Pantheon Report

Generated at 2018-08-31 05:53:15 (UTC).

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

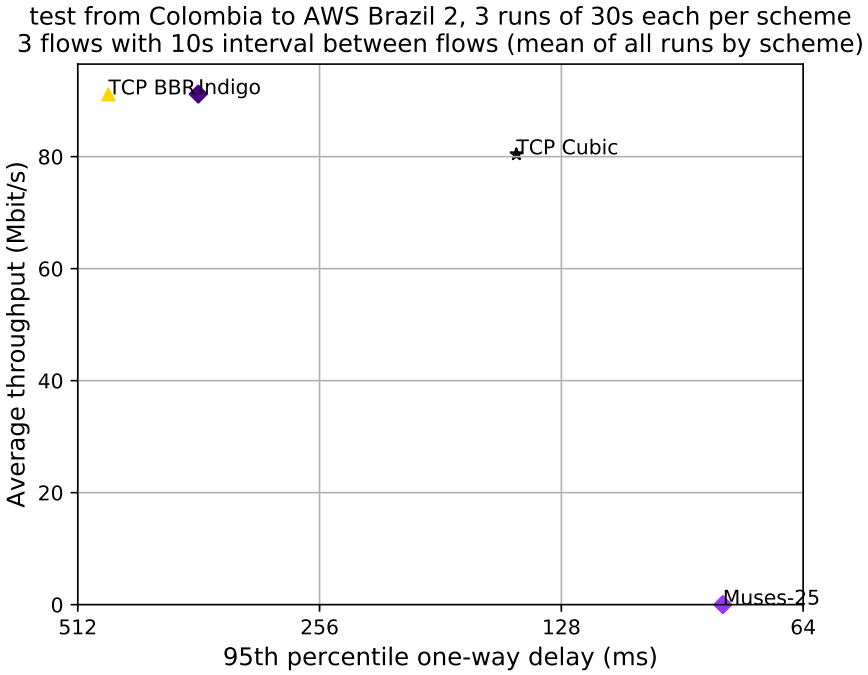
Repeated the test of 4 congestion control schemes 3 times.

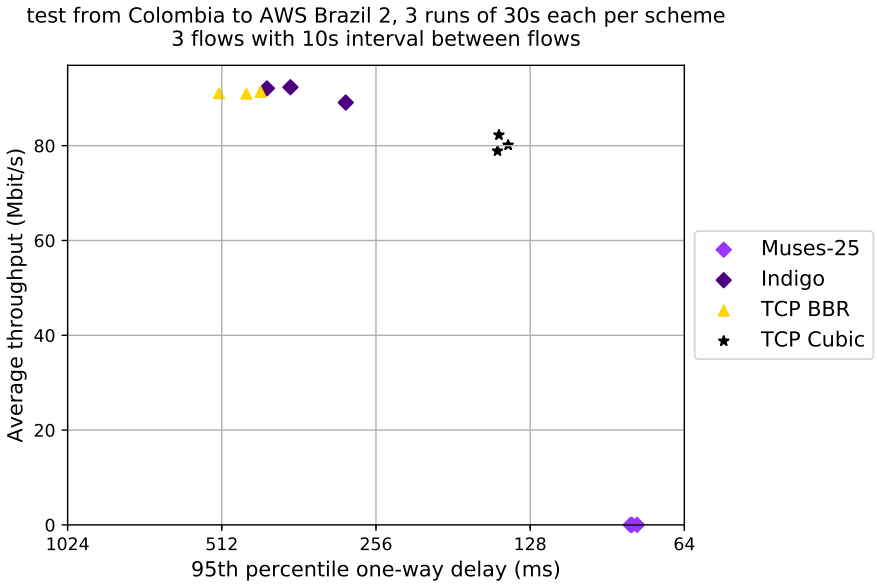
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `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 @ 2de97ca91a065473c29a25fffe63fb137c97a67c
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 Colombia to AWS Brazil 2, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
TCP BBR
Indigo
TCP Cubic
Muses-25
Average throughput (Mbit/s)
0
20
40
60
80
512
256
128
64
95th percentile one-way delay (ms)


test from Colombia to AWS Brazil 2, 3 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
0
20
40
60
80
1024
512
256
128
64
95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic

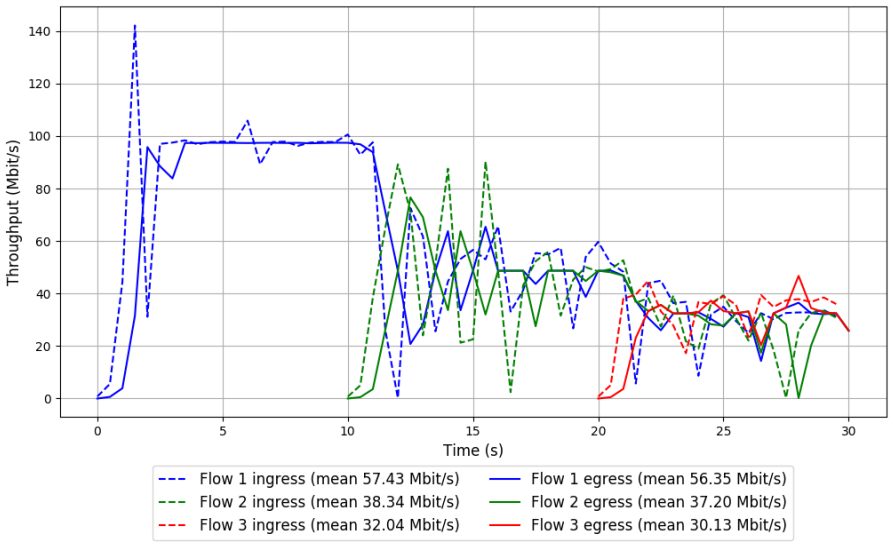
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	56.17	37.78	29.97	373.61	582.42	531.85	2.99	4.58	7.90
TCP Cubic	3	43.40	37.68	36.50	170.11	139.92	113.72	0.40	0.74	2.15
Indigo	3	57.49	39.46	27.15	380.15	139.10	126.70	7.18	1.24	2.68
Muses-25	3	0.00	0.00	0.00	80.53	79.64	80.33	0.00	0.00	0.00

