Pantheon Report

Generated at 2018-08-31 09:05:54 (UTC).

Data path: AWS Brazil 2 on `ens5` (*local*) →Colombia on `p4p1` (*remote*).

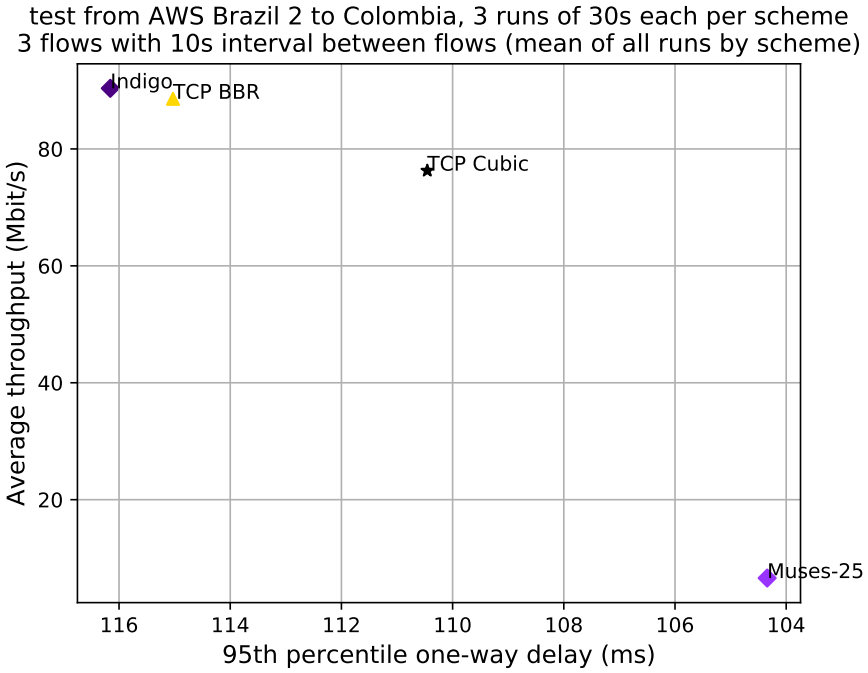
Repeated the test of 4 congestion control schemes 3 times.

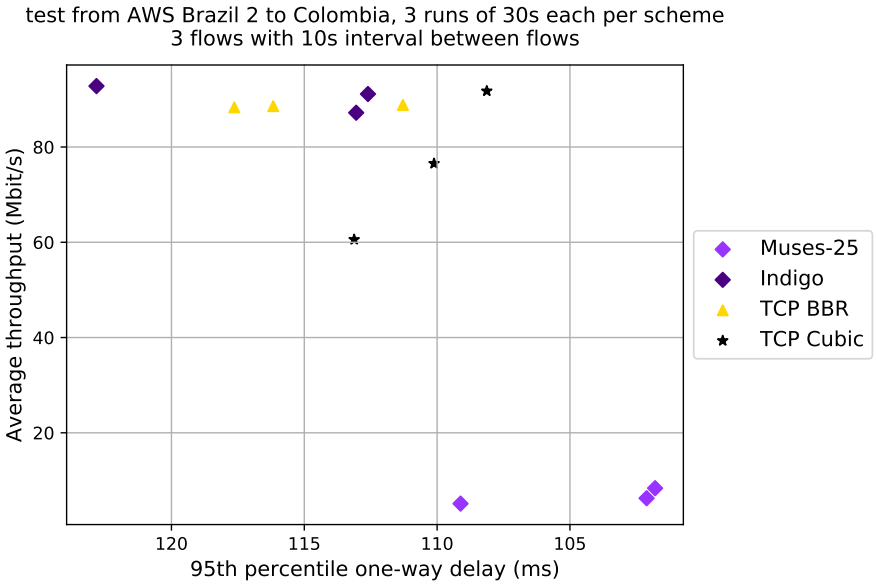
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `gps.ntp.br` 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 Brazil 2 to Colombia, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Indigo
TCP BBR
TCP Cubic
Muses-25
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
20
40
60
80
116
114
112
110
108
106
104


test from AWS Brazil 2 to Colombia, 3 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
20
40
60
80
120
115
110
105
Muses-25
Indigo
TCP BBR
TCP Cubic

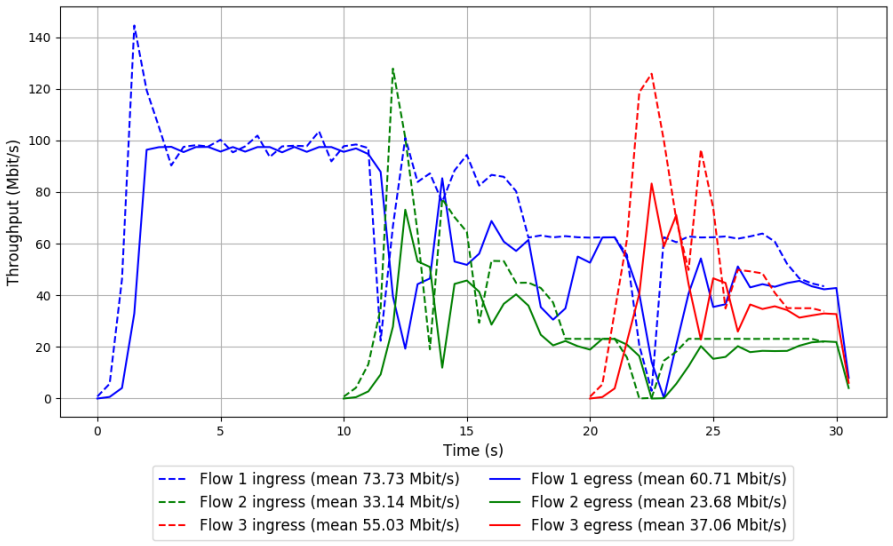
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	54.63	33.98	33.92	114.33	114.61	114.22	14.26	24.50	25.31
TCP Cubic	3	41.09	45.14	15.38	109.90	111.73	111.91	1.18	0.48	0.16
Indigo	3	62.16	29.92	25.95	114.50	115.92	115.83	6.80	18.72	32.75
Muses-25	3	6.41	6.11	1.19	97.56	103.76	104.54	83.23	64.21	81.86

