Pantheon Report

Generated at 2018-09-03 13:14:05 (UTC).

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

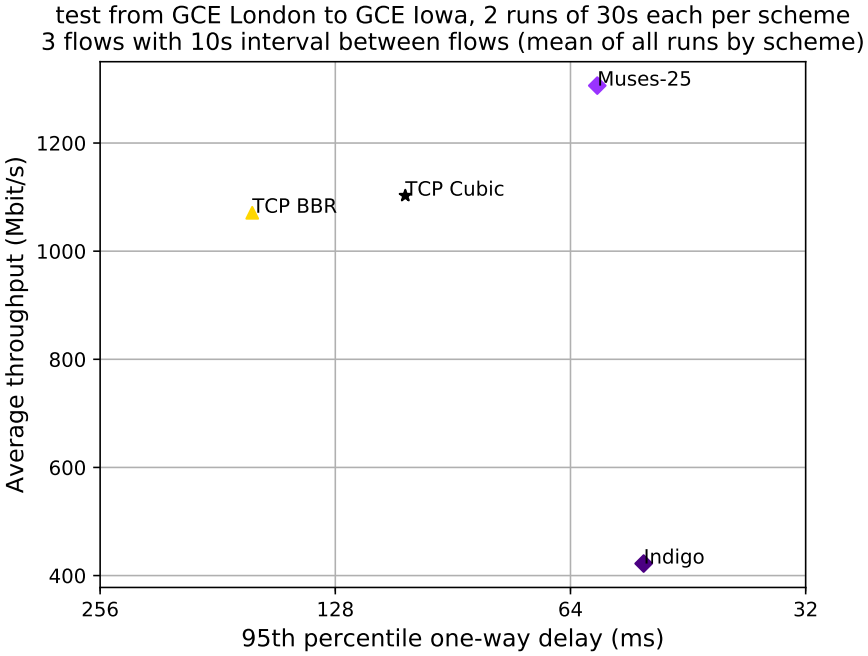
Repeated the test of 4 congestion control schemes twice.

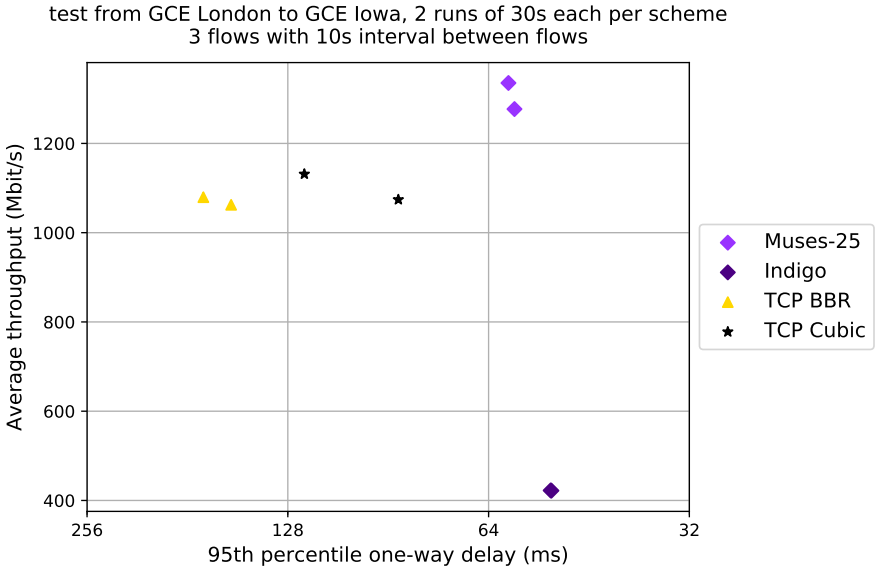
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 London to GCE Iowa, 2 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Muses-25
TCP Cubic
TCP BBR
Indigo
Average throughput (Mbit/s)
1200
1000
800
600
400
256
128
64
32
95th percentile one-way delay (ms)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3 flows with 10s interval between flows
Average throughput (Mbit/s)
1200
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95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic

