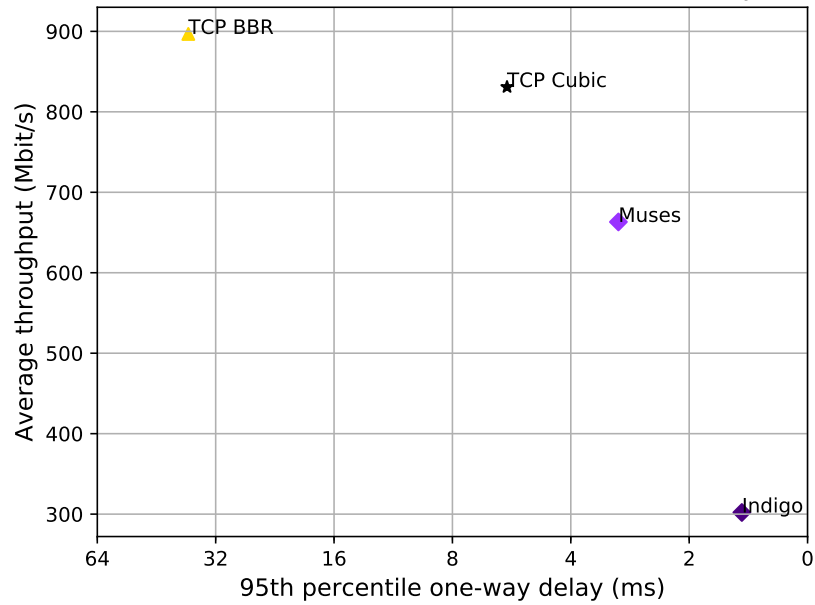
System info:

```
Linux 4.15.0-1019-aws
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
```

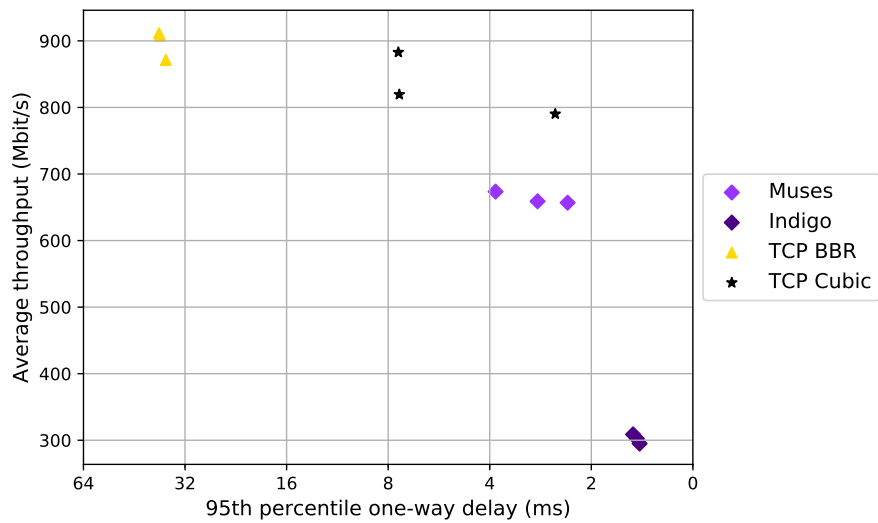
Git summary:

```
branch: muses @ 86ef433b09b2f4ecae1186d6940af93bcf0969cd
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdf58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecd9c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b261c9e99c63be452bc16f94ce0caa99a4c9d39a
third_party/pantheon-tunnel @ cbfce6db5ff5740d4fe1771f813cd646339e1952
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 Stanford to AWS California 1, 3 runs of 30s each per scheme
 3 flows with 10s interval between flows (mean of all runs by scheme)



test from Stanford to AWS California 1, 3 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	3	522.11	401.07	324.06	30.57	39.10	51.01	0.34	0.64	0.92
TCP Cubic	3	534.41	300.08	290.62	6.17	5.20	5.13	0.06	0.12	0.27
Indigo	3	169.39	147.79	105.02	1.10	1.12	1.15	0.05	0.10	0.19
Muses	3	378.07	337.27	183.40	2.93	3.38	1.47	0.02	0.10	0.24

Run 1: Statistics of TCP BBR

Start at: 2018-08-28 06:16:54

End at: 2018-08-28 06:17:24

Local clock offset: -0.46 ms

Remote clock offset: 1.121 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 911.61 Mbit/s

95th percentile per-packet one-way delay: 38.206 ms

