Pantheon Report

Generated at 2018-09-03 09:04:42 (UTC).

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

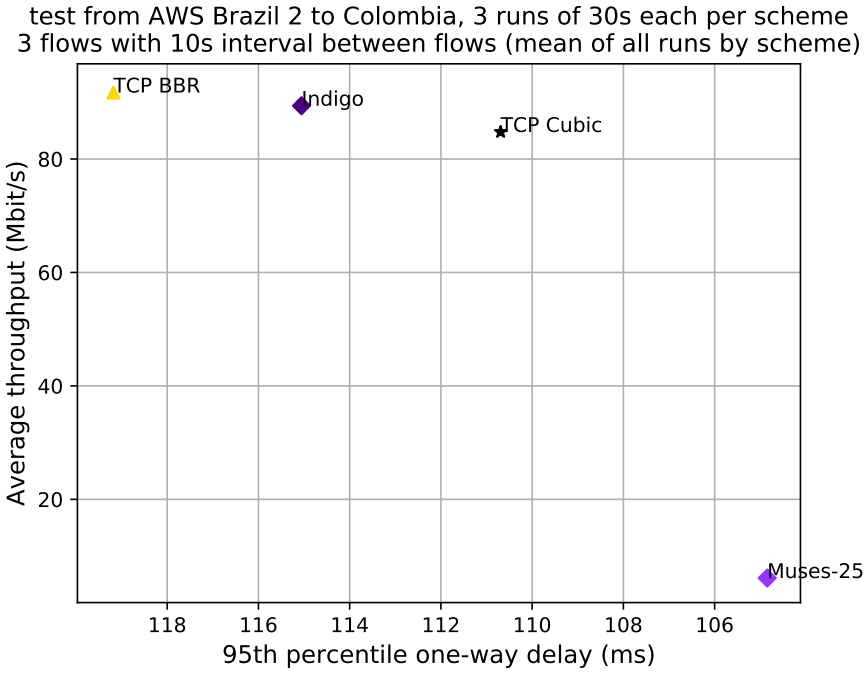
Repeated the test of 4 congestion control schemes 3 times.

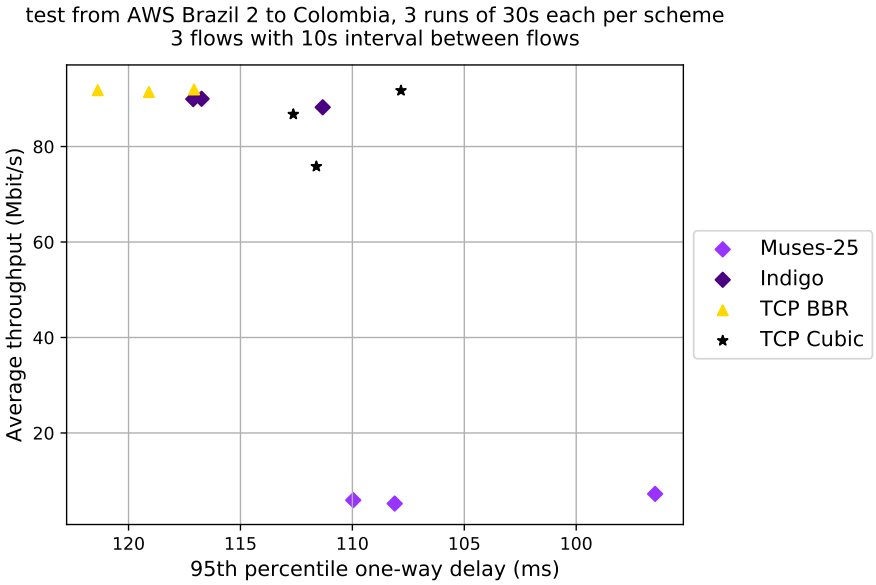
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 @ 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 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)
TCP BBR
Indigo
TCP Cubic
Muses-25
Average throughput (Mbit/s)
80
60
40
20
118
116
114
112
110
108
106
95th percentile one-way delay (ms)


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)
80
60
40
20
120
115
110
105
100
95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic

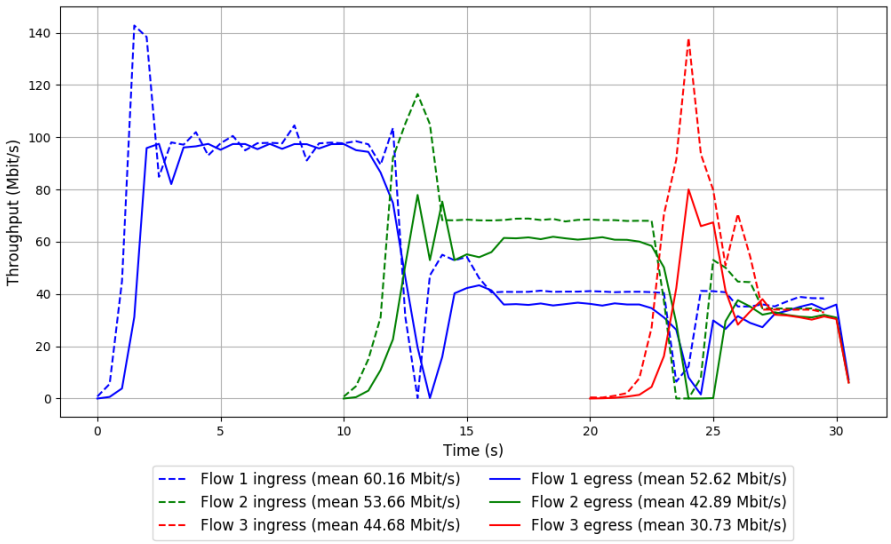
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	54.00	40.59	32.12	118.01	116.87	115.19	12.17	19.77	28.57
TCP Cubic	3	68.38	15.49	18.26	109.60	113.18	110.91	0.88	0.56	2.96
Indigo	3	63.54	26.22	26.56	113.70	115.13	113.44	13.62	30.84	59.43
Muses-25	3	2.30	4.77	2.36	91.62	103.31	100.90	88.29	70.84	80.92

