Pantheon Report

Generated at 2018-09-05 02:50:21 (UTC).

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

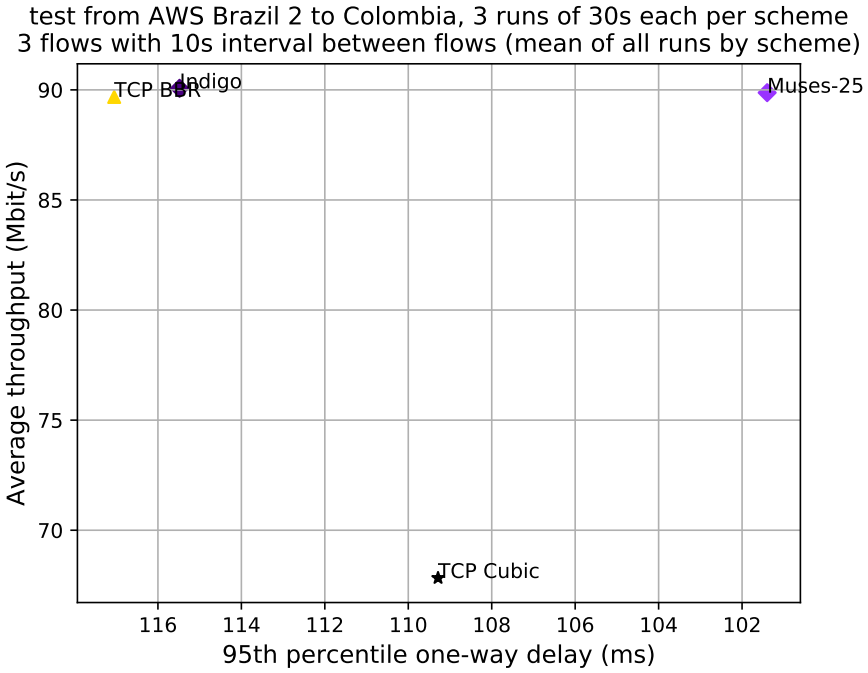
Repeated the test of 4 congestion control schemes 3 times.

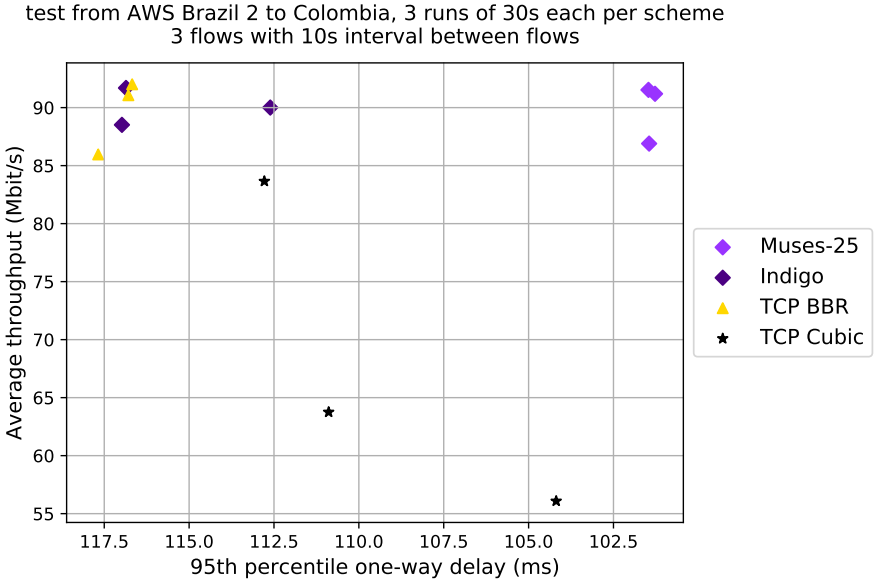
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 @ 71e71e9a55b945431a7dea72180c1c9381097db9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ 96fbc95fb38373d71fbc80c5a105e62e7636623b
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
Muses-25
TCP Cubic
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
90
85
80
75
70
116
114
112
110
108
106
104
102


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)
Muses-25
Indigo
TCP BBR
TCP Cubic
90
85
80
75
70
65
60
55
117.5
115.0
112.5
110.0
107.5
105.0
102.5

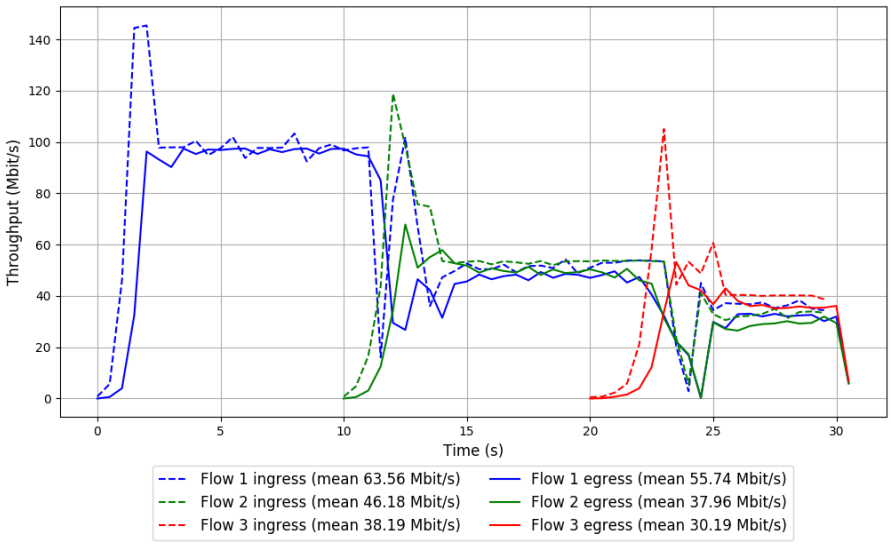
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	56.67	32.91	33.26	116.09	117.24	120.25	12.20	19.42	24.71
TCP Cubic	3	40.65	17.66	46.38	109.21	103.98	110.72	1.55	1.56	3.26
Indigo	3	61.61	32.36	21.83	114.41	113.46	118.05	6.27	14.43	19.03
Muses-25	3	53.38	42.33	25.75	97.05	108.76	102.48	2.11	1.31	2.70