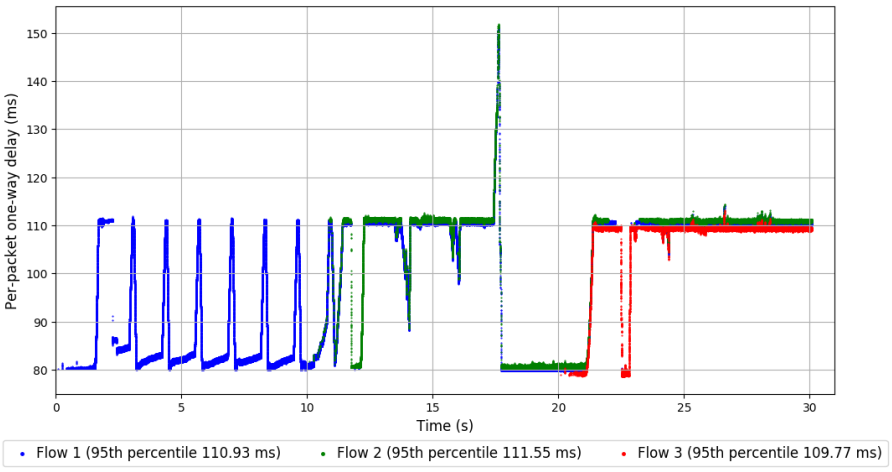
```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 08:52:21
End at: 2018-08-31 08:52:51
Local clock offset: -11.252 ms
Remote clock offset: -2.507 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.84 Mbit/s
95th percentile per-packet one-way delay: 111.288 ms
Loss rate: 22.06%
-- Flow 1:
Average throughput: 60.71 Mbit/s
95th percentile per-packet one-way delay: 110.927 ms
Loss rate: 17.58%
-- Flow 2:
Average throughput: 23.68 Mbit/s
95th percentile per-packet one-way delay: 111.546 ms
Loss rate: 28.44%
-- Flow 3:
Average throughput: 37.06 Mbit/s
95th percentile per-packet one-way delay: 109.770 ms
Loss rate: 32.45%
```

Run 1: Report of TCP BBR — Data Link



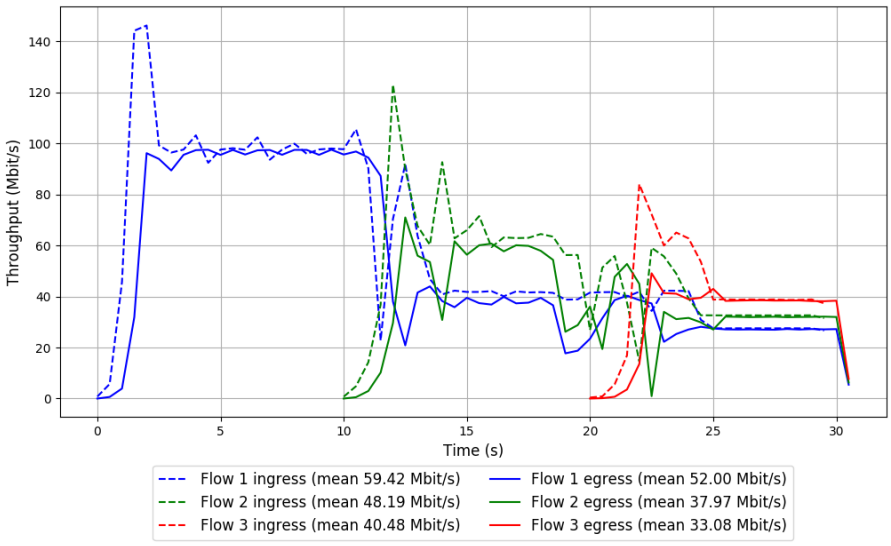


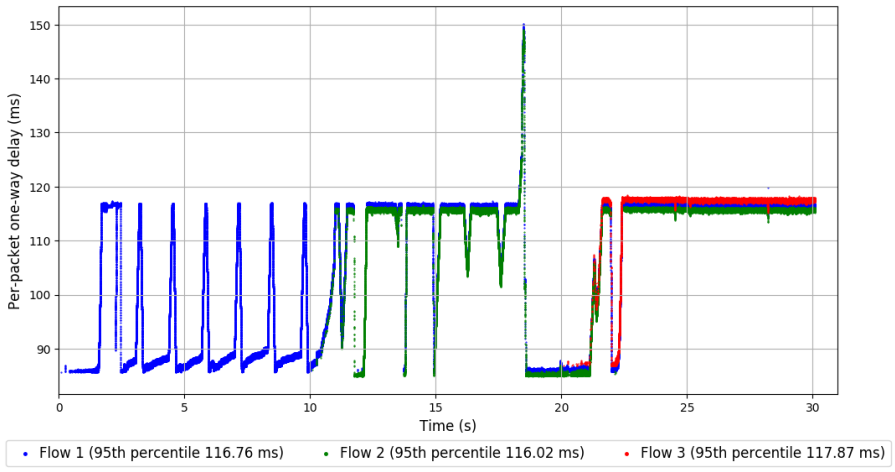
```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 08:57:21
End at: 2018-08-31 08:57:51
Local clock offset: -11.186 ms
Remote clock offset: 2.704 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.33 Mbit/s
95th percentile per-packet one-way delay: 117.633 ms
Loss rate: 15.78%
-- Flow 1:
Average throughput: 52.00 Mbit/s
95th percentile per-packet one-way delay: 116.763 ms
Loss rate: 12.40%
-- Flow 2:
Average throughput: 37.97 Mbit/s
95th percentile per-packet one-way delay: 116.023 ms
Loss rate: 21.08%
-- Flow 3:
Average throughput: 33.08 Mbit/s
95th percentile per-packet one-way delay: 117.874 ms
Loss rate: 18.02%
```

