Pantheon Report

Generated at 2018-08-28 15:02:30 (UTC).

Data path: GCE Iowa on `ens4` (*local*) →GCE Tokyo on `ens4` (*remote*).

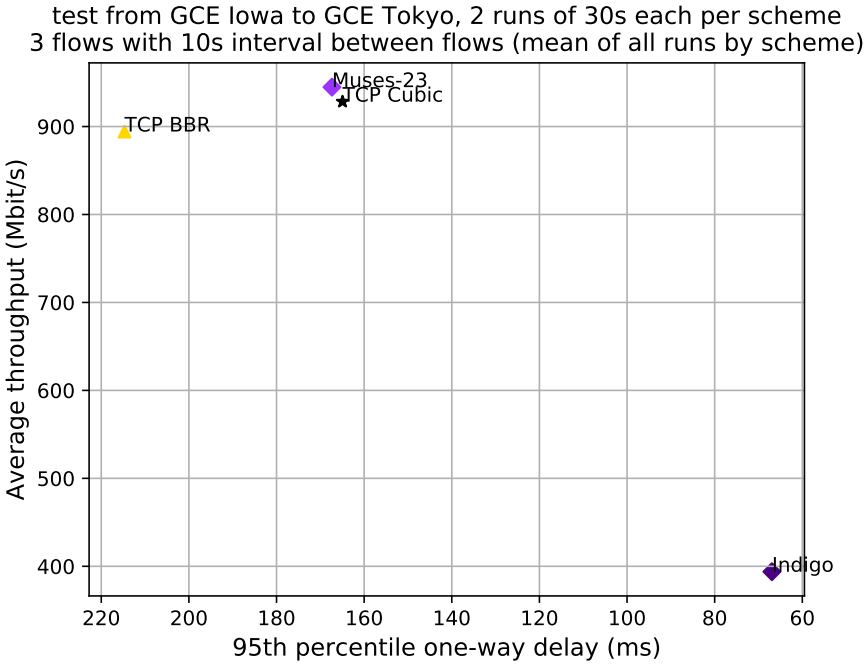
Repeated the test of 4 congestion control schemes twice.