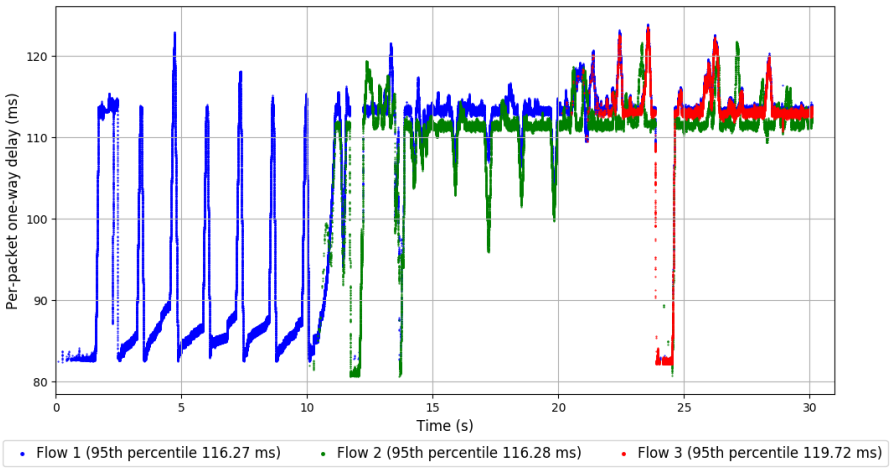
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 02:37:07
End at: 2018-09-05 02:37:37
Local clock offset: 1.808 ms
Remote clock offset: 2.185 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.07 Mbit/s
95th percentile per-packet one-way delay: 116.789 ms
Loss rate: 14.82%
-- Flow 1:
Average throughput: 55.74 Mbit/s
95th percentile per-packet one-way delay: 116.265 ms
Loss rate: 12.21%
-- Flow 2:
Average throughput: 37.96 Mbit/s
95th percentile per-packet one-way delay: 116.285 ms
Loss rate: 17.68%
-- Flow 3:
Average throughput: 30.19 Mbit/s
95th percentile per-packet one-way delay: 119.721 ms
Loss rate: 20.95%
```

Run 1: Report of TCP BBR — Data Link



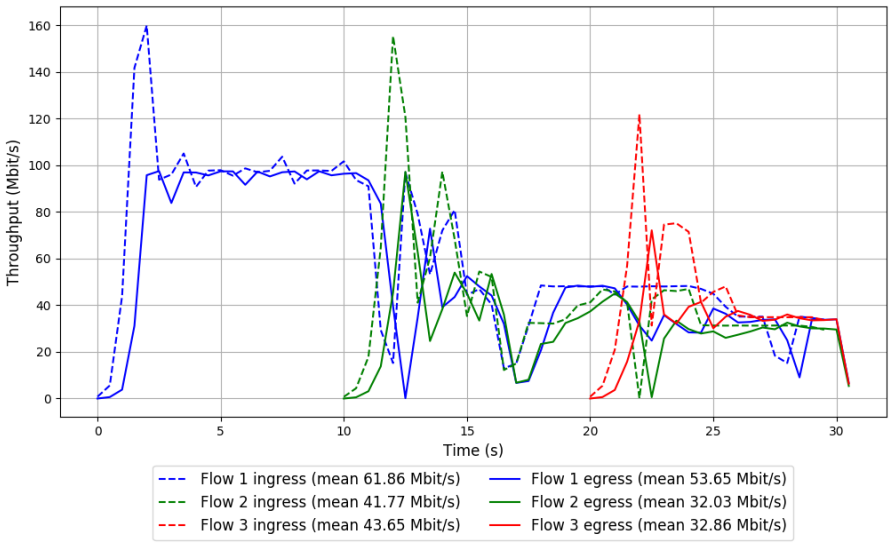


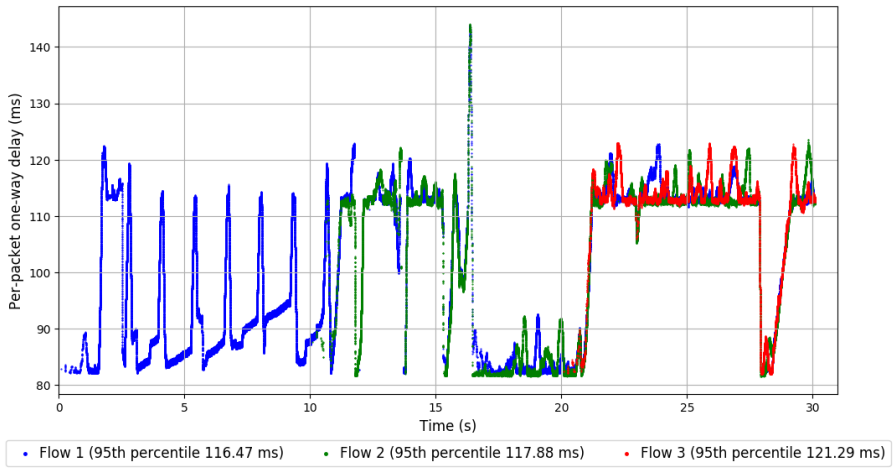
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 02:42:23
End at: 2018-09-05 02:42:53
Local clock offset: 2.225 ms
Remote clock offset: 1.826 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 85.97 Mbit/s
95th percentile per-packet one-way delay: 117.678 ms
Loss rate: 17.44%
-- Flow 1:
Average throughput: 53.65 Mbit/s
95th percentile per-packet one-way delay: 116.466 ms
Loss rate: 13.18%
-- Flow 2:
Average throughput: 32.03 Mbit/s
95th percentile per-packet one-way delay: 117.880 ms
Loss rate: 23.23%
-- Flow 3:
Average throughput: 32.86 Mbit/s
95th percentile per-packet one-way delay: 121.286 ms
Loss rate: 24.50%
```