Run 2: Report of TCP BBR — Data Link



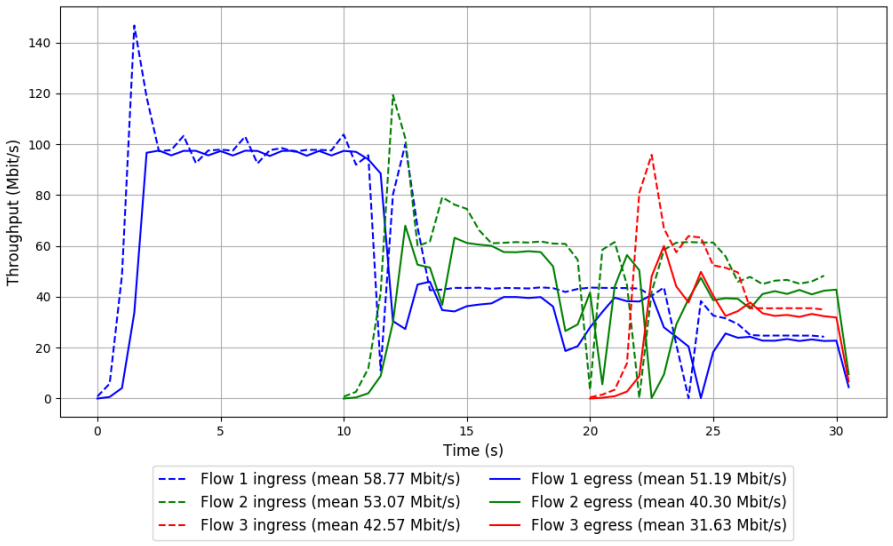


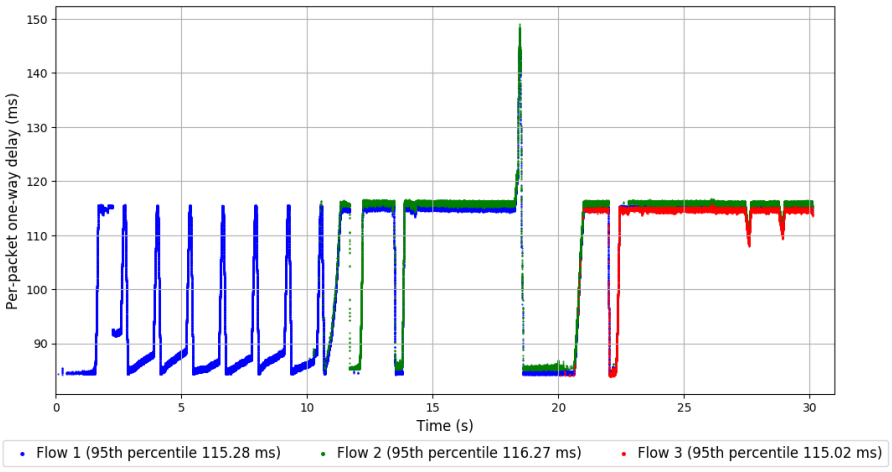
```
Run 3: Statistics of TCP BBR

Start at: 2018-08-31 09:02:21
End at: 2018-08-31 09:02:51
Local clock offset: -10.744 ms
Remote clock offset: 1.79 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.58 Mbit/s
95th percentile per-packet one-way delay: 116.168 ms
Loss rate: 18.11%
-- Flow 1:
Average throughput: 51.19 Mbit/s
95th percentile per-packet one-way delay: 115.285 ms
Loss rate: 12.81%
-- Flow 2:
Average throughput: 40.30 Mbit/s
95th percentile per-packet one-way delay: 116.273 ms
Loss rate: 23.97%
-- Flow 3:
Average throughput: 31.63 Mbit/s
95th percentile per-packet one-way delay: 115.022 ms
Loss rate: 25.47%
```