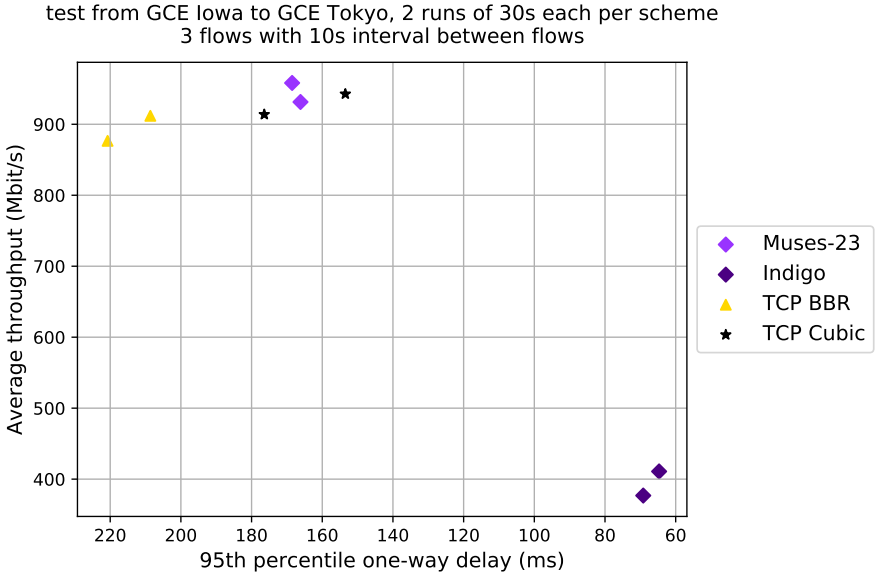
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `time.google.com` and have been applied to correct the timestamps in logs.

```
System info:
Linux 4.15.0-1017-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

Git summary:
branch: muses-23 @ 88af05c5b0b7531637ca401951507a2fde628df6
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b261c9e99c63be452bc16f94ce0caa99a4c9d39a
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)
Muses-23
TCP Cubic
TCP BBR
Indigo
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
900
800
700
600
500
400
220
200
180
160
140
120
100
80
60


test from GCE Iowa to GCE Tokyo, 2 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
Muses-23
Indigo
TCP BBR
TCP Cubic
900
800
700
600
500
400
220
200
180
160
140
120
100
80
60

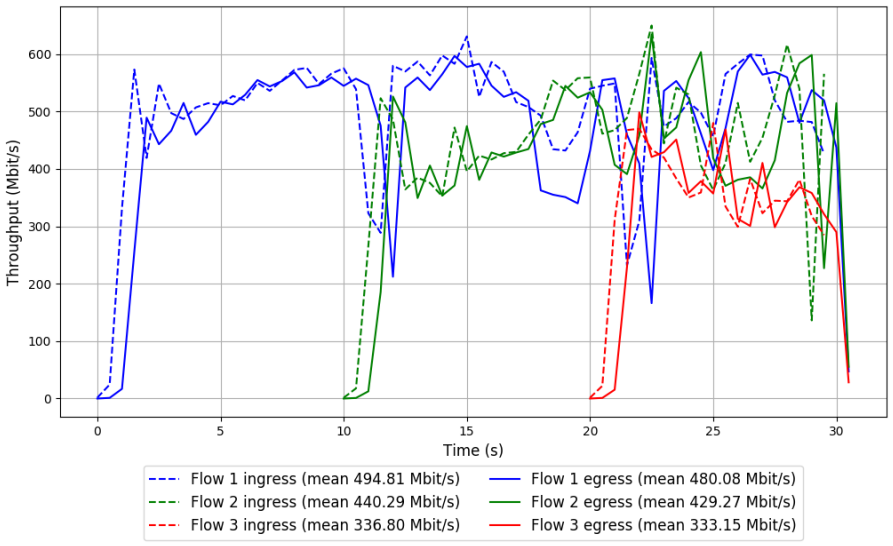
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	2	475.24	452.83	353.87	230.58	198.44	158.44	3.39	1.55	0.74
TCP Cubic	2	469.56	494.03	390.07	159.54	163.93	153.42	0.25	0.37	1.11
Indigo	2	207.22	208.94	149.37	66.93	67.37	63.93	0.00	0.00	0.00
Muses-23	2	522.00	433.61	414.84	164.36	169.33	170.91	3.31	4.72	4.86

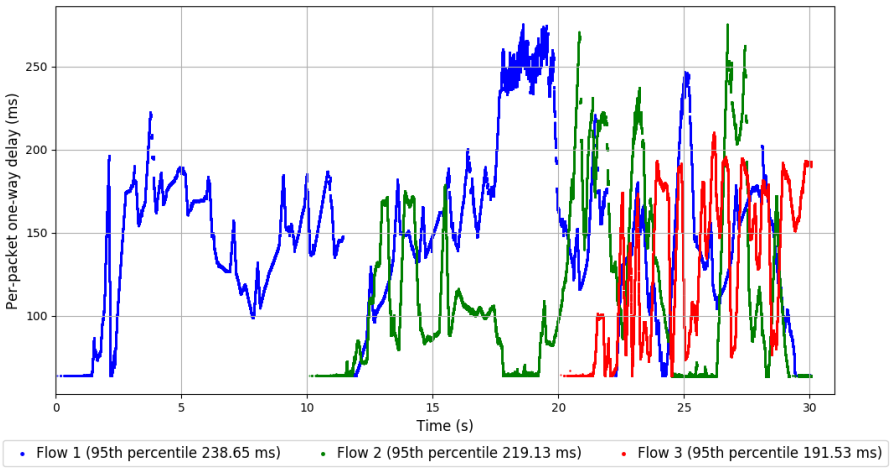
```
Run 1: Statistics of TCP BBR

Start at: 2018-08-28 14:31:52
End at: 2018-08-28 14:32:22
Local clock offset: -0.099 ms
Remote clock offset: 2.751 ms

