Pantheon Report

Generated at 2018-08-31 09:04:01 (UTC).

Data path: AWS India 1 on `ens5` (*local*) →India on `em1` (*remote*).

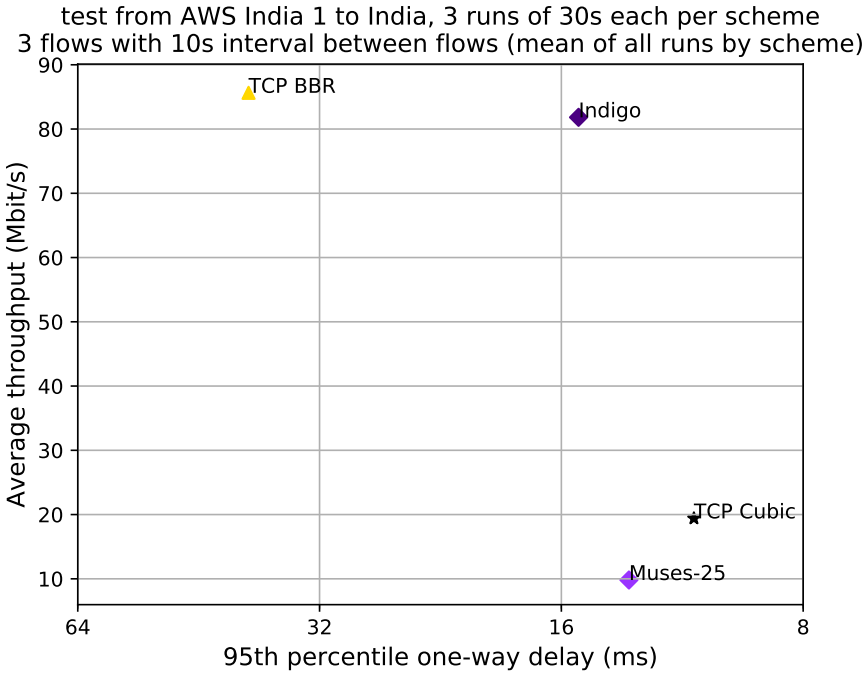
Repeated the test of 4 congestion control schemes 3 times.

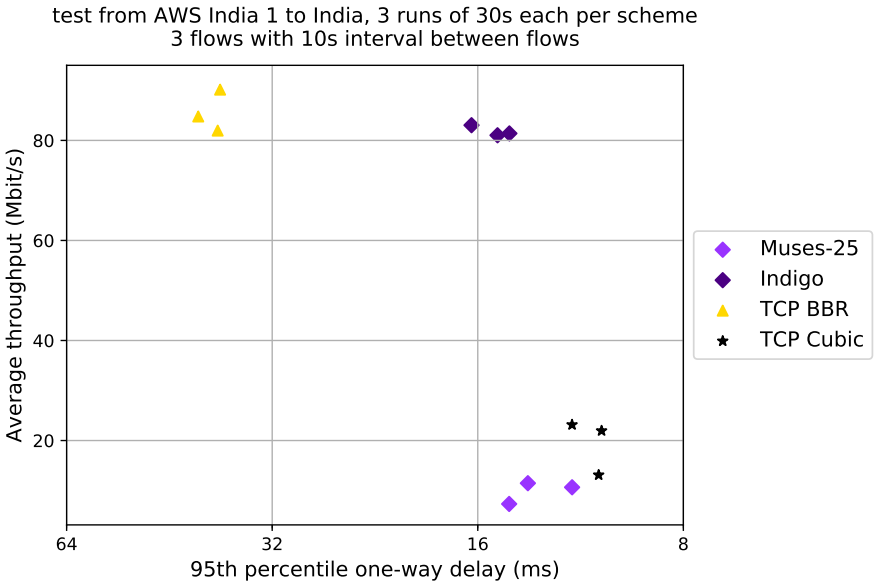
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `nets.org.sg` and have been applied to correct the timestamps in logs.

```
System info:
Linux 4.15.0-1020-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
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 AWS India 1 to India, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
TCP BBR
Indigo
TCP Cubic
Muses-25
90
80
70
60
50
40
30
20
10
64
32
16
8


test from AWS India 1 to India, 3 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic
80
60
40
20
64
32
16
8

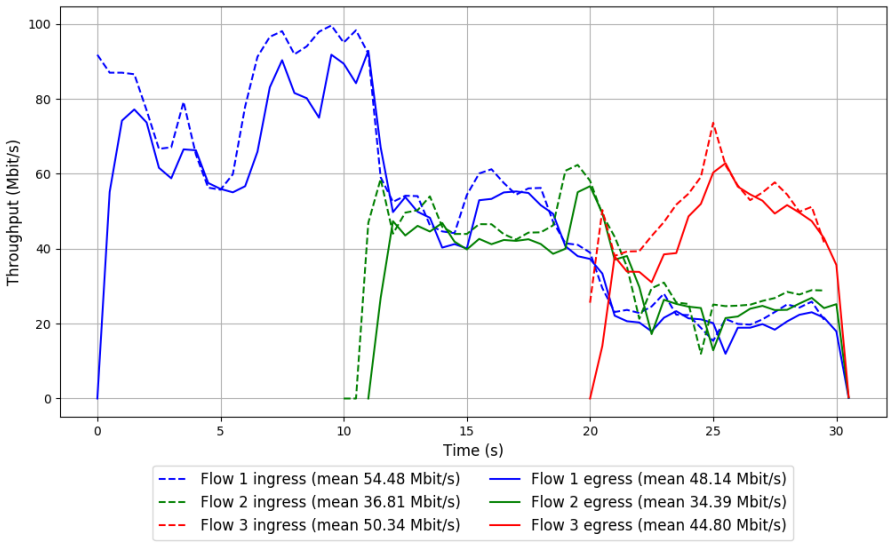
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	49.23	34.70	41.17	37.47	40.54	40.01	10.20	10.81	11.34
TCP Cubic	3	10.36	9.20	8.78	10.29	10.77	12.54	0.81	0.77	2.00
Indigo	3	47.27	37.44	29.58	14.30	15.26	21.80	10.01	11.64	11.37
Muses-25	3	4.17	5.29	6.79	11.56	14.21	15.60	40.78	15.02	24.51

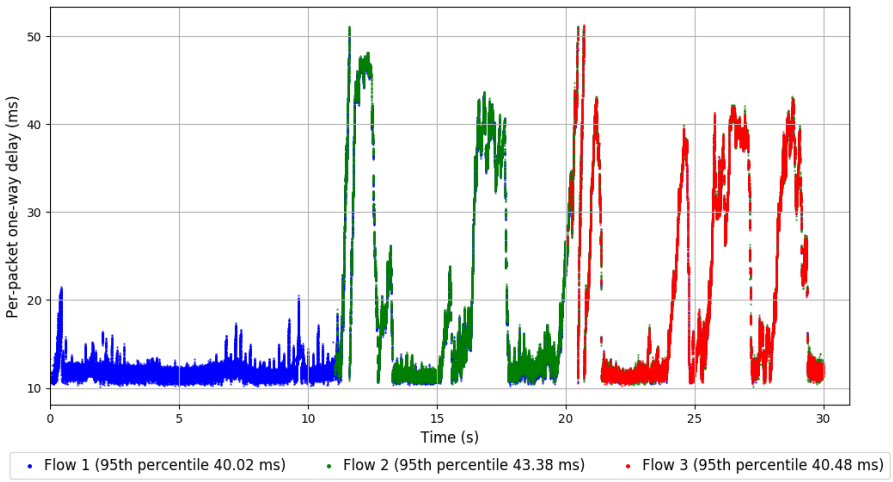
```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 08:49:42
End at: 2018-08-31 08:50:12
Local clock offset: 0.92 ms
Remote clock offset: -3.024 ms