Run 3: Report of TCP BBR — Data Link



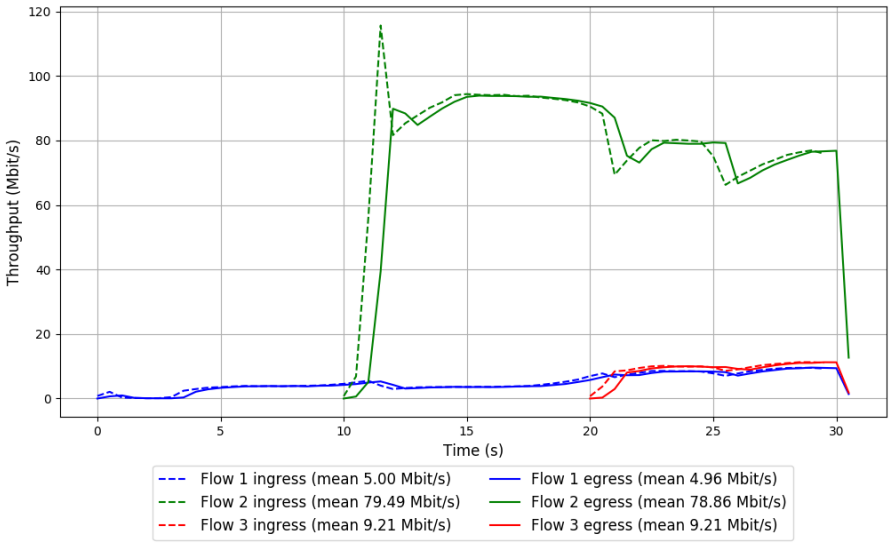


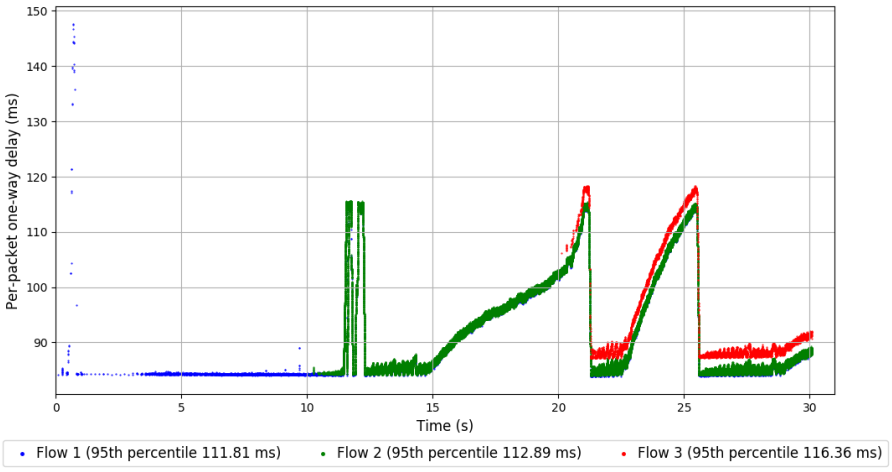
```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 08:53:38
End at: 2018-08-31 08:54:08
Local clock offset: -12.48 ms
Remote clock offset: 2.644 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 60.57 Mbit/s
95th percentile per-packet one-way delay: 113.122 ms
Loss rate: 0.73%
-- Flow 1:
Average throughput: 4.96 Mbit/s
95th percentile per-packet one-way delay: 111.813 ms
Loss rate: 0.63%
-- Flow 2:
Average throughput: 78.86 Mbit/s
95th percentile per-packet one-way delay: 112.895 ms
Loss rate: 0.77%
-- Flow 3:
Average throughput: 9.21 Mbit/s
95th percentile per-packet one-way delay: 116.365 ms
Loss rate: 0.14%
```

