Pantheon Report

Generated at 2018-09-05 22:44:46 (UTC).

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

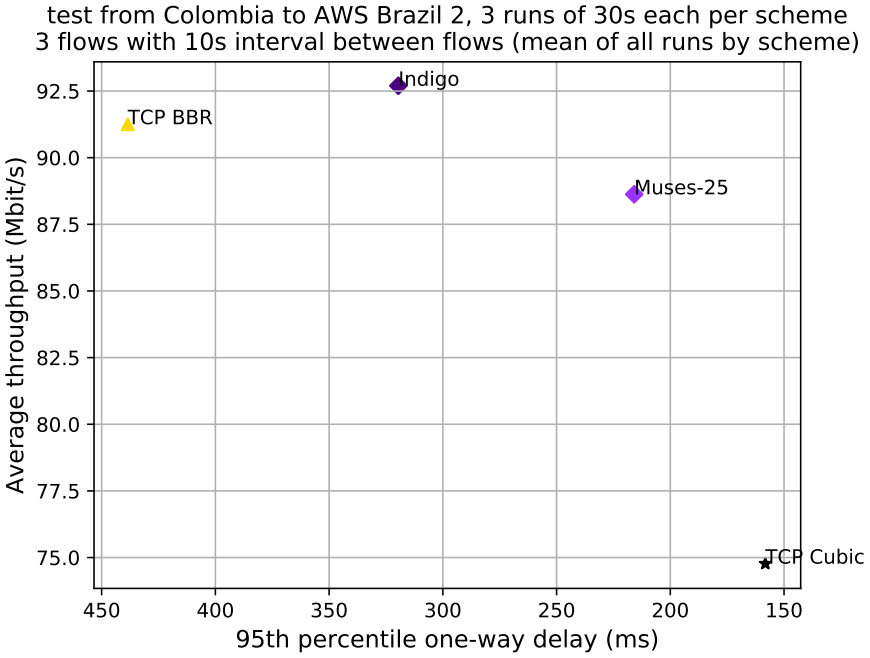
Repeated the test of 4 congestion control schemes 3 times.

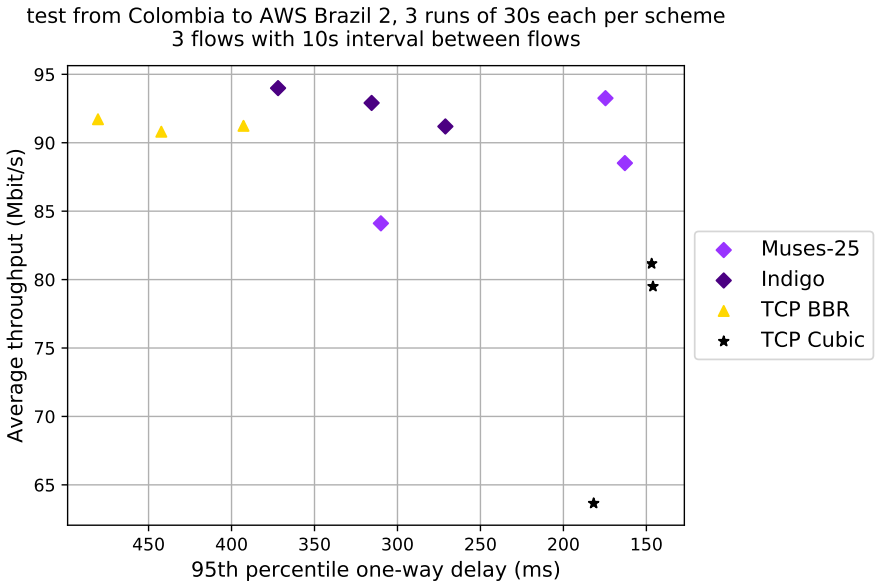
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 @ 18b9165265c8ba2915c862e8713fd9ad82c1ac21
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ a28d20fb82a95a965a3da65fd1eb71b8994e9b84
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
TCP BBR
Muses-25
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
450
400
350
300
250
200
150


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
65
450
400
350
300
250
200
150
Muses-25
Indigo
TCP BBR
TCP Cubic

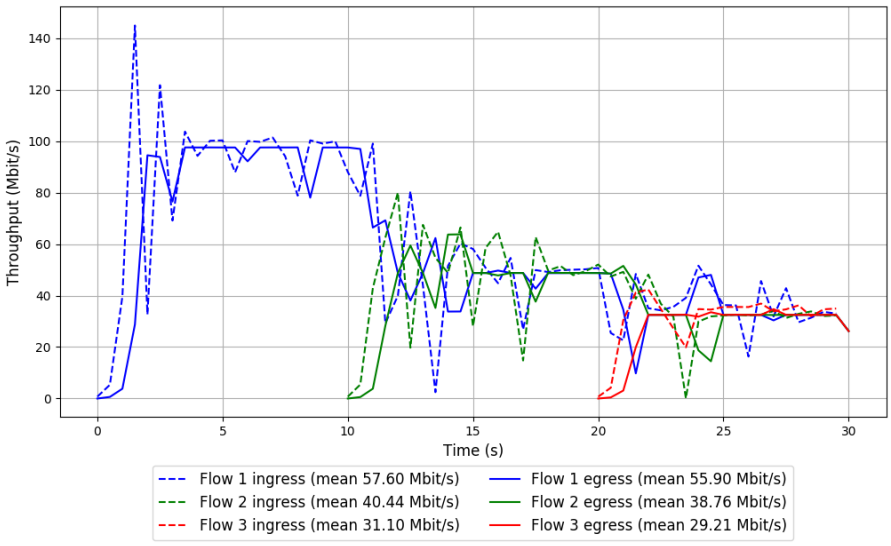
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	56.04	38.42	29.59	403.53	487.26	395.82	3.03	4.35	7.38
TCP Cubic	3	42.25	34.09	30.06	175.17	141.67	149.70	0.37	0.74	2.72
Indigo	3	57.40	38.70	29.62	339.35	140.70	130.97	4.30	1.75	2.52
Muses-25	3	55.67	29.88	40.12	121.14	298.56	367.16	1.07	1.52	2.23