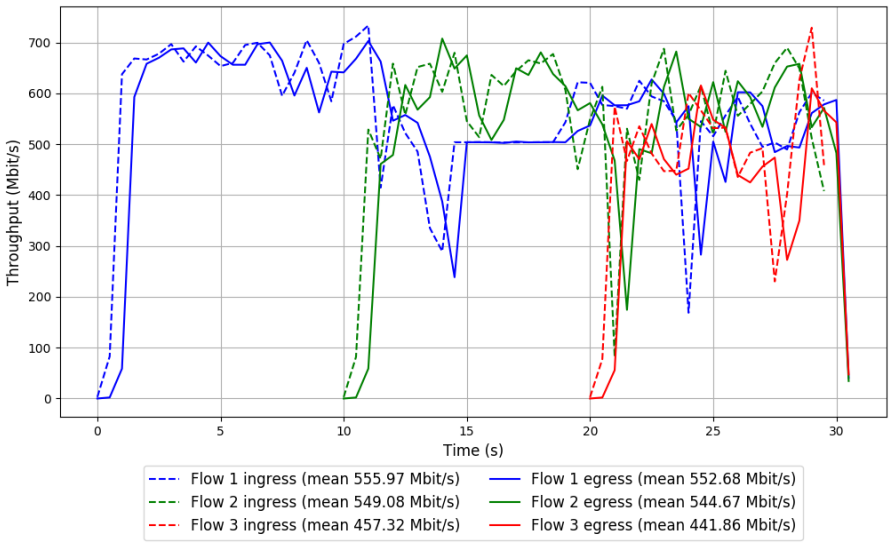
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	2	560.12	527.39	479.56	158.53	162.21	185.35	0.89	0.91	2.35
TCP Cubic	2	596.57	533.64	452.78	113.00	65.12	78.62	0.09	0.06	0.00
Indigo	2	225.25	207.99	182.22	51.25	51.67	51.65	0.00	0.00	0.00
Muses-25	2	713.80	618.12	557.09	58.91	58.81	59.92	0.00	0.01	0.00

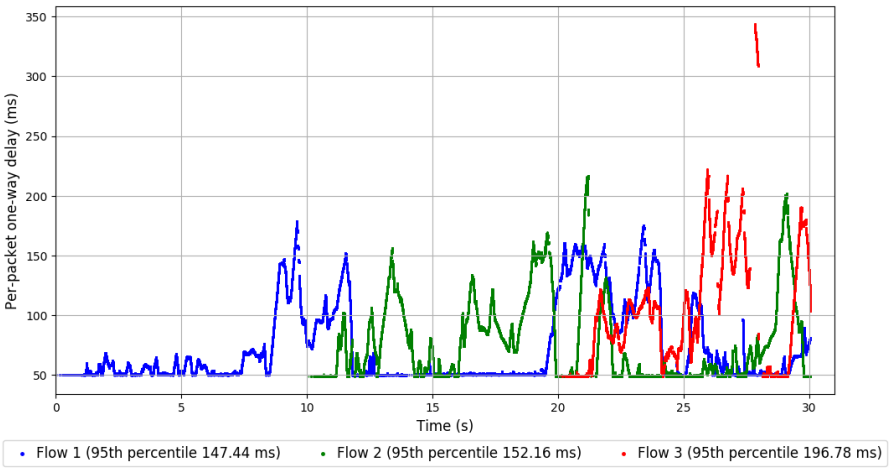
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-03 12:41:43
End at: 2018-09-03 12:42:13
Local clock offset: 0.366 ms
Remote clock offset: -0.108 ms