Run 2: Report of TCP BBR — Data Link



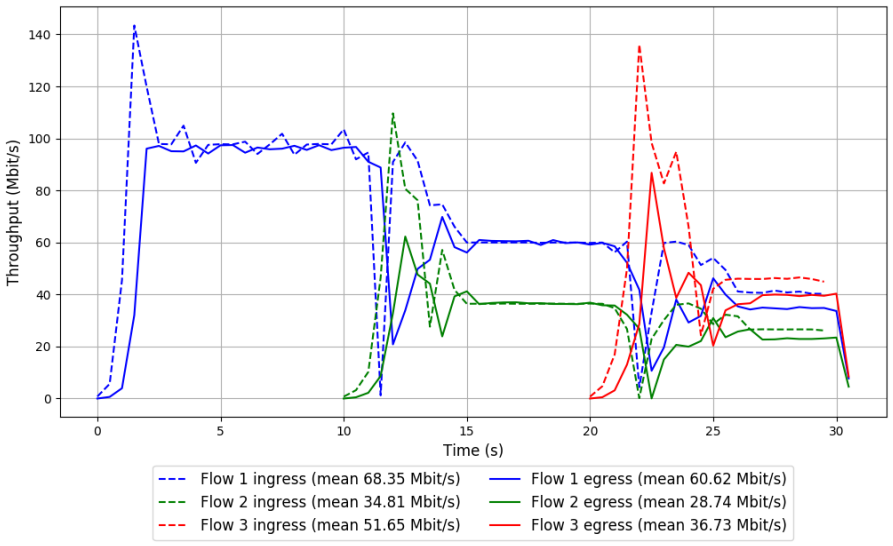


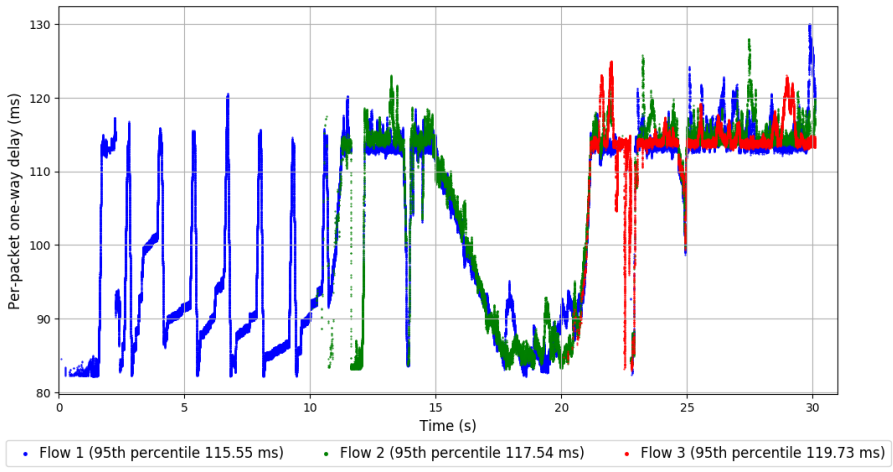
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 02:47:48
End at: 2018-09-05 02:48:18
Local clock offset: 3.181 ms
Remote clock offset: 5.897 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.01 Mbit/s
95th percentile per-packet one-way delay: 116.678 ms
Loss rate: 15.29%
-- Flow 1:
Average throughput: 60.62 Mbit/s
95th percentile per-packet one-way delay: 115.545 ms
Loss rate: 11.22%
-- Flow 2:
Average throughput: 28.74 Mbit/s
95th percentile per-packet one-way delay: 117.542 ms
Loss rate: 17.35%
-- Flow 3:
Average throughput: 36.73 Mbit/s
95th percentile per-packet one-way delay: 119.734 ms
Loss rate: 28.68%
```

Run 3: Report of TCP BBR — Data Link



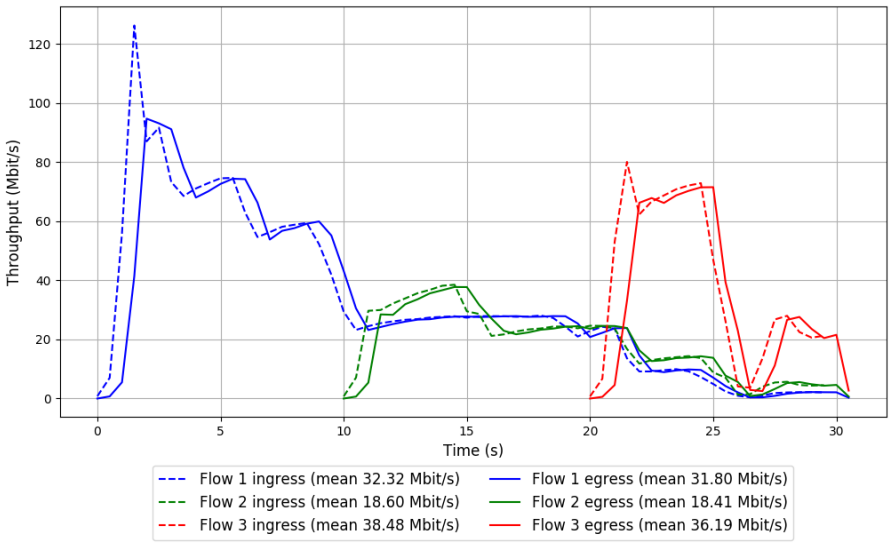


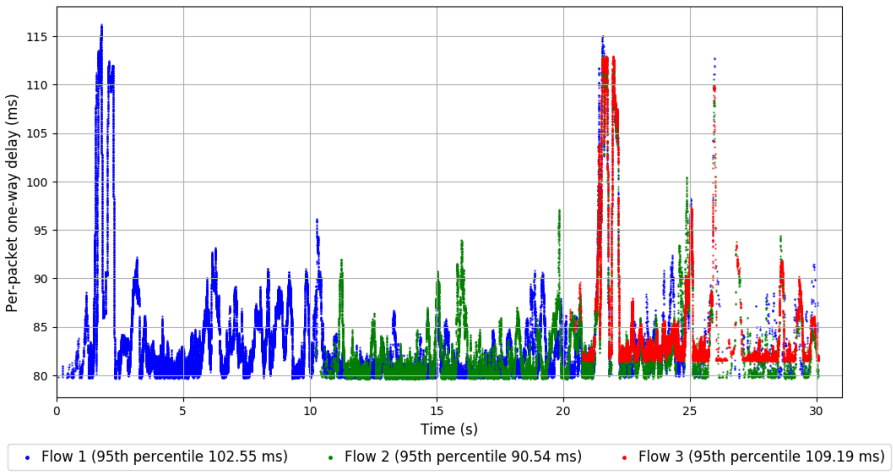
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 02:33:14
End at: 2018-09-05 02:33:44
Local clock offset: 2.065 ms
Remote clock offset: 2.017 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 56.09 Mbit/s
95th percentile per-packet one-way delay: 104.187 ms
Loss rate: 2.46%
-- Flow 1:
Average throughput: 31.80 Mbit/s
95th percentile per-packet one-way delay: 102.545 ms
Loss rate: 1.64%
-- Flow 2:
Average throughput: 18.41 Mbit/s
95th percentile per-packet one-way delay: 90.542 ms
Loss rate: 1.00%
-- Flow 3:
Average throughput: 36.19 Mbit/s
95th percentile per-packet one-way delay: 109.187 ms
Loss rate: 5.95%
```