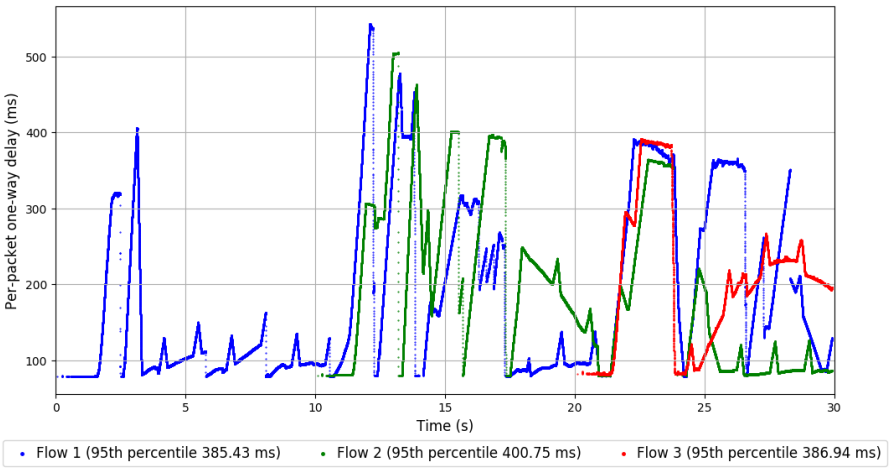
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 22:31:47
End at: 2018-09-05 22:32:17
Local clock offset: 12.919 ms
Remote clock offset: 1.962 ms

# Below is generated by plot.py at 2018-09-05 22:44:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.24 Mbit/s
95th percentile per-packet one-way delay: 392.795 ms
Loss rate: 4.37%
-- Flow 1:
Average throughput: 55.90 Mbit/s
95th percentile per-packet one-way delay: 385.429 ms
Loss rate: 3.49%
-- Flow 2:
Average throughput: 38.76 Mbit/s
95th percentile per-packet one-way delay: 400.747 ms
Loss rate: 4.99%
-- Flow 3:
Average throughput: 29.21 Mbit/s
95th percentile per-packet one-way delay: 386.942 ms
Loss rate: 7.69%
```

Run 1: Report of TCP BBR — Data Link



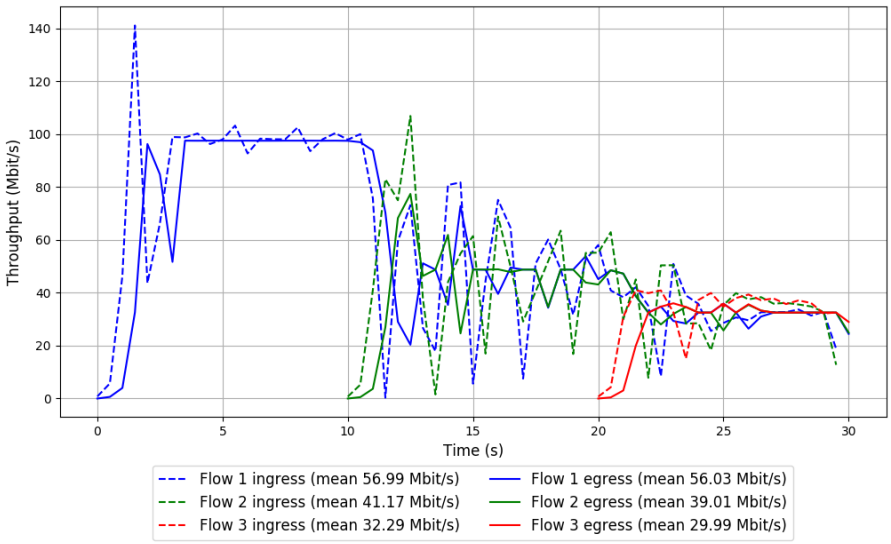


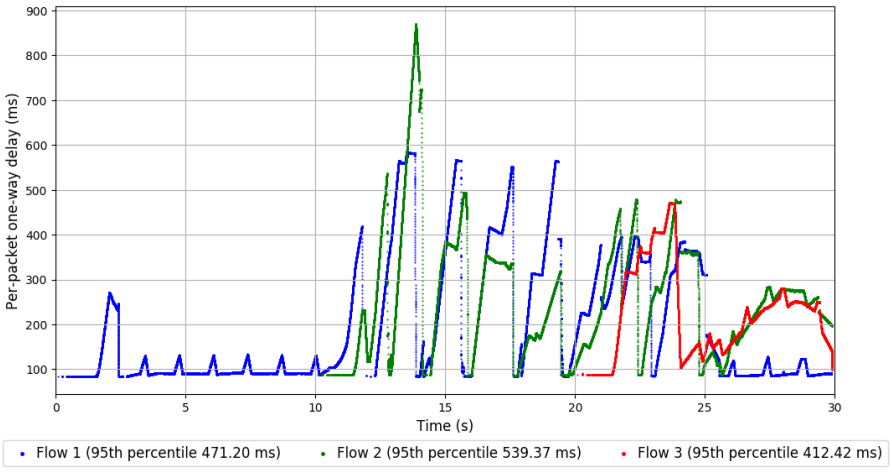
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 22:36:58
End at: 2018-09-05 22:37:28
Local clock offset: 10.621 ms
Remote clock offset: -1.972 ms

# Below is generated by plot.py at 2018-09-05 22:44:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.72 Mbit/s
95th percentile per-packet one-way delay: 480.490 ms
Loss rate: 3.66%
-- Flow 1:
Average throughput: 56.03 Mbit/s
95th percentile per-packet one-way delay: 471.203 ms
Loss rate: 2.22%
-- Flow 2:
Average throughput: 39.01 Mbit/s
95th percentile per-packet one-way delay: 539.374 ms
Loss rate: 4.73%
-- Flow 3:
Average throughput: 29.99 Mbit/s
95th percentile per-packet one-way delay: 412.422 ms
Loss rate: 8.65%
```