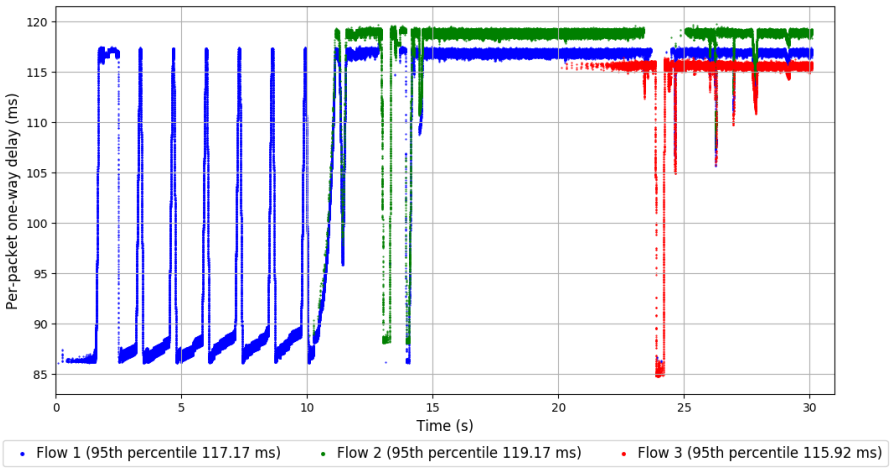
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-03 08:49:45
End at: 2018-09-03 08:50:15
Local clock offset: -2.921 ms
Remote clock offset: 4.459 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.41 Mbit/s
95th percentile per-packet one-way delay: 119.091 ms
Loss rate: 17.39%
-- Flow 1:
Average throughput: 52.62 Mbit/s
95th percentile per-packet one-way delay: 117.168 ms
Loss rate: 12.45%
-- Flow 2:
Average throughput: 42.89 Mbit/s
95th percentile per-packet one-way delay: 119.173 ms
Loss rate: 19.96%
-- Flow 3:
Average throughput: 30.73 Mbit/s
95th percentile per-packet one-way delay: 115.919 ms
Loss rate: 31.22%
```

Run 1: Report of TCP BBR — Data Link



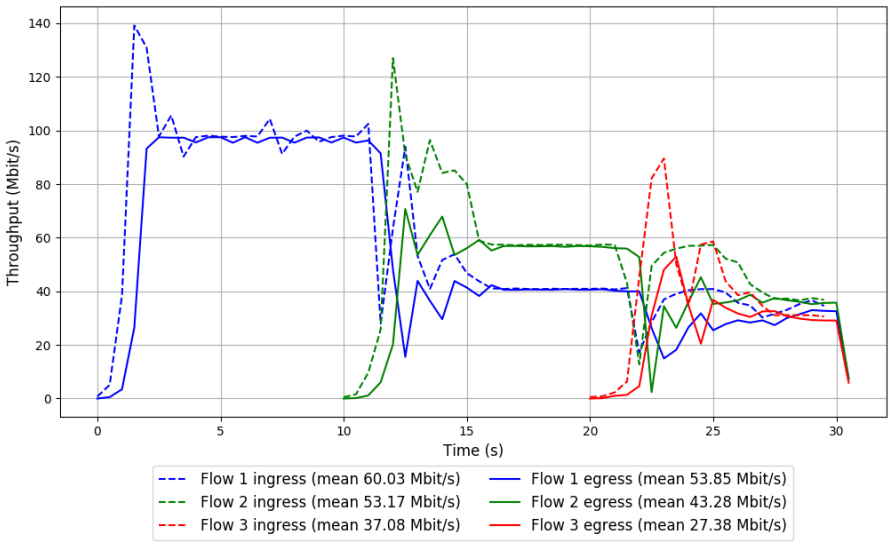


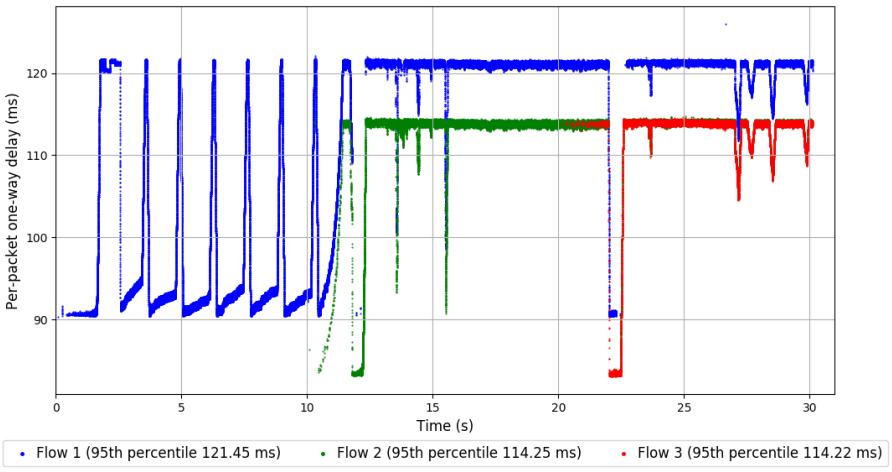
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-03 08:54:47
End at: 2018-09-03 08:55:17
Local clock offset: -3.709 ms
Remote clock offset: 2.383 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.80 Mbit/s
95th percentile per-packet one-way delay: 121.376 ms
Loss rate: 14.76%
-- Flow 1:
Average throughput: 53.85 Mbit/s
95th percentile per-packet one-way delay: 121.447 ms
Loss rate: 10.22%
-- Flow 2:
Average throughput: 43.28 Mbit/s
95th percentile per-packet one-way delay: 114.248 ms
Loss rate: 18.50%
-- Flow 3:
Average throughput: 27.38 Mbit/s
95th percentile per-packet one-way delay: 114.215 ms
Loss rate: 26.16%
```