# Below is generated by plot.py at 2018-08-31 09:03:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 84.79 Mbit/s
95th percentile per-packet one-way delay: 41.062 ms
Loss rate: 11.46%
-- Flow 1:
Average throughput: 48.14 Mbit/s
95th percentile per-packet one-way delay: 40.024 ms
Loss rate: 11.64%
-- Flow 2:
Average throughput: 34.39 Mbit/s
95th percentile per-packet one-way delay: 43.384 ms
Loss rate: 11.27%
-- Flow 3:
Average throughput: 44.80 Mbit/s
95th percentile per-packet one-way delay: 40.478 ms
Loss rate: 11.14%
```

Run 1: Report of TCP BBR — Data Link



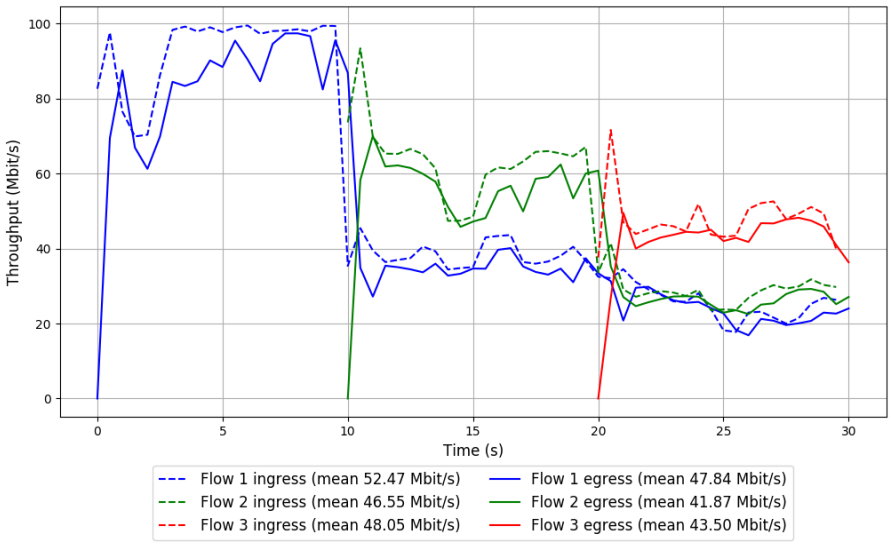


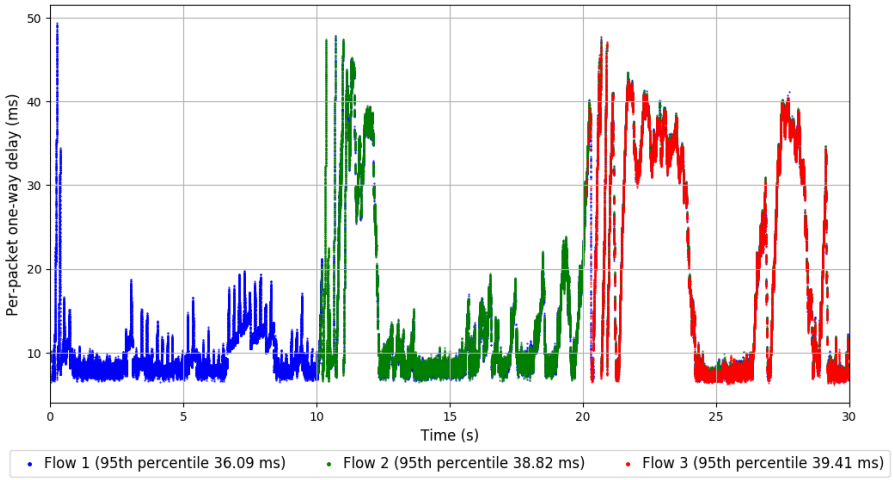
```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 08:54:15
End at: 2018-08-31 08:54:45
Local clock offset: 5.341 ms
Remote clock offset: -3.001 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.16 Mbit/s
95th percentile per-packet one-way delay: 38.145 ms
Loss rate: 9.33%
-- Flow 1:
Average throughput: 47.84 Mbit/s
95th percentile per-packet one-way delay: 36.087 ms
Loss rate: 8.82%
-- Flow 2:
Average throughput: 41.87 Mbit/s
95th percentile per-packet one-way delay: 38.821 ms
Loss rate: 10.05%
-- Flow 3:
Average throughput: 43.50 Mbit/s
95th percentile per-packet one-way delay: 39.407 ms
Loss rate: 9.61%
```

Run 2: Report of TCP BBR — Data Link



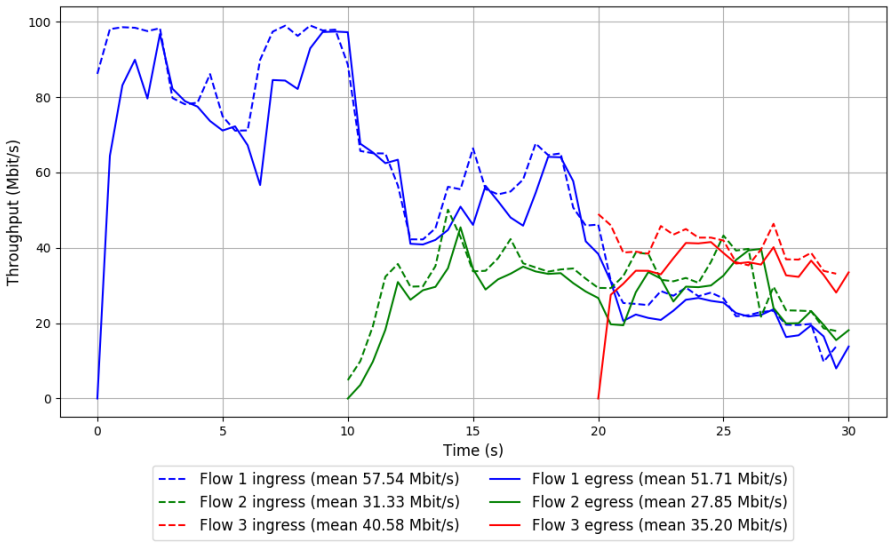


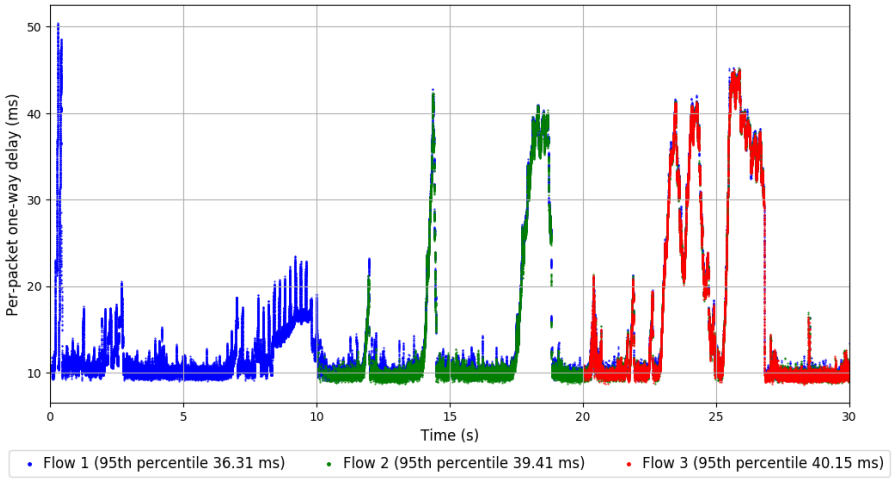
```
Run 3: Statistics of TCP BBR

