# Pantheon Report

Generated at 2018-09-03 10:02:49 (UTC).

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

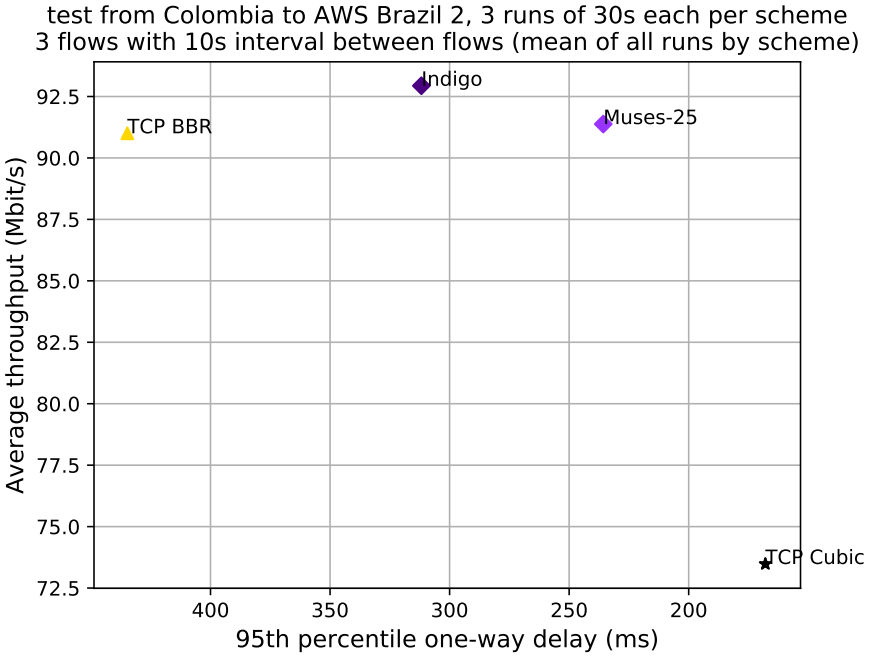
Repeated the test of 4 congestion control schemes 3 times.

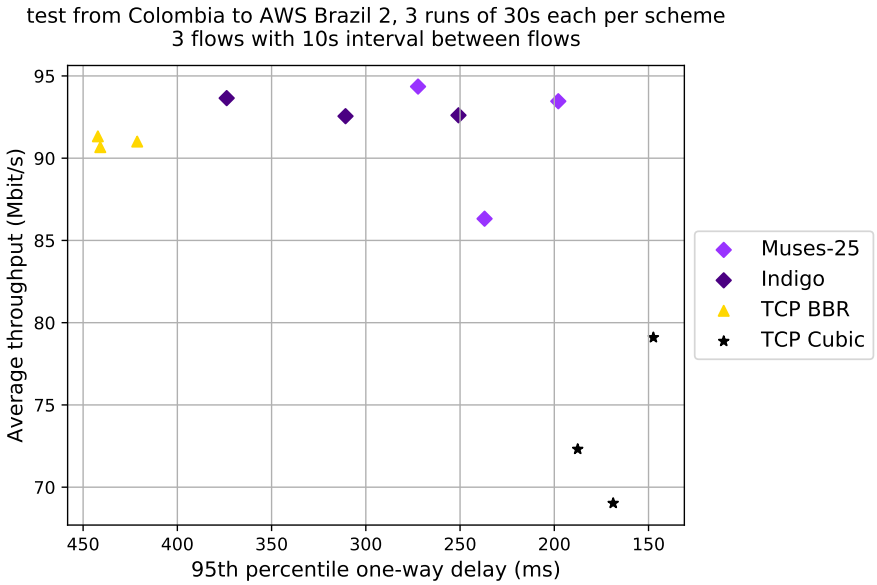
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 @ 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 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)
Indigo
Muses-25
TCP BBR
TCP Cubic
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
92.5
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
400
350
300
250
200


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)
95th percentile one-way delay (ms)
95
90
85
80
75
70
450
400
350
300
250
200
150
Muses-25
Indigo
TCP BBR
TCP Cubic

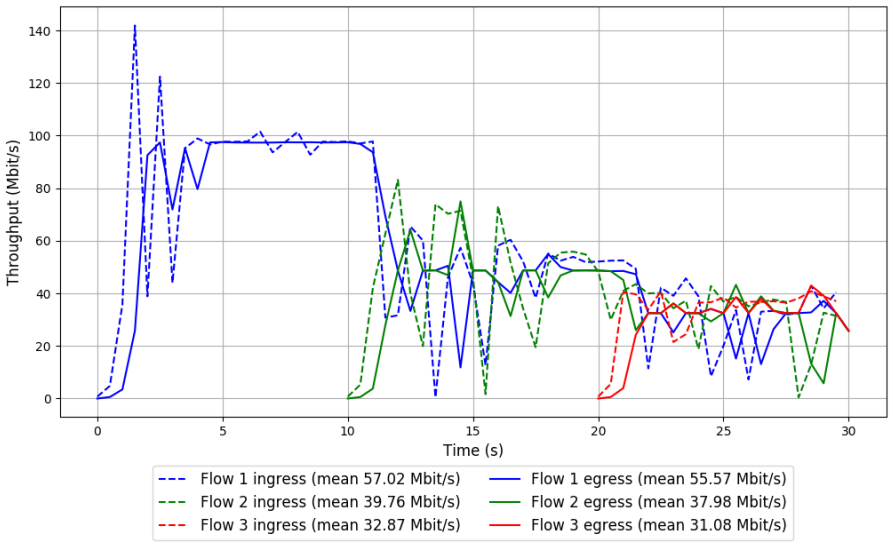
| scheme | # runs | mean avg tput (Mbit/s) | | | mean 95th-%ile delay (ms) | | | mean loss rate (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | flow 1 | flow 2 | flow 3 | flow 1 | flow 2 | flow 3 | flow 1 | flow 2 | flow 3 |
| TCP BBR | 3 | 55.69 | 37.91 | 30.87 | 408.41 | 541.75 | 431.31 | 2.34 | 5.36 | 8.94 |
| TCP Cubic | 3 | 41.29 | 31.09 | 38.20 | 181.78 | 152.92 | 160.29 | 0.44 | 0.84 | 2.20 |
| Indigo | 3 | 58.69 | 37.17 | 29.49 | 341.57 | 123.80 | 136.34 | 8.42 | 2.48 | 2.87 |
| Muses-25 | 3 | 54.66 | 36.22 | 38.70 | 140.33 | 287.03 | 336.39 | 0.78 | 1.49 | 2.33 |