Run 2: Report of TCP BBR — Data Link



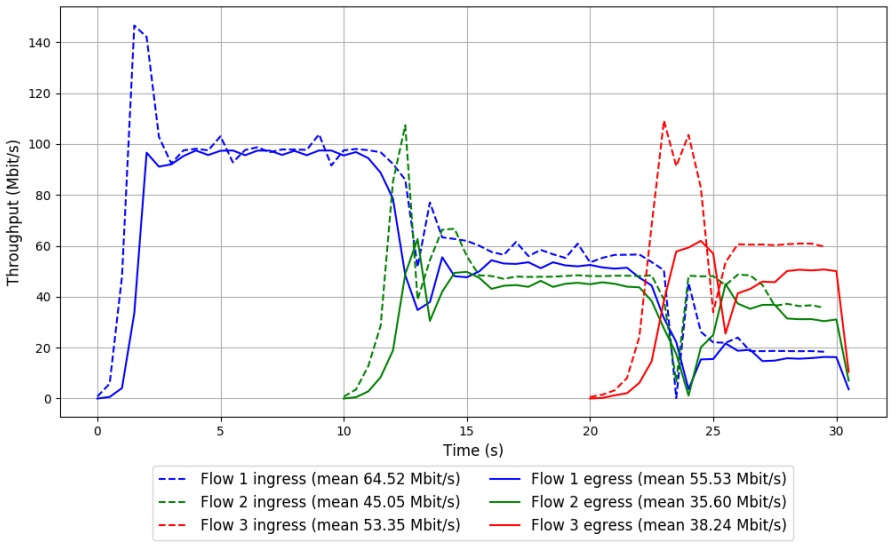


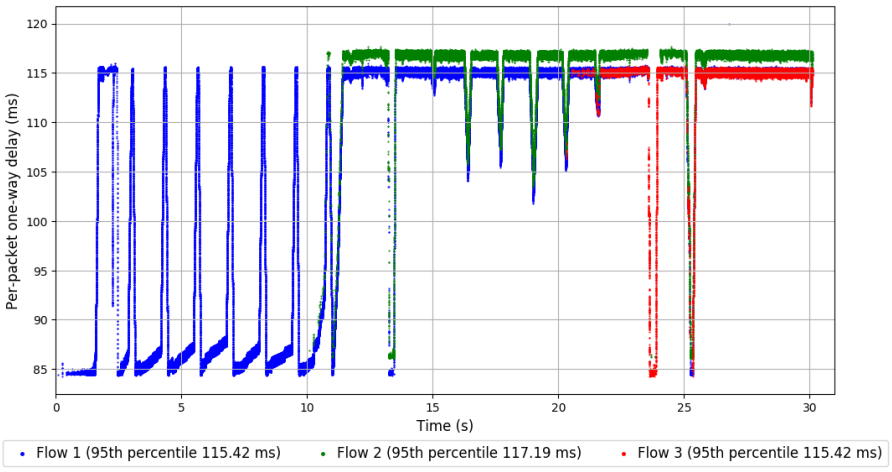
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-03 08:59:59
End at: 2018-09-03 09:00:29
Local clock offset: -2.937 ms
Remote clock offset: 4.536 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.96 Mbit/s
95th percentile per-packet one-way delay: 117.071 ms
Loss rate: 18.00%
-- Flow 1:
Average throughput: 55.53 Mbit/s
95th percentile per-packet one-way delay: 115.415 ms
Loss rate: 13.84%
-- Flow 2:
Average throughput: 35.60 Mbit/s
95th percentile per-packet one-way delay: 117.192 ms
Loss rate: 20.86%
-- Flow 3:
Average throughput: 38.24 Mbit/s
95th percentile per-packet one-way delay: 115.423 ms
Loss rate: 28.32%
```

Run 3: Report of TCP BBR — Data Link



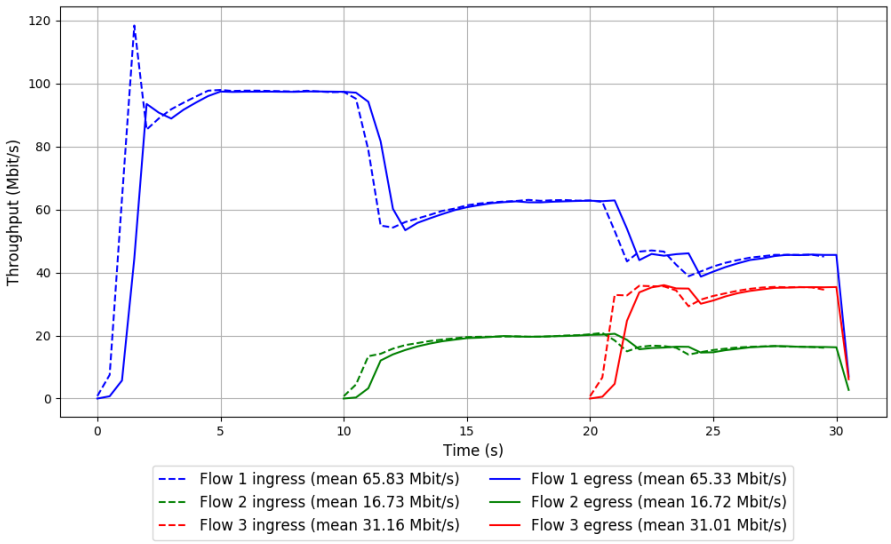


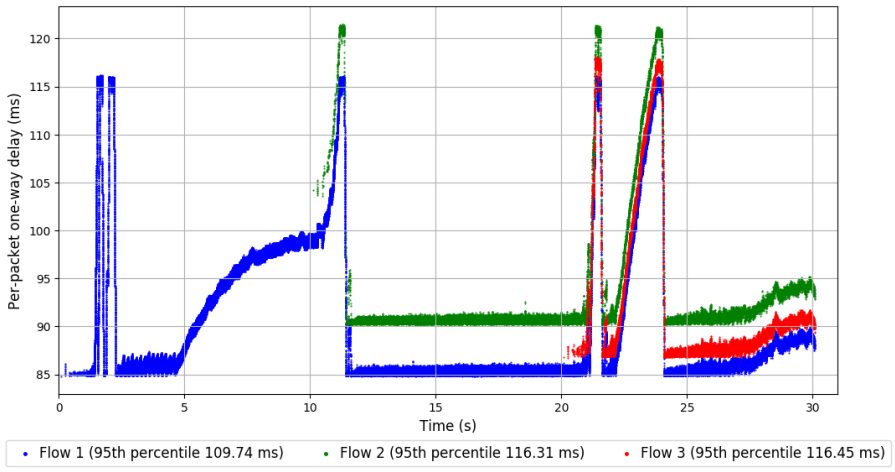
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-03 08:51:02
End at: 2018-09-03 08:51:32
Local clock offset: -2.913 ms
Remote clock offset: 4.528 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 86.76 Mbit/s
95th percentile per-packet one-way delay: 112.638 ms
Loss rate: 0.64%
-- Flow 1:
Average throughput: 65.33 Mbit/s
95th percentile per-packet one-way delay: 109.744 ms
Loss rate: 0.75%
-- Flow 2:
Average throughput: 16.72 Mbit/s
95th percentile per-packet one-way delay: 116.308 ms
Loss rate: 0.15%
-- Flow 3:
Average throughput: 31.01 Mbit/s
95th percentile per-packet one-way delay: 116.446 ms
Loss rate: 0.45%
```