Loss rate: 0.44%

-- Flow 1:

Average throughput: 536.08 Mbit/s

95th percentile per-packet one-way delay: 32.325 ms

Loss rate: 0.33%

-- Flow 2:

Average throughput: 401.33 Mbit/s

95th percentile per-packet one-way delay: 41.795 ms

Loss rate: 0.53%

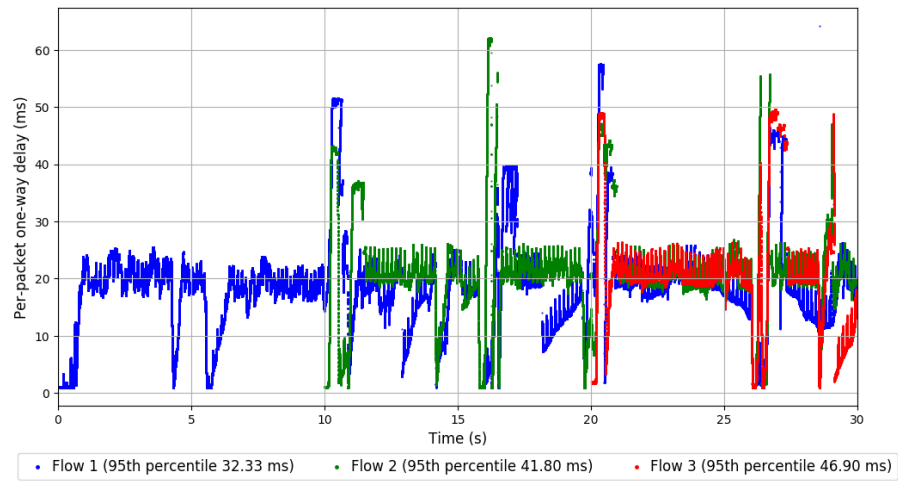
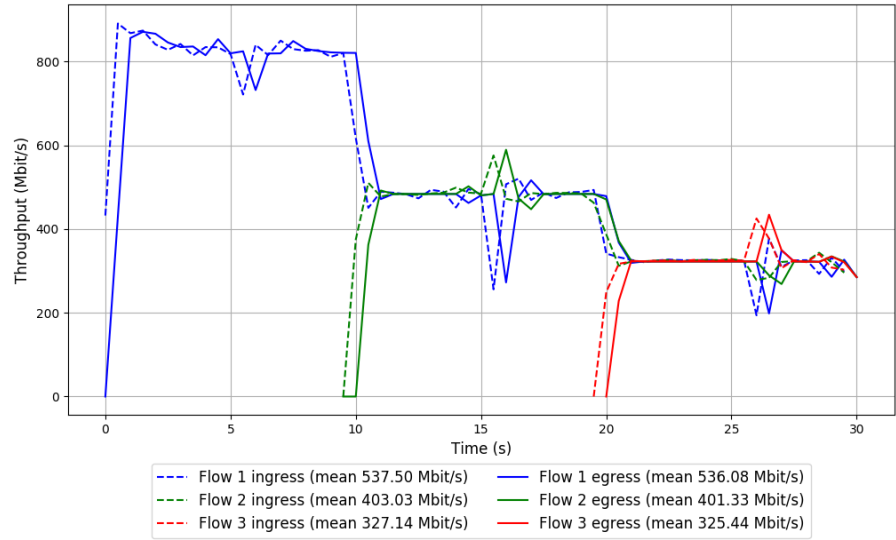
-- Flow 3:

Average throughput: 325.44 Mbit/s

95th percentile per-packet one-way delay: 46.902 ms

Loss rate: 0.73%

Run 1: Report of TCP BBR — Data Link



Run 2: Statistics of TCP BBR

Start at: 2018-08-28 06:23:45

End at: 2018-08-28 06:24:15

Local clock offset: -0.663 ms

Remote clock offset: 0.849 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 907.52 Mbit/s

95th percentile per-packet one-way delay: 37.981 ms

Loss rate: 0.50%

-- Flow 1:

Average throughput: 533.16 Mbit/s

95th percentile per-packet one-way delay: 27.422 ms

Loss rate: 0.30%

-- Flow 2:

Average throughput: 400.90 Mbit/s

95th percentile per-packet one-way delay: 38.892 ms

Loss rate: 0.70%

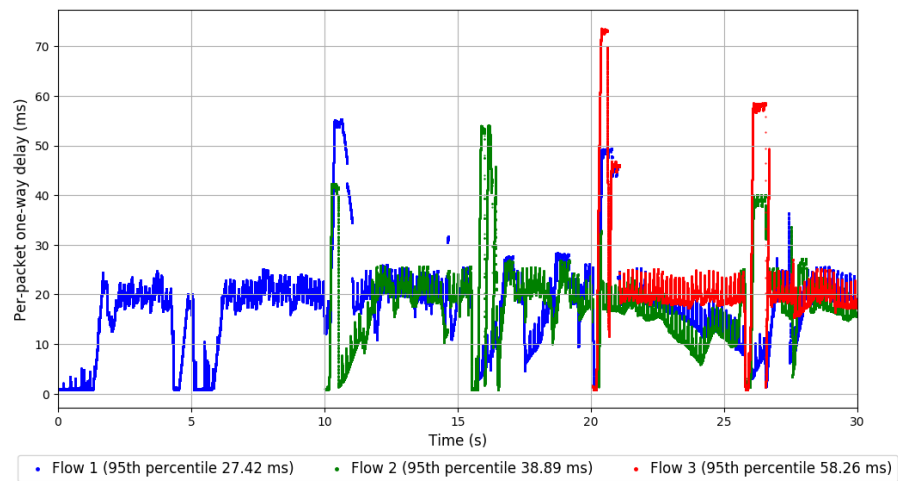
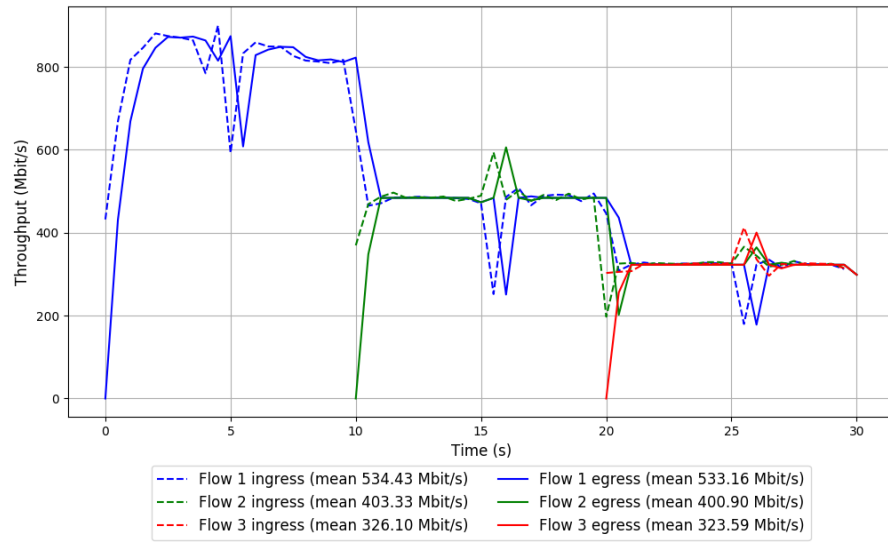
-- Flow 3:

Average throughput: 323.59 Mbit/s

95th percentile per-packet one-way delay: 58.263 ms

Loss rate: 0.97%

Run 2: Report of TCP BBR — Data Link



Run 3: Statistics of TCP BBR