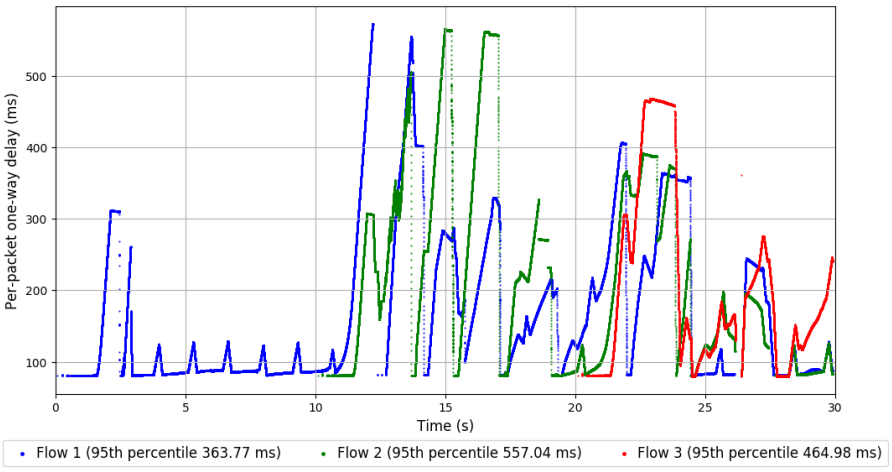
```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 05:41:01
End at: 2018-08-31 05:41:31
Local clock offset: -3.929 ms
Remote clock offset: 1.144 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.95 Mbit/s
95th percentile per-packet one-way delay: 458.627 ms
Loss rate: 3.37%
-- Flow 1:
Average throughput: 56.35 Mbit/s
95th percentile per-packet one-way delay: 363.773 ms
Loss rate: 2.43%
-- Flow 2:
Average throughput: 37.20 Mbit/s
95th percentile per-packet one-way delay: 557.037 ms
Loss rate: 3.77%
-- Flow 3:
Average throughput: 30.13 Mbit/s
95th percentile per-packet one-way delay: 464.976 ms
Loss rate: 7.53%
```

Run 1: Report of TCP BBR — Data Link



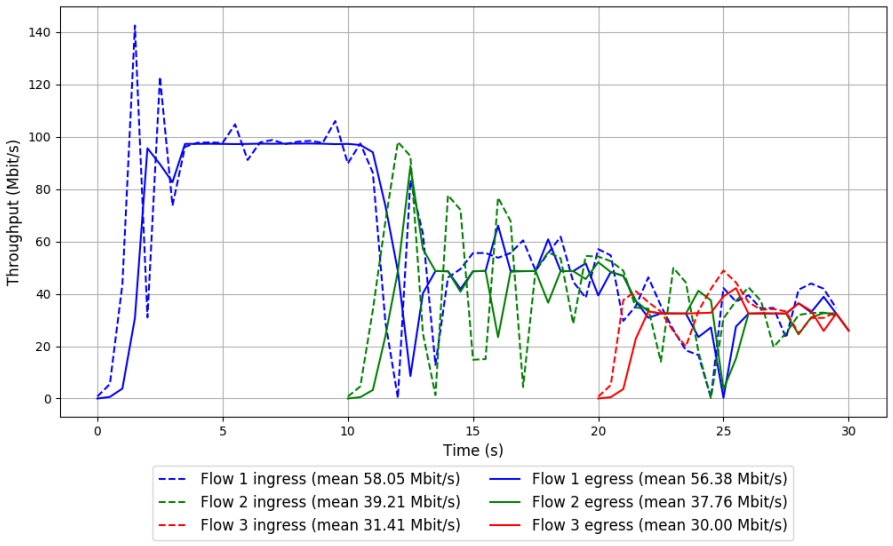


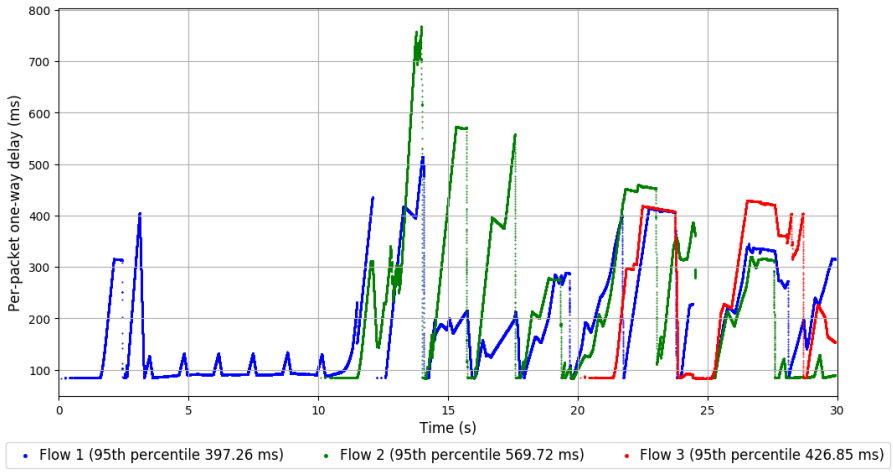
```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 05:46:05
End at: 2018-08-31 05:46:35
Local clock offset: -4.01 ms
Remote clock offset: -2.641 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.33 Mbit/s
95th percentile per-packet one-way delay: 430.131 ms
Loss rate: 4.02%
-- Flow 1:
Average throughput: 56.38 Mbit/s
95th percentile per-packet one-way delay: 397.265 ms
Loss rate: 3.43%
-- Flow 2:
Average throughput: 37.76 Mbit/s
95th percentile per-packet one-way delay: 569.718 ms
Loss rate: 4.51%
-- Flow 3:
Average throughput: 30.00 Mbit/s
95th percentile per-packet one-way delay: 426.848 ms
Loss rate: 6.07%
```