# Below is generated by plot.py at 2018-09-03 13:12:46
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1062.51 Mbit/s
95th percentile per-packet one-way delay: 155.674 ms
Loss rate: 1.06%
-- Flow 1:
Average throughput: 552.68 Mbit/s
95th percentile per-packet one-way delay: 147.436 ms
Loss rate: 0.59%
-- Flow 2:
Average throughput: 544.67 Mbit/s
95th percentile per-packet one-way delay: 152.160 ms
Loss rate: 0.80%
-- Flow 3:
Average throughput: 441.86 Mbit/s
95th percentile per-packet one-way delay: 196.777 ms
Loss rate: 3.37%
```

Run 1: Report of TCP BBR — Data Link



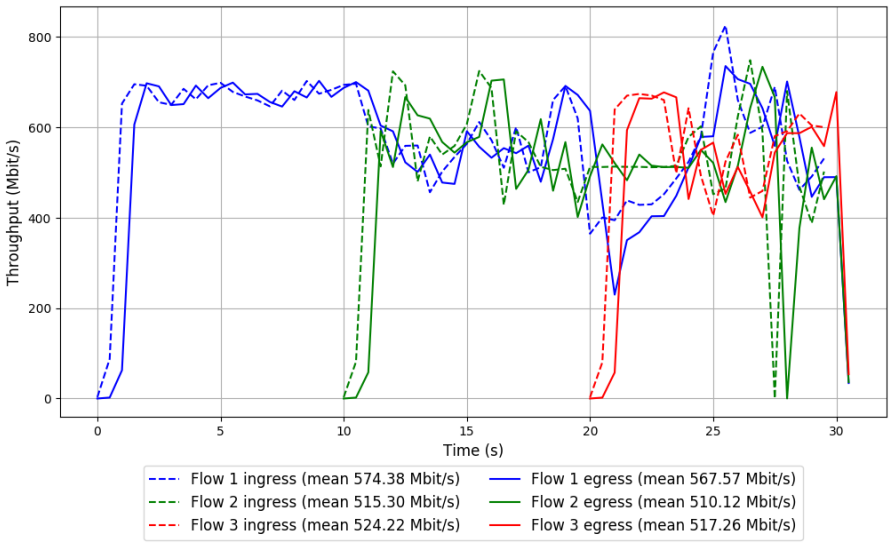


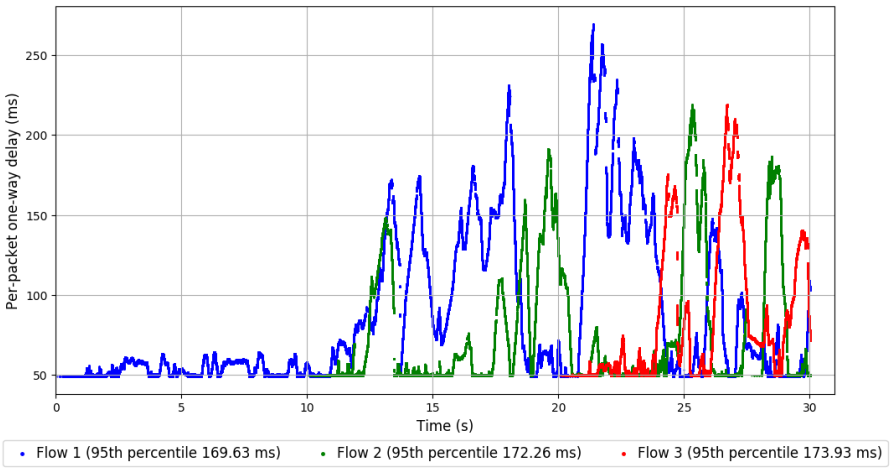
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-03 12:49:31
End at: 2018-09-03 12:50:01
Local clock offset: 0.365 ms
Remote clock offset: -0.079 ms

# Below is generated by plot.py at 2018-09-03 13:12:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1079.53 Mbit/s
95th percentile per-packet one-way delay: 171.339 ms
Loss rate: 1.15%
-- Flow 1:
Average throughput: 567.57 Mbit/s
95th percentile per-packet one-way delay: 169.630 ms
Loss rate: 1.18%
-- Flow 2:
Average throughput: 510.12 Mbit/s
95th percentile per-packet one-way delay: 172.265 ms
Loss rate: 1.01%
-- Flow 3:
Average throughput: 517.26 Mbit/s
95th percentile per-packet one-way delay: 173.933 ms
Loss rate: 1.32%
```