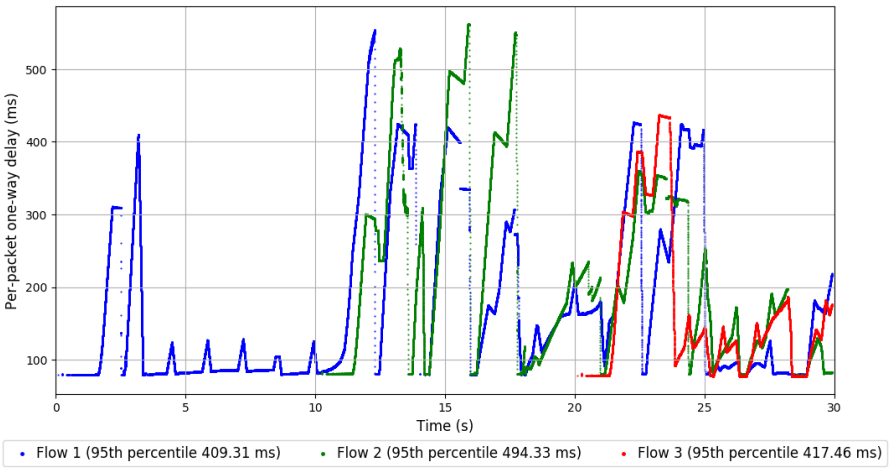
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-03 09:48:52
End at: 2018-09-03 09:49:22
Local clock offset: -3.134 ms
Remote clock offset: 4.725 ms

# Below is generated by plot.py at 2018-09-03 10:02:18
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.01 Mbit/s
95th percentile per-packet one-way delay: 421.304 ms
Loss rate: 4.15%
-- Flow 1:
Average throughput: 55.57 Mbit/s
95th percentile per-packet one-way delay: 409.306 ms
Loss rate: 3.08%
-- Flow 2:
Average throughput: 37.98 Mbit/s
95th percentile per-packet one-way delay: 494.329 ms
Loss rate: 5.29%
-- Flow 3:
Average throughput: 31.08 Mbit/s
95th percentile per-packet one-way delay: 417.463 ms
Loss rate: 7.01%
```

Run 1: Report of TCP BBR — Data Link



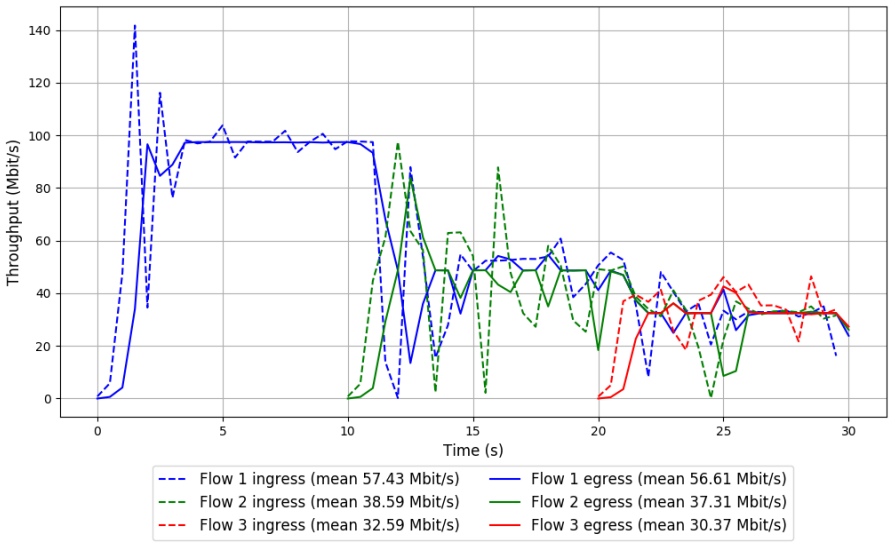



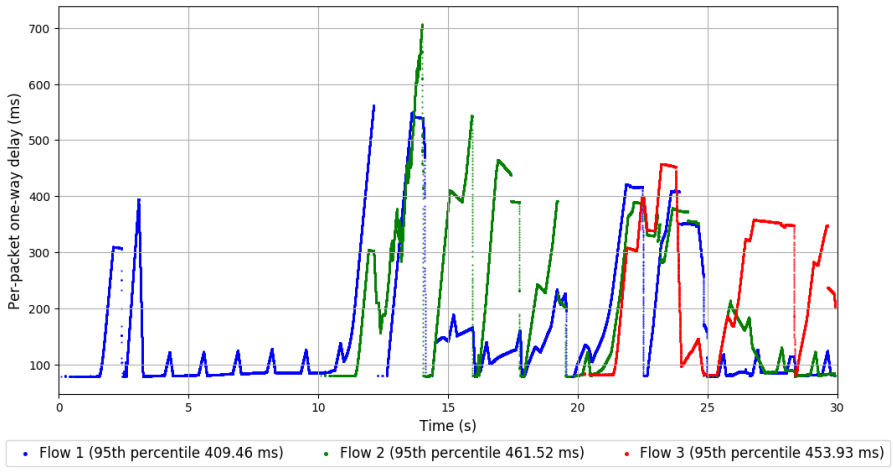
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-03 09:53:58
End at: 2018-09-03 09:54:28
Local clock offset: -3.066 ms
Remote clock offset: 3.559 ms

# Below is generated by plot.py at 2018-09-03 10:02:19
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.33 Mbit/s
95th percentile per-packet one-way delay: 442.172 ms
Loss rate: 3.30%
-- Flow 1:
Average throughput: 56.61 Mbit/s
95th percentile per-packet one-way delay: 409.460 ms
Loss rate: 1.96%
-- Flow 2:
Average throughput: 37.31 Mbit/s
95th percentile per-packet one-way delay: 461.516 ms
Loss rate: 4.12%
-- Flow 3:
Average throughput: 30.37 Mbit/s
95th percentile per-packet one-way delay: 453.928 ms
Loss rate: 8.39%
```