Run 1: Report of TCP Cubic — Data Link



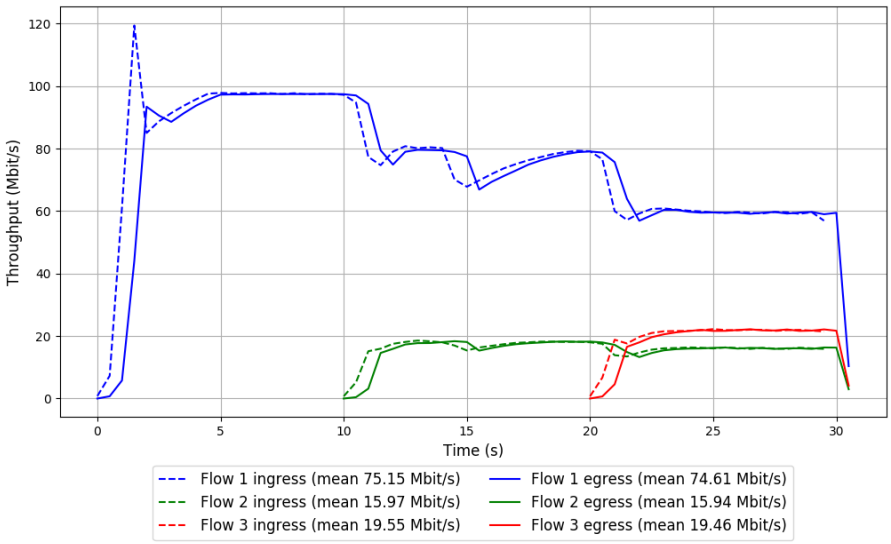


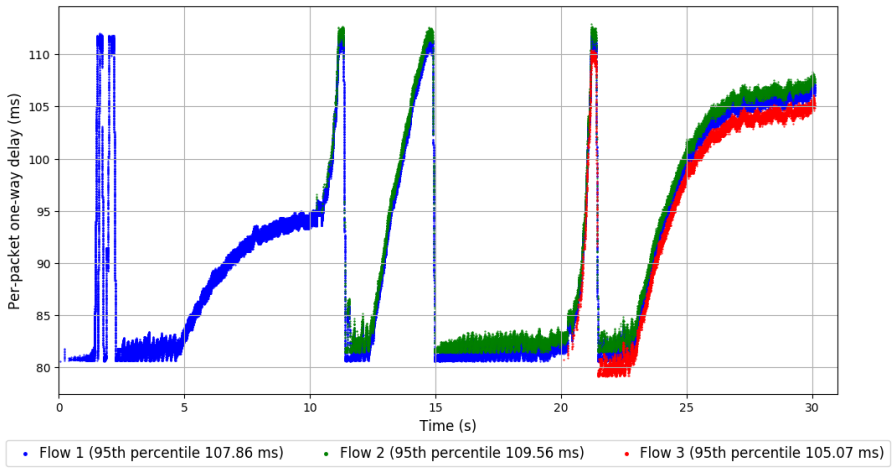
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-03 08:56:05
End at: 2018-09-03 08:56:35
Local clock offset: -3.663 ms
Remote clock offset: -1.359 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.71 Mbit/s
95th percentile per-packet one-way delay: 107.828 ms
Loss rate: 0.54%
-- Flow 1:
Average throughput: 74.61 Mbit/s
95th percentile per-packet one-way delay: 107.859 ms
Loss rate: 0.63%
-- Flow 2:
Average throughput: 15.94 Mbit/s
95th percentile per-packet one-way delay: 109.556 ms
Loss rate: 0.12%
-- Flow 3:
Average throughput: 19.46 Mbit/s
95th percentile per-packet one-way delay: 105.073 ms
Loss rate: 0.20%
```

Run 2: Report of TCP Cubic — Data Link



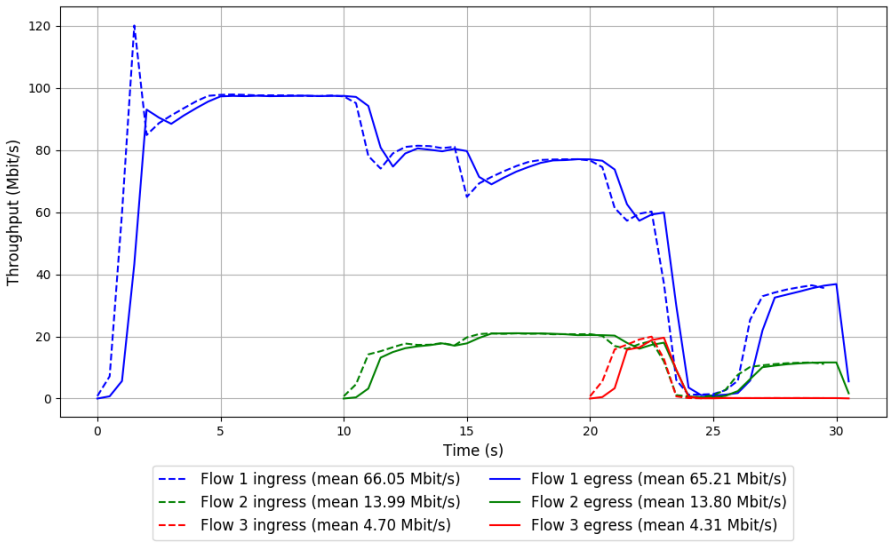


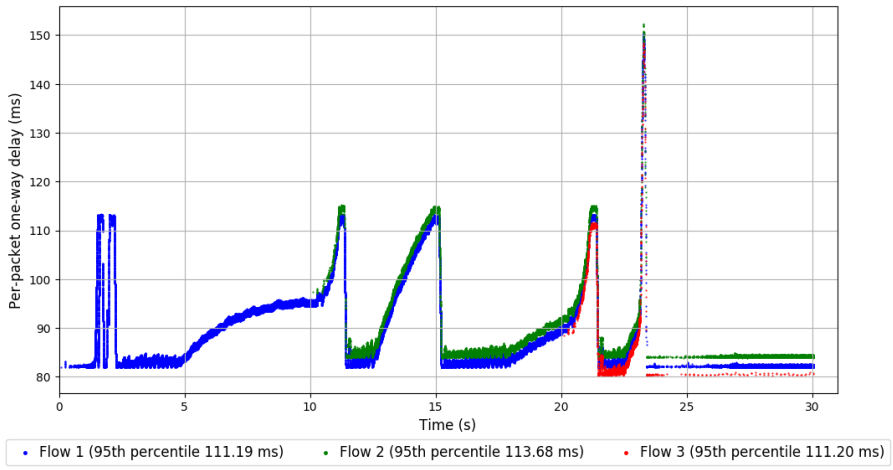
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-03 09:01:17
End at: 2018-09-03 09:01:47
Local clock offset: -3.728 ms
Remote clock offset: -0.304 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 75.83 Mbit/s
95th percentile per-packet one-way delay: 111.608 ms
Loss rate: 1.43%
-- Flow 1:
Average throughput: 65.21 Mbit/s
95th percentile per-packet one-way delay: 111.195 ms
Loss rate: 1.27%
-- Flow 2:
Average throughput: 13.80 Mbit/s
95th percentile per-packet one-way delay: 113.682 ms
Loss rate: 1.42%
-- Flow 3:
Average throughput: 4.31 Mbit/s
95th percentile per-packet one-way delay: 111.197 ms
Loss rate: 8.23%
```