Run 2: Report of TCP BBR — Data Link



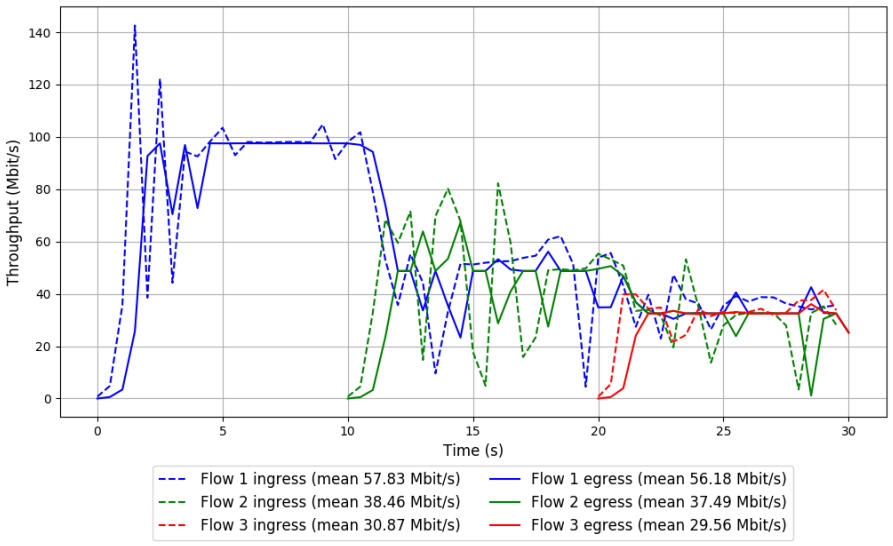


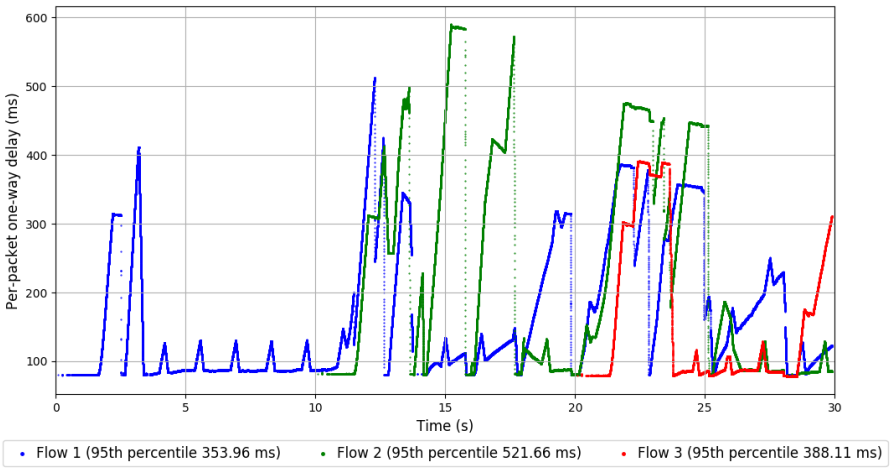
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 22:42:08
End at: 2018-09-05 22:42:38
Local clock offset: 8.694 ms
Remote clock offset: 3.253 ms

# Below is generated by plot.py at 2018-09-05 22:44:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 90.81 Mbit/s
95th percentile per-packet one-way delay: 442.319 ms
Loss rate: 3.63%
-- Flow 1:
Average throughput: 56.18 Mbit/s
95th percentile per-packet one-way delay: 353.959 ms
Loss rate: 3.38%
-- Flow 2:
Average throughput: 37.49 Mbit/s
95th percentile per-packet one-way delay: 521.665 ms
Loss rate: 3.34%
-- Flow 3:
Average throughput: 29.56 Mbit/s
95th percentile per-packet one-way delay: 388.105 ms
Loss rate: 5.79%
```

Run 3: Report of TCP BBR — Data Link



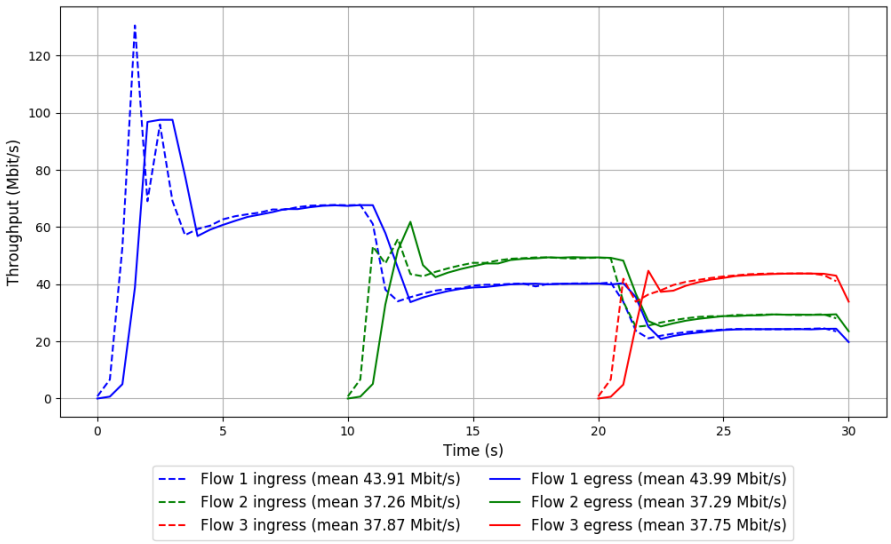


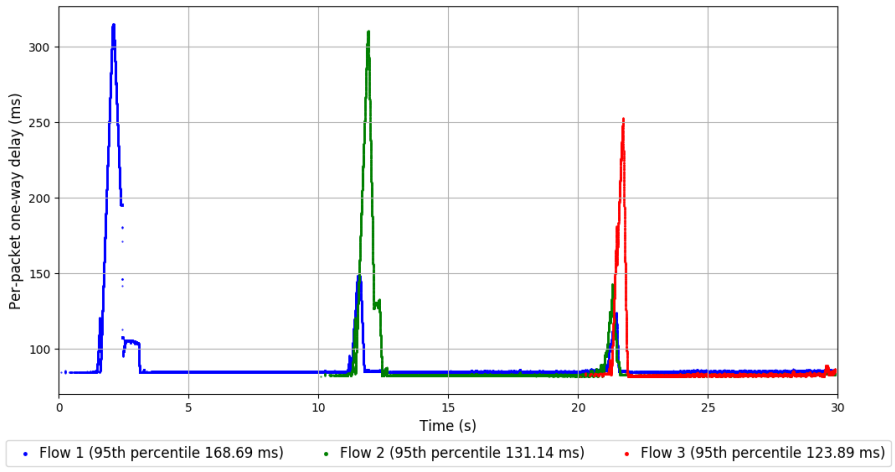
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 22:27:53
End at: 2018-09-05 22:28:23
Local clock offset: 13.919 ms
Remote clock offset: -0.834 ms

# Below is generated by plot.py at 2018-09-05 22:44:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 81.16 Mbit/s
95th percentile per-packet one-way delay: 146.832 ms
Loss rate: 0.72%
-- Flow 1:
Average throughput: 43.99 Mbit/s
95th percentile per-packet one-way delay: 168.692 ms
Loss rate: 0.38%
-- Flow 2:
Average throughput: 37.29 Mbit/s
95th percentile per-packet one-way delay: 131.142 ms
Loss rate: 0.71%
-- Flow 3:
Average throughput: 37.75 Mbit/s
95th percentile per-packet one-way delay: 123.893 ms
Loss rate: 1.93%
```