# Below is generated by plot.py at 2018-08-28 15:00:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 876.69 Mbit/s
95th percentile per-packet one-way delay: 220.736 ms
Loss rate: 2.59%
-- Flow 1:
Average throughput: 480.08 Mbit/s
95th percentile per-packet one-way delay: 238.650 ms
Loss rate: 2.98%
-- Flow 2:
Average throughput: 429.27 Mbit/s
95th percentile per-packet one-way delay: 219.126 ms
Loss rate: 2.50%
-- Flow 3:
Average throughput: 333.15 Mbit/s
95th percentile per-packet one-way delay: 191.527 ms
Loss rate: 1.08%
```

Run 1: Report of TCP BBR — Data Link



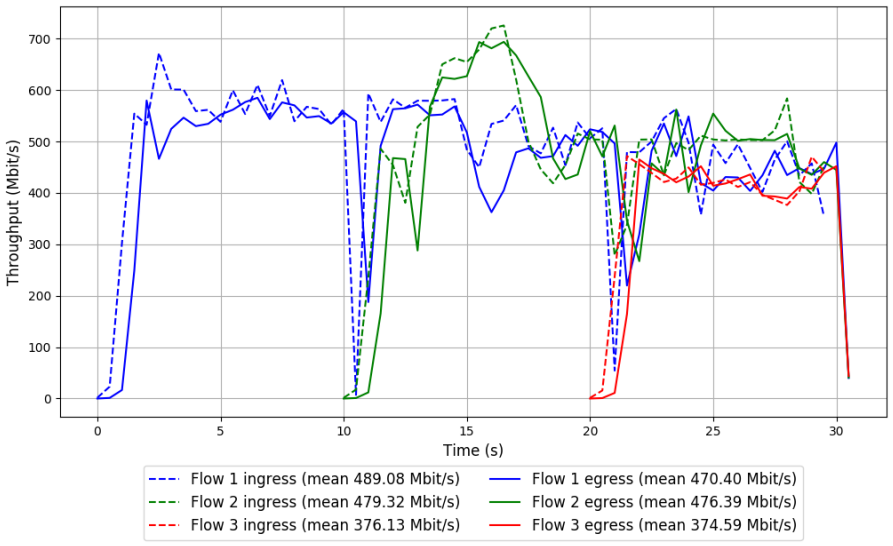


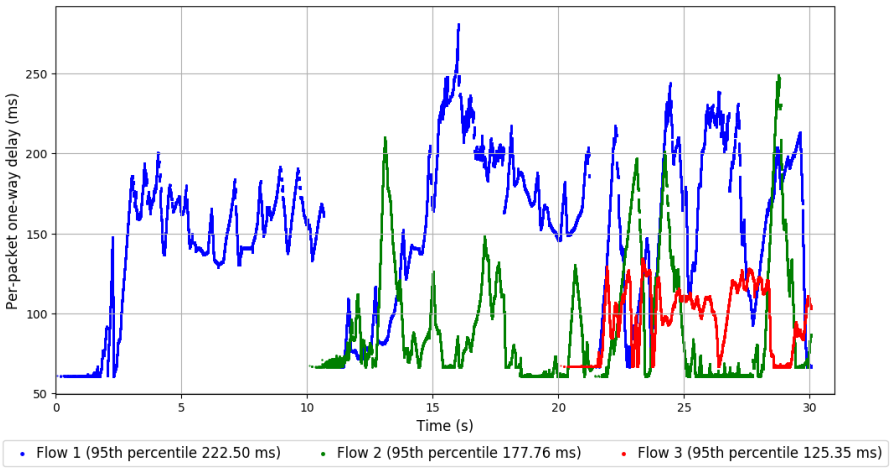
```
Run 2: Statistics of TCP BBR

Start at: 2018-08-28 14:39:34
End at: 2018-08-28 14:40:04
Local clock offset: -0.122 ms
Remote clock offset: -0.089 ms