Run 1: Report of TCP Cubic — Data Link



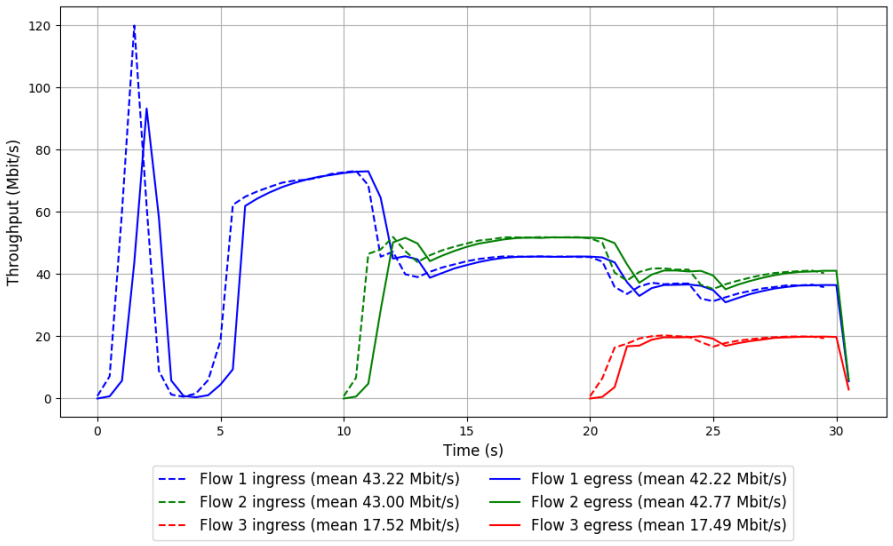


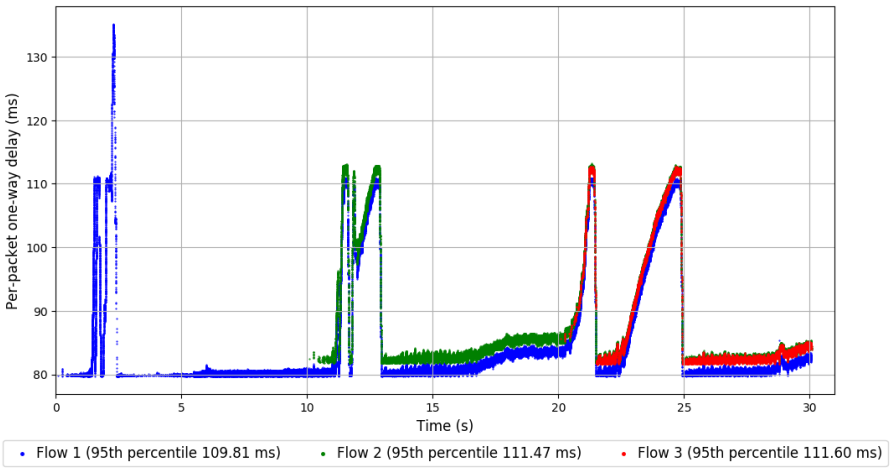
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 08:58:37
End at: 2018-08-31 08:59:07
Local clock offset: -9.881 ms
Remote clock offset: -1.235 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 76.53 Mbit/s
95th percentile per-packet one-way delay: 110.115 ms
Loss rate: 1.49%
-- Flow 1:
Average throughput: 42.22 Mbit/s
95th percentile per-packet one-way delay: 109.805 ms
Loss rate: 2.29%
-- Flow 2:
Average throughput: 42.77 Mbit/s
95th percentile per-packet one-way delay: 111.467 ms
Loss rate: 0.53%
-- Flow 3:
Average throughput: 17.49 Mbit/s
95th percentile per-packet one-way delay: 111.603 ms
Loss rate: 0.21%
```

Run 2: Report of TCP Cubic — Data Link



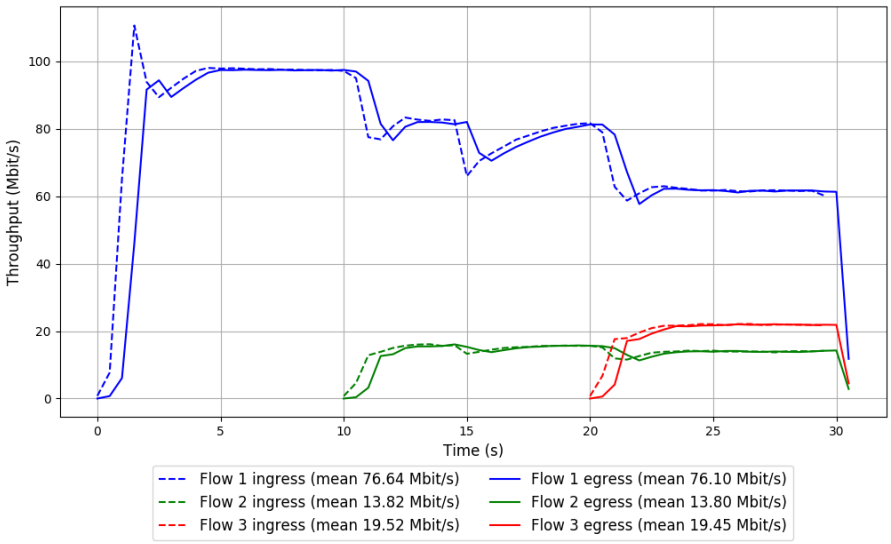


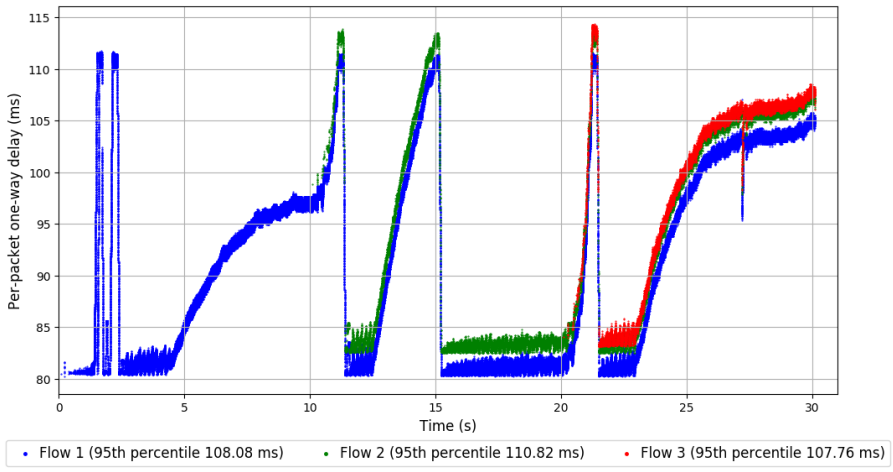
```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-31 09:03:46
End at: 2018-08-31 09:04:16
Local clock offset: -11.078 ms
Remote clock offset: -1.066 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.76 Mbit/s
95th percentile per-packet one-way delay: 108.130 ms
Loss rate: 0.54%
-- Flow 1:
Average throughput: 76.10 Mbit/s
95th percentile per-packet one-way delay: 108.079 ms
Loss rate: 0.63%
-- Flow 2:
Average throughput: 13.80 Mbit/s
95th percentile per-packet one-way delay: 110.817 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 19.45 Mbit/s
95th percentile per-packet one-way delay: 107.762 ms
Loss rate: 0.14%
```

Run 3: Report of TCP Cubic — Data Link



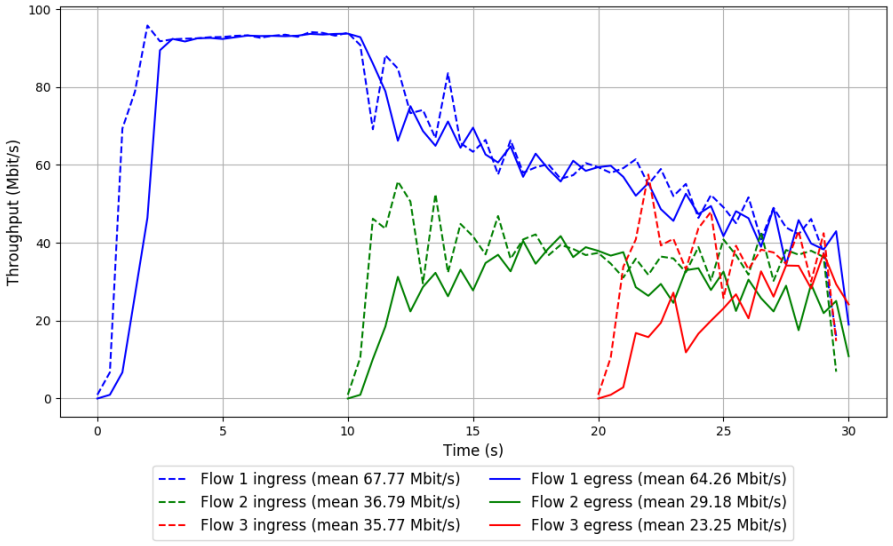


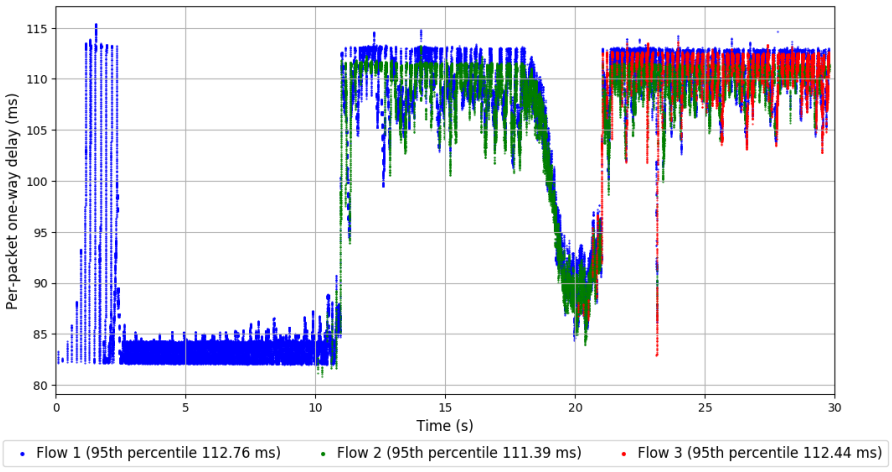
```
Run 1: Statistics of Indigo