Run 2: Report of TCP BBR — Data Link



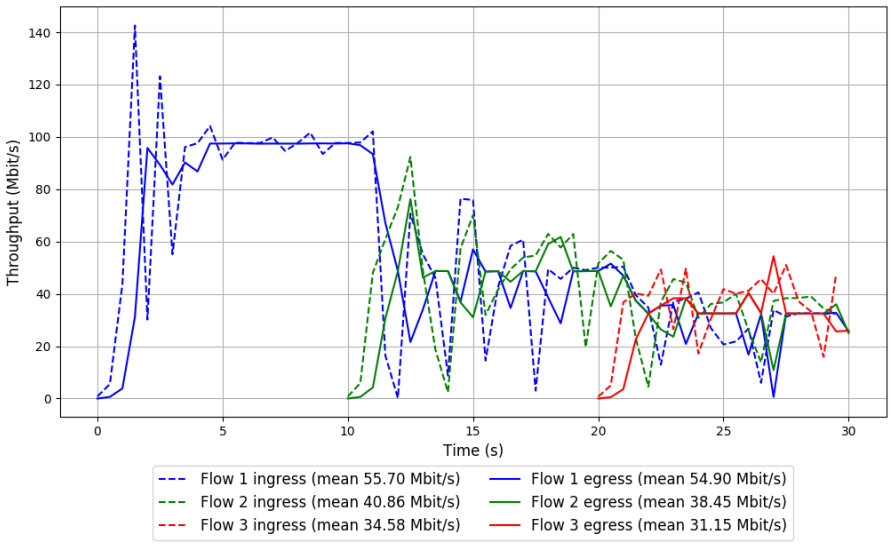



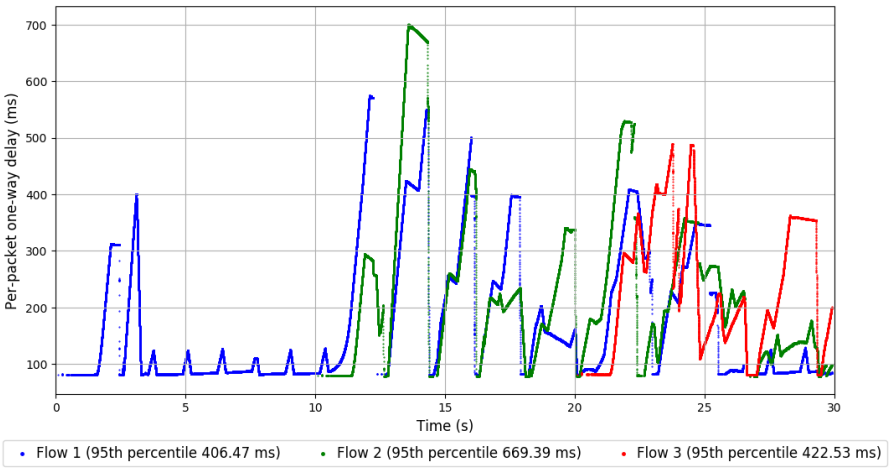
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-03 09:59:01
End at: 2018-09-03 09:59:31
Local clock offset: -3.04 ms
Remote clock offset: 3.422 ms

# Below is generated by plot.py at 2018-09-03 10:02:19
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.67 Mbit/s
95th percentile per-packet one-way delay: 440.891 ms
Loss rate: 4.48%
-- Flow 1:
Average throughput: 54.90 Mbit/s
95th percentile per-packet one-way delay: 406.468 ms
Loss rate: 1.98%
-- Flow 2:
Average throughput: 38.45 Mbit/s
95th percentile per-packet one-way delay: 669.394 ms
Loss rate: 6.68%
-- Flow 3:
Average throughput: 31.15 Mbit/s
95th percentile per-packet one-way delay: 422.529 ms
Loss rate: 11.43%
```

Run 3: Report of TCP BBR — Data Link



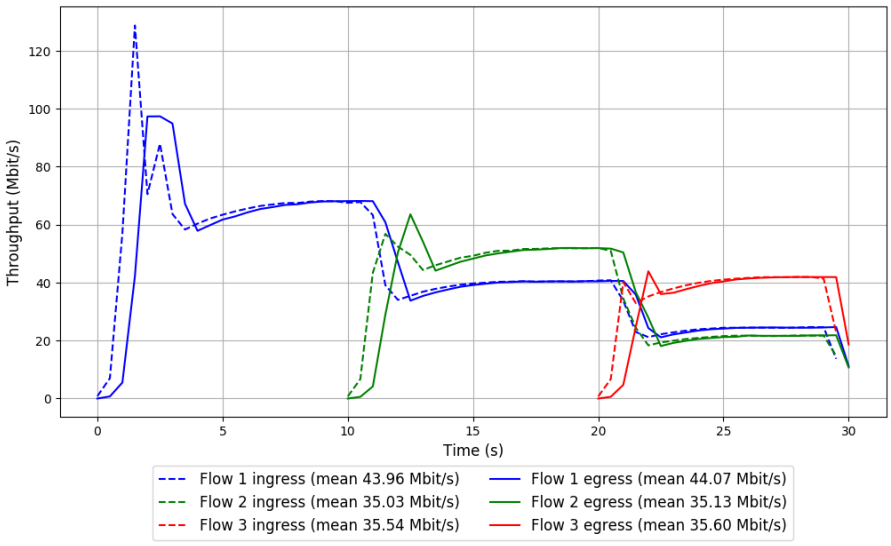



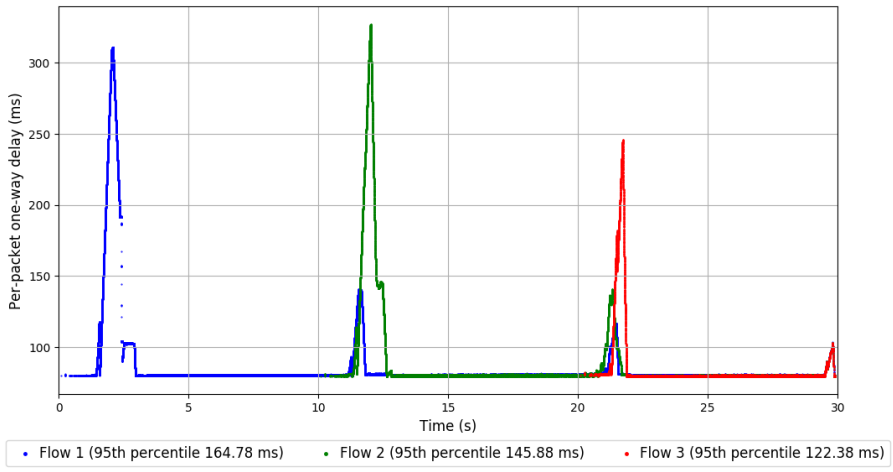
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-03 09:50:09
End at: 2018-09-03 09:50:39
Local clock offset: -3.847 ms
Remote clock offset: 3.508 ms

# Below is generated by plot.py at 2018-09-03 10:02:19
# Datalink statistics
-- Total of 3 flows:
Average throughput: 79.10 Mbit/s
95th percentile per-packet one-way delay: 147.422 ms
Loss rate: 0.56%
-- Flow 1:
Average throughput: 44.07 Mbit/s
95th percentile per-packet one-way delay: 164.779 ms
Loss rate: 0.30%
-- Flow 2:
Average throughput: 35.13 Mbit/s
95th percentile per-packet one-way delay: 145.876 ms
Loss rate: 0.60%
-- Flow 3:
Average throughput: 35.60 Mbit/s
95th percentile per-packet one-way delay: 122.384 ms
Loss rate: 1.47%
```