# Below is generated by plot.py at 2018-08-28 15:00:30
# Datalink statistics
-- Total of 3 flows:
Average throughput: 911.95 Mbit/s
95th percentile per-packet one-way delay: 208.641 ms
Loss rate: 2.26%
-- Flow 1:
Average throughput: 470.40 Mbit/s
95th percentile per-packet one-way delay: 222.503 ms
Loss rate: 3.80%
-- Flow 2:
Average throughput: 476.39 Mbit/s
95th percentile per-packet one-way delay: 177.764 ms
Loss rate: 0.61%
-- Flow 3:
Average throughput: 374.59 Mbit/s
95th percentile per-packet one-way delay: 125.353 ms
Loss rate: 0.41%
```

Run 2: Report of TCP BBR — Data Link



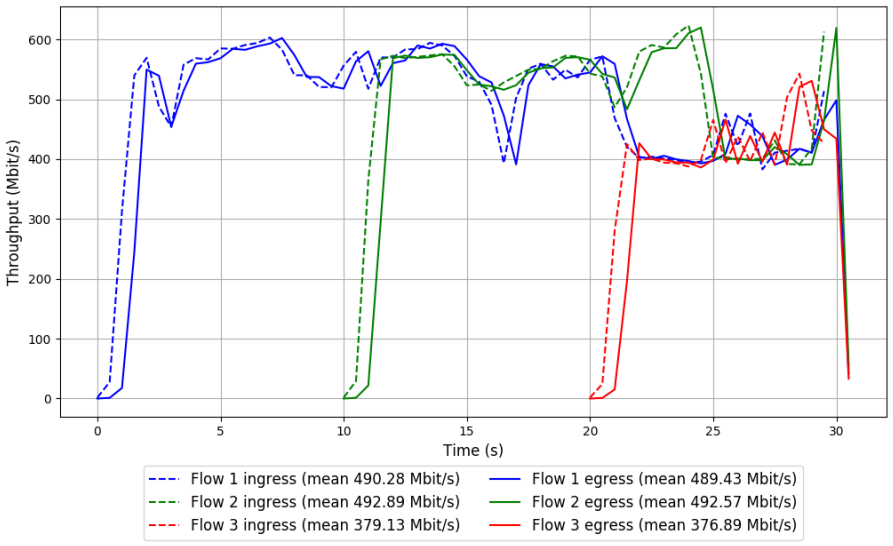


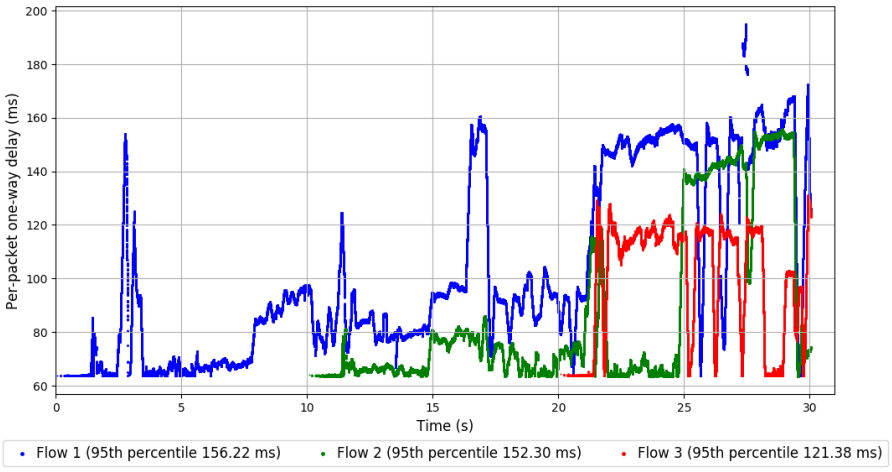
```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 14:29:56
End at: 2018-08-28 14:30:26
Local clock offset: -0.101 ms
Remote clock offset: 2.739 ms