Start at: 2018-08-31 08:49:45
End at: 2018-08-31 08:50:15
Local clock offset: -9.952 ms
Remote clock offset: -2.563 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.13 Mbit/s
95th percentile per-packet one-way delay: 112.603 ms
Loss rate: 12.05%
-- Flow 1:
Average throughput: 64.26 Mbit/s
95th percentile per-packet one-way delay: 112.764 ms
Loss rate: 5.09%
-- Flow 2:
Average throughput: 29.18 Mbit/s
95th percentile per-packet one-way delay: 111.391 ms
Loss rate: 20.55%
-- Flow 3:
Average throughput: 23.25 Mbit/s
95th percentile per-packet one-way delay: 112.439 ms
Loss rate: 34.84%
```

Run 1: Report of Indigo — Data Link



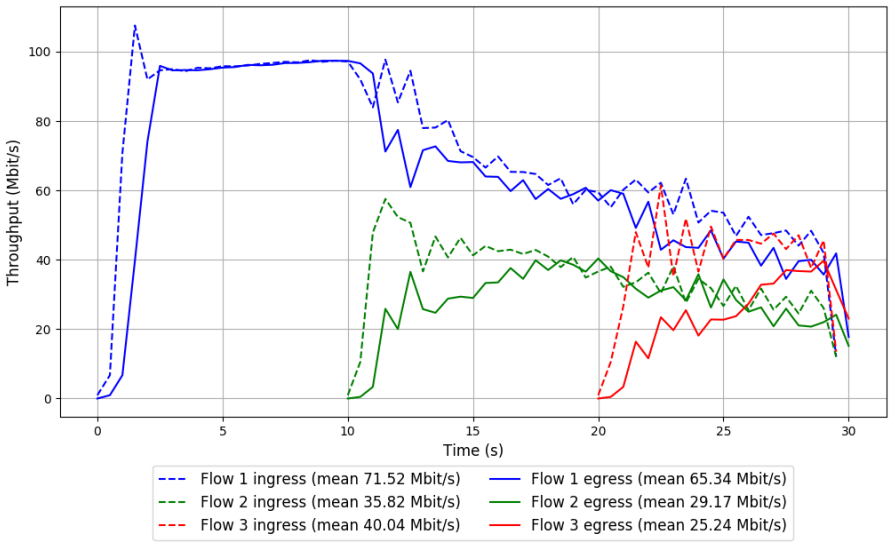


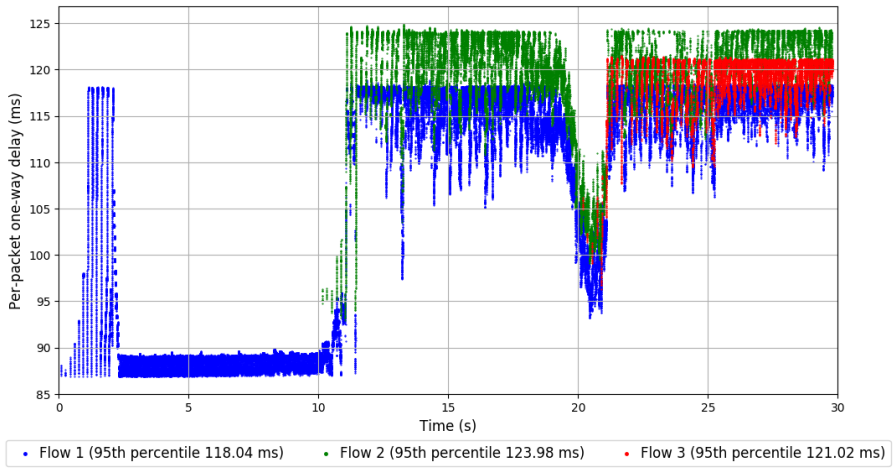
```
Run 2: Statistics of Indigo

Start at: 2018-08-31 08:54:52
End at: 2018-08-31 08:55:22
Local clock offset: -13.63 ms
Remote clock offset: 3.769 ms