Run 1: Report of TCP Cubic — Data Link



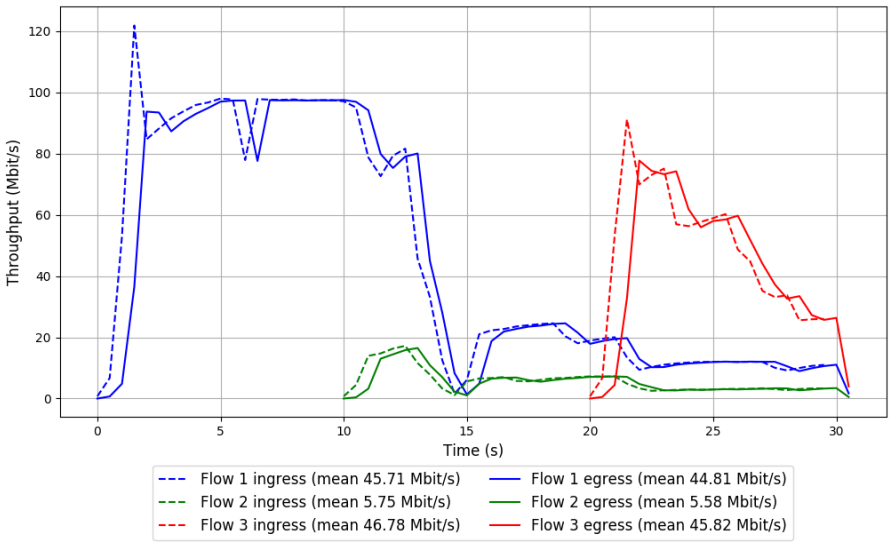


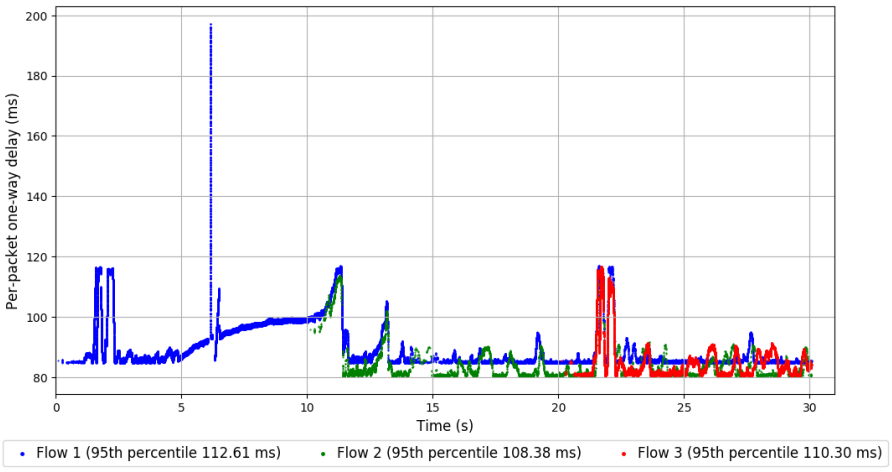
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 02:38:27
End at: 2018-09-05 02:38:57
Local clock offset: 2.629 ms
Remote clock offset: 1.394 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 63.75 Mbit/s
95th percentile per-packet one-way delay: 110.890 ms
Loss rate: 2.07%
-- Flow 1:
Average throughput: 44.81 Mbit/s
95th percentile per-packet one-way delay: 112.605 ms
Loss rate: 1.99%
-- Flow 2:
Average throughput: 5.58 Mbit/s
95th percentile per-packet one-way delay: 108.379 ms
Loss rate: 3.06%
-- Flow 3:
Average throughput: 45.82 Mbit/s
95th percentile per-packet one-way delay: 110.298 ms
Loss rate: 2.06%
```

Run 2: Report of TCP Cubic — Data Link



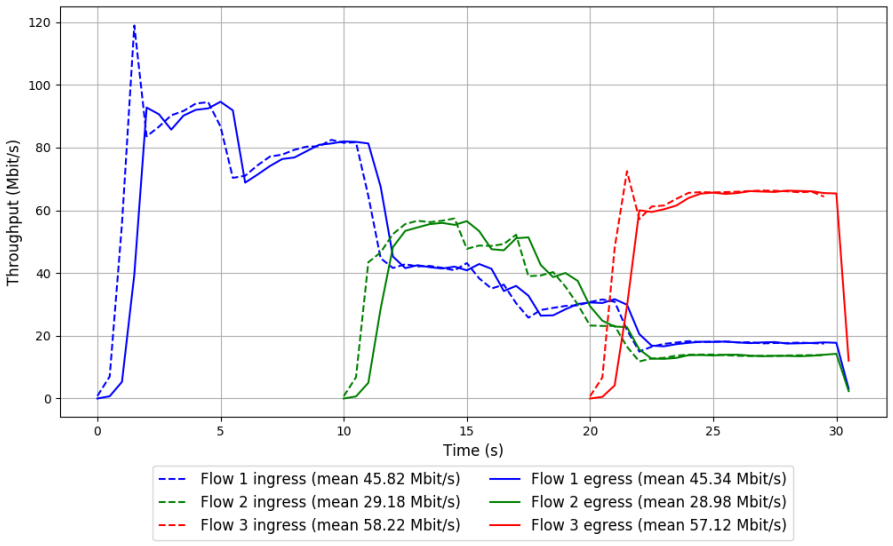


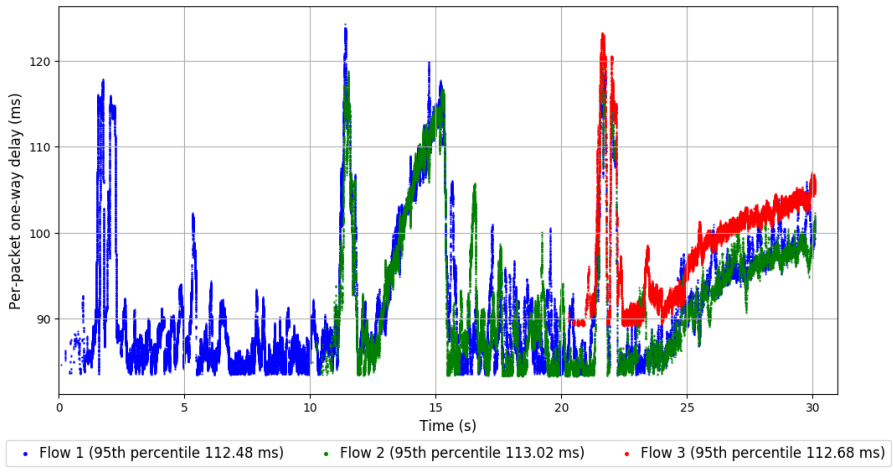
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 02:43:44
End at: 2018-09-05 02:44:14
Local clock offset: 3.016 ms
Remote clock offset: 6.748 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 83.65 Mbit/s
95th percentile per-packet one-way delay: 112.783 ms
Loss rate: 1.09%
-- Flow 1:
Average throughput: 45.34 Mbit/s
95th percentile per-packet one-way delay: 112.482 ms
Loss rate: 1.01%
-- Flow 2:
Average throughput: 28.98 Mbit/s
95th percentile per-packet one-way delay: 113.022 ms
Loss rate: 0.61%
-- Flow 3:
Average throughput: 57.12 Mbit/s
95th percentile per-packet one-way delay: 112.679 ms
Loss rate: 1.78%
```