Start at: 2018-08-28 06:30:39

End at: 2018-08-28 06:31:09

Local clock offset: -0.677 ms

Remote clock offset: 0.34 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 871.29 Mbit/s

95th percentile per-packet one-way delay: 36.483 ms

Loss rate: 0.57%

-- Flow 1:

Average throughput: 497.10 Mbit/s

95th percentile per-packet one-way delay: 31.972 ms

Loss rate: 0.39%

-- Flow 2:

Average throughput: 400.99 Mbit/s

95th percentile per-packet one-way delay: 36.613 ms

Loss rate: 0.69%

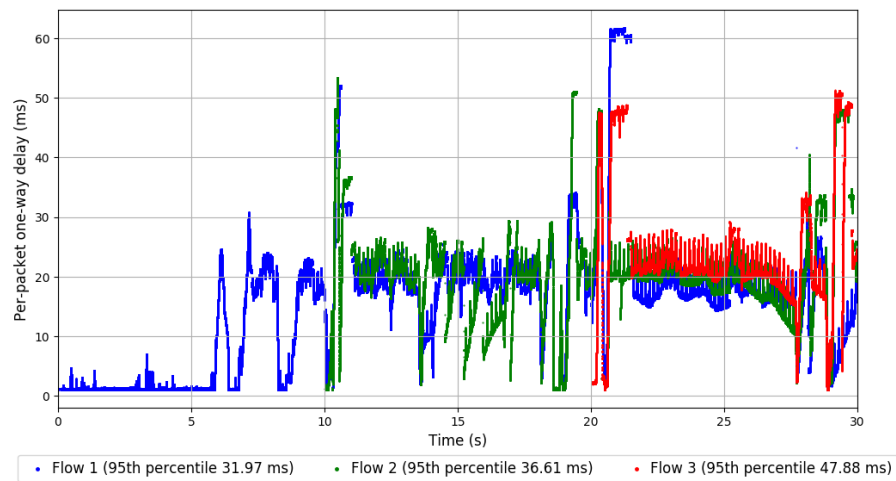
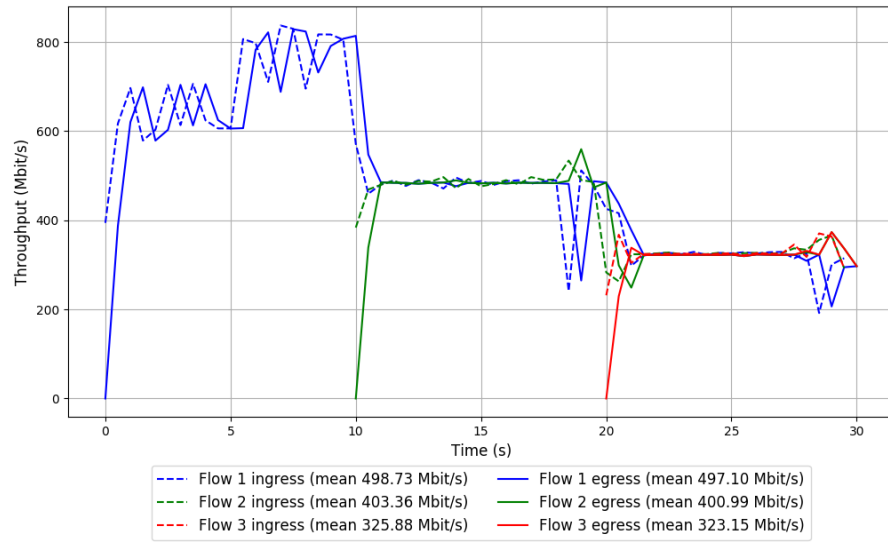
-- Flow 3:

Average throughput: 323.15 Mbit/s

95th percentile per-packet one-way delay: 47.879 ms

Loss rate: 1.07%

Run 3: Report of TCP BBR — Data Link



Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 06:11:56

End at: 2018-08-28 06:12:26

Local clock offset: -0.155 ms

Remote clock offset: 0.99 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 819.40 Mbit/s

95th percentile per-packet one-way delay: 7.414 ms

Loss rate: 0.11%

-- Flow 1:

Average throughput: 464.87 Mbit/s

95th percentile per-packet one-way delay: 7.735 ms

Loss rate: 0.07%

-- Flow 2:

Average throughput: 384.65 Mbit/s

95th percentile per-packet one-way delay: 7.067 ms

Loss rate: 0.11%

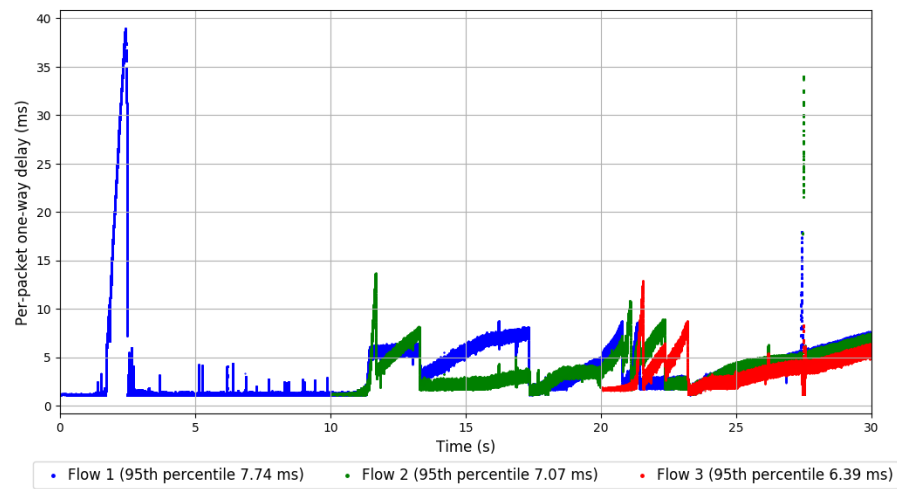