Run 2: Report of TCP BBR — Data Link



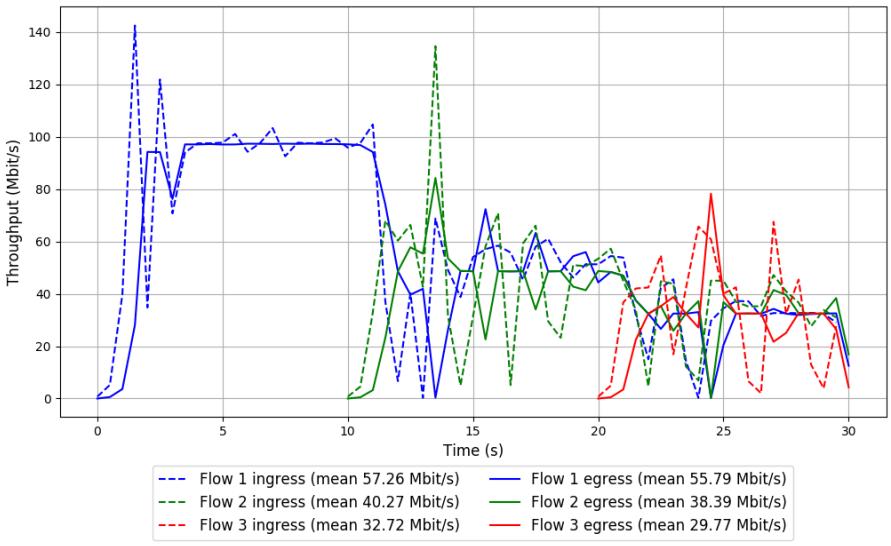


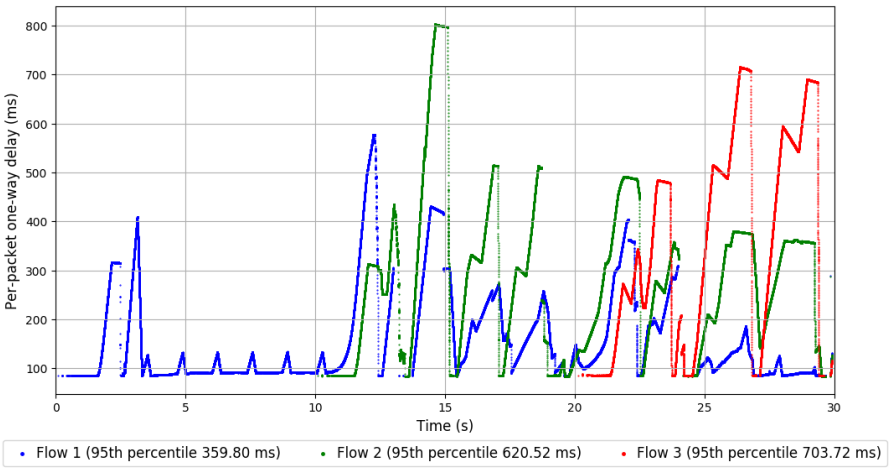
```
Run 3: Statistics of TCP BBR

Start at: 2018-08-31 05:51:07
End at: 2018-08-31 05:51:37
Local clock offset: -4.666 ms
Remote clock offset: -2.873 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.06 Mbit/s
95th percentile per-packet one-way delay: 518.148 ms
Loss rate: 4.57%
-- Flow 1:
Average throughput: 55.79 Mbit/s
95th percentile per-packet one-way delay: 359.798 ms
Loss rate: 3.11%
-- Flow 2:
Average throughput: 38.39 Mbit/s
95th percentile per-packet one-way delay: 620.518 ms
Loss rate: 5.45%
-- Flow 3:
Average throughput: 29.77 Mbit/s
95th percentile per-packet one-way delay: 703.722 ms
Loss rate: 10.11%
```