Run 1: Report of TCP Cubic — Data Link



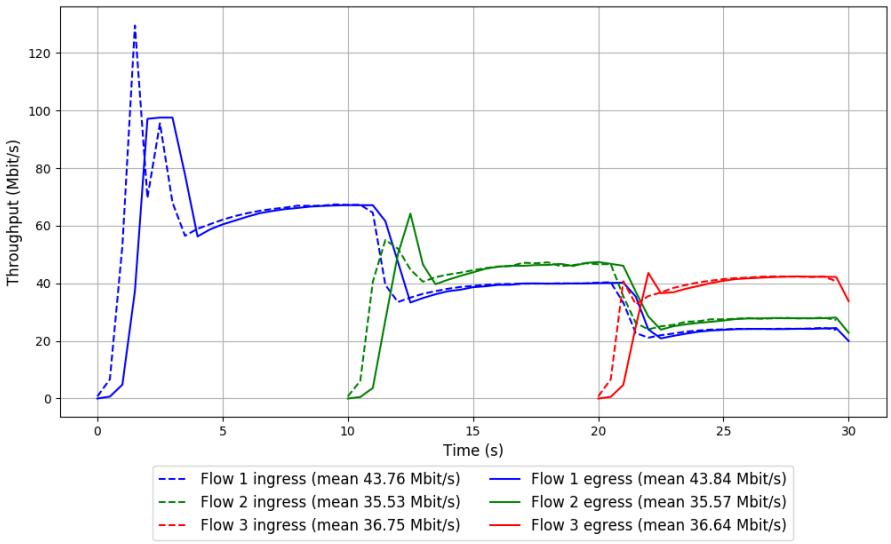


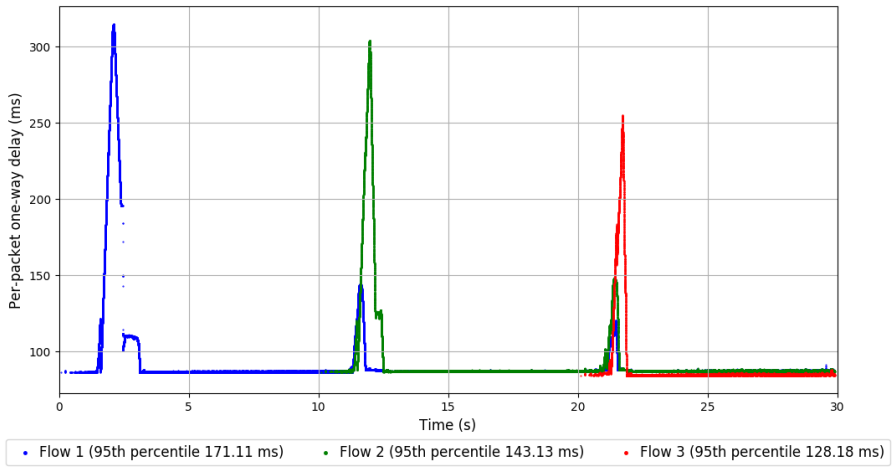
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 22:33:06
End at: 2018-09-05 22:33:36
Local clock offset: 12.704 ms
Remote clock offset: -1.903 ms