Run 2: Report of TCP BBR — Data Link



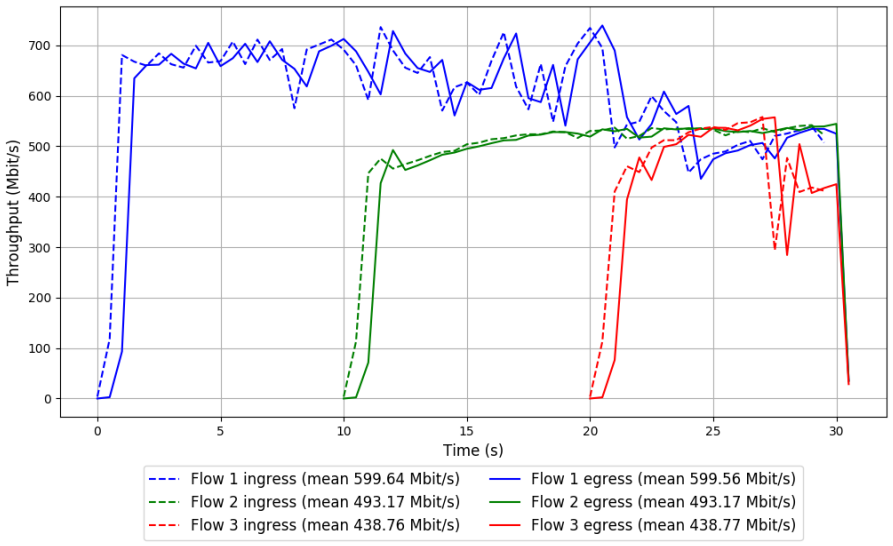


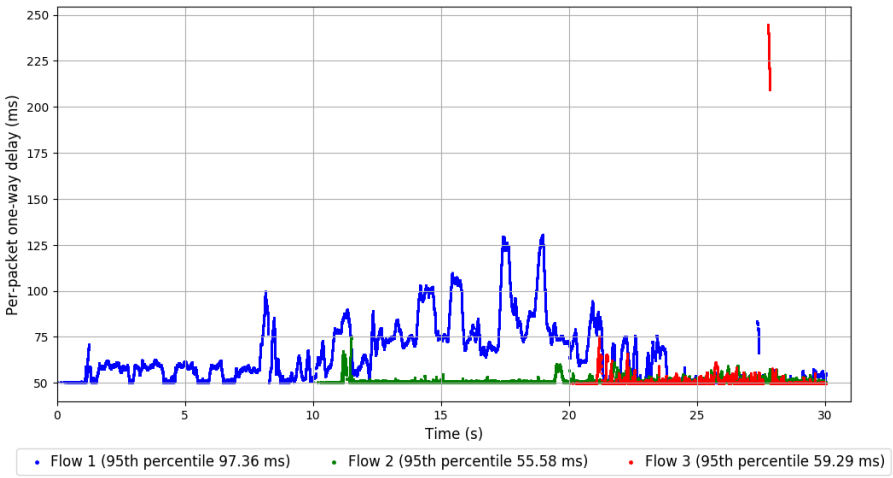
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-03 12:45:46
End at: 2018-09-03 12:46:16
Local clock offset: -0.239 ms
Remote clock offset: -0.115 ms