Run 3: Report of TCP BBR — Data Link



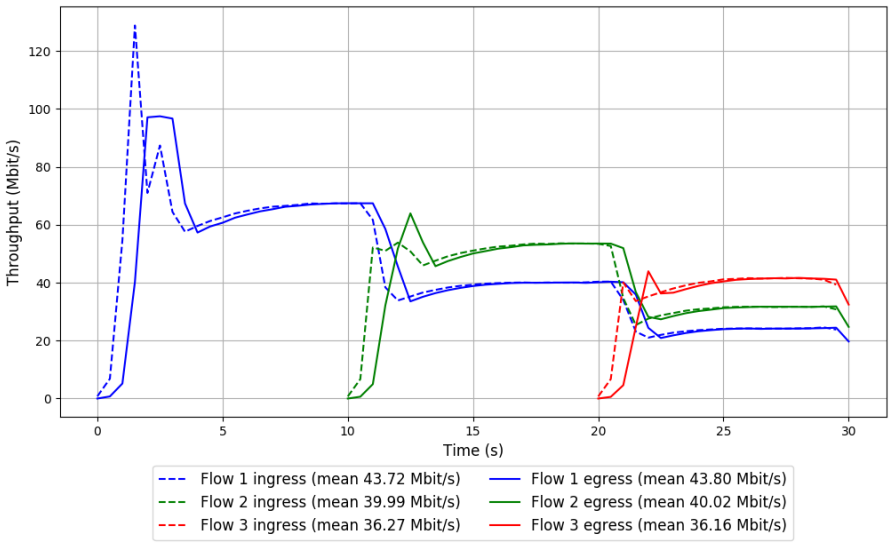


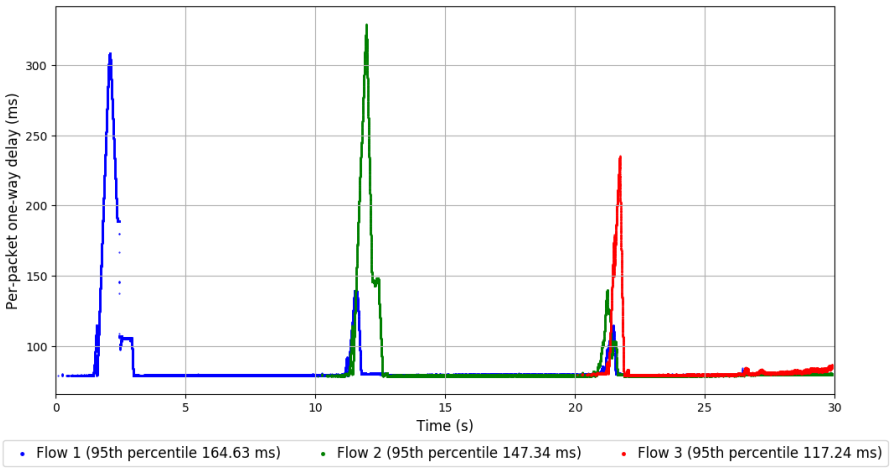
```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 05:39:46
End at: 2018-08-31 05:40:16
Local clock offset: -3.155 ms
Remote clock offset: 2.332 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 82.26 Mbit/s
95th percentile per-packet one-way delay: 147.295 ms
Loss rate: 0.73%
-- Flow 1:
Average throughput: 43.80 Mbit/s
95th percentile per-packet one-way delay: 164.631 ms
Loss rate: 0.38%
-- Flow 2:
Average throughput: 40.02 Mbit/s
95th percentile per-packet one-way delay: 147.341 ms
Loss rate: 0.74%
-- Flow 3:
Average throughput: 36.16 Mbit/s
95th percentile per-packet one-way delay: 117.236 ms
Loss rate: 1.97%
```