# Below is generated by plot.py at 2018-09-05 22:44:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 79.50 Mbit/s
95th percentile per-packet one-way delay: 146.033 ms
Loss rate: 0.72%
-- Flow 1:
Average throughput: 43.84 Mbit/s
95th percentile per-packet one-way delay: 171.110 ms
Loss rate: 0.38%
-- Flow 2:
Average throughput: 35.57 Mbit/s
95th percentile per-packet one-way delay: 143.133 ms
Loss rate: 0.72%
-- Flow 3:
Average throughput: 36.64 Mbit/s
95th percentile per-packet one-way delay: 128.180 ms
Loss rate: 1.92%
```

Run 2: Report of TCP Cubic — Data Link



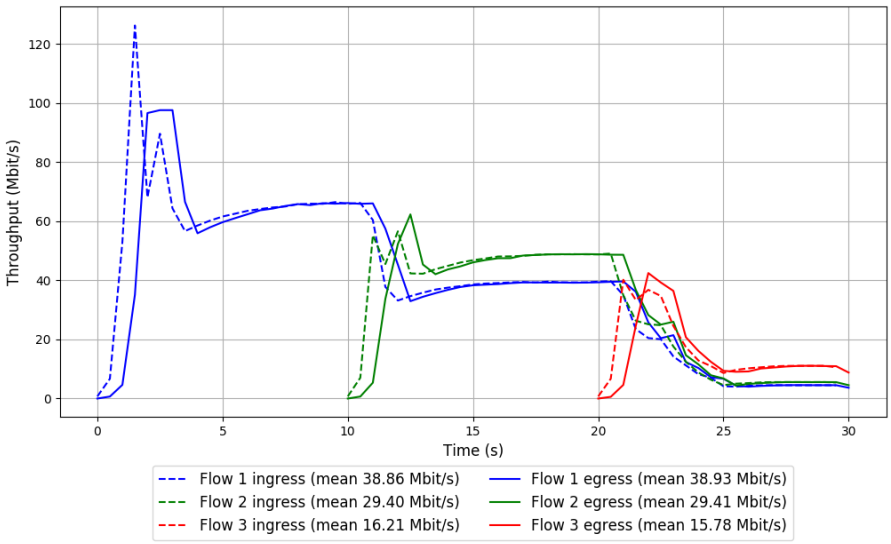


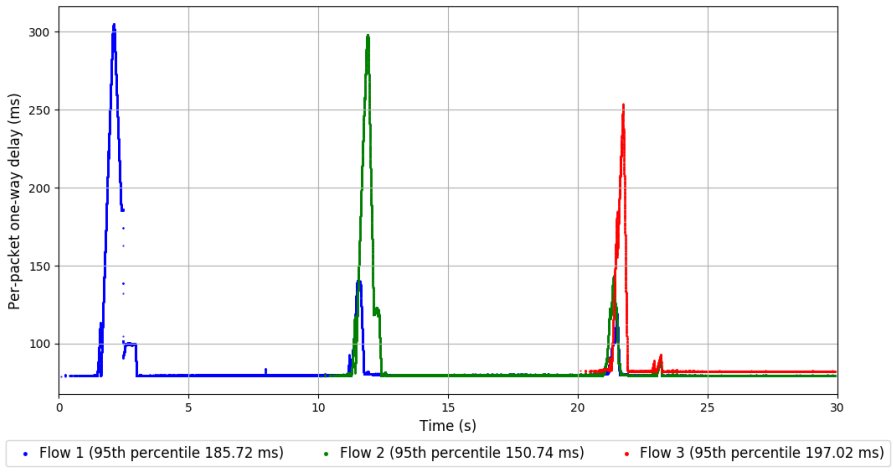
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 22:38:16
End at: 2018-09-05 22:38:46
Local clock offset: 9.551 ms
Remote clock offset: 1.898 ms

# Below is generated by plot.py at 2018-09-05 22:44:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 63.65 Mbit/s
95th percentile per-packet one-way delay: 181.779 ms
Loss rate: 0.82%
-- Flow 1:
Average throughput: 38.93 Mbit/s
95th percentile per-packet one-way delay: 185.715 ms
Loss rate: 0.36%
-- Flow 2:
Average throughput: 29.41 Mbit/s
95th percentile per-packet one-way delay: 150.742 ms
Loss rate: 0.78%
-- Flow 3:
Average throughput: 15.78 Mbit/s
95th percentile per-packet one-way delay: 197.024 ms
Loss rate: 4.30%
```

Run 3: Report of TCP Cubic — Data Link



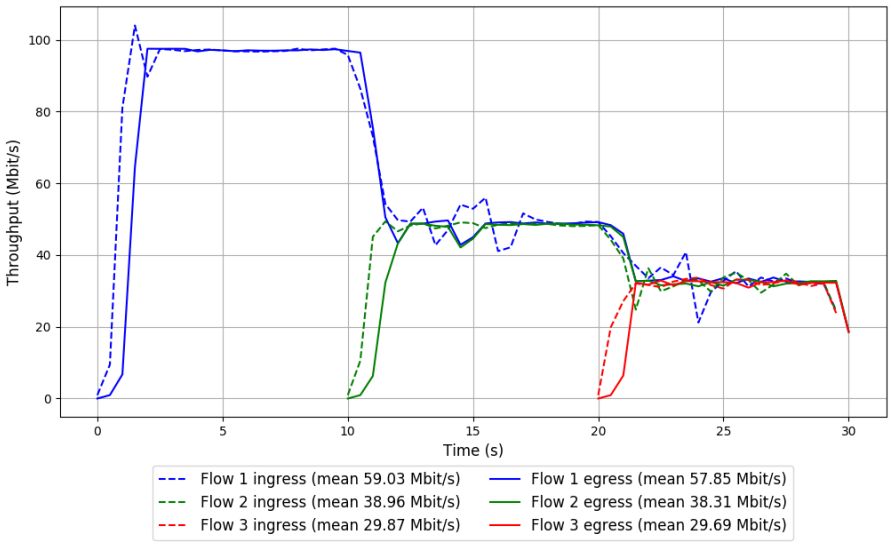


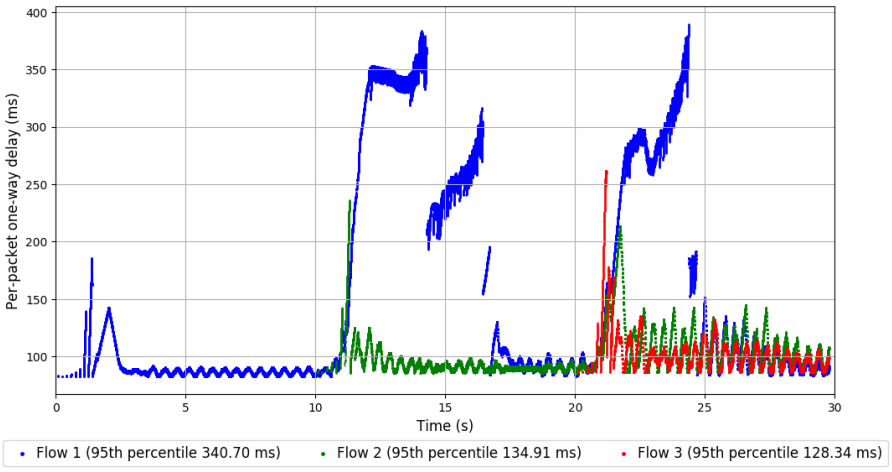
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 22:30:28
End at: 2018-09-05 22:30:58
Local clock offset: 13.677 ms
Remote clock offset: -1.928 ms