# Below is generated by plot.py at 2018-08-28 15:00:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 942.70 Mbit/s
95th percentile per-packet one-way delay: 153.464 ms
Loss rate: 0.19%
-- Flow 1:
Average throughput: 489.43 Mbit/s
95th percentile per-packet one-way delay: 156.222 ms
Loss rate: 0.17%
-- Flow 2:
Average throughput: 492.57 Mbit/s
95th percentile per-packet one-way delay: 152.298 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 376.89 Mbit/s
95th percentile per-packet one-way delay: 121.375 ms
Loss rate: 0.59%
```

Run 1: Report of TCP Cubic — Data Link



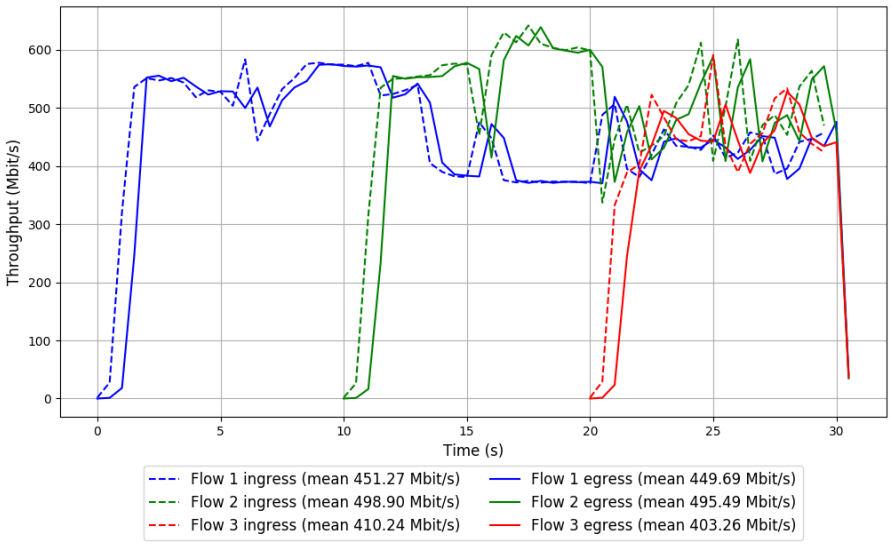


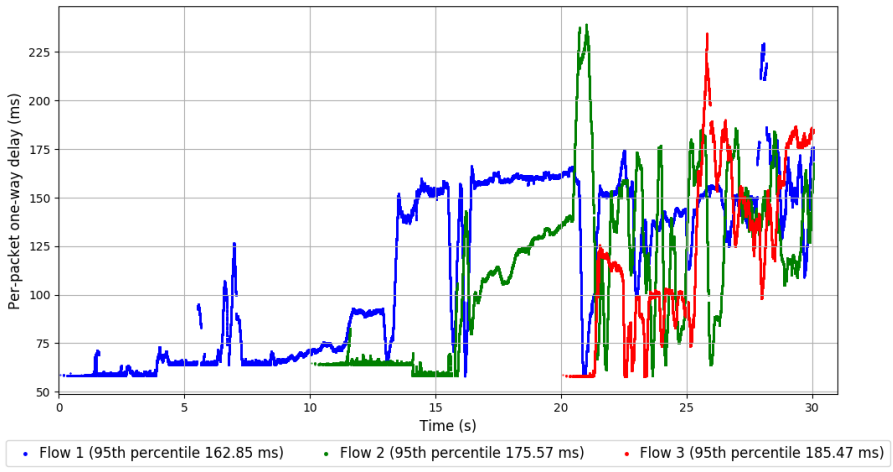
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 14:37:38
End at: 2018-08-28 14:38:08
Local clock offset: -0.078 ms
Remote clock offset: -2.815 ms

# Below is generated by plot.py at 2018-08-28 15:00:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 913.80 Mbit/s
95th percentile per-packet one-way delay: 176.403 ms
Loss rate: 0.65%
-- Flow 1:
Average throughput: 449.69 Mbit/s
95th percentile per-packet one-way delay: 162.851 ms
Loss rate: 0.33%
-- Flow 2:
Average throughput: 495.49 Mbit/s
95th percentile per-packet one-way delay: 175.566 ms
Loss rate: 0.68%
-- Flow 3:
Average throughput: 403.26 Mbit/s
95th percentile per-packet one-way delay: 185.471 ms
Loss rate: 1.64%
```