# Below is generated by plot.py at 2018-08-31 09:05:50
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.79 Mbit/s
95th percentile per-packet one-way delay: 122.822 ms
Loss rate: 14.11%
-- Flow 1:
Average throughput: 65.34 Mbit/s
95th percentile per-packet one-way delay: 118.041 ms
Loss rate: 8.55%
-- Flow 2:
Average throughput: 29.17 Mbit/s
95th percentile per-packet one-way delay: 123.978 ms
Loss rate: 18.44%
-- Flow 3:
Average throughput: 25.24 Mbit/s
95th percentile per-packet one-way delay: 121.023 ms
Loss rate: 36.88%
```

Run 2: Report of Indigo — Data Link



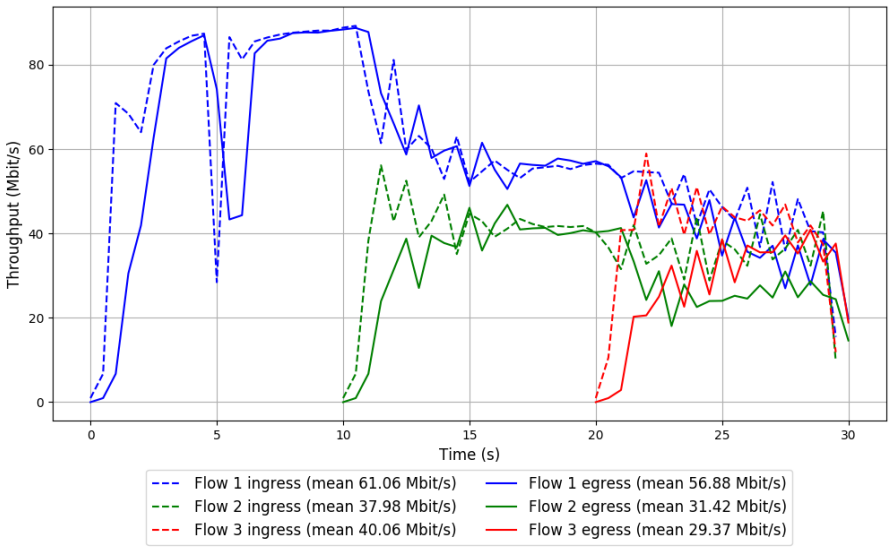


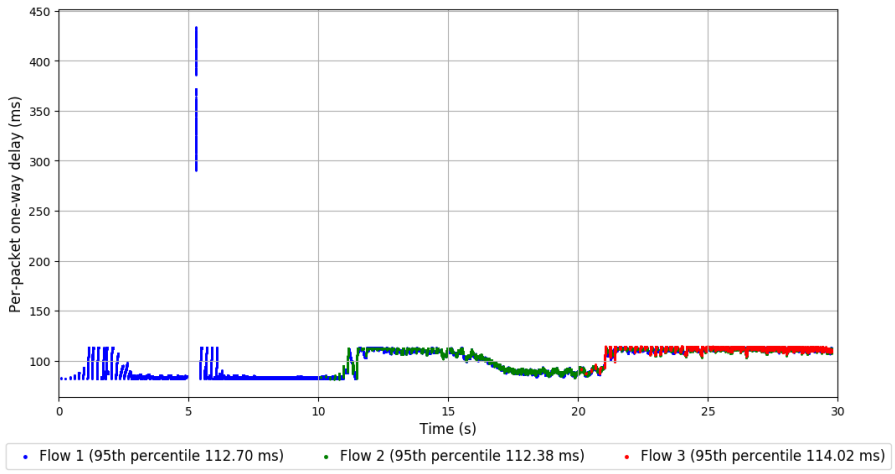
```
Run 3: Statistics of Indigo

Start at: 2018-08-31 08:59:51
End at: 2018-08-31 09:00:21
Local clock offset: -11.299 ms
Remote clock offset: -1.054 ms

# Below is generated by plot.py at 2018-08-31 09:05:53
# Datalink statistics
-- Total of 3 flows:
Average throughput: 87.20 Mbit/s
95th percentile per-packet one-way delay: 113.046 ms
Loss rate: 11.99%
-- Flow 1:
Average throughput: 56.88 Mbit/s
95th percentile per-packet one-way delay: 112.703 ms
Loss rate: 6.75%
-- Flow 2:
Average throughput: 31.42 Mbit/s
95th percentile per-packet one-way delay: 112.379 ms
Loss rate: 17.16%
-- Flow 3:
Average throughput: 29.37 Mbit/s
95th percentile per-packet one-way delay: 114.021 ms
Loss rate: 26.53%
```

Run 3: Report of Indigo — Data Link



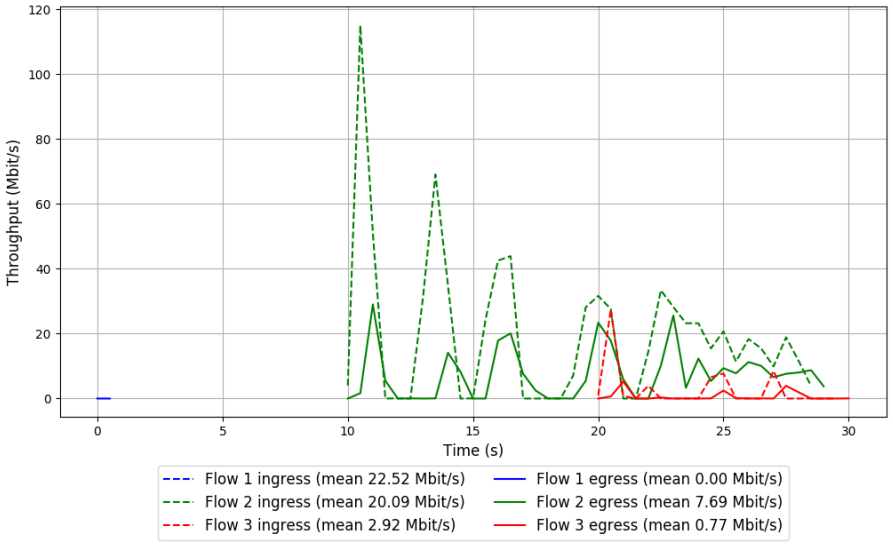


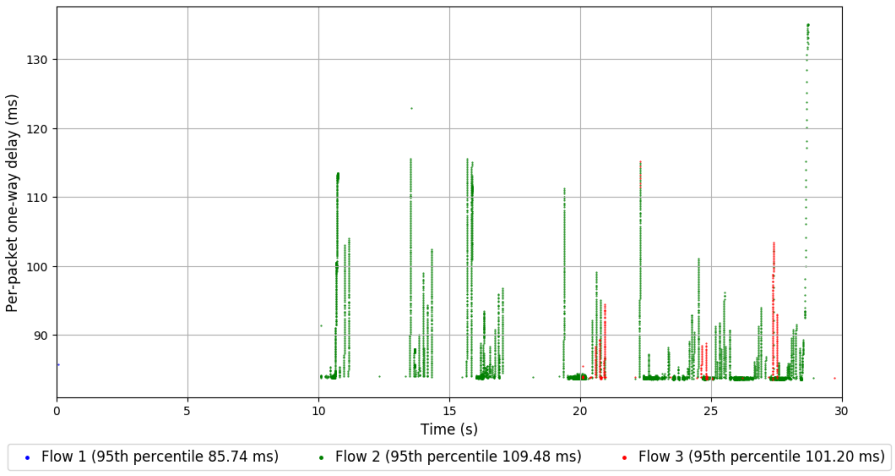
```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 08:51:10
End at: 2018-08-31 08:51:40
Local clock offset: -10.146 ms
Remote clock offset: 2.564 ms