Run 3: Report of TCP Cubic — Data Link



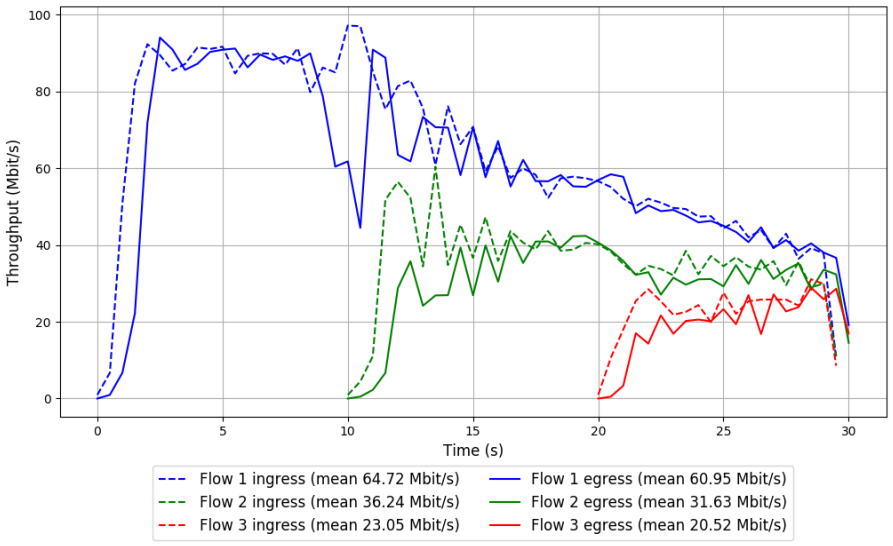


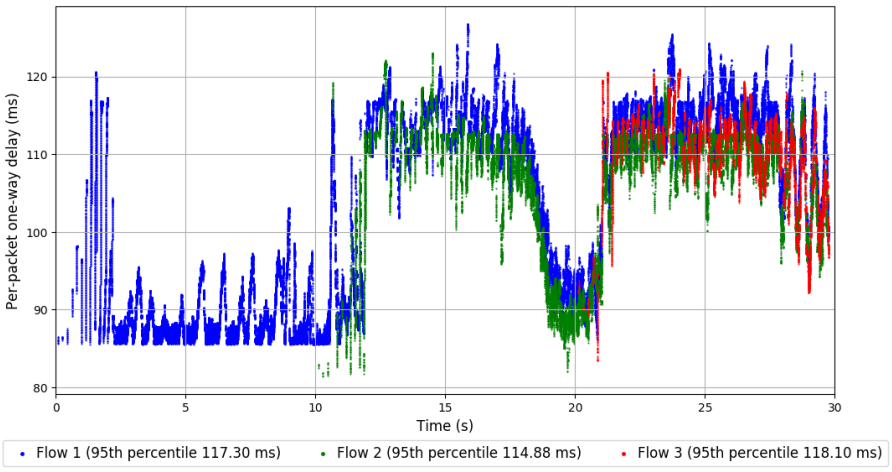
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 02:34:30
End at: 2018-09-05 02:35:00
Local clock offset: 2.277 ms
Remote clock offset: 1.989 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.52 Mbit/s
95th percentile per-packet one-way delay: 116.979 ms
Loss rate: 7.90%
-- Flow 1:
Average throughput: 60.95 Mbit/s
95th percentile per-packet one-way delay: 117.295 ms
Loss rate: 5.79%
-- Flow 2:
Average throughput: 31.63 Mbit/s
95th percentile per-packet one-way delay: 114.879 ms
Loss rate: 12.64%
-- Flow 3:
Average throughput: 20.52 Mbit/s
95th percentile per-packet one-way delay: 118.099 ms
Loss rate: 10.94%
```

Run 1: Report of Indigo — Data Link