Run 2: Report of TCP Cubic — Data Link



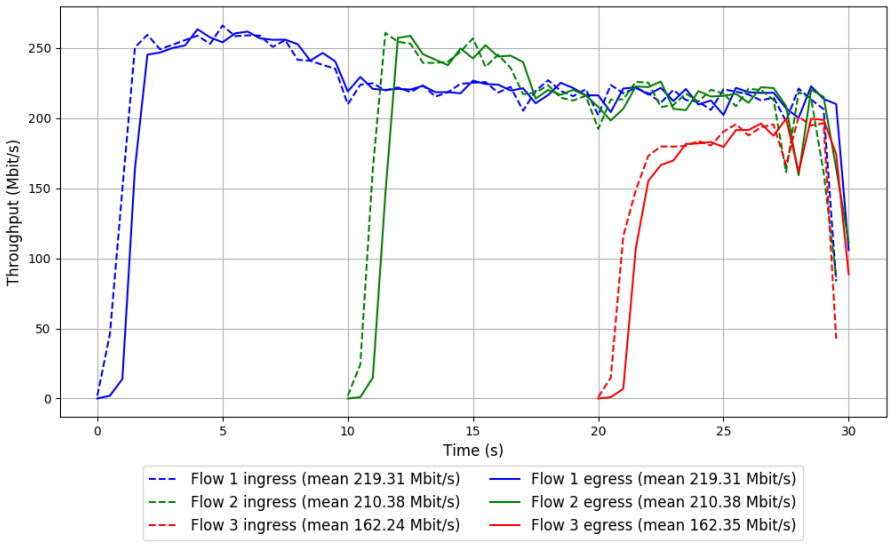


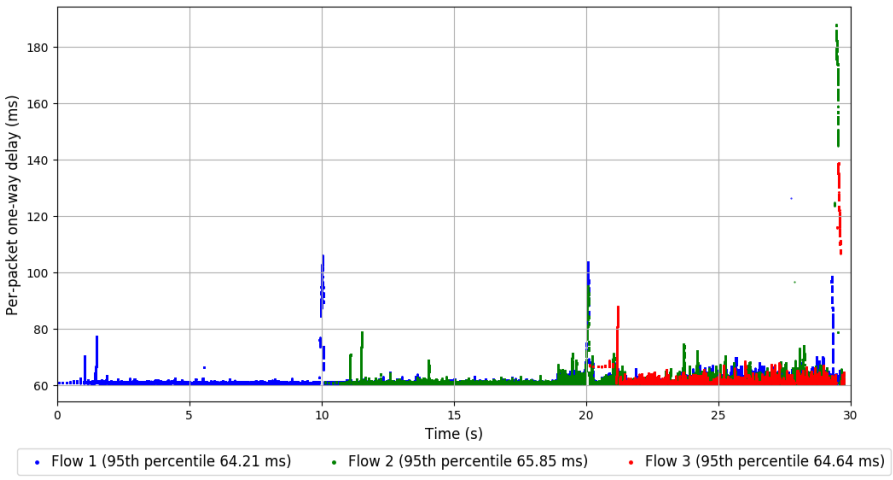
```
Run 1: Statistics of Indigo

Start at: 2018-08-28 14:35:51
End at: 2018-08-28 14:36:21
Local clock offset: 0.093 ms
Remote clock offset: -0.091 ms

# Below is generated by plot.py at 2018-08-28 15:00:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 410.86 Mbit/s
95th percentile per-packet one-way delay: 64.691 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 219.31 Mbit/s
95th percentile per-packet one-way delay: 64.212 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 210.38 Mbit/s
95th percentile per-packet one-way delay: 65.846 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 162.35 Mbit/s
95th percentile per-packet one-way delay: 64.636 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link