Run 3: Report of TCP Cubic — Data Link



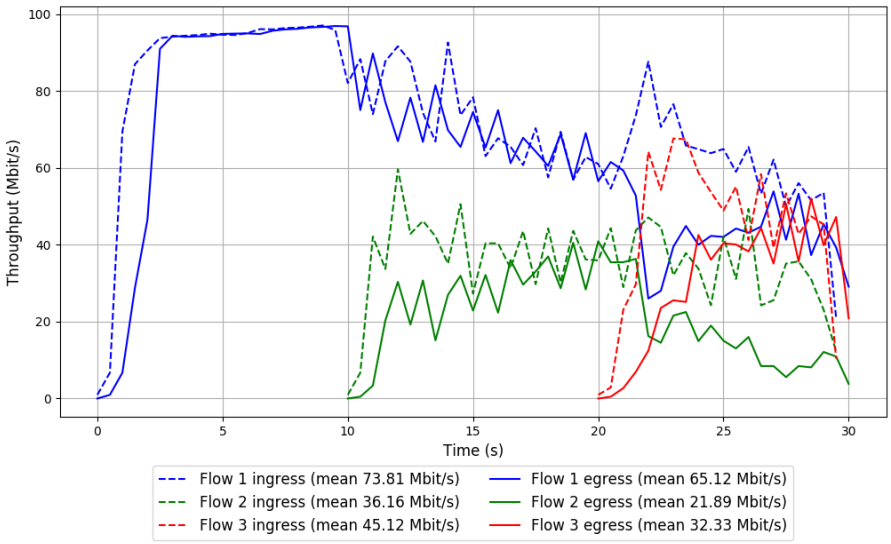


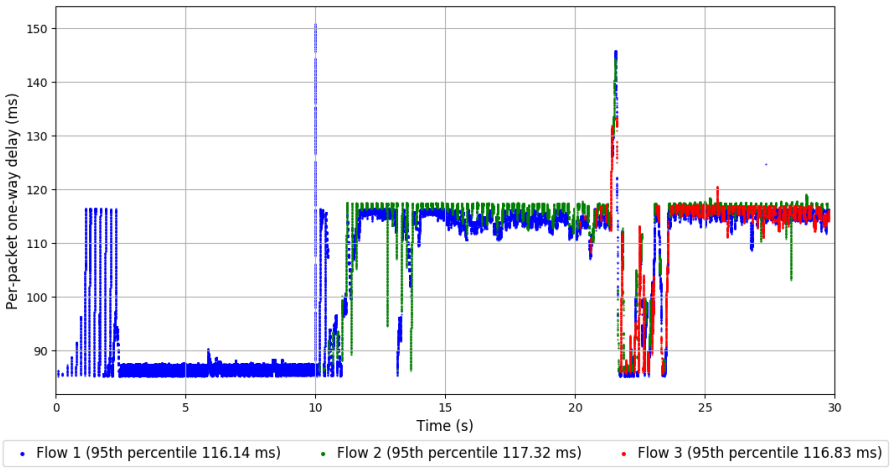
```
Run 1: Statistics of Indigo

Start at: 2018-09-03 08:52:18
End at: 2018-09-03 08:52:48
Local clock offset: -3.735 ms
Remote clock offset: 3.408 ms

# Below is generated by plot.py at 2018-09-03 09:04:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.94 Mbit/s
95th percentile per-packet one-way delay: 117.109 ms
Loss rate: 19.72%
-- Flow 1:
Average throughput: 65.12 Mbit/s
95th percentile per-packet one-way delay: 116.136 ms
Loss rate: 11.68%
-- Flow 2:
Average throughput: 21.89 Mbit/s
95th percentile per-packet one-way delay: 117.317 ms
Loss rate: 39.36%
-- Flow 3:
Average throughput: 32.33 Mbit/s
95th percentile per-packet one-way delay: 116.835 ms
Loss rate: 28.33%
```

Run 1: Report of Indigo — Data Link



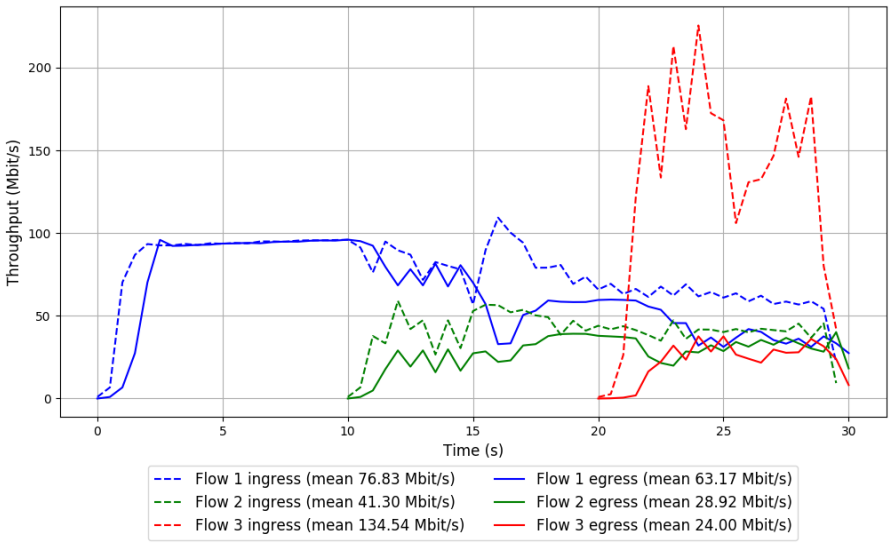


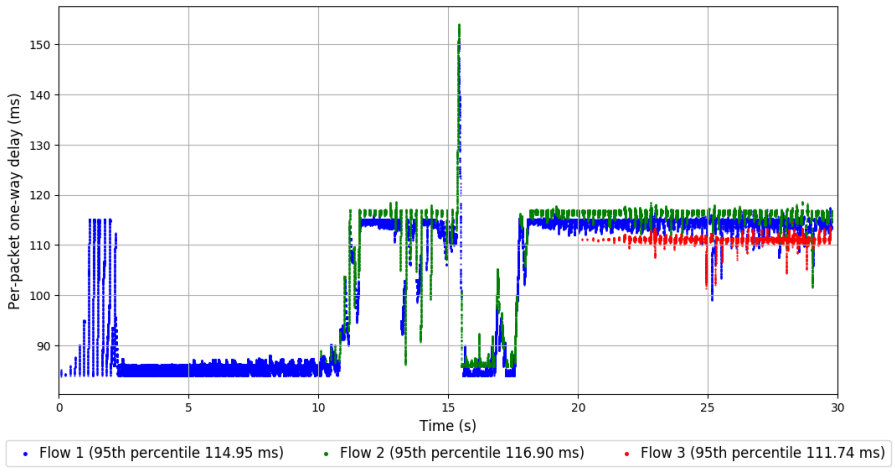
```
Run 2: Statistics of Indigo

Start at: 2018-09-03 08:57:24
End at: 2018-09-03 08:57:54
Local clock offset: -2.9 ms
Remote clock offset: -1.53 ms

# Below is generated by plot.py at 2018-09-03 09:04:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.00 Mbit/s
95th percentile per-packet one-way delay: 116.737 ms
Loss rate: 38.88%
-- Flow 1:
Average throughput: 63.17 Mbit/s
95th percentile per-packet one-way delay: 114.955 ms
Loss rate: 17.70%
-- Flow 2:
Average throughput: 28.92 Mbit/s
95th percentile per-packet one-way delay: 116.896 ms
Loss rate: 29.91%
-- Flow 3:
Average throughput: 24.00 Mbit/s
95th percentile per-packet one-way delay: 111.736 ms
Loss rate: 82.16%
```