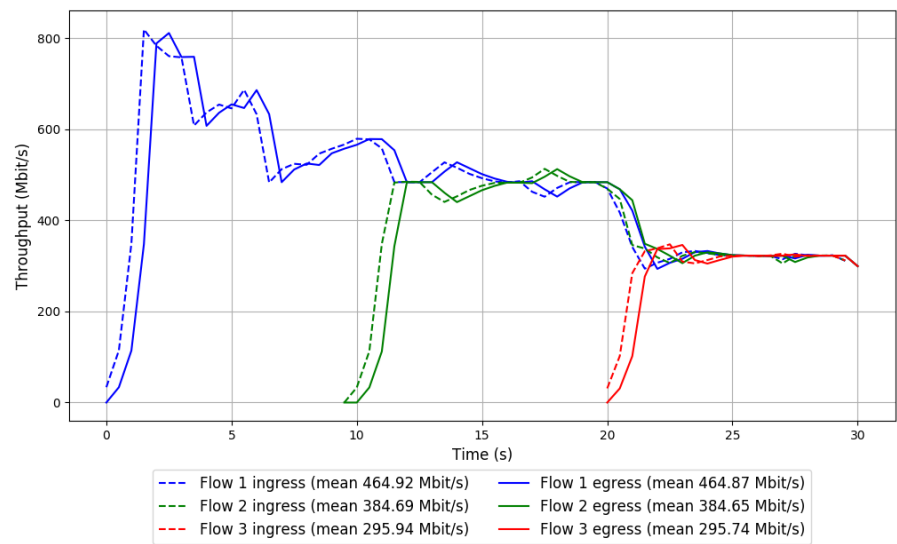
-- Flow 3:

Average throughput: 295.74 Mbit/s

95th percentile per-packet one-way delay: 6.392 ms

Loss rate: 0.27%

Run 1: Report of TCP Cubic — Data Link



Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 06:18:48

End at: 2018-08-28 06:19:18

Local clock offset: -0.527 ms

Remote clock offset: 1.149 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 790.22 Mbit/s

95th percentile per-packet one-way delay: 2.558 ms

Loss rate: 0.08%

-- Flow 1:

Average throughput: 609.18 Mbit/s

95th percentile per-packet one-way delay: 2.645 ms

Loss rate: 0.05%

-- Flow 2:

Average throughput: 132.13 Mbit/s

95th percentile per-packet one-way delay: 1.674 ms

Loss rate: 0.15%

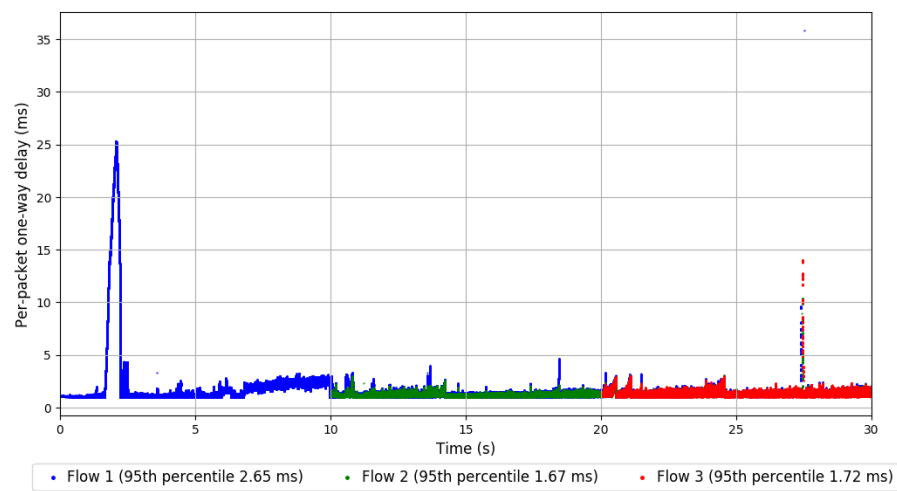
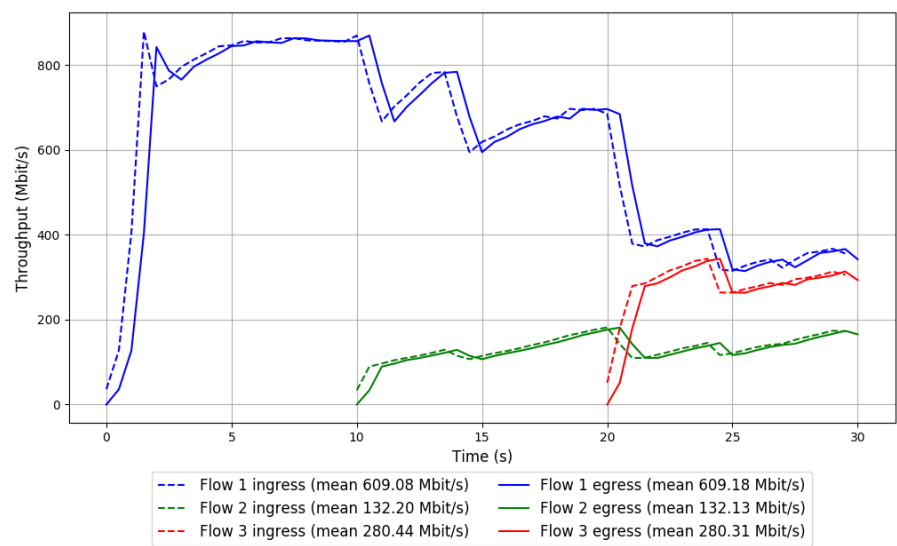
-- Flow 3:

Average throughput: 280.31 Mbit/s

95th percentile per-packet one-way delay: 1.719 ms

Loss rate: 0.25%

Run 2: Report of TCP Cubic — Data Link



Run 3: Statistics of TCP Cubic

Start at: 2018-08-28 06:25:39

End at: 2018-08-28 06:26:09

Local clock offset: -0.6 ms

Remote clock offset: 0.591 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 882.86 Mbit/s

95th percentile per-packet one-way delay: 7.462 ms

Loss rate: 0.10%

-- Flow 1:

Average throughput: 529.19 Mbit/s