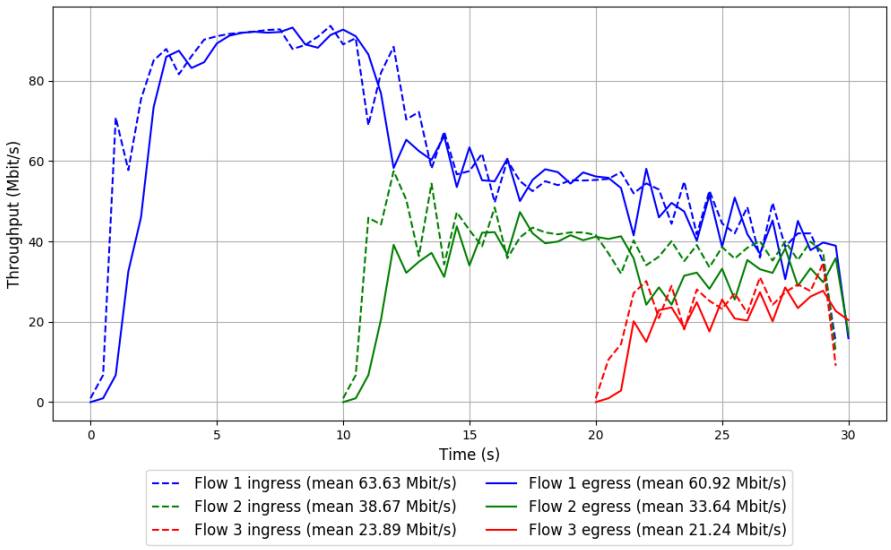


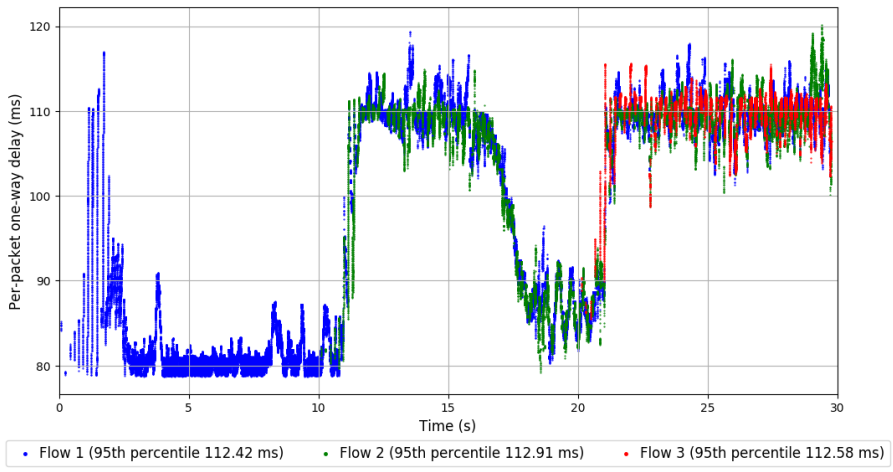
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 02:39:43
End at: 2018-09-05 02:40:13
Local clock offset: 2.81 ms
Remote clock offset: 1.523 ms

# Below is generated by plot.py at 2018-09-05 02:49:54
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.01 Mbit/s
95th percentile per-packet one-way delay: 112.609 ms
Loss rate: 7.03%
-- Flow 1:
Average throughput: 60.92 Mbit/s
95th percentile per-packet one-way delay: 112.421 ms
Loss rate: 4.19%
-- Flow 2:
Average throughput: 33.64 Mbit/s
95th percentile per-packet one-way delay: 112.911 ms
Loss rate: 12.88%
-- Flow 3:
Average throughput: 21.24 Mbit/s
95th percentile per-packet one-way delay: 112.578 ms
Loss rate: 10.97%
```