Start at: 2018-08-31 08:58:51
End at: 2018-08-31 08:59:21
Local clock offset: 1.811 ms
Remote clock offset: -2.799 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 81.97 Mbit/s
95th percentile per-packet one-way delay: 38.456 ms
Loss rate: 10.81%
-- Flow 1:
Average throughput: 51.71 Mbit/s
95th percentile per-packet one-way delay: 36.306 ms
Loss rate: 10.13%
-- Flow 2:
Average throughput: 27.85 Mbit/s
95th percentile per-packet one-way delay: 39.414 ms
Loss rate: 11.12%
-- Flow 3:
Average throughput: 35.20 Mbit/s
95th percentile per-packet one-way delay: 40.150 ms
Loss rate: 13.26%
```

Run 3: Report of TCP BBR — Data Link



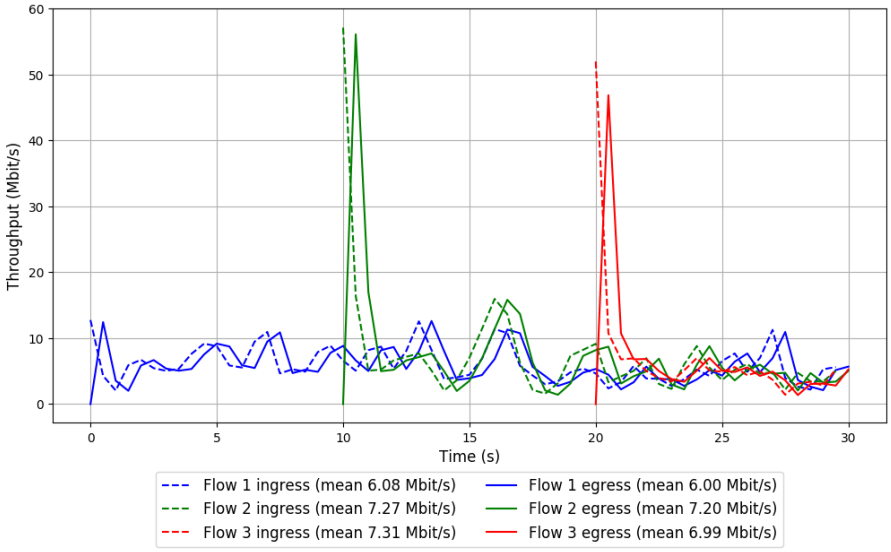


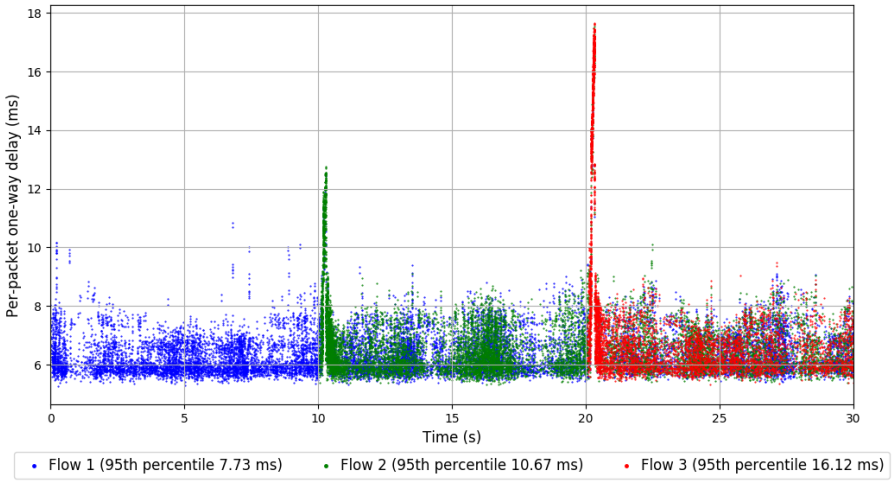
```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 08:53:09
End at: 2018-08-31 08:53:39
Local clock offset: 5.653 ms
Remote clock offset: -3.595 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 13.12 Mbit/s
95th percentile per-packet one-way delay: 10.644 ms
Loss rate: 1.75%
-- Flow 1:
Average throughput: 6.00 Mbit/s
95th percentile per-packet one-way delay: 7.730 ms
Loss rate: 1.32%
-- Flow 2:
Average throughput: 7.20 Mbit/s
95th percentile per-packet one-way delay: 10.670 ms
Loss rate: 1.02%
-- Flow 3:
Average throughput: 6.99 Mbit/s
95th percentile per-packet one-way delay: 16.120 ms
Loss rate: 4.30%
```

Run 1: Report of TCP Cubic — Data Link



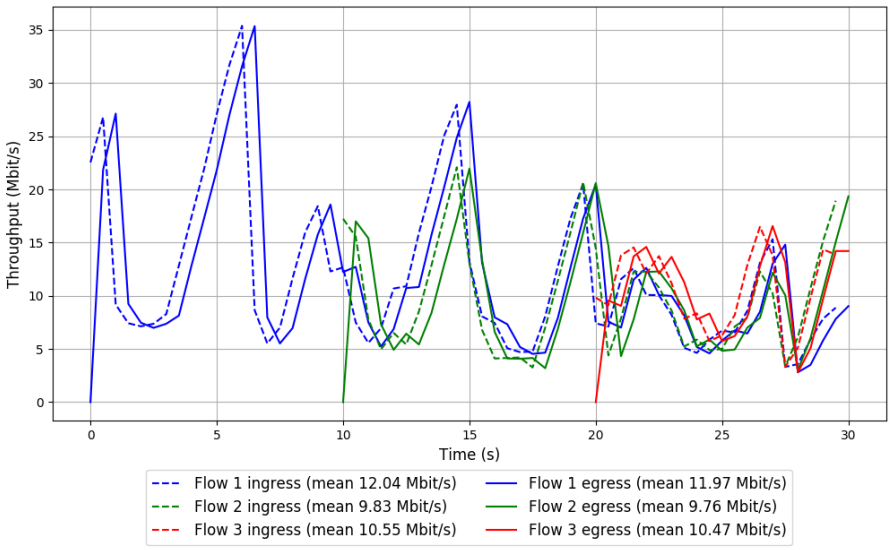


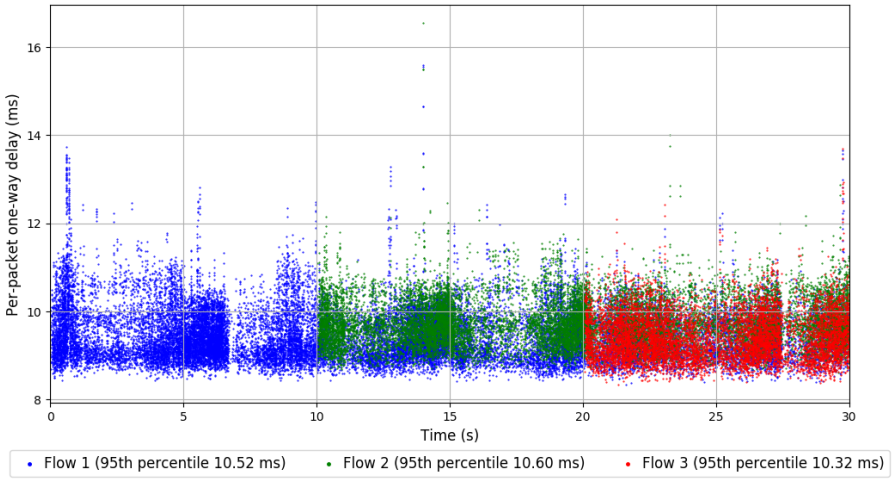
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 08:57:45
End at: 2018-08-31 08:58:15
Local clock offset: 2.666 ms
Remote clock offset: -2.408 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 21.95 Mbit/s
95th percentile per-packet one-way delay: 10.540 ms
Loss rate: 0.69%
-- Flow 1:
Average throughput: 11.97 Mbit/s
95th percentile per-packet one-way delay: 10.523 ms
Loss rate: 0.64%
-- Flow 2:
Average throughput: 9.76 Mbit/s
95th percentile per-packet one-way delay: 10.603 ms
Loss rate: 0.68%
-- Flow 3:
Average throughput: 10.47 Mbit/s
95th percentile per-packet one-way delay: 10.318 ms
Loss rate: 0.84%
```