95th percentile per-packet one-way delay: 8.128 ms

Loss rate: 0.06%

-- Flow 2:

Average throughput: 383.45 Mbit/s

95th percentile per-packet one-way delay: 6.844 ms

Loss rate: 0.11%

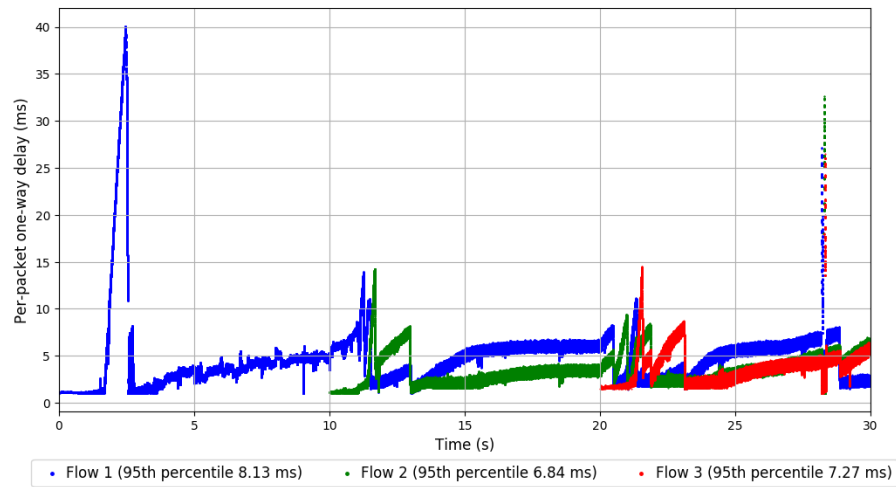
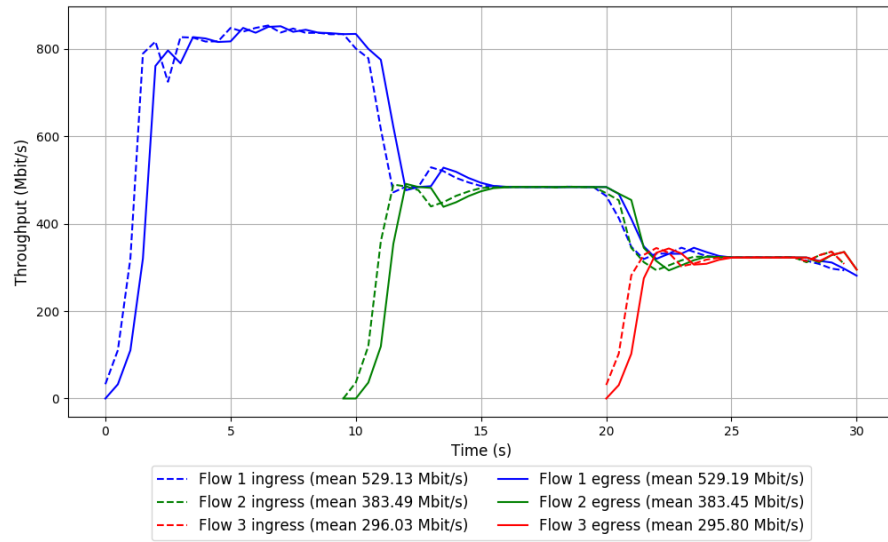
-- Flow 3:

Average throughput: 295.80 Mbit/s

95th percentile per-packet one-way delay: 7.270 ms

Loss rate: 0.28%

Run 3: Report of TCP Cubic — Data Link

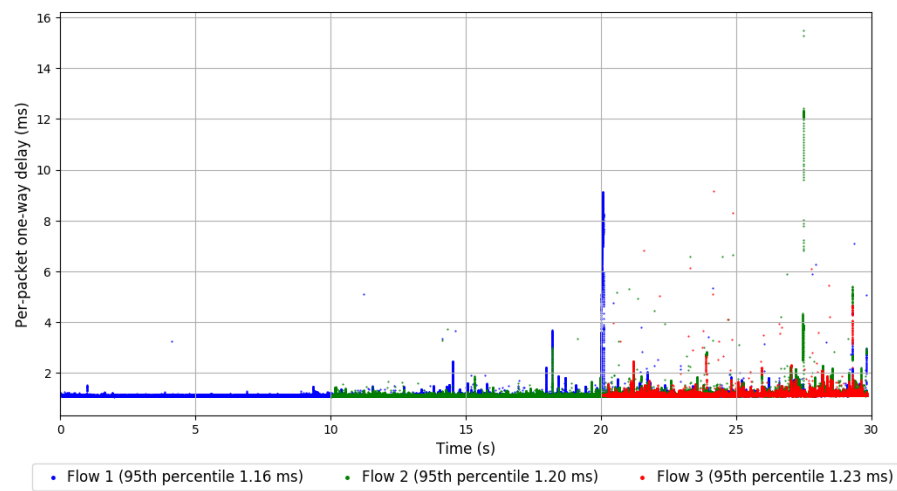
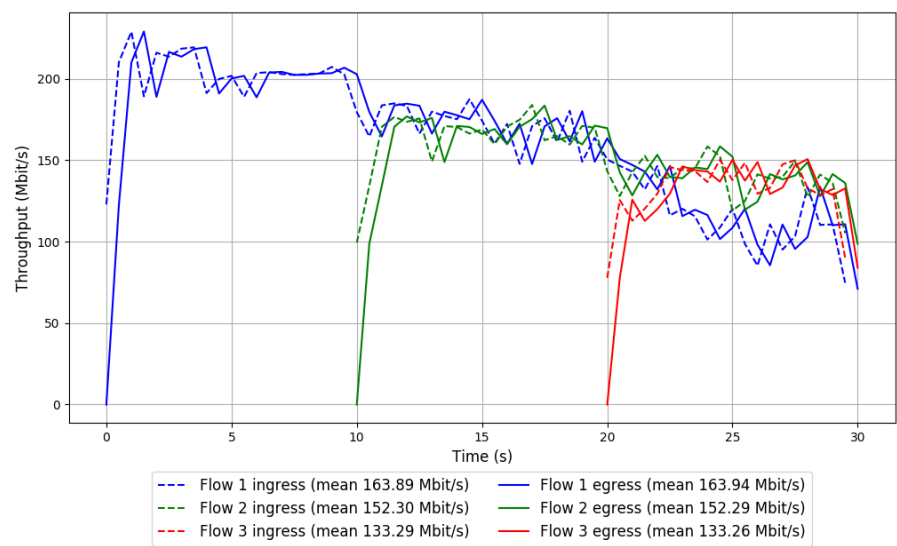


```
Run 1: Statistics of Indigo

Start at: 2018-08-28 06:15:23
End at: 2018-08-28 06:15:53
Local clock offset: -0.325 ms
Remote clock offset: 1.07 ms

# Below is generated by plot.py at 2018-08-28 06:42:56
# Datalink statistics
-- Total of 3 flows:
Average throughput: 308.78 Mbit/s
95th percentile per-packet one-way delay: 1.178 ms
Loss rate: 0.09%
-- Flow 1:
Average throughput: 163.94 Mbit/s
95th percentile per-packet one-way delay: 1.159 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 152.29 Mbit/s
95th percentile per-packet one-way delay: 1.196 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 133.26 Mbit/s
95th percentile per-packet one-way delay: 1.228 ms
Loss rate: 0.23%
```

Run 1: Report of Indigo — Data Link



Run 2: Statistics of Indigo

Start at: 2018-08-28 06:22:14