Run 1: Report of TCP Cubic — Data Link



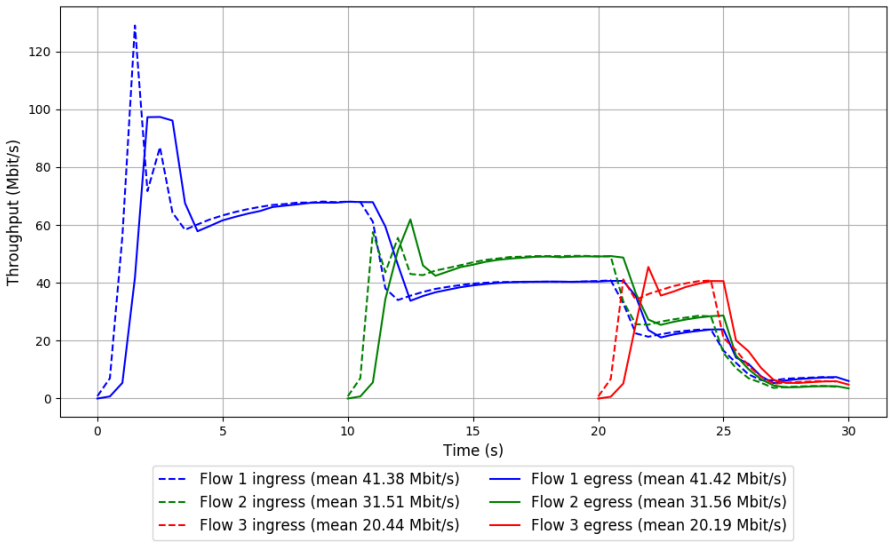



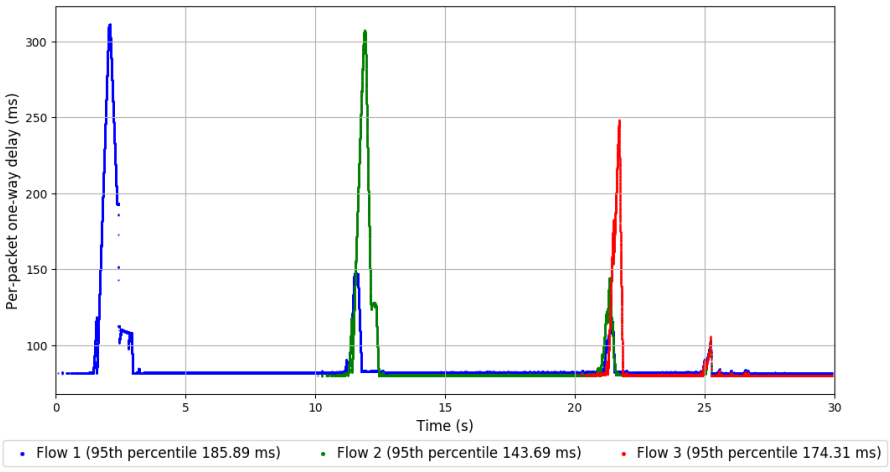
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-03 09:55:14
End at: 2018-09-03 09:55:44
Local clock offset: -3.071 ms
Remote clock offset: 2.45 ms