Run 2: Report of Indigo — Data Link



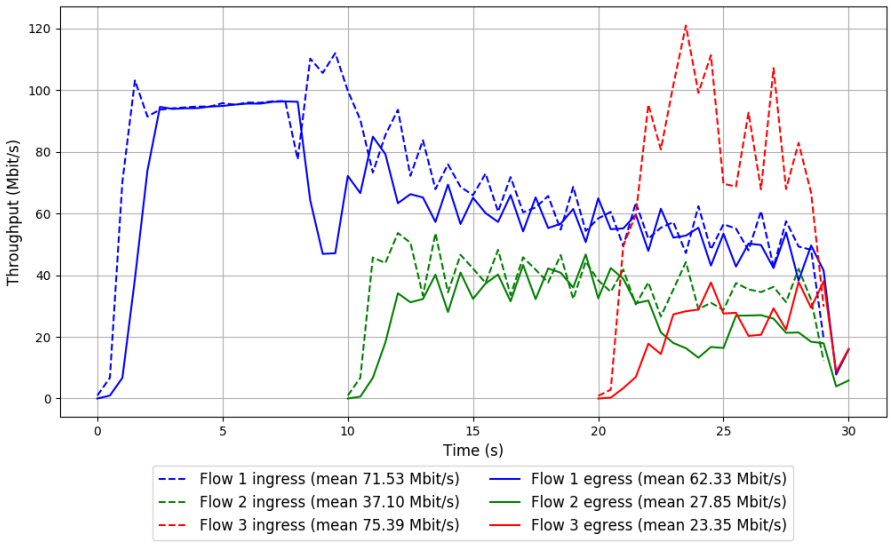


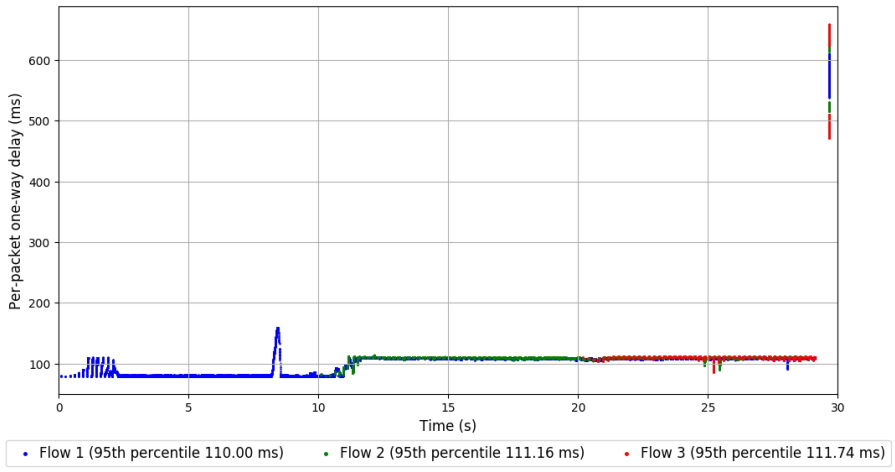
```
Run 3: Statistics of Indigo

Start at: 2018-09-03 09:02:31
End at: 2018-09-03 09:03:01
Local clock offset: -3.044 ms
Remote clock offset: -1.395 ms

# Below is generated by plot.py at 2018-09-03 09:04:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.23 Mbit/s
95th percentile per-packet one-way delay: 111.325 ms
Loss rate: 25.02%
-- Flow 1:
Average throughput: 62.33 Mbit/s
95th percentile per-packet one-way delay: 110.004 ms
Loss rate: 11.49%
-- Flow 2:
Average throughput: 27.85 Mbit/s
95th percentile per-packet one-way delay: 111.163 ms
Loss rate: 23.25%
-- Flow 3:
Average throughput: 23.35 Mbit/s
95th percentile per-packet one-way delay: 111.736 ms
Loss rate: 67.80%
```