Run 2: Report of Indigo — Data Link



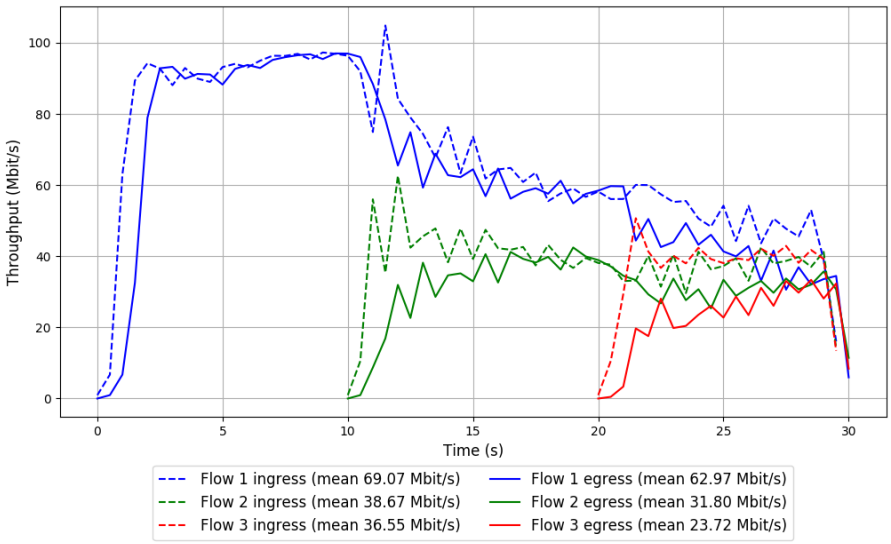


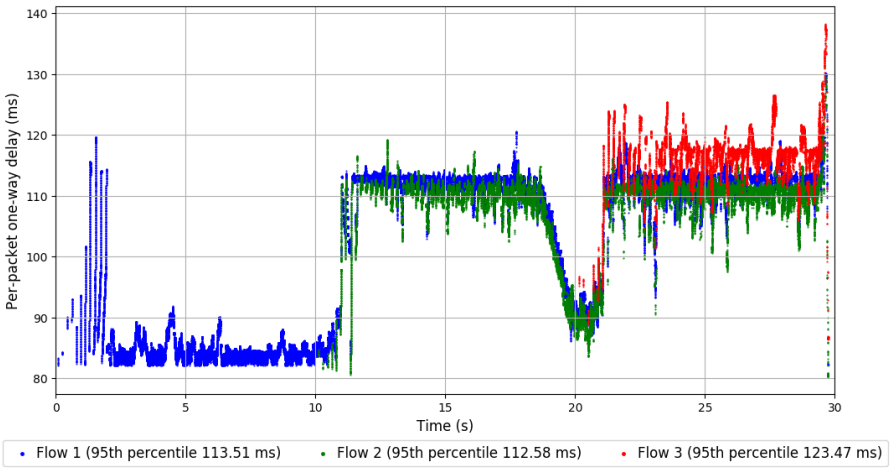
```
Run 3: Statistics of Indigo

Start at: 2018-09-05 02:45:09
End at: 2018-09-05 02:45:39
Local clock offset: 2.369 ms
Remote clock offset: 3.266 ms

# Below is generated by plot.py at 2018-09-05 02:50:12
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.69 Mbit/s
95th percentile per-packet one-way delay: 116.859 ms
Loss rate: 13.91%
-- Flow 1:
Average throughput: 62.97 Mbit/s
95th percentile per-packet one-way delay: 113.514 ms
Loss rate: 8.84%
-- Flow 2:
Average throughput: 31.80 Mbit/s
95th percentile per-packet one-way delay: 112.583 ms
Loss rate: 17.77%
-- Flow 3:
Average throughput: 23.72 Mbit/s
95th percentile per-packet one-way delay: 123.467 ms
Loss rate: 35.17%
```

Run 3: Report of Indigo — Data Link



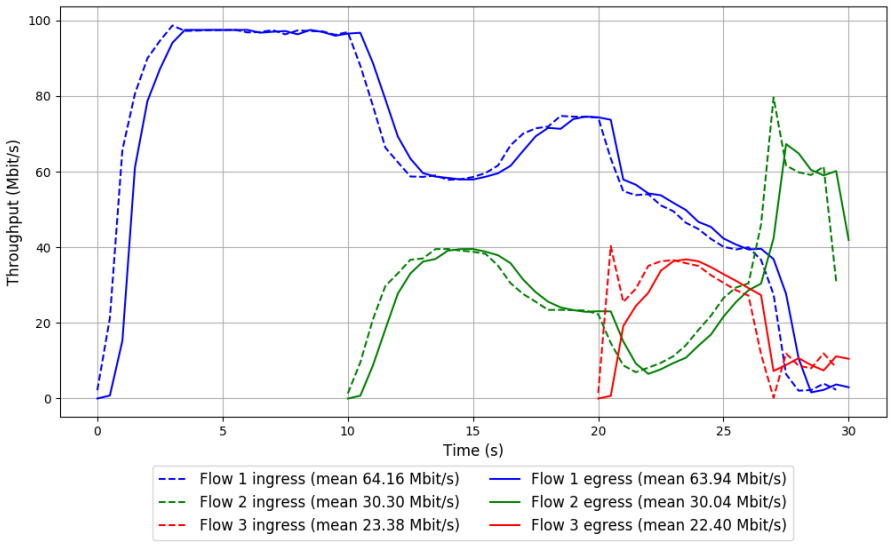


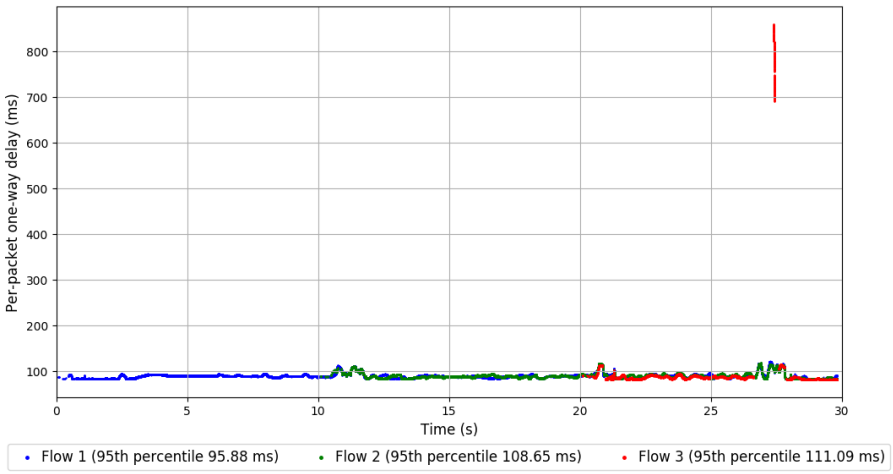
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 02:35:49
End at: 2018-09-05 02:36:19
Local clock offset: 1.651 ms
Remote clock offset: 2.028 ms