Run 1: Report of TCP Cubic — Data Link



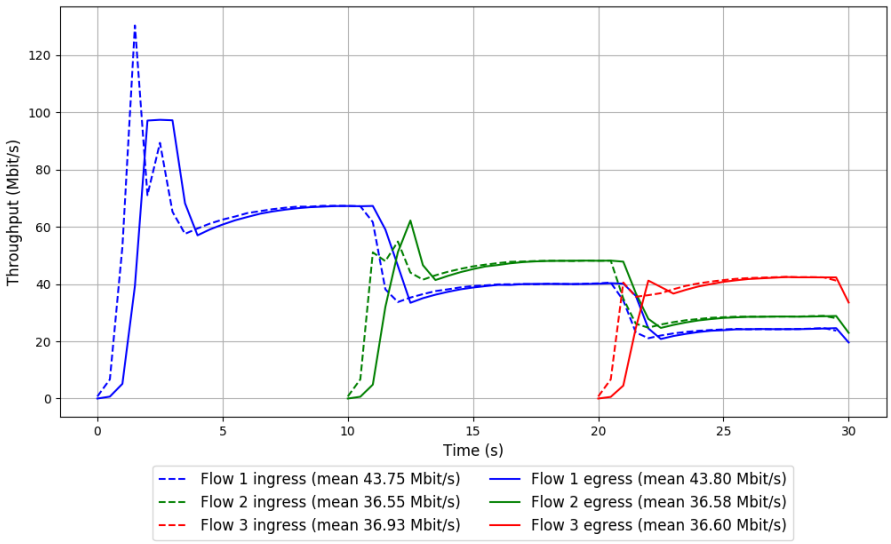


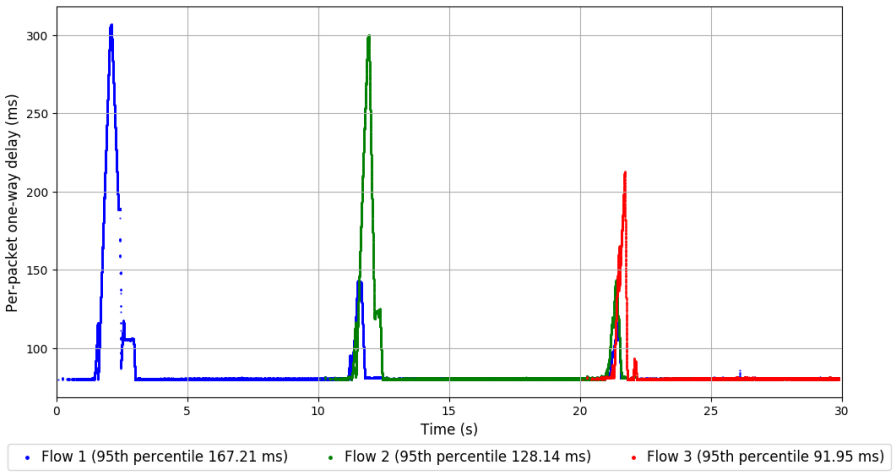
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 05:44:49
End at: 2018-08-31 05:45:19
Local clock offset: -4.749 ms
Remote clock offset: 0.867 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 80.13 Mbit/s
95th percentile per-packet one-way delay: 141.320 ms
Loss rate: 0.85%
-- Flow 1:
Average throughput: 43.80 Mbit/s
95th percentile per-packet one-way delay: 167.211 ms
Loss rate: 0.43%
-- Flow 2:
Average throughput: 36.58 Mbit/s
95th percentile per-packet one-way delay: 128.140 ms
Loss rate: 0.76%
-- Flow 3:
Average throughput: 36.60 Mbit/s
95th percentile per-packet one-way delay: 91.946 ms
Loss rate: 2.55%
```

Run 2: Report of TCP Cubic — Data Link



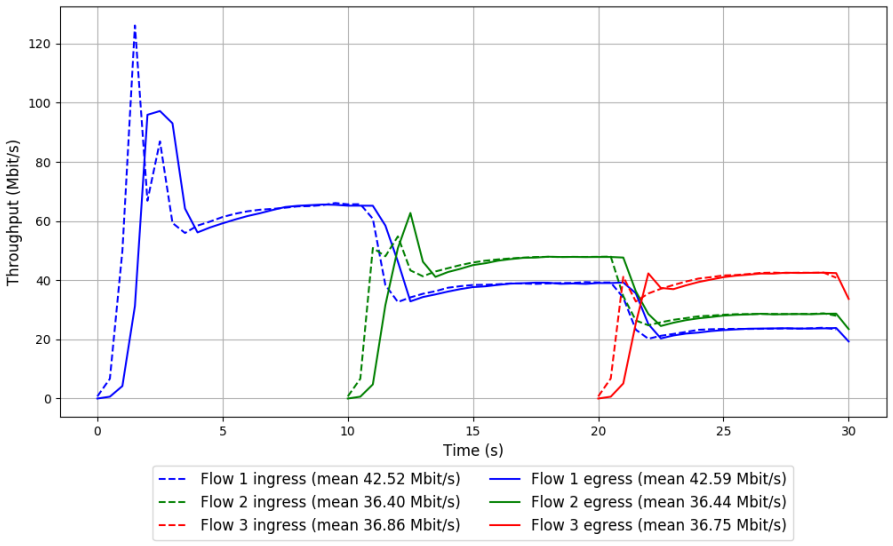


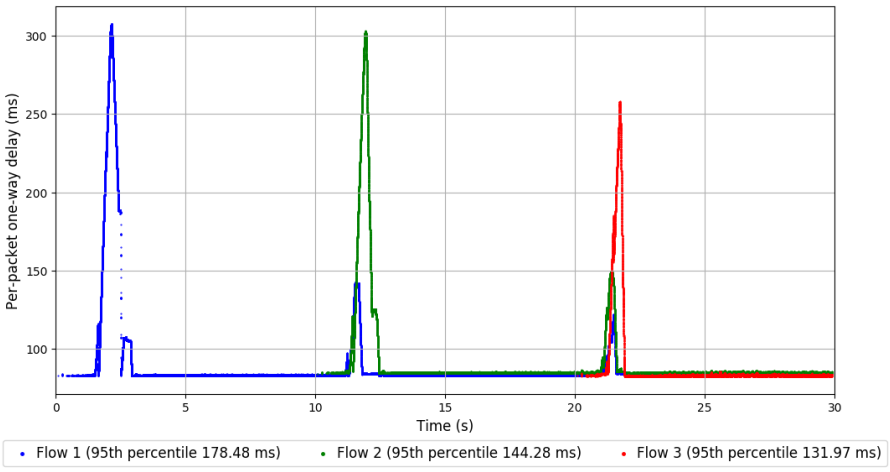
```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-31 05:49:52
End at: 2018-08-31 05:50:22
Local clock offset: -5.244 ms
Remote clock offset: -2.766 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 78.88 Mbit/s
95th percentile per-packet one-way delay: 148.248 ms
Loss rate: 0.73%
-- Flow 1:
Average throughput: 42.59 Mbit/s
95th percentile per-packet one-way delay: 178.483 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 36.44 Mbit/s
95th percentile per-packet one-way delay: 144.279 ms
Loss rate: 0.73%
-- Flow 3:
Average throughput: 36.75 Mbit/s
95th percentile per-packet one-way delay: 131.972 ms
Loss rate: 1.94%
```

Run 3: Report of TCP Cubic — Data Link



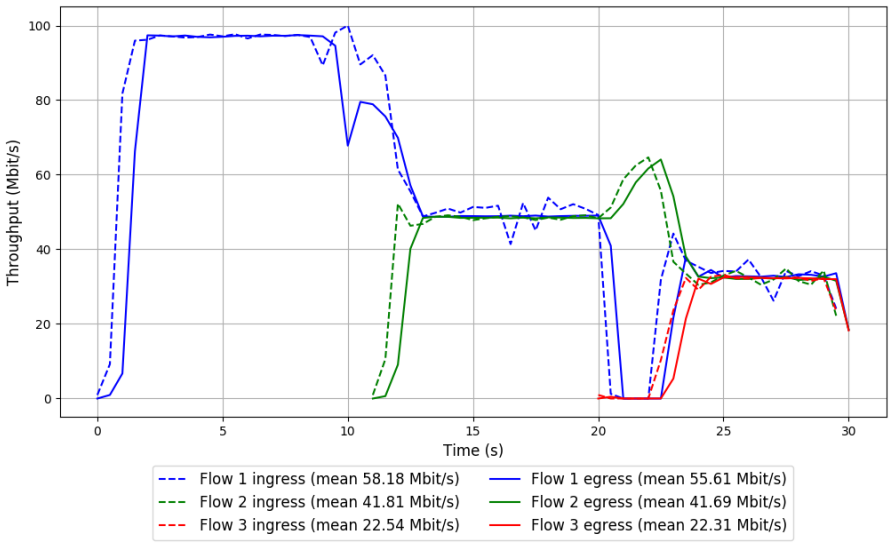


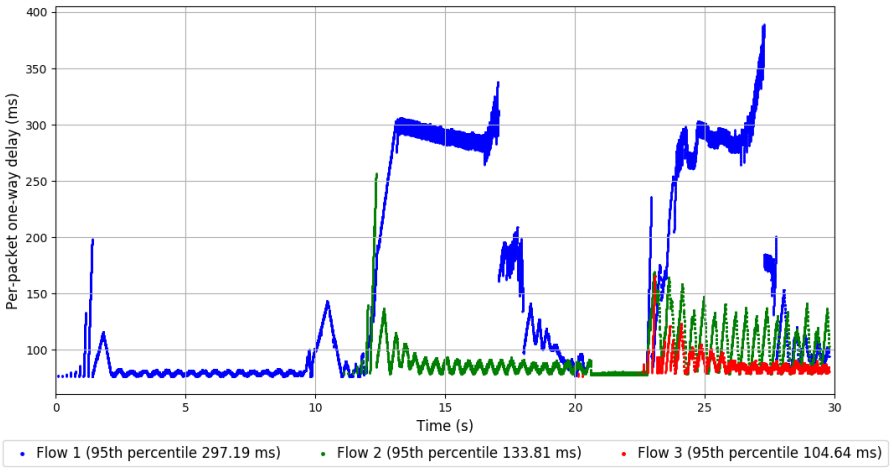
```
Run 1: Statistics of Indigo