Run 2: Report of TCP Cubic — Data Link



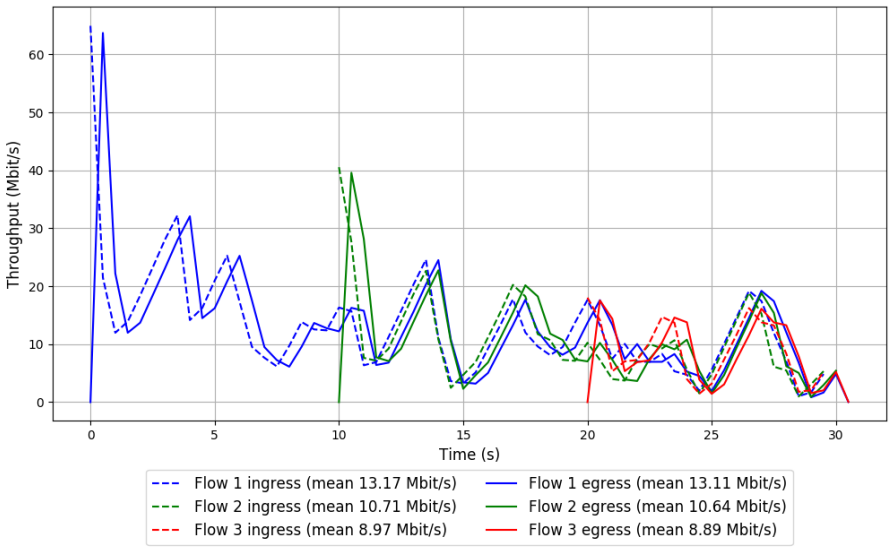


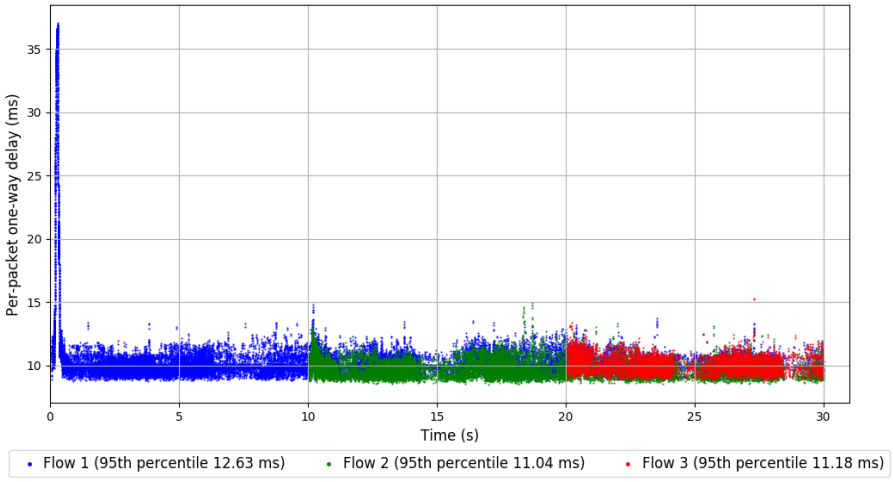
```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-31 09:02:20
End at: 2018-08-31 09:02:50
Local clock offset: 1.981 ms
Remote clock offset: -2.428 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 23.15 Mbit/s
95th percentile per-packet one-way delay: 11.643 ms
Loss rate: 0.57%
-- Flow 1:
Average throughput: 13.11 Mbit/s
95th percentile per-packet one-way delay: 12.629 ms
Loss rate: 0.47%
-- Flow 2:
Average throughput: 10.64 Mbit/s
95th percentile per-packet one-way delay: 11.036 ms
Loss rate: 0.61%
-- Flow 3:
Average throughput: 8.89 Mbit/s
95th percentile per-packet one-way delay: 11.183 ms
Loss rate: 0.87%
```