# Below is generated by plot.py at 2018-09-05 02:50:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.19 Mbit/s
95th percentile per-packet one-way delay: 101.276 ms
Loss rate: 0.80%
-- Flow 1:
Average throughput: 63.94 Mbit/s
95th percentile per-packet one-way delay: 95.881 ms
Loss rate: 0.37%
-- Flow 2:
Average throughput: 30.04 Mbit/s
95th percentile per-packet one-way delay: 108.647 ms
Loss rate: 0.87%
-- Flow 3:
Average throughput: 22.40 Mbit/s
95th percentile per-packet one-way delay: 111.090 ms
Loss rate: 4.26%
```

Run 1: Report of Muses-25 — Data Link



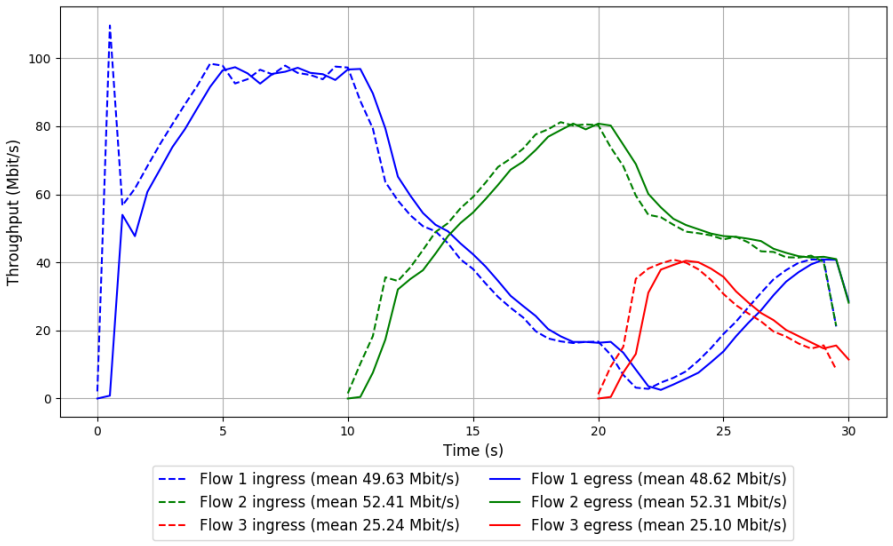


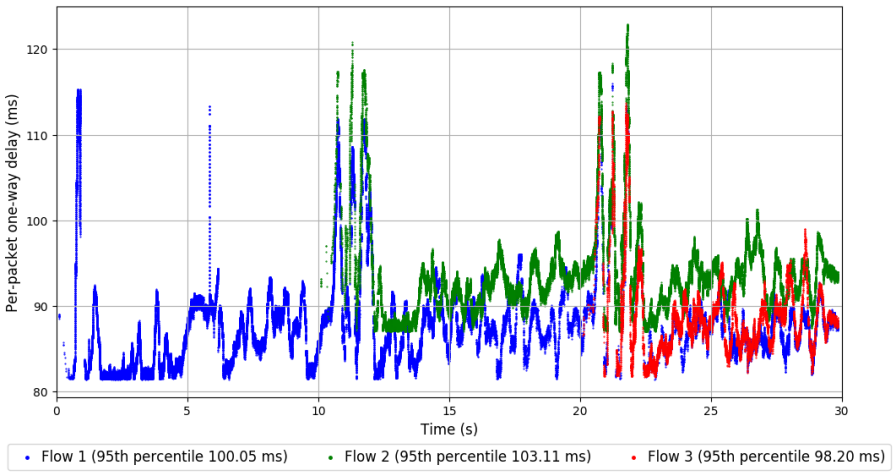
```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 02:41:03
End at: 2018-09-05 02:41:33
Local clock offset: 2.881 ms
Remote clock offset: 2.819 ms

# Below is generated by plot.py at 2018-09-05 02:50:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.53 Mbit/s
95th percentile per-packet one-way delay: 101.469 ms
Loss rate: 1.24%
-- Flow 1:
Average throughput: 48.62 Mbit/s
95th percentile per-packet one-way delay: 100.048 ms
Loss rate: 2.05%
-- Flow 2:
Average throughput: 52.31 Mbit/s
95th percentile per-packet one-way delay: 103.110 ms
Loss rate: 0.25%
-- Flow 3:
Average throughput: 25.10 Mbit/s
95th percentile per-packet one-way delay: 98.198 ms
Loss rate: 0.55%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 02:46:31
End at: 2018-09-05 02:47:01
Local clock offset: 2.388 ms
Remote clock offset: 3.307 ms

# Below is generated by plot.py at 2018-09-05 02:50:20
# Datalink statistics
-- Total of 3 flows:
Average throughput: 86.90 Mbit/s
95th percentile per-packet one-way delay: 101.450 ms
Loss rate: 3.46%
-- Flow 1:
Average throughput: 47.59 Mbit/s
95th percentile per-packet one-way delay: 95.228 ms
Loss rate: 3.91%
-- Flow 2:
Average throughput: 44.63 Mbit/s
95th percentile per-packet one-way delay: 114.518 ms
Loss rate: 2.80%
-- Flow 3:
Average throughput: 29.74 Mbit/s
95th percentile per-packet one-way delay: 98.154 ms
Loss rate: 3.29%
```

Run 3: Report of Muses-25 — Data Link