# Below is generated by plot.py at 2018-09-05 22:44:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.91 Mbit/s
95th percentile per-packet one-way delay: 315.581 ms
Loss rate: 2.49%
-- Flow 1:
Average throughput: 57.85 Mbit/s
95th percentile per-packet one-way delay: 340.697 ms
Loss rate: 2.53%
-- Flow 2:
Average throughput: 38.31 Mbit/s
95th percentile per-packet one-way delay: 134.915 ms
Loss rate: 2.48%
-- Flow 3:
Average throughput: 29.69 Mbit/s
95th percentile per-packet one-way delay: 128.343 ms
Loss rate: 2.26%
```

Run 1: Report of Indigo — Data Link



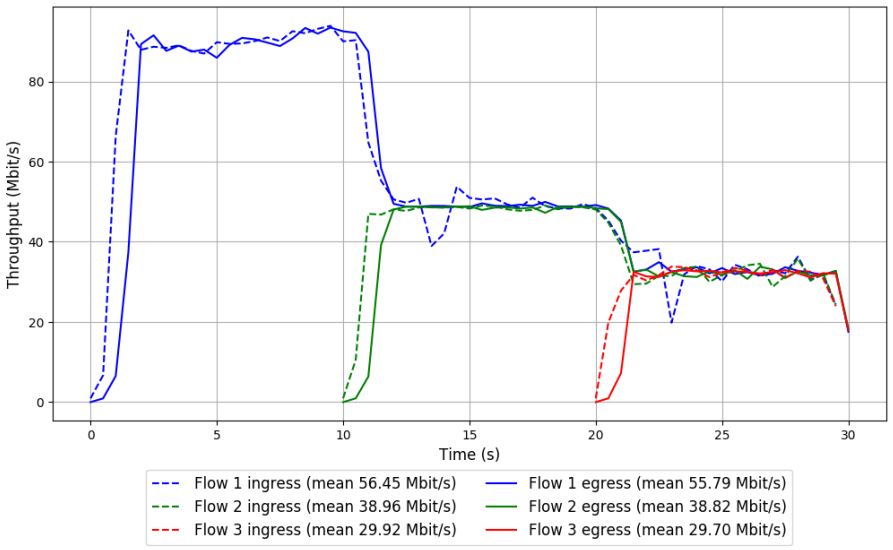


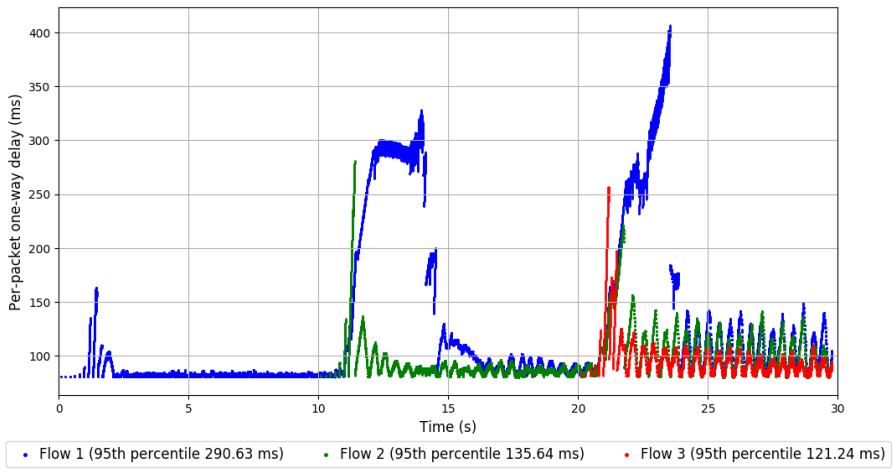
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 22:35:40
End at: 2018-09-05 22:36:10
Local clock offset: 10.543 ms
Remote clock offset: 3.002 ms

# Below is generated by plot.py at 2018-09-05 22:44:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 91.19 Mbit/s
95th percentile per-packet one-way delay: 271.131 ms
Loss rate: 1.63%
-- Flow 1:
Average throughput: 55.79 Mbit/s
95th percentile per-packet one-way delay: 290.632 ms
Loss rate: 1.72%
-- Flow 2:
Average throughput: 38.82 Mbit/s
95th percentile per-packet one-way delay: 135.637 ms
Loss rate: 1.17%
-- Flow 3:
Average throughput: 29.70 Mbit/s
95th percentile per-packet one-way delay: 121.240 ms
Loss rate: 2.37%
```