Start at: 2018-08-31 05:38:29
End at: 2018-08-31 05:38:59
Local clock offset: -4.72 ms
Remote clock offset: 2.531 ms

# Below is generated by plot.py at 2018-08-31 05:53:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.10 Mbit/s
95th percentile per-packet one-way delay: 293.279 ms
Loss rate: 3.66%
-- Flow 1:
Average throughput: 55.61 Mbit/s
95th percentile per-packet one-way delay: 297.186 ms
Loss rate: 4.93%
-- Flow 2:
Average throughput: 41.69 Mbit/s
95th percentile per-packet one-way delay: 133.805 ms
Loss rate: 1.15%
-- Flow 3:
Average throughput: 22.31 Mbit/s
95th percentile per-packet one-way delay: 104.639 ms
Loss rate: 2.68%
```

Run 1: Report of Indigo — Data Link



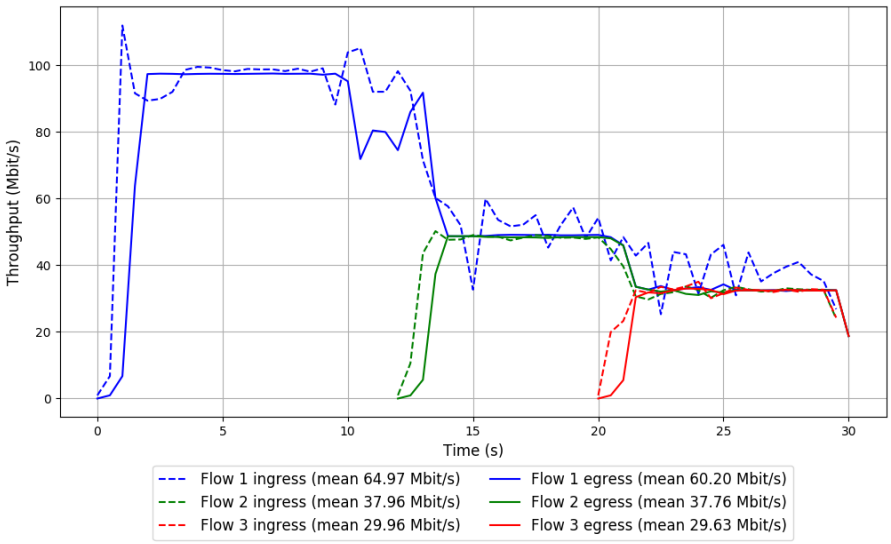


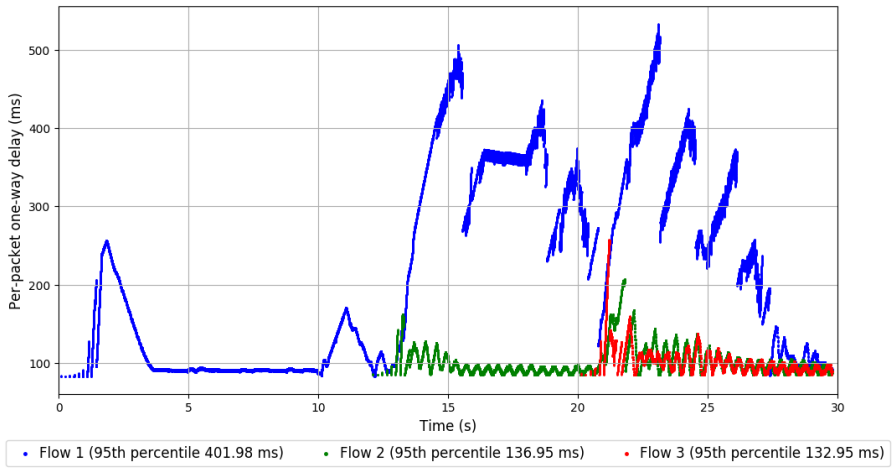
```
Run 2: Statistics of Indigo