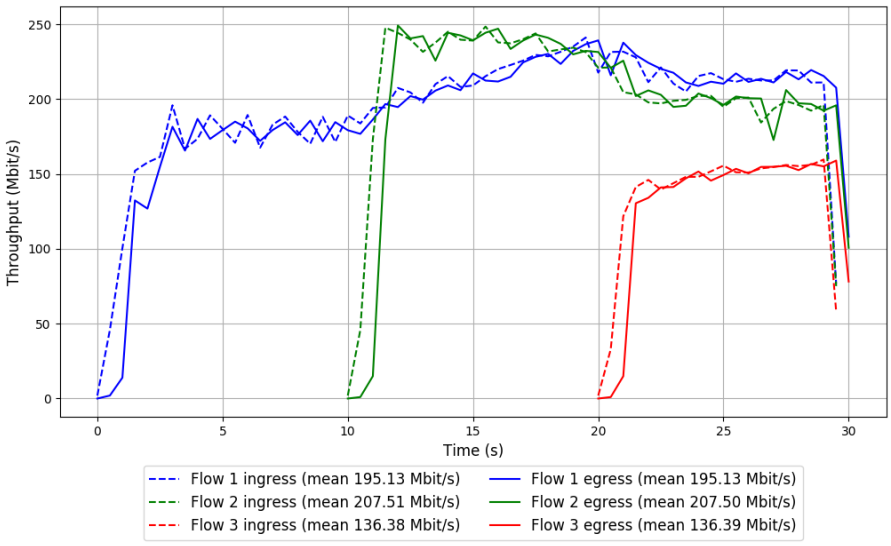


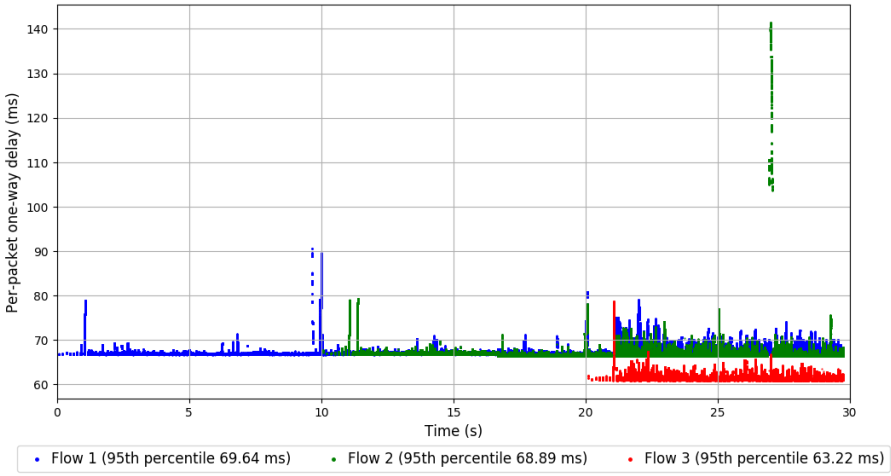
```
Run 2: Statistics of Indigo

Start at: 2018-08-28 14:43:35
End at: 2018-08-28 14:44:05
Local clock offset: -0.062 ms
Remote clock offset: -0.063 ms

# Below is generated by plot.py at 2018-08-28 15:00:34
# Datalink statistics
-- Total of 3 flows:
Average throughput: 376.86 Mbit/s
95th percentile per-packet one-way delay: 69.179 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 195.13 Mbit/s
95th percentile per-packet one-way delay: 69.640 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 207.50 Mbit/s
95th percentile per-packet one-way delay: 68.894 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 136.39 Mbit/s
95th percentile per-packet one-way delay: 63.217 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link