# Below is generated by plot.py at 2018-09-03 13:12:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1074.00 Mbit/s
95th percentile per-packet one-way delay: 87.394 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 599.56 Mbit/s
95th percentile per-packet one-way delay: 97.358 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 493.17 Mbit/s
95th percentile per-packet one-way delay: 55.578 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 438.77 Mbit/s
95th percentile per-packet one-way delay: 59.292 ms
Loss rate: 0.00%
```

Run 1: Report of TCP Cubic — Data Link



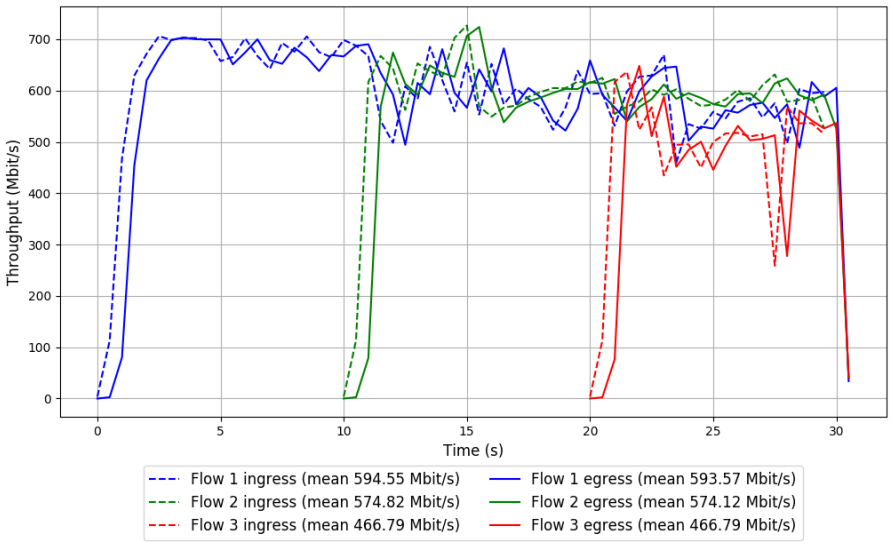


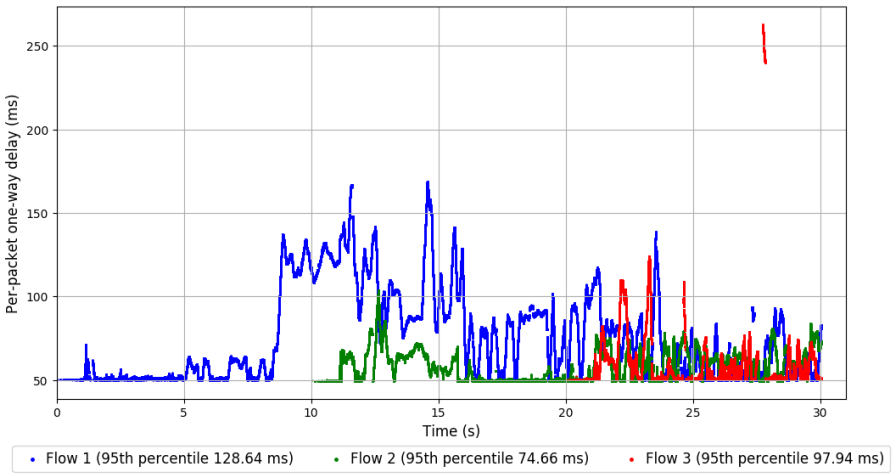
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-03 12:53:37
End at: 2018-09-03 12:54:07
Local clock offset: -0.1 ms
Remote clock offset: -0.086 ms

# Below is generated by plot.py at 2018-09-03 13:13:11
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1131.34 Mbit/s
95th percentile per-packet one-way delay: 120.892 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 593.57 Mbit/s
95th percentile per-packet one-way delay: 128.644 ms
Loss rate: 0.16%
-- Flow 2:
Average throughput: 574.12 Mbit/s
95th percentile per-packet one-way delay: 74.658 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 466.79 Mbit/s
95th percentile per-packet one-way delay: 97.941 ms
Loss rate: 0.00%
```