Start at: 2018-08-31 05:43:29
End at: 2018-08-31 05:43:59
Local clock offset: -4.713 ms
Remote clock offset: -2.682 ms

# Below is generated by plot.py at 2018-08-31 05:53:11
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.33 Mbit/s
95th percentile per-packet one-way delay: 376.109 ms
Loss rate: 5.85%
-- Flow 1:
Average throughput: 60.20 Mbit/s
95th percentile per-packet one-way delay: 401.981 ms
Loss rate: 7.86%
-- Flow 2:
Average throughput: 37.76 Mbit/s
95th percentile per-packet one-way delay: 136.950 ms
Loss rate: 1.45%
-- Flow 3:
Average throughput: 29.63 Mbit/s
95th percentile per-packet one-way delay: 132.949 ms
Loss rate: 2.77%
```

Run 2: Report of Indigo — Data Link



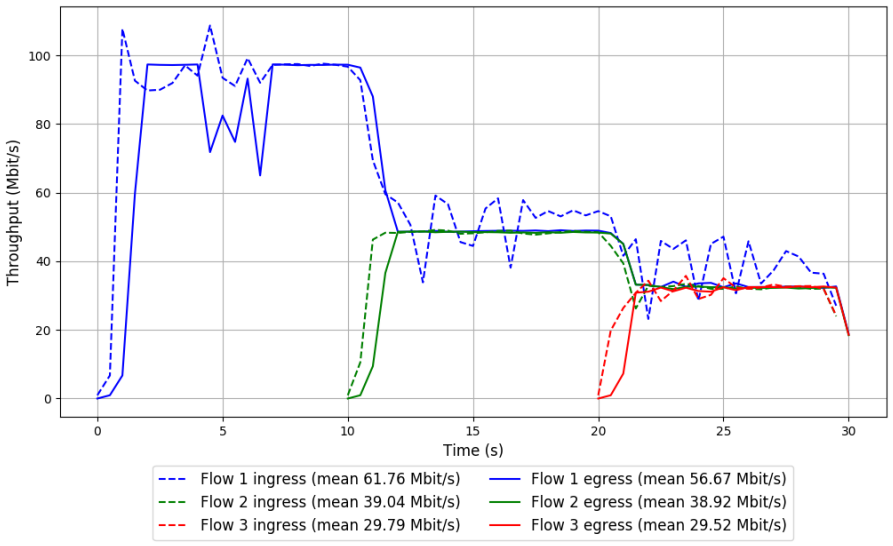


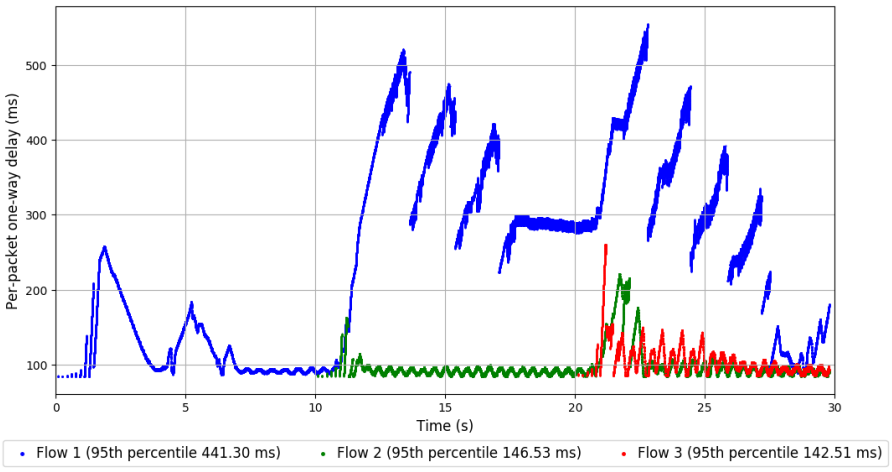
```
Run 3: Statistics of Indigo

Start at: 2018-08-31 05:48:35
End at: 2018-08-31 05:49:05
Local clock offset: -4.333 ms
Remote clock offset: -2.639 ms