# Below is generated by plot.py at 2018-09-03 10:02:19
# Datalink statistics
-- Total of 3 flows:
Average throughput: 69.03 Mbit/s
95th percentile per-packet one-way delay: 168.744 ms
Loss rate: 0.74%
-- Flow 1:
Average throughput: 41.42 Mbit/s
95th percentile per-packet one-way delay: 185.886 ms
Loss rate: 0.43%
-- Flow 2:
Average throughput: 31.56 Mbit/s
95th percentile per-packet one-way delay: 143.689 ms
Loss rate: 0.66%
-- Flow 3:
Average throughput: 20.19 Mbit/s
95th percentile per-packet one-way delay: 174.307 ms
Loss rate: 2.81%
```

Run 2: Report of TCP Cubic — Data Link



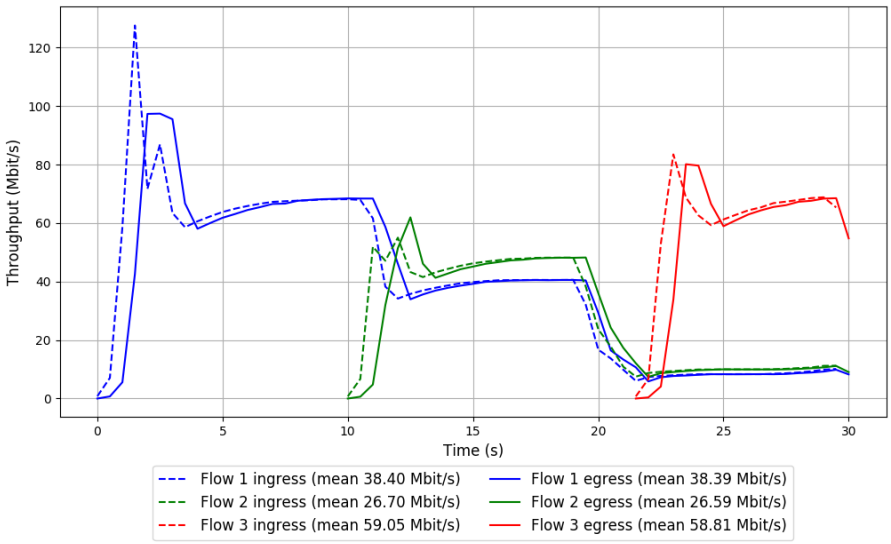



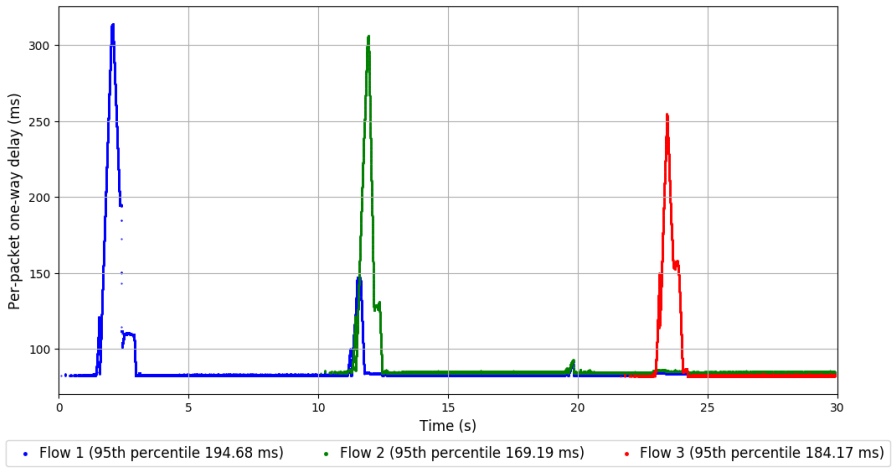
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-03 10:00:20
End at: 2018-09-03 10:00:50
Local clock offset: -3.037 ms
Remote clock offset: -0.23 ms

# Below is generated by plot.py at 2018-09-03 10:02:19
# Datalink statistics
-- Total of 3 flows:
Average throughput: 72.31 Mbit/s
95th percentile per-packet one-way delay: 187.586 ms
Loss rate: 1.14%
-- Flow 1:
Average throughput: 38.39 Mbit/s
95th percentile per-packet one-way delay: 194.680 ms
Loss rate: 0.58%
-- Flow 2:
Average throughput: 26.59 Mbit/s
95th percentile per-packet one-way delay: 169.193 ms
Loss rate: 1.25%
-- Flow 3:
Average throughput: 58.81 Mbit/s
95th percentile per-packet one-way delay: 184.166 ms
Loss rate: 2.32%
```