Run 3: Report of TCP Cubic — Data Link



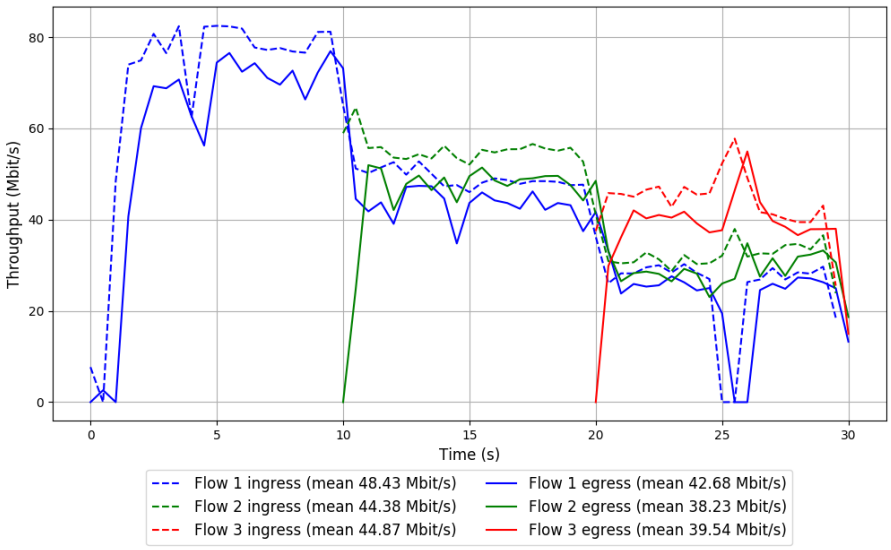


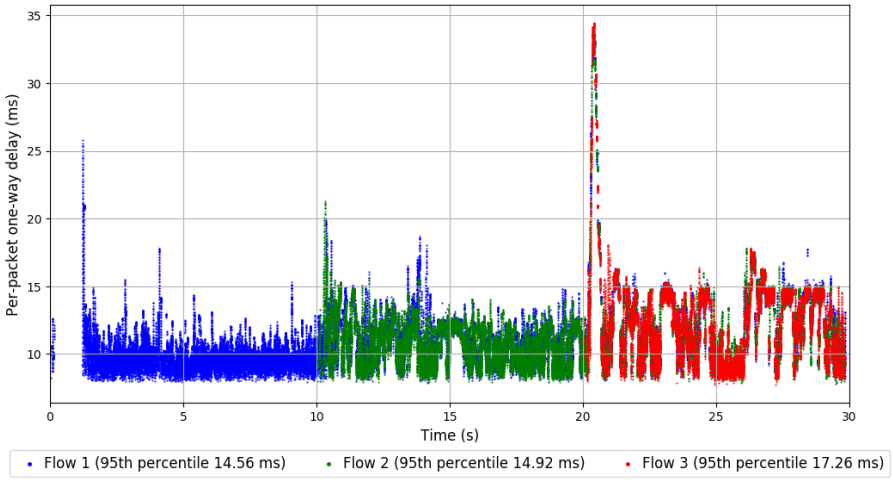
```
Run 1: Statistics of Indigo

Start at: 2018-08-31 08:50:53
End at: 2018-08-31 08:51:23
Local clock offset: 4.31 ms
Remote clock offset: -2.32 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 81.03 Mbit/s
95th percentile per-packet one-way delay: 14.969 ms
Loss rate: 12.49%
-- Flow 1:
Average throughput: 42.68 Mbit/s
95th percentile per-packet one-way delay: 14.563 ms
Loss rate: 11.86%
-- Flow 2:
Average throughput: 38.23 Mbit/s
95th percentile per-packet one-way delay: 14.921 ms
Loss rate: 13.83%
-- Flow 3:
Average throughput: 39.54 Mbit/s
95th percentile per-packet one-way delay: 17.256 ms
Loss rate: 11.89%
```

Run 1: Report of Indigo — Data Link



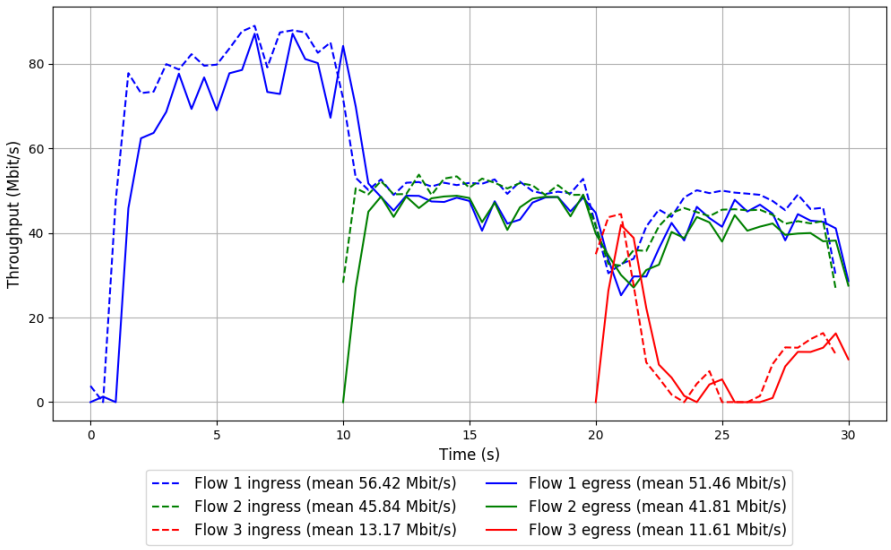


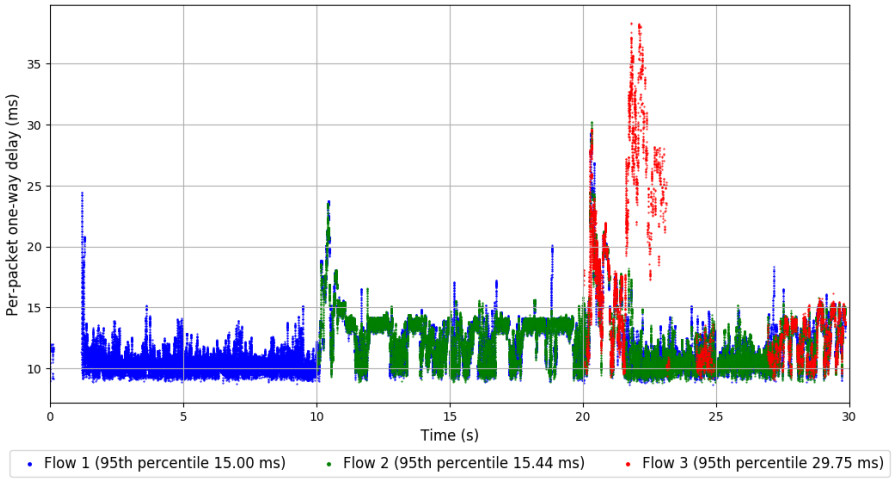
```
Run 2: Statistics of Indigo

Start at: 2018-08-31 08:55:28
End at: 2018-08-31 08:55:58
Local clock offset: 3.517 ms
Remote clock offset: -1.83 ms

# Below is generated by plot.py at 2018-08-31 09:03:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 83.04 Mbit/s
95th percentile per-packet one-way delay: 16.341 ms
Loss rate: 8.92%
-- Flow 1:
Average throughput: 51.46 Mbit/s
95th percentile per-packet one-way delay: 14.998 ms
Loss rate: 8.78%
-- Flow 2:
Average throughput: 41.81 Mbit/s
95th percentile per-packet one-way delay: 15.444 ms
Loss rate: 8.77%
-- Flow 3:
Average throughput: 11.61 Mbit/s
95th percentile per-packet one-way delay: 29.746 ms
Loss rate: 11.89%
```