Run 2: Report of Indigo — Data Link



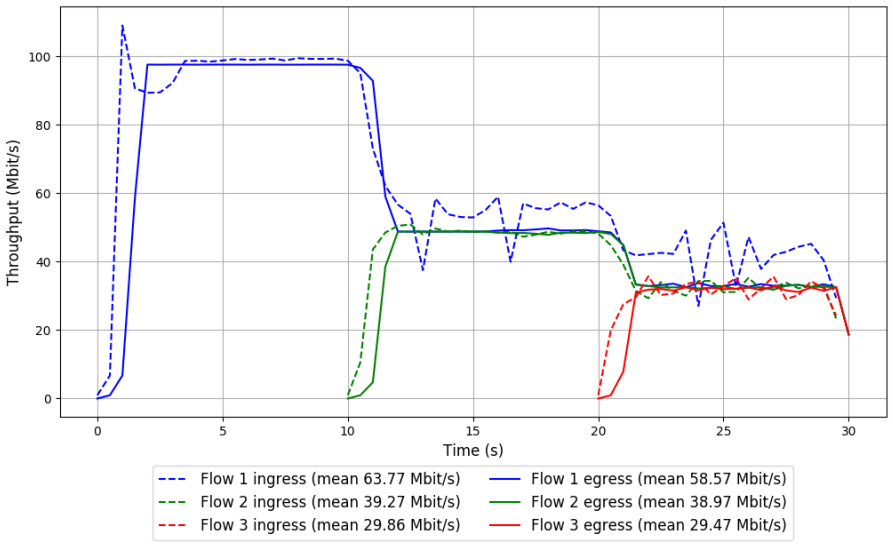


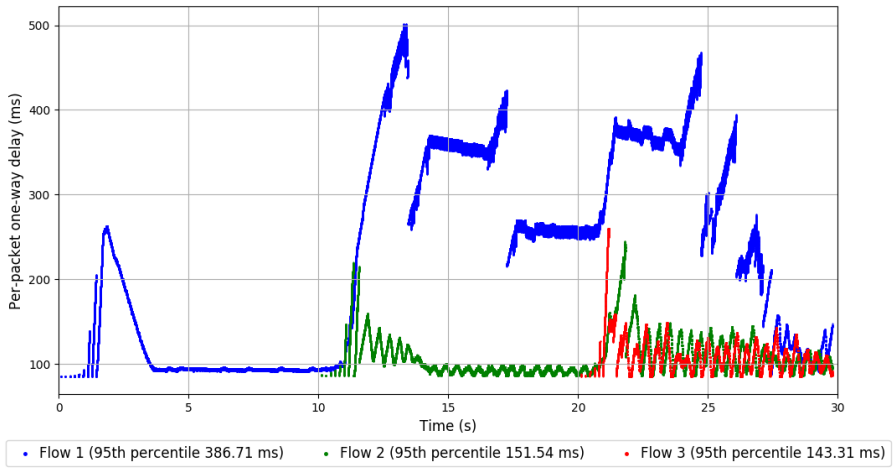
```
Run 3: Statistics of Indigo

Start at: 2018-09-05 22:40:49
End at: 2018-09-05 22:41:19
Local clock offset: 9.657 ms
Remote clock offset: -0.692 ms

# Below is generated by plot.py at 2018-09-05 22:44:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.99 Mbit/s
95th percentile per-packet one-way delay: 371.963 ms
Loss rate: 6.24%
-- Flow 1:
Average throughput: 58.57 Mbit/s
95th percentile per-packet one-way delay: 386.708 ms
Loss rate: 8.66%
-- Flow 2:
Average throughput: 38.97 Mbit/s
95th percentile per-packet one-way delay: 151.540 ms
Loss rate: 1.59%
-- Flow 3:
Average throughput: 29.47 Mbit/s
95th percentile per-packet one-way delay: 143.312 ms
Loss rate: 2.93%
```

Run 3: Report of Indigo — Data Link



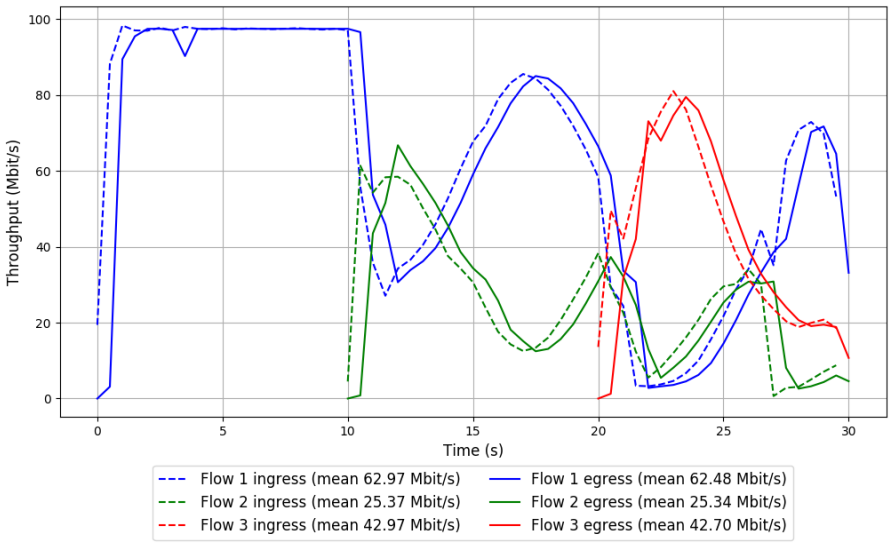


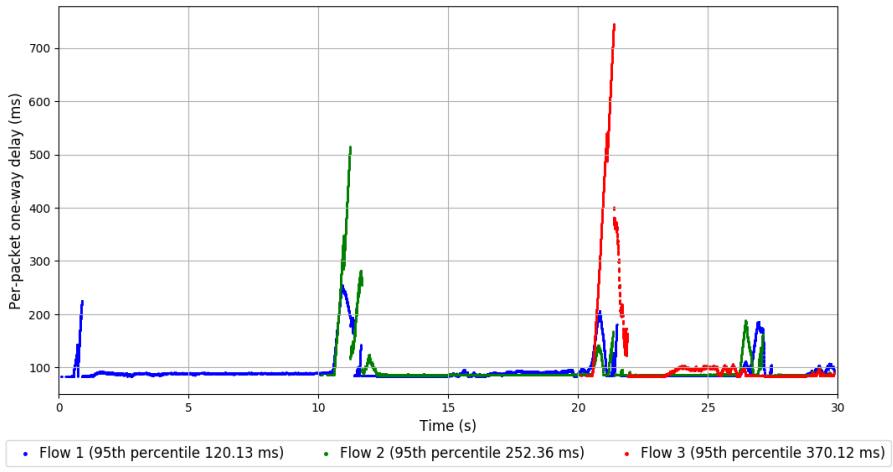
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 22:29:10
End at: 2018-09-05 22:29:40
Local clock offset: 14.223 ms
Remote clock offset: -1.97 ms