Run 2: Report of TCP Cubic — Data Link



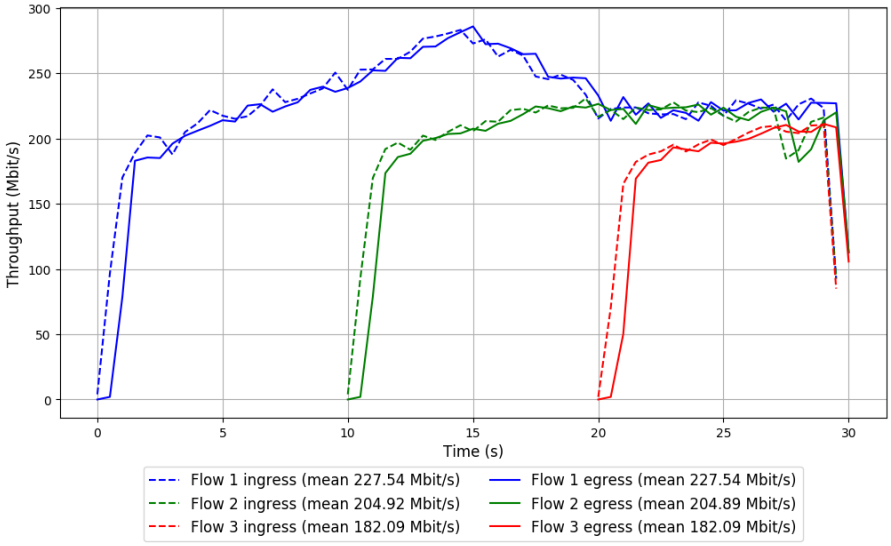


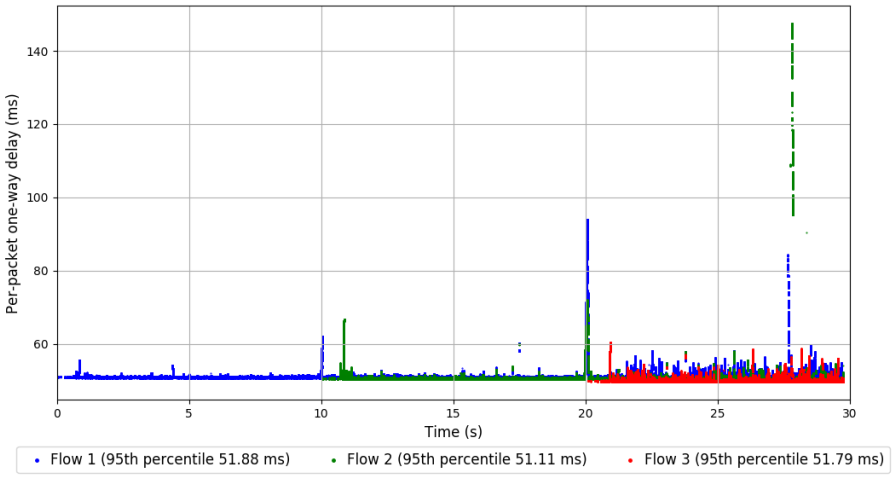
```
Run 1: Statistics of Indigo

Start at: 2018-09-03 12:39:57
End at: 2018-09-03 12:40:27
Local clock offset: -0.247 ms
Remote clock offset: -0.096 ms

# Below is generated by plot.py at 2018-09-03 13:13:11
# Datalink statistics
-- Total of 3 flows:
Average throughput: 422.47 Mbit/s
95th percentile per-packet one-way delay: 51.656 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 227.54 Mbit/s
95th percentile per-packet one-way delay: 51.877 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 204.89 Mbit/s
95th percentile per-packet one-way delay: 51.110 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 182.09 Mbit/s
95th percentile per-packet one-way delay: 51.791 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link