Run 3: Report of TCP Cubic — Data Link



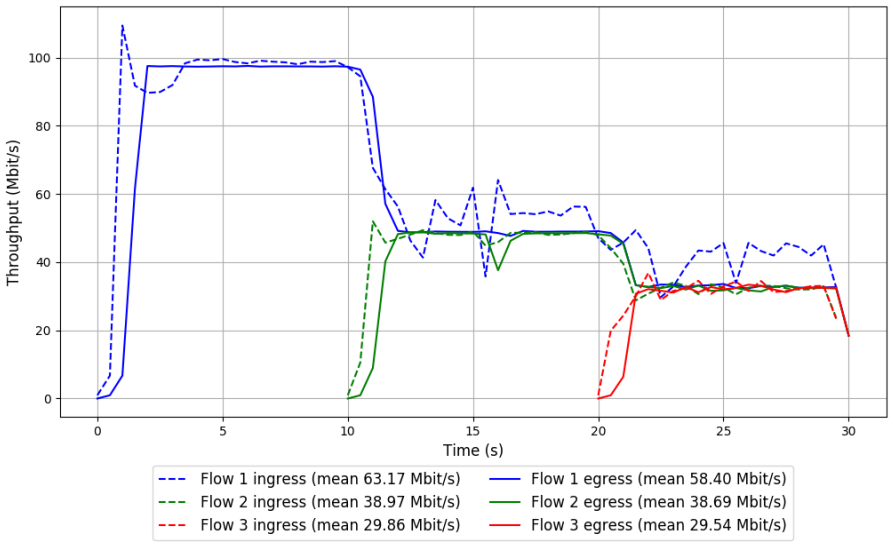



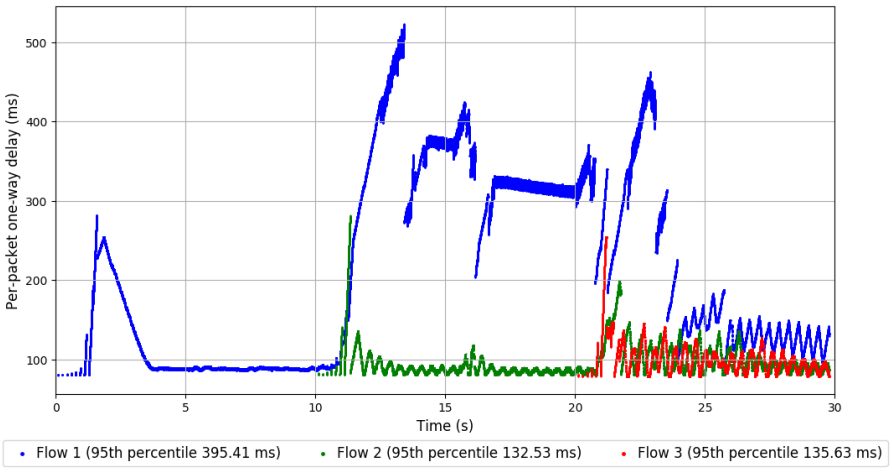
```
Run 1: Statistics of Indigo

Start at: 2018-09-03 09:46:08
End at: 2018-09-03 09:46:38
Local clock offset: -3.829 ms
Remote clock offset: 3.661 ms

# Below is generated by plot.py at 2018-09-03 10:02:21
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.65 Mbit/s
95th percentile per-packet one-way delay: 373.823 ms
Loss rate: 5.83%
-- Flow 1:
Average throughput: 58.40 Mbit/s
95th percentile per-packet one-way delay: 395.407 ms
Loss rate: 8.06%
-- Flow 2:
Average throughput: 38.69 Mbit/s
95th percentile per-packet one-way delay: 132.527 ms
Loss rate: 1.56%
-- Flow 3:
Average throughput: 29.54 Mbit/s
95th percentile per-packet one-way delay: 135.631 ms
Loss rate: 2.71%
```

Run 1: Report of Indigo — Data Link



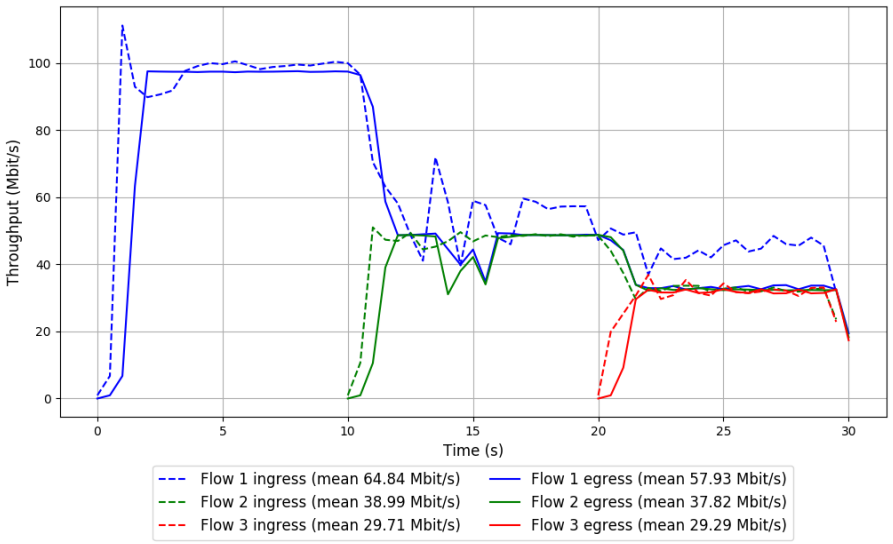



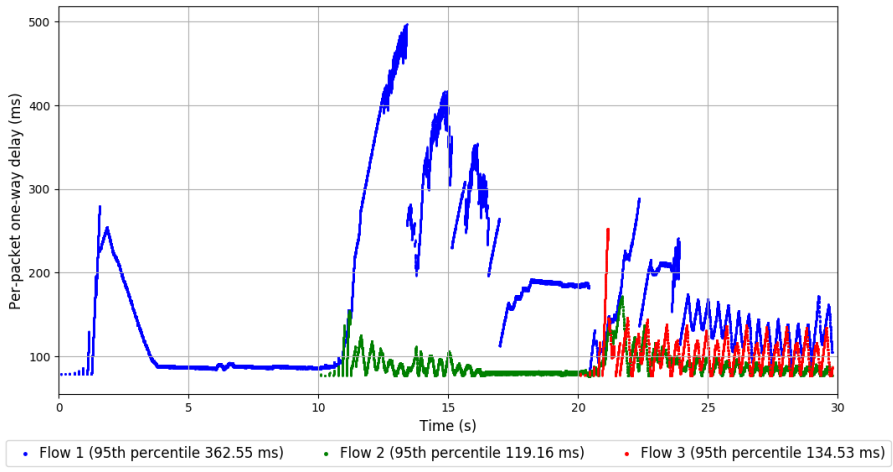
```
Run 2: Statistics of Indigo

Start at: 2018-09-03 09:51:25
End at: 2018-09-03 09:51:55
Local clock offset: -3.904 ms
Remote clock offset: 4.769 ms

# Below is generated by plot.py at 2018-09-03 10:02:22
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.55 Mbit/s
95th percentile per-packet one-way delay: 310.772 ms
Loss rate: 8.47%
-- Flow 1:
Average throughput: 57.93 Mbit/s
95th percentile per-packet one-way delay: 362.554 ms
Loss rate: 11.15%
-- Flow 2:
Average throughput: 37.82 Mbit/s
95th percentile per-packet one-way delay: 119.156 ms
Loss rate: 3.81%
-- Flow 3:
Average throughput: 29.29 Mbit/s
95th percentile per-packet one-way delay: 134.525 ms
Loss rate: 3.05%
```

