Pantheon Report

Generated at 2018-09-05 22:43:09 (UTC).

Data path: Brazil on `p4p1` (*remote*) →AWS Brazil 1 on `ens5` (*local*).

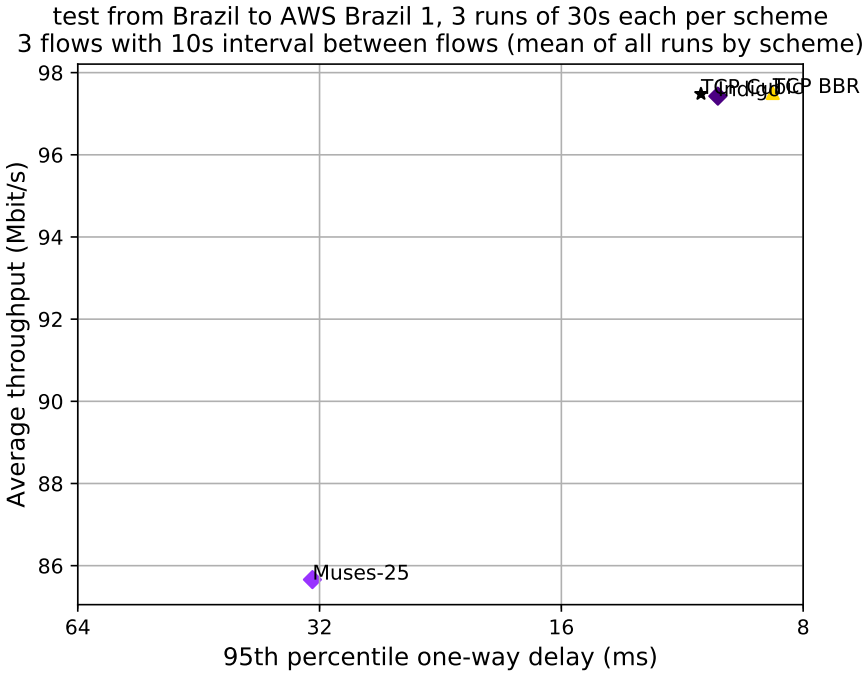
Repeated the test of 4 congestion control schemes 3 times.

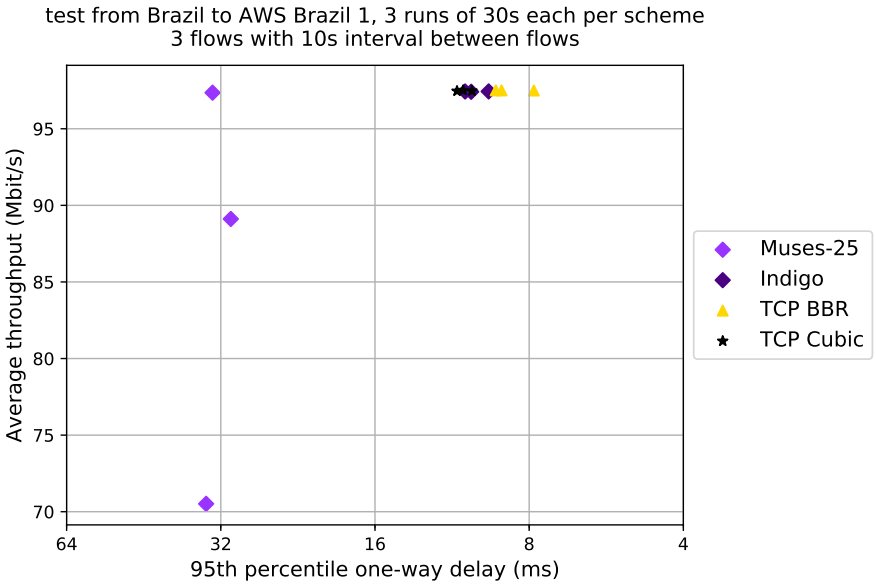
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 Brazil to AWS Brazil 1, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Average throughput (Mbit/s)
98
96
94
92
90
88
86
Muses-25
64
32
16
8
95th percentile one-way delay (ms)


test from Brazil to AWS Brazil 1, 3 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
95
90
85
80
75
70
64
32
16
8
4
95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic

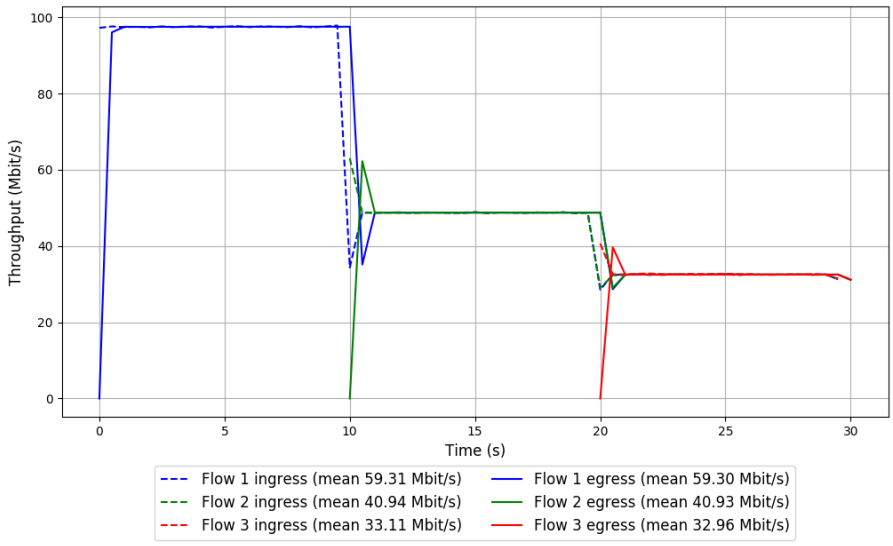
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	59.32	40.93	32.92	7.78	8.09	9.14	0.12	0.04	0.44
TCP Cubic	3	59.61	40.65	32.49	10.74	10.54	10.81	0.09	0.16	0.26
Indigo	3	59.70	40.68	32.47	9.85	10.34	8.96	0.37	1.52	0.20
Muses-25	3	45.35	41.28	38.78	17.37	28.49	28.82	0.67	2.51	0.61

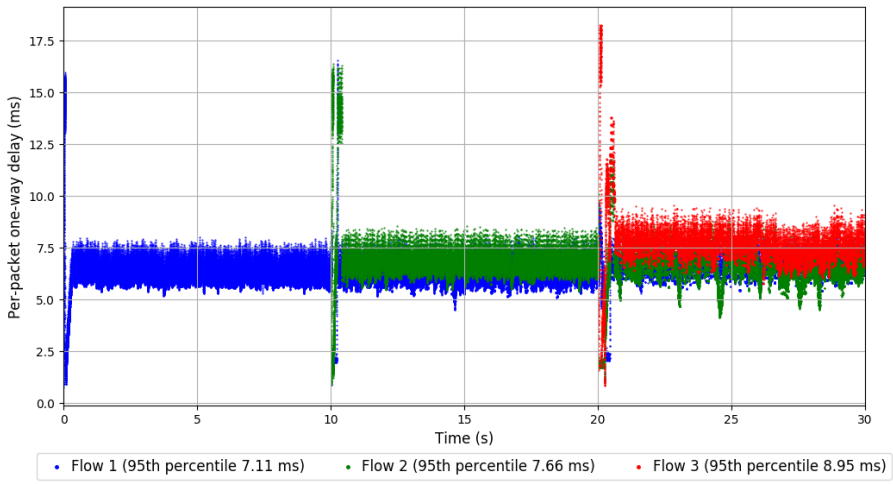
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 22:28:59
End at: 2018-09-05 22:29:29
Local clock offset: 12.155 ms
Remote clock offset: 0.367 ms

# Below is generated by plot.py at 2018-09-05 22:42:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.50 Mbit/s
95th percentile per-packet one-way delay: 7.834 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 59.30 Mbit/s
95th percentile per-packet one-way delay: 7.107 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 40.93 Mbit/s
95th percentile per-packet one-way delay: 7.663 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 32.96 Mbit/s
95th percentile per-packet one-way delay: 8.953 ms
Loss rate: 0.50%
```

Run 1: Report of TCP BBR — Data Link



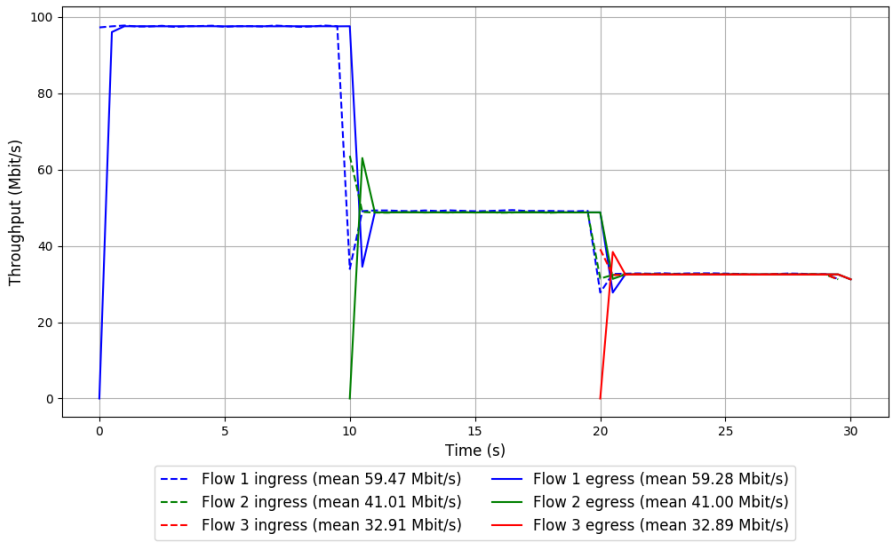


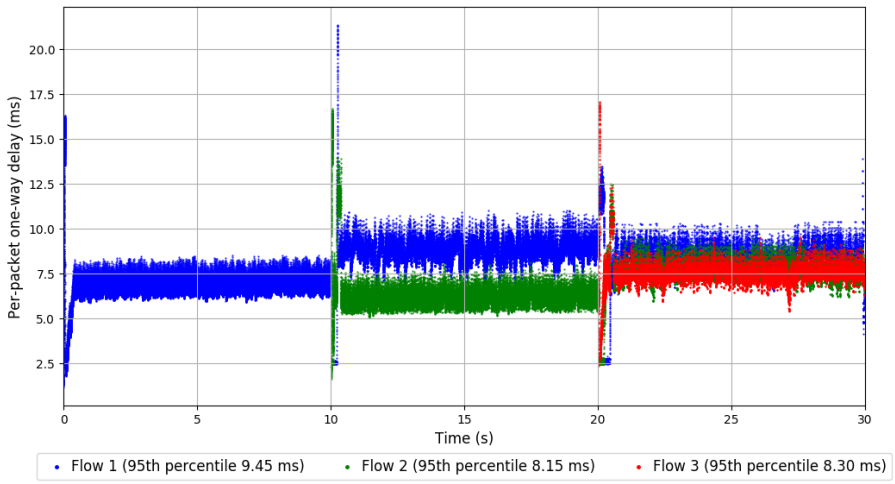
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 22:33:36
End at: 2018-09-05 22:34:06
Local clock offset: 9.434 ms
Remote clock offset: 0.342 ms

# Below is generated by plot.py at 2018-09-05 22:42:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.51 Mbit/s
95th percentile per-packet one-way delay: 9.297 ms
Loss rate: 0.22%
-- Flow 1:
Average throughput: 59.28 Mbit/s
95th percentile per-packet one-way delay: 9.447 ms
Loss rate: 0.33%
-- Flow 2:
Average throughput: 41.00 Mbit/s
95th percentile per-packet one-way delay: 8.155 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 32.89 Mbit/s
95th percentile per-packet one-way delay: 8.296 ms
Loss rate: 0.08%
```