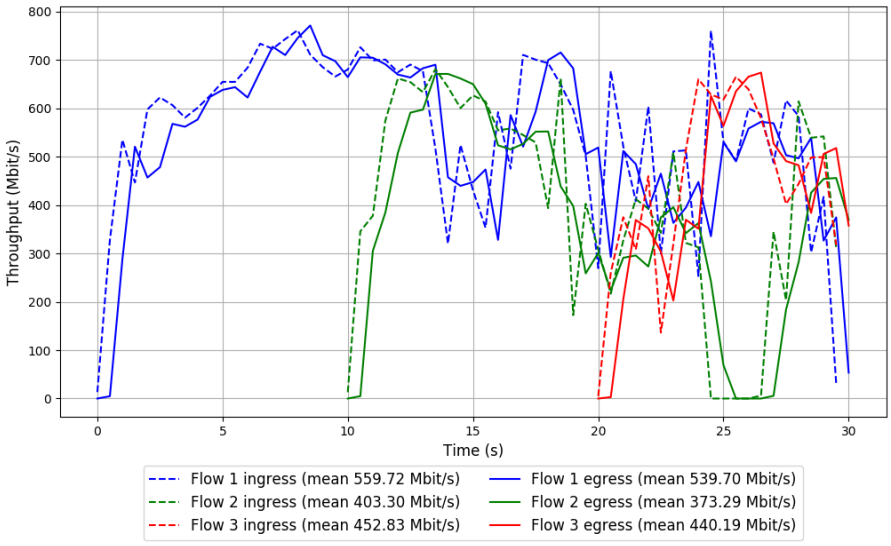


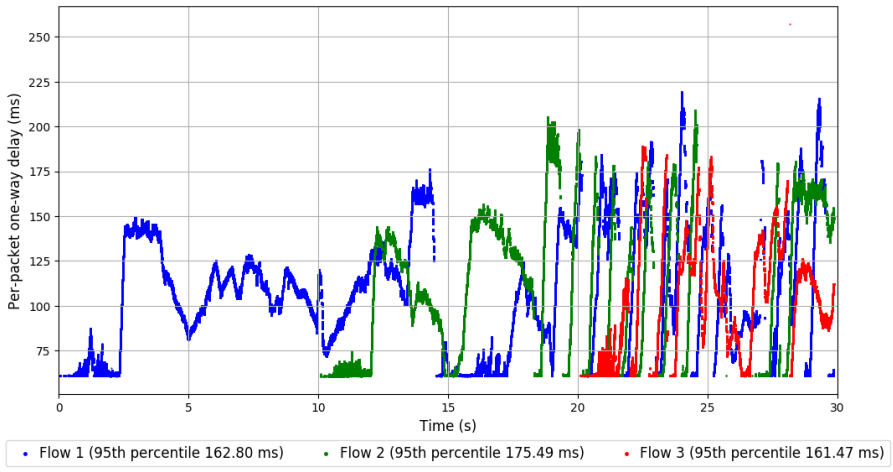
```
Run 1: Statistics of Muses-23

Start at: 2018-08-28 14:33:50
End at: 2018-08-28 14:34:20
Local clock offset: -0.087 ms
Remote clock offset: -0.182 ms

# Below is generated by plot.py at 2018-08-28 15:02:23
# Datalink statistics
-- Total of 3 flows:
Average throughput: 931.40 Mbit/s
95th percentile per-packet one-way delay: 166.159 ms
Loss rate: 4.50%
-- Flow 1:
Average throughput: 539.70 Mbit/s
95th percentile per-packet one-way delay: 162.796 ms
Loss rate: 3.57%
-- Flow 2:
Average throughput: 373.29 Mbit/s
95th percentile per-packet one-way delay: 175.490 ms
Loss rate: 7.41%
-- Flow 3:
Average throughput: 440.19 Mbit/s
95th percentile per-packet one-way delay: 161.469 ms
Loss rate: 2.73%
```

Run 1: Report of Muses-23 — Data Link





```
Run 2: Statistics of Muses-23

Start at: 2018-08-28 14:41:33
End at: 2018-08-28 14:42:03
Local clock offset: -0.069 ms
Remote clock offset: 2.848 ms

# Below is generated by plot.py at 2018-08-28 15:02:28
# Datalink statistics
-- Total of 3 flows:
Average throughput: 958.21 Mbit/s
95th percentile per-packet one-way delay: 168.528 ms
Loss rate: 3.25%
-- Flow 1:
Average throughput: 504.30 Mbit/s
95th percentile per-packet one-way delay: 165.924 ms
Loss rate: 3.06%
-- Flow 2:
Average throughput: 493.92 Mbit/s
95th percentile per-packet one-way delay: 163.169 ms
Loss rate: 2.04%
-- Flow 3:
Average throughput: 389.49 Mbit/s
95th percentile per-packet one-way delay: 180.357 ms
Loss rate: 6.98%
```

Run 2: Report of Muses-23 — Data Link