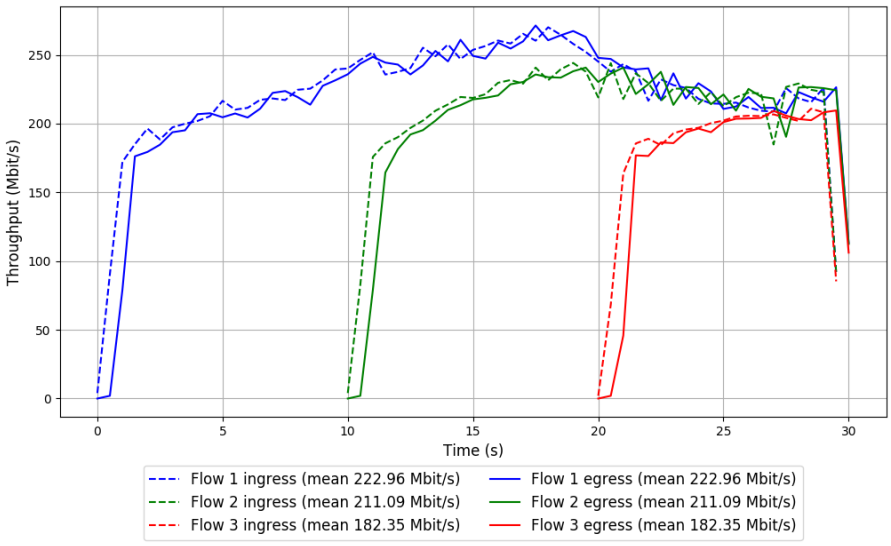


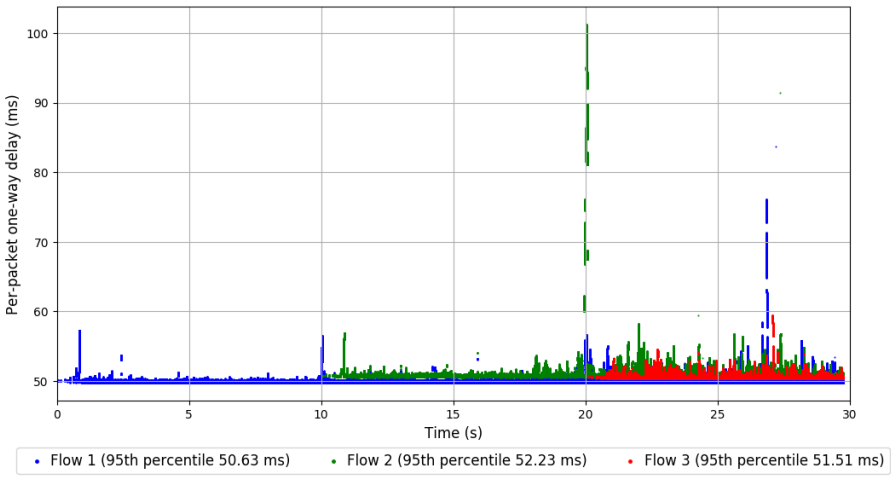
```
Run 2: Statistics of Indigo

Start at: 2018-09-03 12:47:46
End at: 2018-09-03 12:48:16
Local clock offset: -0.391 ms
Remote clock offset: -0.088 ms

# Below is generated by plot.py at 2018-09-03 13:13:11
# Datalink statistics
-- Total of 3 flows:
Average throughput: 421.96 Mbit/s
95th percentile per-packet one-way delay: 51.519 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 222.96 Mbit/s
95th percentile per-packet one-way delay: 50.628 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 211.09 Mbit/s
95th percentile per-packet one-way delay: 52.226 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 182.35 Mbit/s
95th percentile per-packet one-way delay: 51.507 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link