Run 2: Report of Indigo — Data Link



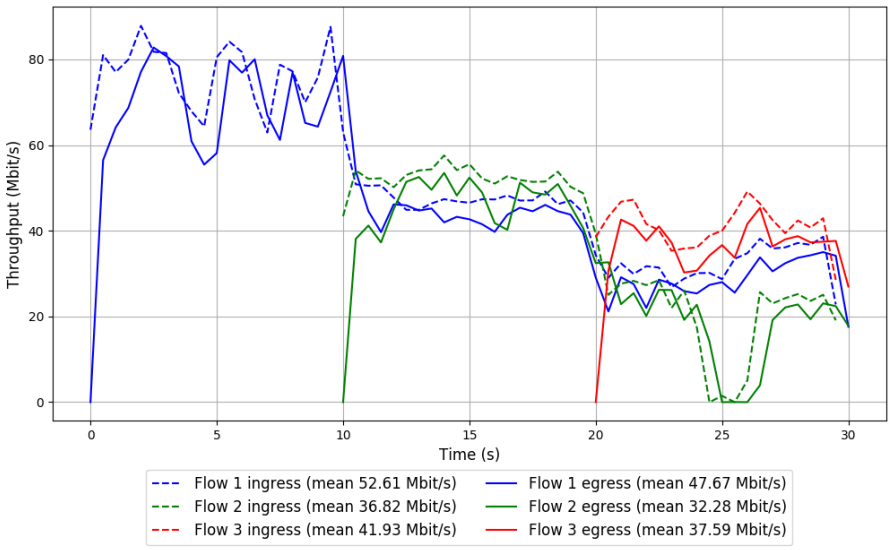


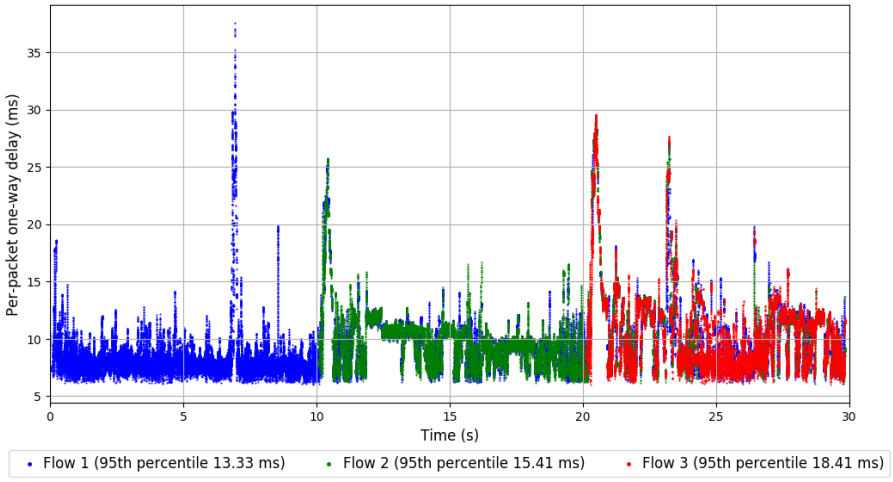
```
Run 3: Statistics of Indigo

Start at: 2018-08-31 09:00:04
End at: 2018-08-31 09:00:34
Local clock offset: 4.291 ms
Remote clock offset: -3.097 ms

# Below is generated by plot.py at 2018-08-31 09:04:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 81.40 Mbit/s
95th percentile per-packet one-way delay: 14.382 ms
Loss rate: 10.31%
-- Flow 1:
Average throughput: 47.67 Mbit/s
95th percentile per-packet one-way delay: 13.333 ms
Loss rate: 9.38%
-- Flow 2:
Average throughput: 32.28 Mbit/s
95th percentile per-packet one-way delay: 15.409 ms
Loss rate: 12.31%
-- Flow 3:
Average throughput: 37.59 Mbit/s
95th percentile per-packet one-way delay: 18.408 ms
Loss rate: 10.32%
```