Run 2: Report of Indigo — Data Link



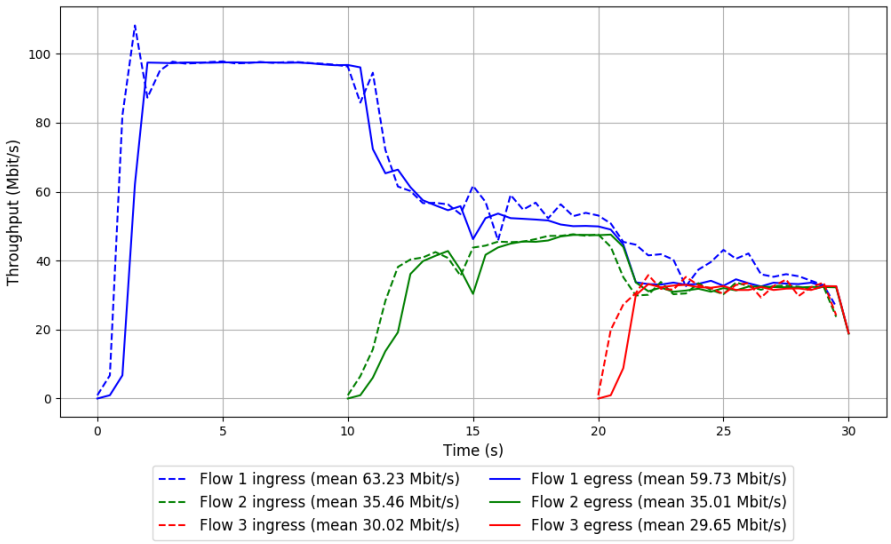



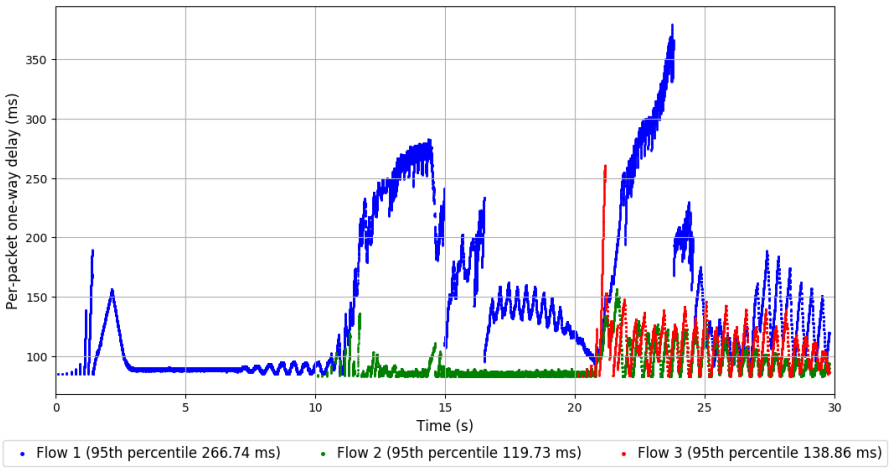
```
Run 3: Statistics of Indigo

Start at: 2018-09-03 09:56:28
End at: 2018-09-03 09:56:58
Local clock offset: -3.906 ms
Remote clock offset: -1.412 ms

# Below is generated by plot.py at 2018-09-03 10:02:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.61 Mbit/s
95th percentile per-packet one-way delay: 250.835 ms
Loss rate: 4.75%
-- Flow 1:
Average throughput: 59.73 Mbit/s
95th percentile per-packet one-way delay: 266.740 ms
Loss rate: 6.05%
-- Flow 2:
Average throughput: 35.01 Mbit/s
95th percentile per-packet one-way delay: 119.728 ms
Loss rate: 2.07%
-- Flow 3:
Average throughput: 29.65 Mbit/s
95th percentile per-packet one-way delay: 138.858 ms
Loss rate: 2.85%
```