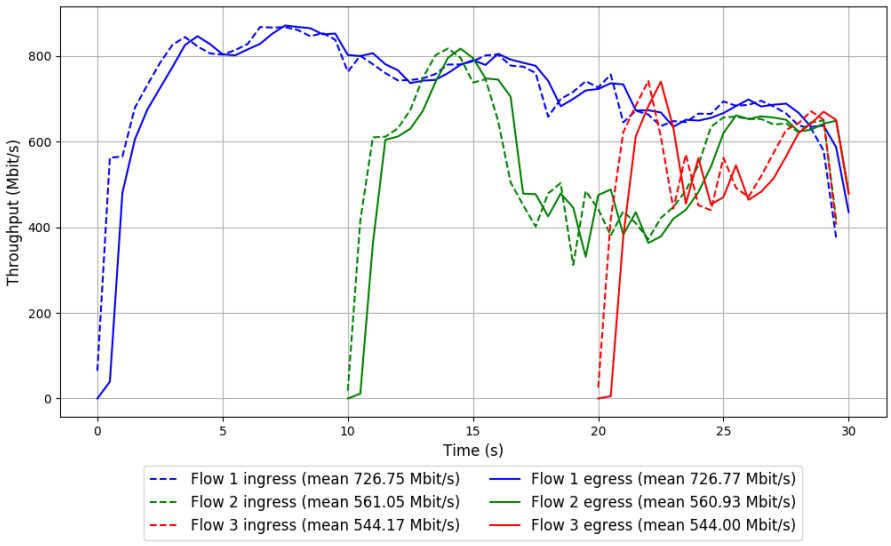


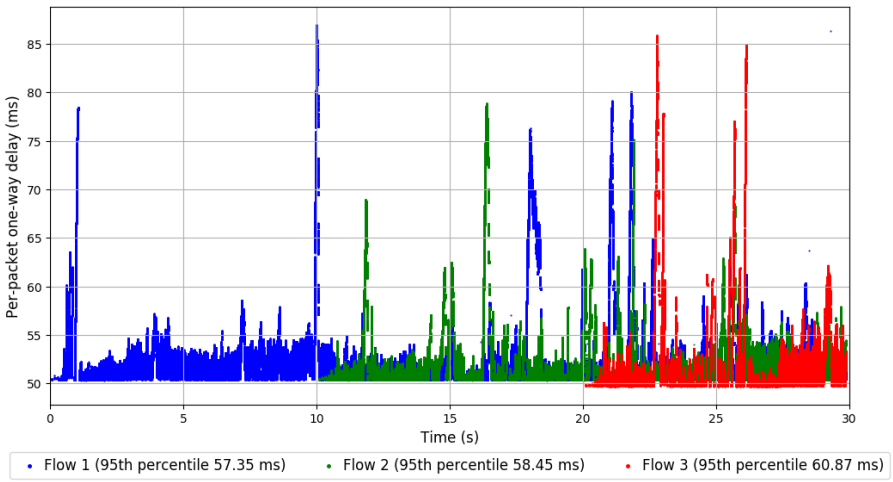
```
Run 1: Statistics of Muses-25

Start at: 2018-09-03 12:43:47
End at: 2018-09-03 12:44:17
Local clock offset: -0.315 ms
Remote clock offset: -0.121 ms

# Below is generated by plot.py at 2018-09-03 13:13:53
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1276.99 Mbit/s
95th percentile per-packet one-way delay: 58.528 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 726.77 Mbit/s
95th percentile per-packet one-way delay: 57.351 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 560.93 Mbit/s
95th percentile per-packet one-way delay: 58.445 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 544.00 Mbit/s
95th percentile per-packet one-way delay: 60.868 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link





```
Run 2: Statistics of Muses-25

Start at: 2018-09-03 12:51:36
End at: 2018-09-03 12:52:06
Local clock offset: 0.184 ms
Remote clock offset: -0.088 ms

# Below is generated by plot.py at 2018-09-03 13:14:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1335.43 Mbit/s
95th percentile per-packet one-way delay: 59.758 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 700.83 Mbit/s
95th percentile per-packet one-way delay: 60.470 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 675.31 Mbit/s
95th percentile per-packet one-way delay: 59.173 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 570.18 Mbit/s
95th percentile per-packet one-way delay: 58.982 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link