Run 3: Report of Indigo — Data Link



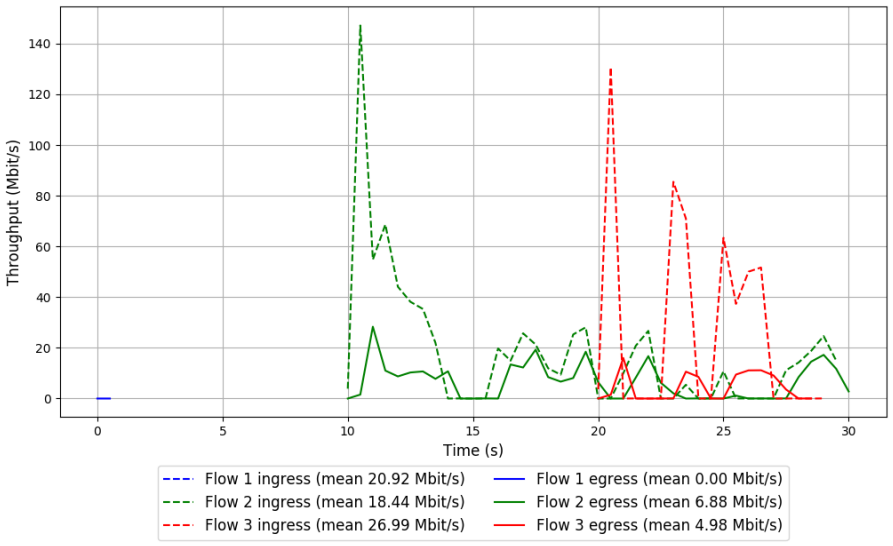


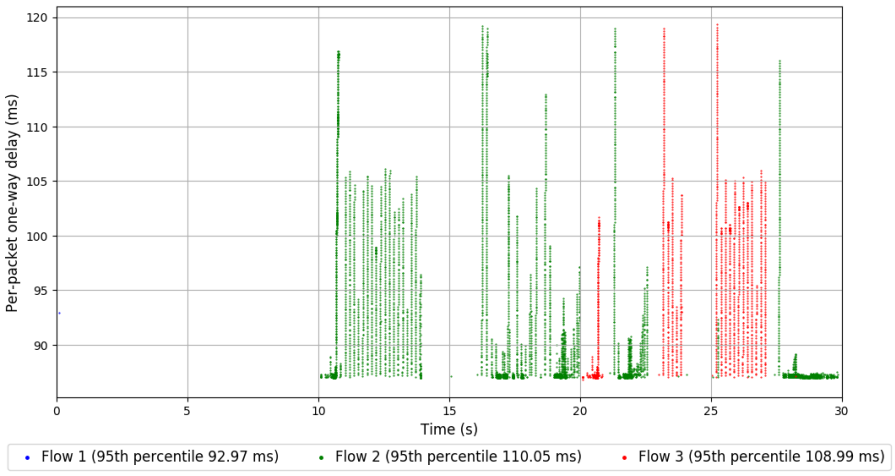
```
Run 1: Statistics of Muses-25

Start at: 2018-09-03 08:48:34
End at: 2018-09-03 08:49:04
Local clock offset: -3.706 ms
Remote clock offset: 4.587 ms

# Below is generated by plot.py at 2018-09-03 09:04:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 5.93 Mbit/s
95th percentile per-packet one-way delay: 109.961 ms
Loss rate: 71.13%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 92.968 ms
Loss rate: 97.24%
-- Flow 2:
Average throughput: 6.88 Mbit/s
95th percentile per-packet one-way delay: 110.051 ms
Loss rate: 62.71%
-- Flow 3:
Average throughput: 4.98 Mbit/s
95th percentile per-packet one-way delay: 108.989 ms
Loss rate: 83.56%
```

Run 1: Report of Muses-25 — Data Link



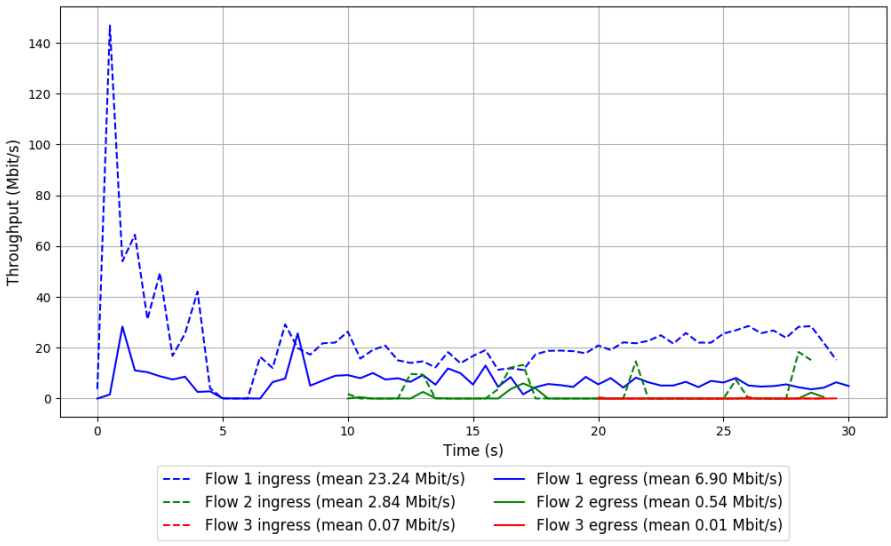


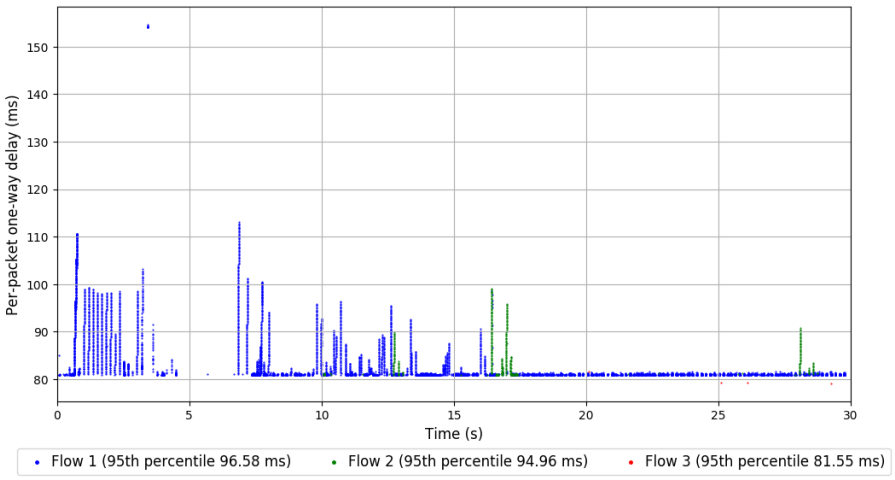
```
Run 2: Statistics of Muses-25

Start at: 2018-09-03 08:53:36
End at: 2018-09-03 08:54:06
Local clock offset: -3.65 ms
Remote clock offset: -1.528 ms