End at: 2018-08-28 06:22:44

Local clock offset: -0.531 ms

Remote clock offset: 0.914 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 302.41 Mbit/s

95th percentile per-packet one-way delay: 1.104 ms

Loss rate: 0.09%

-- Flow 1:

Average throughput: 174.78 Mbit/s

95th percentile per-packet one-way delay: 1.102 ms

Loss rate: 0.07%

-- Flow 2:

Average throughput: 153.20 Mbit/s

95th percentile per-packet one-way delay: 1.115 ms

Loss rate: 0.11%

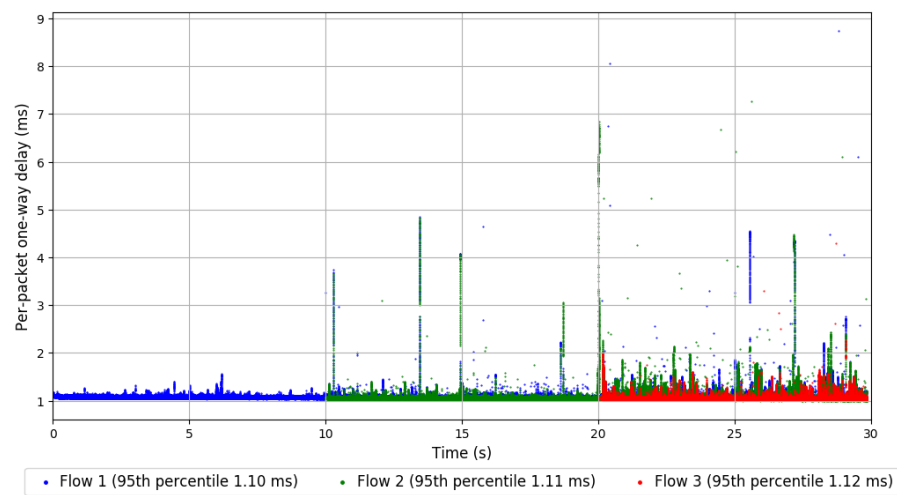
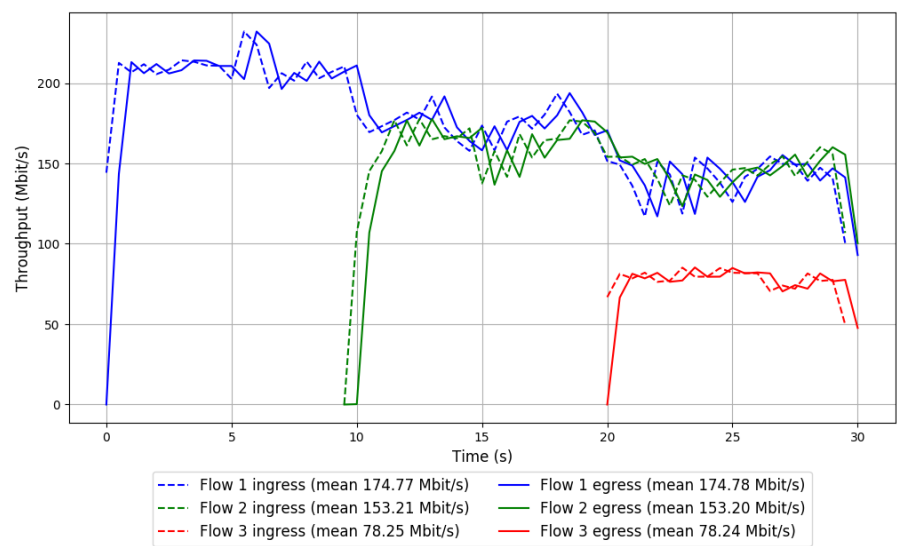
-- Flow 3:

Average throughput: 78.24 Mbit/s

95th percentile per-packet one-way delay: 1.123 ms

Loss rate: 0.15%

Run 2: Report of Indigo — Data Link



Run 3: Statistics of Indigo

Start at: 2018-08-28 06:29:08

End at: 2018-08-28 06:29:38

Local clock offset: -0.75 ms

Remote clock offset: 0.384 ms

Below is generated by plot.py at 2018-08-28 06:42:56

Datalink statistics

-- Total of 3 flows:

Average throughput: 294.94 Mbit/s

95th percentile per-packet one-way delay: 1.049 ms

Loss rate: 0.07%

-- Flow 1:

Average throughput: 169.46 Mbit/s

95th percentile per-packet one-way delay: 1.046 ms

Loss rate: 0.04%

-- Flow 2:

Average throughput: 137.87 Mbit/s

95th percentile per-packet one-way delay: 1.054 ms

Loss rate: 0.08%