Run 3: Report of Indigo — Data Link



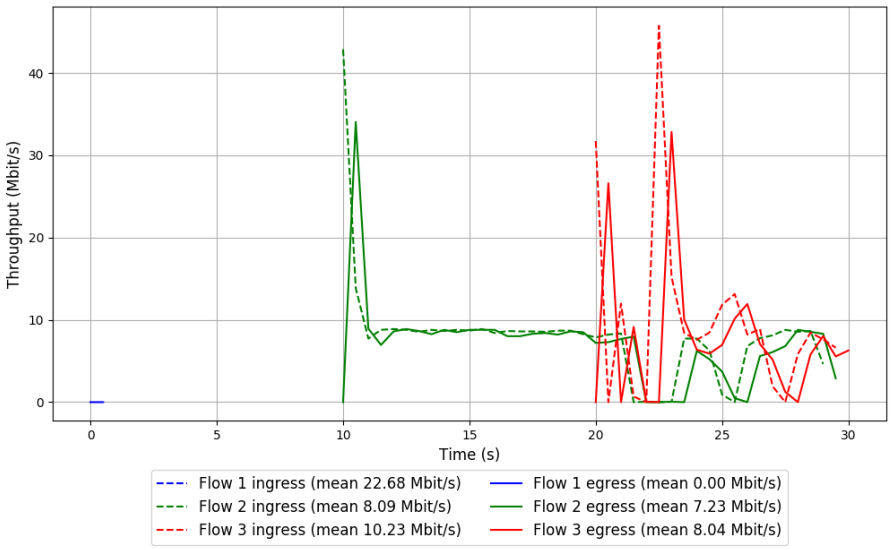


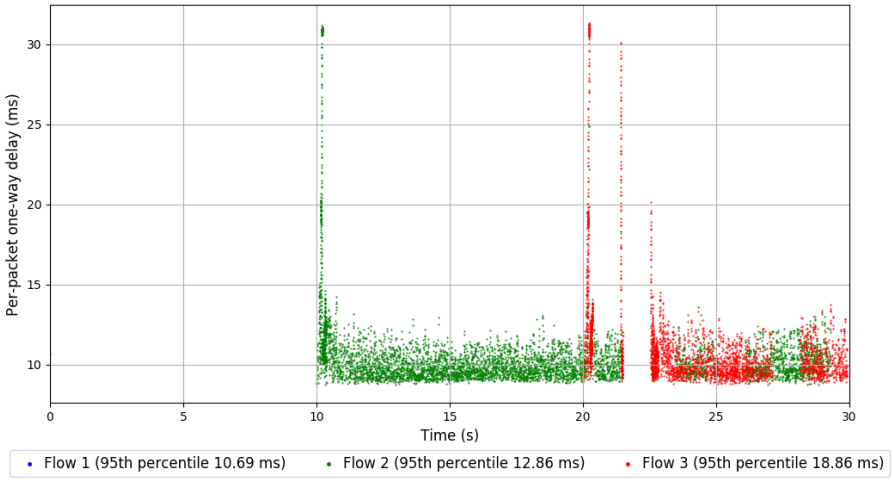
```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 08:52:04
End at: 2018-08-31 08:52:34
Local clock offset: 4.118 ms
Remote clock offset: -2.129 ms

# Below is generated by plot.py at 2018-08-31 09:04:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 7.32 Mbit/s
95th percentile per-packet one-way delay: 14.393 ms
Loss rate: 14.88%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 10.685 ms
Loss rate: 97.39%
-- Flow 2:
Average throughput: 7.23 Mbit/s
95th percentile per-packet one-way delay: 12.858 ms
Loss rate: 10.67%
-- Flow 3:
Average throughput: 8.04 Mbit/s
95th percentile per-packet one-way delay: 18.855 ms
Loss rate: 21.37%
```

Run 1: Report of Muses-25 — Data Link



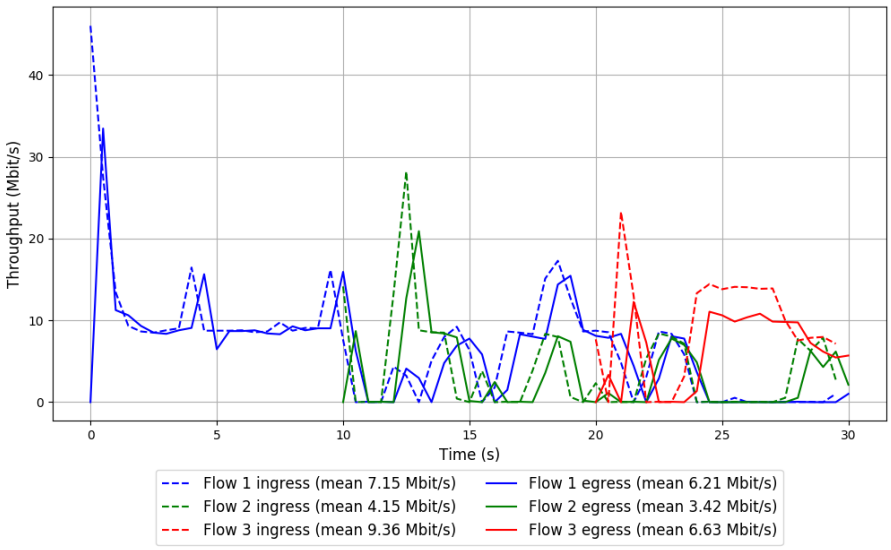


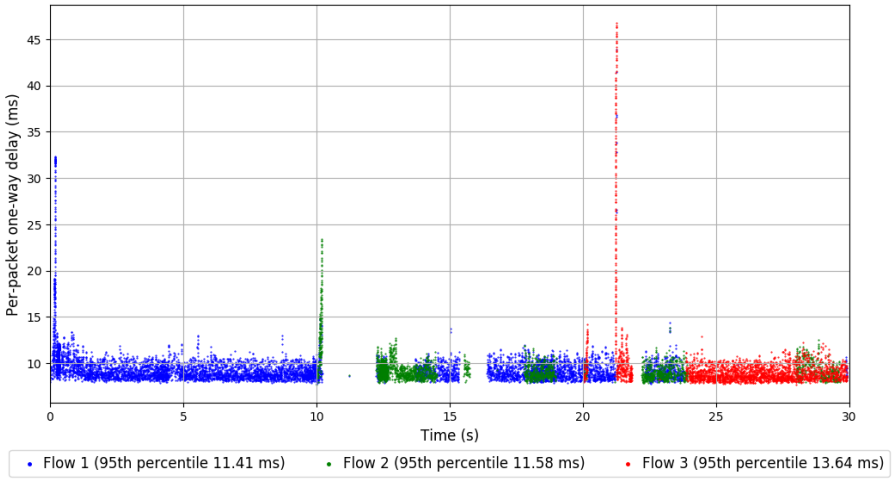
```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 08:56:40
End at: 2018-08-31 08:57:10
Local clock offset: 3.146 ms
Remote clock offset: -3.293 ms

# Below is generated by plot.py at 2018-08-31 09:04:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 10.65 Mbit/s
95th percentile per-packet one-way delay: 11.641 ms