Run 3: Report of Indigo — Data Link



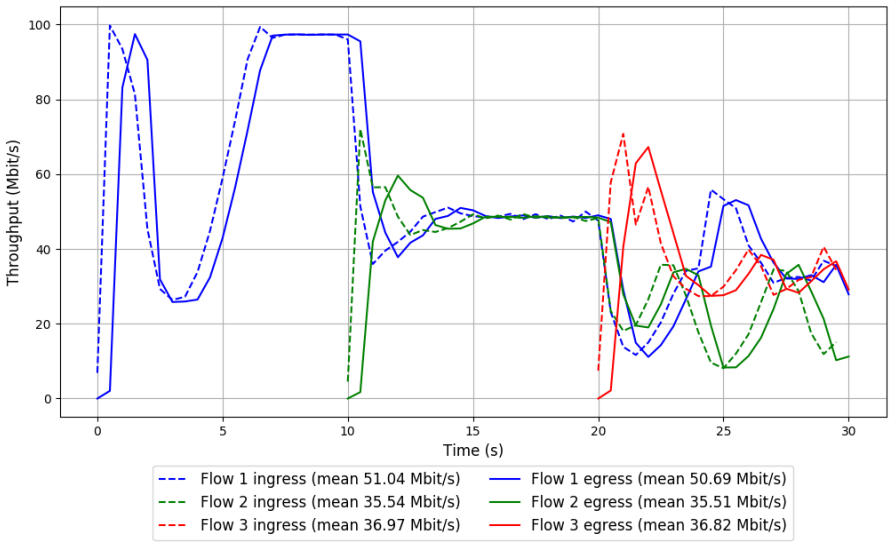



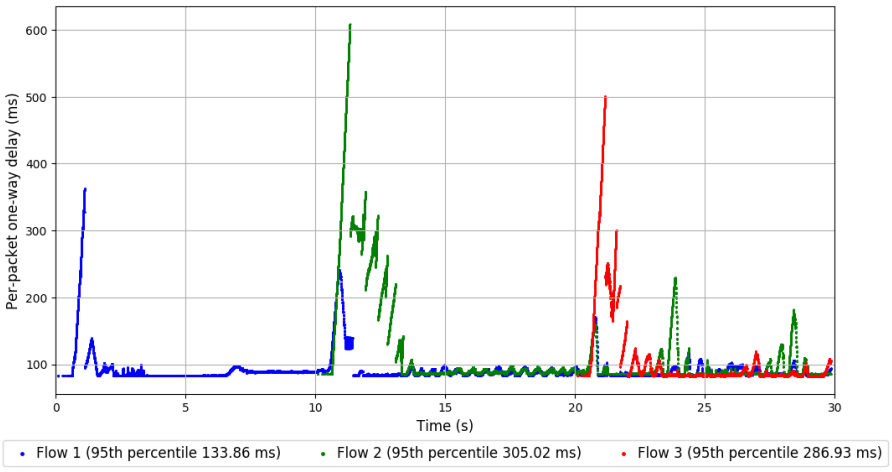
```
Run 1: Statistics of Muses-25

Start at: 2018-09-03 09:47:37
End at: 2018-09-03 09:48:07
Local clock offset: -3.122 ms
Remote clock offset: -0.223 ms

# Below is generated by plot.py at 2018-09-03 10:02:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 86.32 Mbit/s
95th percentile per-packet one-way delay: 236.995 ms
Loss rate: 1.26%
-- Flow 1:
Average throughput: 50.69 Mbit/s
95th percentile per-packet one-way delay: 133.864 ms
Loss rate: 1.23%
-- Flow 2:
Average throughput: 35.51 Mbit/s
95th percentile per-packet one-way delay: 305.024 ms
Loss rate: 0.93%
-- Flow 3:
Average throughput: 36.82 Mbit/s
95th percentile per-packet one-way delay: 286.925 ms
Loss rate: 2.04%
```

Run 1: Report of Muses-25 — Data Link



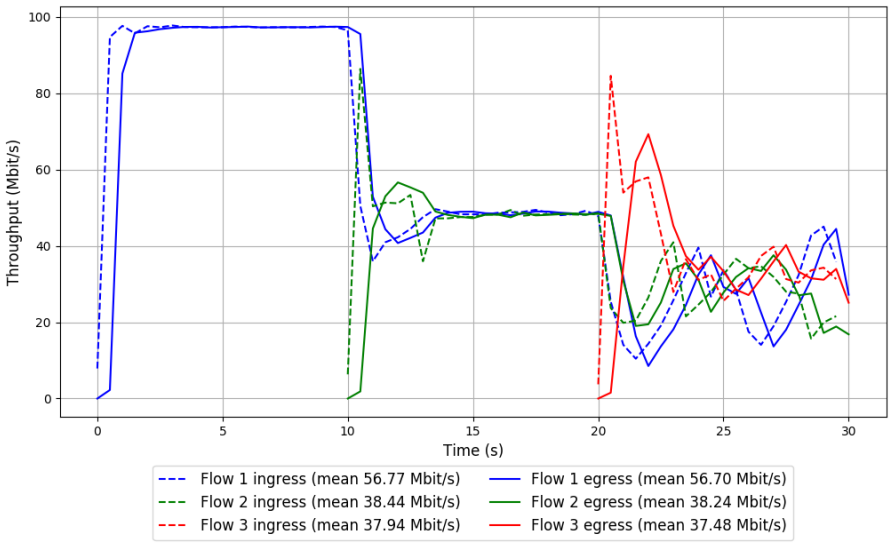



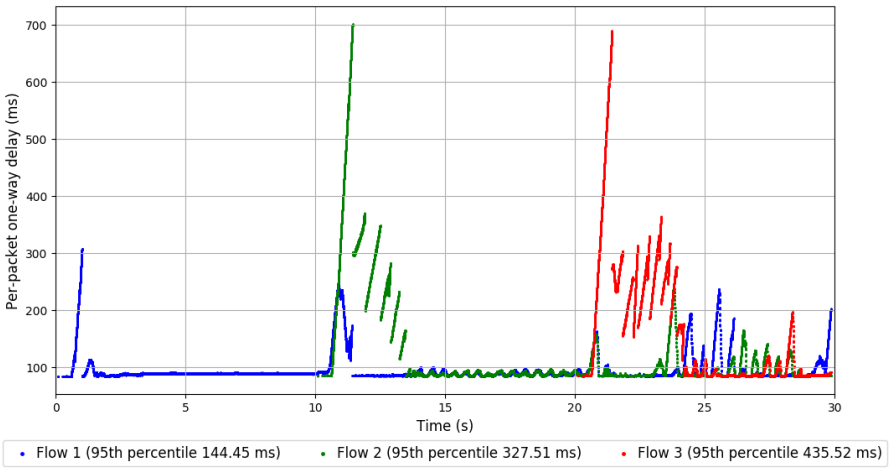
```
Run 2: Statistics of Muses-25

Start at: 2018-09-03 09:52:43
End at: 2018-09-03 09:53:13
Local clock offset: -3.905 ms
Remote clock offset: -0.176 ms

# Below is generated by plot.py at 2018-09-03 10:02:47
# Datalink statistics
-- Total of 3 flows:
Average throughput: 94.35 Mbit/s
95th percentile per-packet one-way delay: 272.298 ms
Loss rate: 1.09%
-- Flow 1:
Average throughput: 56.70 Mbit/s
95th percentile per-packet one-way delay: 144.448 ms
Loss rate: 0.57%
-- Flow 2:
Average throughput: 38.24 Mbit/s
95th percentile per-packet one-way delay: 327.510 ms
Loss rate: 1.36%
-- Flow 3:
Average throughput: 37.48 Mbit/s
95th percentile per-packet one-way delay: 435.518 ms
Loss rate: 2.85%
```

Run 2: Report of Muses-25 — Data Link



```
Run 3: Statistics of Muses-25

Start at: 2018-09-03 09:57:46
End at: 2018-09-03 09:58:16
Local clock offset: -3.822 ms
Remote clock offset: 3.62 ms

# Below is generated by plot.py at 2018-09-03 10:02:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.46 Mbit/s
95th percentile per-packet one-way delay: 197.879 ms
Loss rate: 1.17%
-- Flow 1:
Average throughput: 56.59 Mbit/s
95th percentile per-packet one-way delay: 142.685 ms
Loss rate: 0.53%
-- Flow 2:
Average throughput: 34.90 Mbit/s
95th percentile per-packet one-way delay: 228.563 ms
Loss rate: 2.17%
-- Flow 3:
Average throughput: 41.81 Mbit/s
95th percentile per-packet one-way delay: 286.740 ms
Loss rate: 2.11%
```

Run 3: Report of Muses-25 — Data Link