# Below is generated by plot.py at 2018-08-31 09:05:53
# Datalink statistics
-- Total of 3 flows:
Average throughput: 5.13 Mbit/s
95th percentile per-packet one-way delay: 109.118 ms
Loss rate: 62.67%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 85.741 ms
Loss rate: 97.39%
-- Flow 2:
Average throughput: 7.69 Mbit/s
95th percentile per-packet one-way delay: 109.482 ms
Loss rate: 61.87%
-- Flow 3:
Average throughput: 0.77 Mbit/s
95th percentile per-packet one-way delay: 101.201 ms
Loss rate: 73.56%
```

Run 1: Report of Muses-25 — Data Link



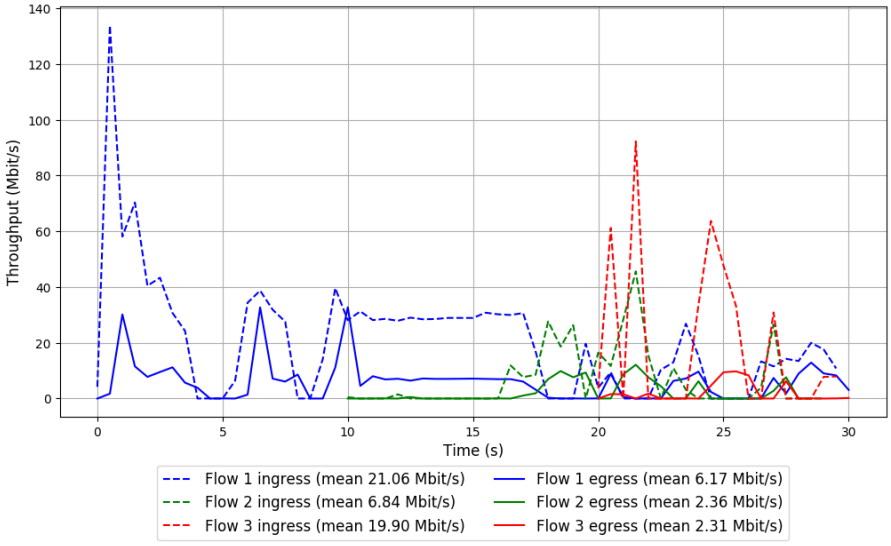


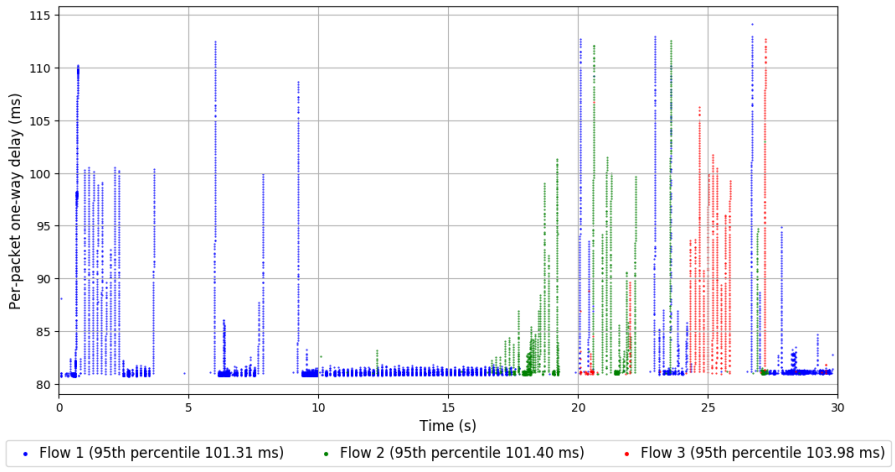
```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 08:56:09
End at: 2018-08-31 08:56:39
Local clock offset: -11.78 ms
Remote clock offset: -1.252 ms

# Below is generated by plot.py at 2018-08-31 09:05:53
# Datalink statistics
-- Total of 3 flows:
Average throughput: 8.37 Mbit/s
95th percentile per-packet one-way delay: 101.795 ms
Loss rate: 73.82%
-- Flow 1:
Average throughput: 6.17 Mbit/s
95th percentile per-packet one-way delay: 101.315 ms
Loss rate: 70.72%
-- Flow 2:
Average throughput: 2.36 Mbit/s
95th percentile per-packet one-way delay: 101.403 ms
Loss rate: 67.23%
-- Flow 3:
Average throughput: 2.31 Mbit/s
95th percentile per-packet one-way delay: 103.982 ms
Loss rate: 88.58%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-08-31 09:01:08
End at: 2018-08-31 09:01:38
Local clock offset: -10.468 ms
Remote clock offset: -2.317 ms

# Below is generated by plot.py at 2018-08-31 09:05:53
# Datalink statistics
-- Total of 3 flows:
Average throughput: 6.27 Mbit/s
95th percentile per-packet one-way delay: 102.114 ms
Loss rate: 67.65%
-- Flow 1:
Average throughput: 13.07 Mbit/s
95th percentile per-packet one-way delay: 105.628 ms
Loss rate: 81.58%
-- Flow 2:
Average throughput: 8.27 Mbit/s
95th percentile per-packet one-way delay: 100.395 ms
Loss rate: 63.54%
-- Flow 3:
Average throughput: 0.50 Mbit/s
95th percentile per-packet one-way delay: 108.430 ms
Loss rate: 83.43%
```

Run 3: Report of Muses-25 — Data Link