# Below is generated by plot.py at 2018-09-03 09:04:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 7.24 Mbit/s
95th percentile per-packet one-way delay: 96.474 ms
Loss rate: 71.15%
-- Flow 1:
Average throughput: 6.90 Mbit/s
95th percentile per-packet one-way delay: 96.582 ms
Loss rate: 70.38%
-- Flow 2:
Average throughput: 0.54 Mbit/s
95th percentile per-packet one-way delay: 94.962 ms
Loss rate: 80.96%
-- Flow 3:
Average throughput: 0.01 Mbit/s
95th percentile per-packet one-way delay: 81.548 ms
Loss rate: 89.57%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-03 08:58:48
End at: 2018-09-03 08:59:18
Local clock offset: -2.914 ms
Remote clock offset: 3.417 ms

# Below is generated by plot.py at 2018-09-03 09:04:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 5.21 Mbit/s
95th percentile per-packet one-way delay: 108.108 ms
Loss rate: 68.95%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 85.298 ms
Loss rate: 97.24%
-- Flow 2:
Average throughput: 6.88 Mbit/s
95th percentile per-packet one-way delay: 104.925 ms
Loss rate: 68.85%
-- Flow 3:
Average throughput: 2.08 Mbit/s
95th percentile per-packet one-way delay: 112.157 ms
Loss rate: 69.62%
```

Run 3: Report of Muses-25 — Data Link