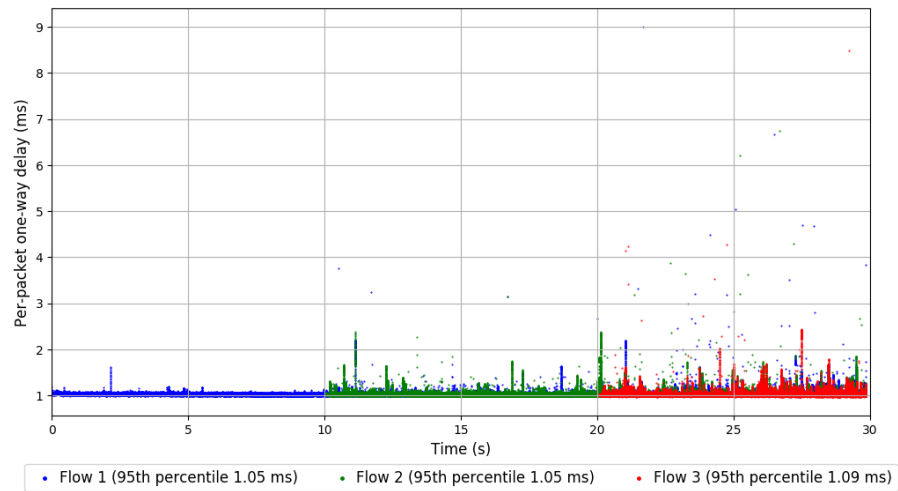
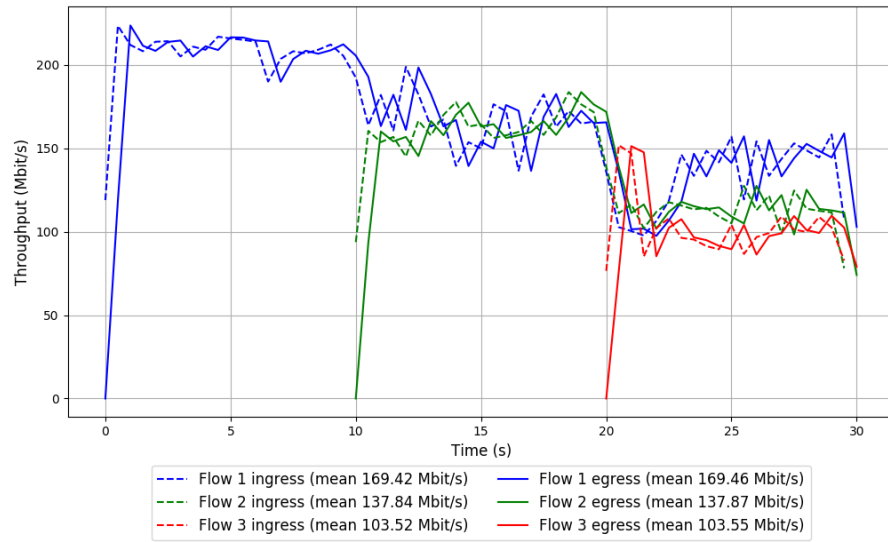
-- Flow 3:

Average throughput: 103.55 Mbit/s

95th percentile per-packet one-way delay: 1.087 ms

Loss rate: 0.20%

Run 3: Report of Indigo — Data Link



Run 1: Statistics of Muses

Start at: 2018-08-28 06:13:41

End at: 2018-08-28 06:14:11

Local clock offset: -0.322 ms

Remote clock offset: 1.022 ms

Below is generated by plot.py at 2018-08-28 06:44:02

Datalink statistics

-- Total of 3 flows:

Average throughput: 656.90 Mbit/s

95th percentile per-packet one-way delay: 2.351 ms

Loss rate: 0.07%

-- Flow 1:

Average throughput: 376.29 Mbit/s

95th percentile per-packet one-way delay: 2.255 ms

Loss rate: 0.03%

-- Flow 2:

Average throughput: 260.10 Mbit/s

95th percentile per-packet one-way delay: 2.877 ms

Loss rate: 0.05%

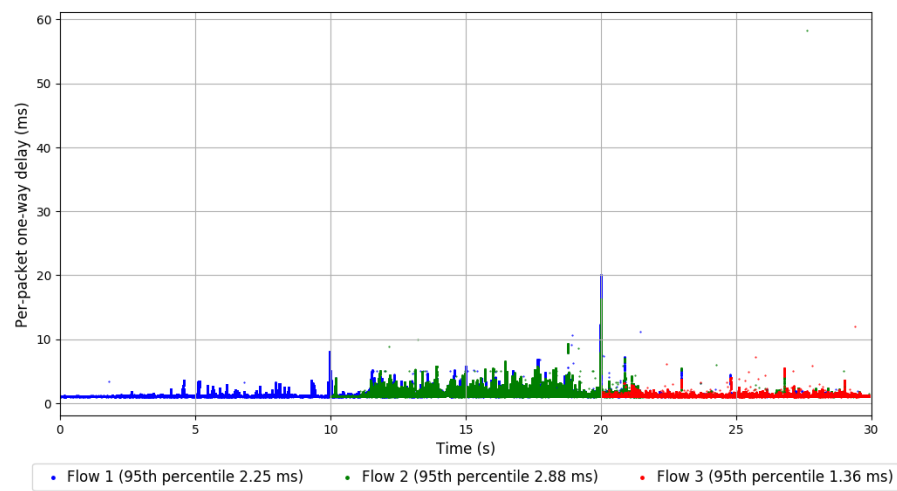
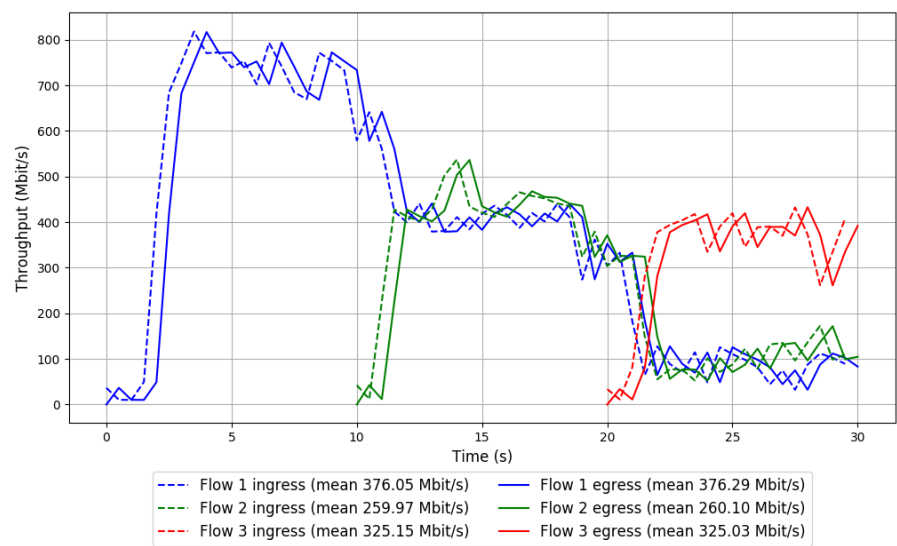
-- Flow 3:

Average throughput: 325.03 Mbit/s

95th percentile per-packet one-way delay: 1.356 ms

Loss rate: 0.26%

Run 1: Report of Muses — Data Link



Run 2: Statistics of Muses

Start at: 2018-08-28 06:20:32

End at: 2018-08-28 06:21:02

Local clock offset: -0.489 ms

Remote clock offset: 1.091 ms

Below is generated by plot.py at 2018-08-28 06:44:58

Datalink statistics

-- Total of 3 flows:

Average throughput: 658.99 Mbit/s

95th percentile per-packet one-way delay: 2.886 ms

Loss rate: 0.07%

-- Flow 1:

Average throughput: 366.64 Mbit/s

95th percentile per-packet one-way delay: 2.825 ms

Loss rate: 0.02%

-- Flow 2:

Average throughput: 380.78 Mbit/s

95th percentile per-packet one-way delay: 3.070 ms

Loss rate: 0.15%

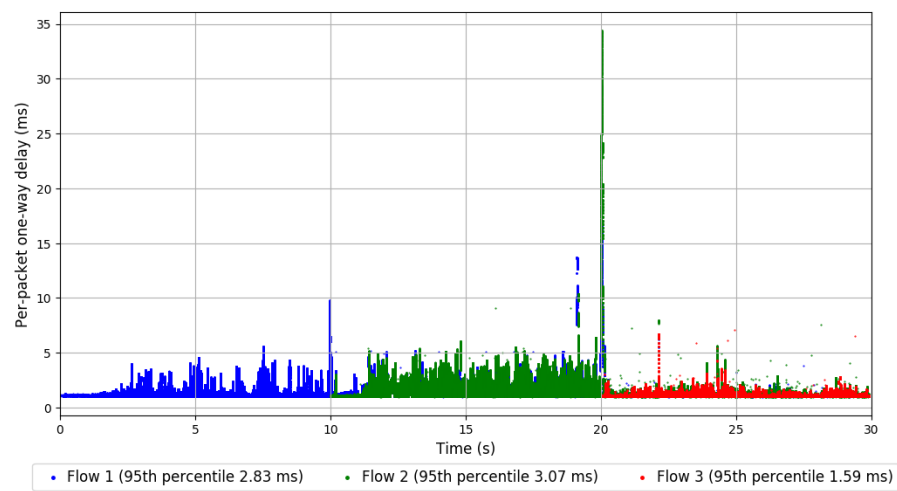
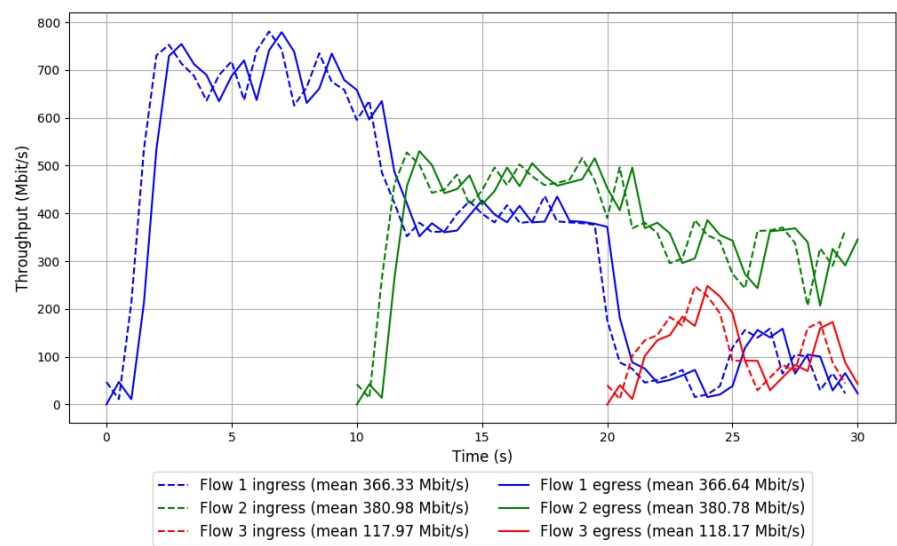
-- Flow 3:

Average throughput: 118.17 Mbit/s

95th percentile per-packet one-way delay: 1.586 ms

Loss rate: 0.05%

Run 2: Report of Muses — Data Link



Run 3: Statistics of Muses

Start at: 2018-08-28 06:27:25

End at: 2018-08-28 06:27:55

Local clock offset: -0.729 ms

Remote clock offset: 0.482 ms

Below is generated by plot.py at 2018-08-28 06:45:09

Datalink statistics

-- Total of 3 flows:

Average throughput: 673.56 Mbit/s

95th percentile per-packet one-way delay: 3.844 ms

Loss rate: 0.06%

-- Flow 1:

Average throughput: 391.27 Mbit/s

95th percentile per-packet one-way delay: 3.699 ms

Loss rate: 0.00%

-- Flow 2:

Average throughput: 370.93 Mbit/s

95th percentile per-packet one-way delay: 4.207 ms

Loss rate: 0.11%

-- Flow 3:

Average throughput: 106.99 Mbit/s

95th percentile per-packet one-way delay: 1.455 ms

Loss rate: 0.41%

Run 3: Report of Muses — Data Link