Loss rate: 17.87%
-- Flow 1:
Average throughput: 6.21 Mbit/s
95th percentile per-packet one-way delay: 11.411 ms
Loss rate: 13.04%
-- Flow 2:
Average throughput: 3.42 Mbit/s
95th percentile per-packet one-way delay: 11.578 ms
Loss rate: 17.63%
-- Flow 3:
Average throughput: 6.63 Mbit/s
95th percentile per-packet one-way delay: 13.639 ms
Loss rate: 29.24%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-08-31 09:01:15
End at: 2018-08-31 09:01:45
Local clock offset: 2.442 ms
Remote clock offset: -2.921 ms

# Below is generated by plot.py at 2018-08-31 09:04:00
# Datalink statistics
-- Total of 3 flows:
Average throughput: 11.47 Mbit/s
95th percentile per-packet one-way delay: 13.513 ms
Loss rate: 15.31%
-- Flow 1:
Average throughput: 6.29 Mbit/s
95th percentile per-packet one-way delay: 12.588 ms
Loss rate: 11.90%
-- Flow 2:
Average throughput: 5.21 Mbit/s
95th percentile per-packet one-way delay: 18.185 ms
Loss rate: 16.77%
-- Flow 3:
Average throughput: 5.70 Mbit/s
95th percentile per-packet one-way delay: 14.316 ms
Loss rate: 22.91%
```

Run 3: Report of Muses-25 — Data Link