# Below is generated by plot.py at 2018-09-05 22:44:45
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.26 Mbit/s
95th percentile per-packet one-way delay: 174.657 ms
Loss rate: 1.37%
-- Flow 1:
Average throughput: 62.48 Mbit/s
95th percentile per-packet one-way delay: 120.127 ms
Loss rate: 1.31%
-- Flow 2:
Average throughput: 25.34 Mbit/s
95th percentile per-packet one-way delay: 252.359 ms
Loss rate: 0.97%
-- Flow 3:
Average throughput: 42.70 Mbit/s
95th percentile per-packet one-way delay: 370.123 ms
Loss rate: 2.07%
```

Run 1: Report of Muses-25 — Data Link



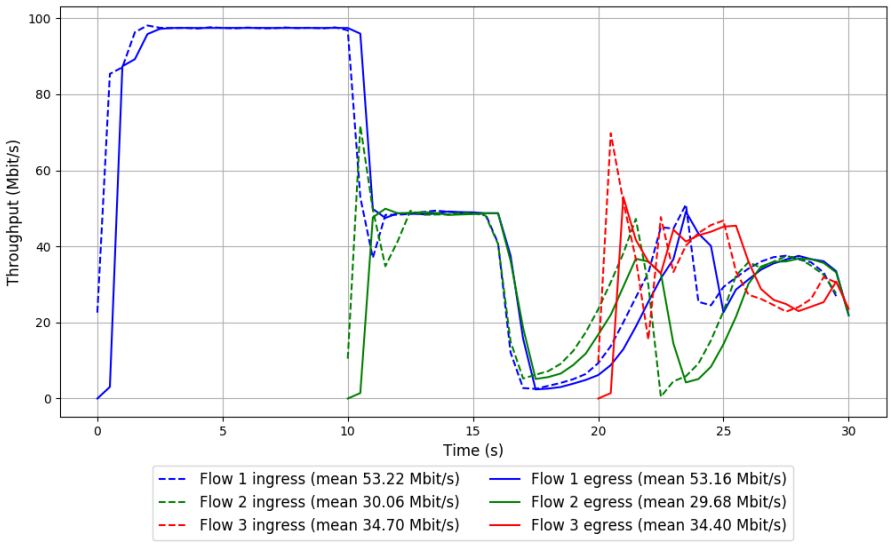


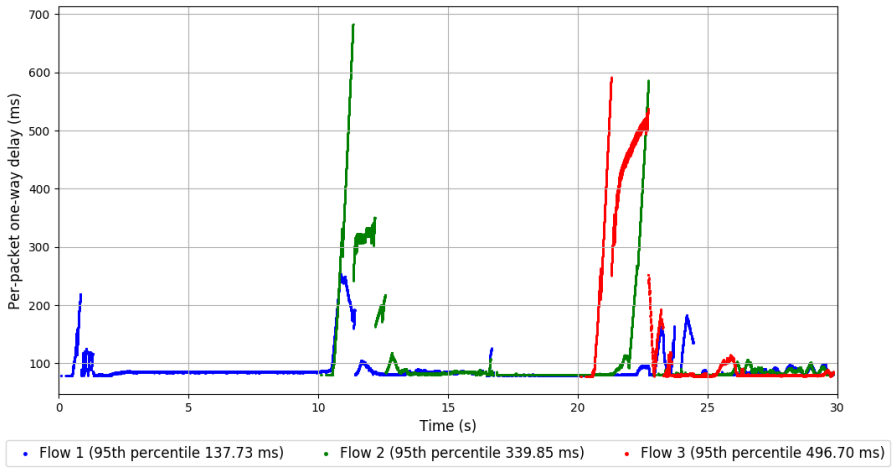
```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 22:34:23
End at: 2018-09-05 22:34:53
Local clock offset: 11.191 ms
Remote clock offset: 4.253 ms

# Below is generated by plot.py at 2018-09-05 22:44:45
# Datalink statistics
-- Total of 3 flows:
Average throughput: 84.11 Mbit/s
95th percentile per-packet one-way delay: 309.998 ms
Loss rate: 1.24%
-- Flow 1:
Average throughput: 53.16 Mbit/s
95th percentile per-packet one-way delay: 137.726 ms
Loss rate: 0.67%
-- Flow 2:
Average throughput: 29.68 Mbit/s
95th percentile per-packet one-way delay: 339.845 ms
Loss rate: 2.04%
-- Flow 3:
Average throughput: 34.40 Mbit/s
95th percentile per-packet one-way delay: 496.702 ms
Loss rate: 2.46%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 22:39:32
End at: 2018-09-05 22:40:02
Local clock offset: 9.931 ms
Remote clock offset: 4.191 ms

# Below is generated by plot.py at 2018-09-05 22:44:45
# Datalink statistics
-- Total of 3 flows:
Average throughput: 88.51 Mbit/s
95th percentile per-packet one-way delay: 162.956 ms
Loss rate: 1.46%
-- Flow 1:
Average throughput: 51.38 Mbit/s
95th percentile per-packet one-way delay: 105.565 ms
Loss rate: 1.22%
-- Flow 2:
Average throughput: 34.62 Mbit/s
95th percentile per-packet one-way delay: 303.465 ms
Loss rate: 1.56%
-- Flow 3:
Average throughput: 43.25 Mbit/s
95th percentile per-packet one-way delay: 234.649 ms
Loss rate: 2.17%
```

Run 3: Report of Muses-25 — Data Link