# Below is generated by plot.py at 2018-08-31 05:53:14
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.08 Mbit/s
95th percentile per-packet one-way delay: 418.040 ms
Loss rate: 6.10%
-- Flow 1:
Average throughput: 56.67 Mbit/s
95th percentile per-packet one-way delay: 441.296 ms
Loss rate: 8.75%
-- Flow 2:
Average throughput: 38.92 Mbit/s
95th percentile per-packet one-way delay: 146.532 ms
Loss rate: 1.13%
-- Flow 3:
Average throughput: 29.52 Mbit/s
95th percentile per-packet one-way delay: 142.511 ms
Loss rate: 2.60%
```

Run 3: Report of Indigo — Data Link



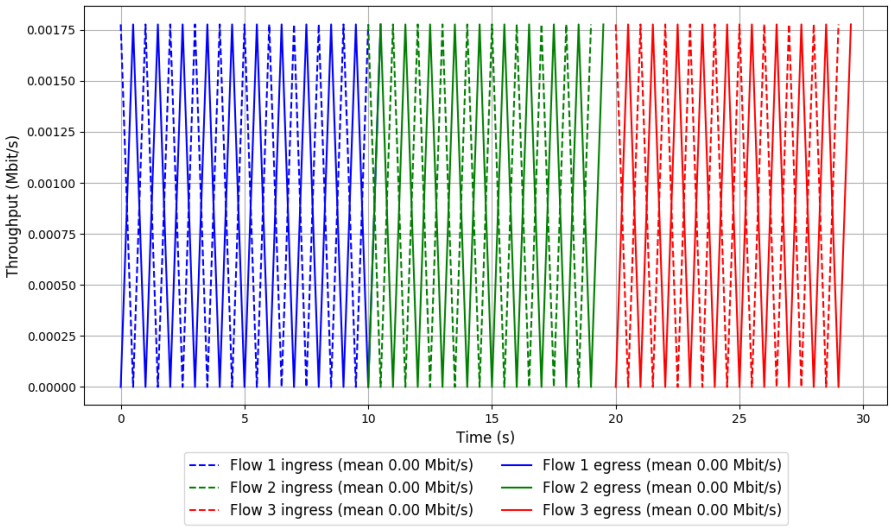


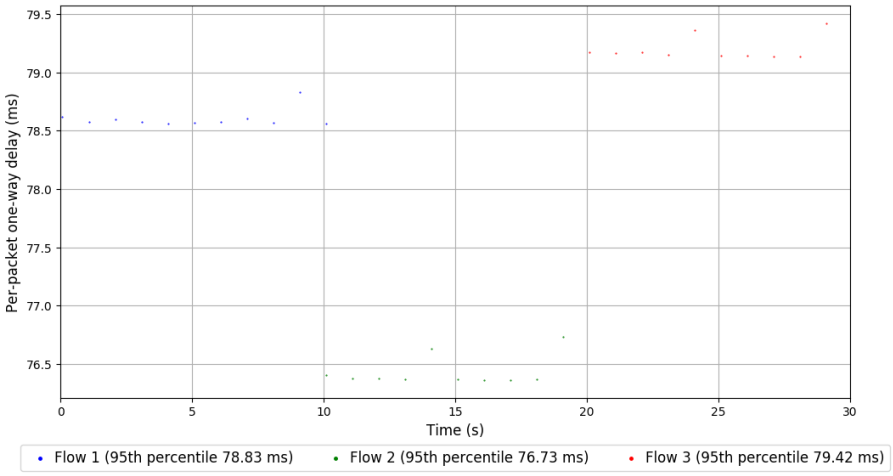
```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 05:37:19
End at: 2018-08-31 05:37:49
Local clock offset: -4.737 ms
Remote clock offset: 1.509 ms

# Below is generated by plot.py at 2018-08-31 05:53:14
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 79.174 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 78.827 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 76.734 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 79.417 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link



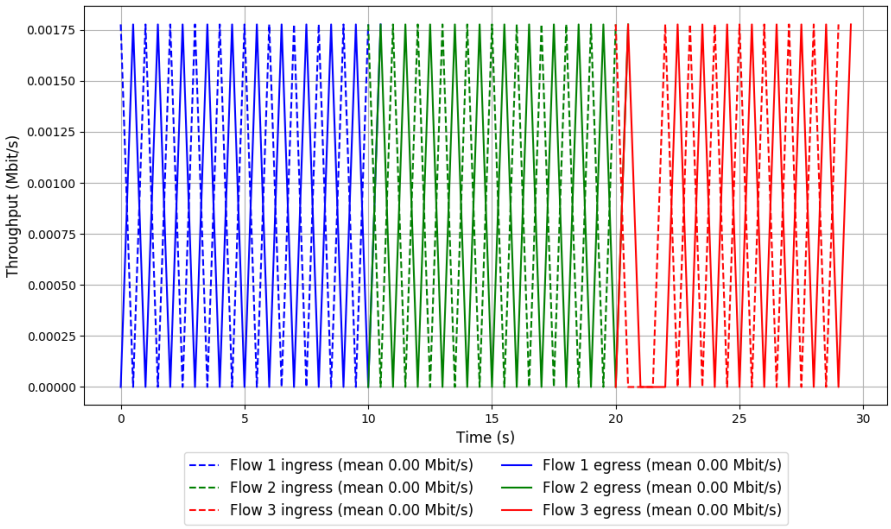


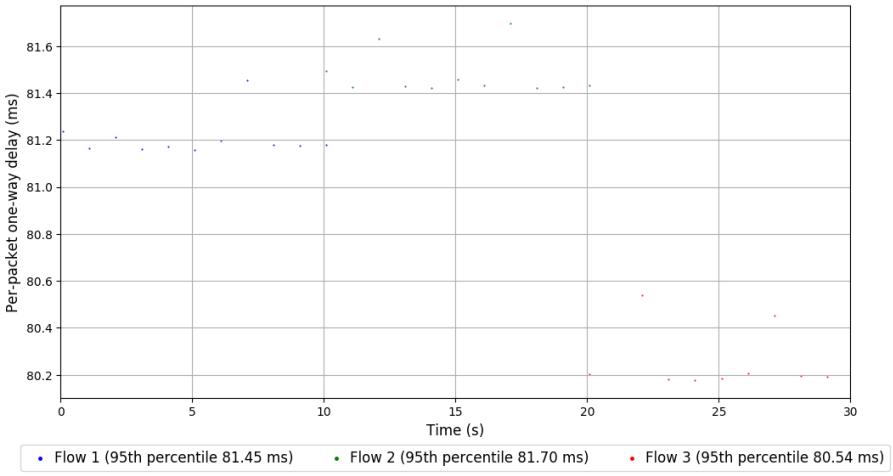
```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 05:42:18
End at: 2018-08-31 05:42:48
Local clock offset: -3.165 ms
Remote clock offset: 1.581 ms

# Below is generated by plot.py at 2018-08-31 05:53:14
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 81.493 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 81.455 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 81.696 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 80.539 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-08-31 05:47:24
End at: 2018-08-31 05:47:54
Local clock offset: -4.163 ms
Remote clock offset: 0.789 ms

# Below is generated by plot.py at 2018-08-31 05:53:14
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 81.060 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 81.319 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 80.487 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 81.041 ms
Loss rate: 0.00%
```

Run 3: Report of Muses-25 — Data Link