Run 2: Report of TCP BBR — Data Link



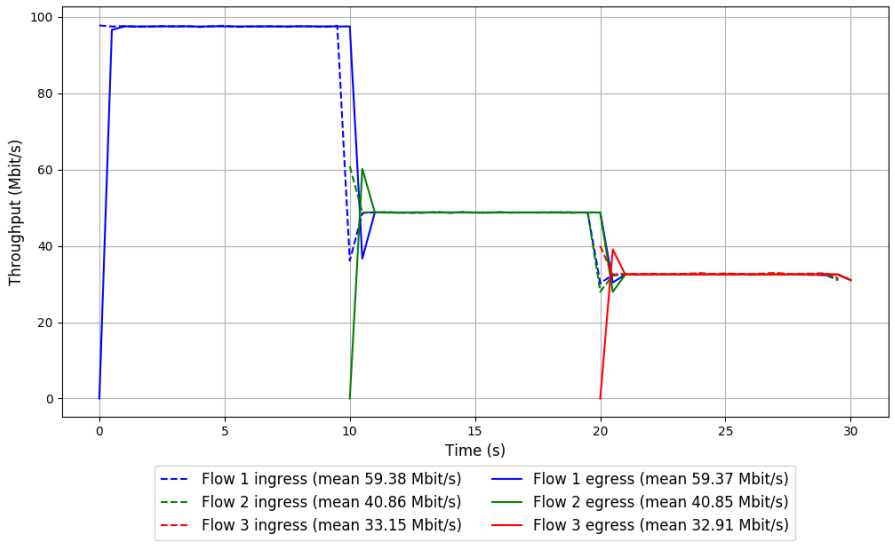


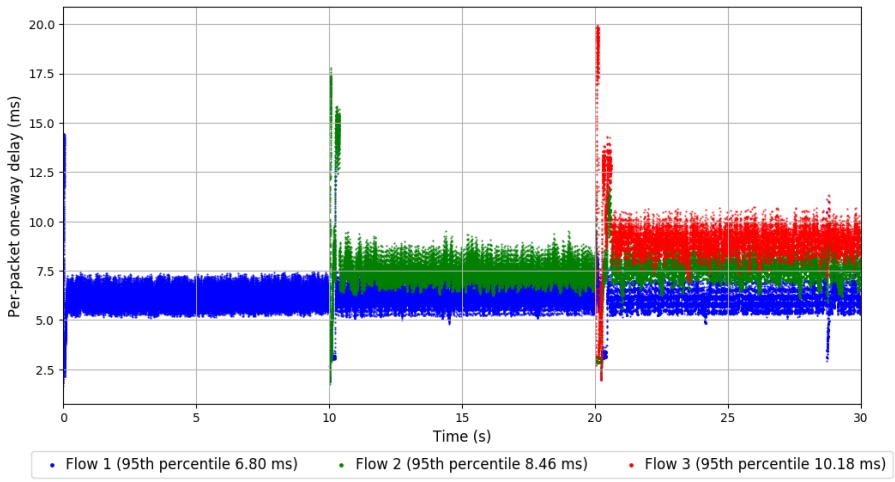
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 22:38:14
End at: 2018-09-05 22:38:44
Local clock offset: 6.915 ms
Remote clock offset: 0.397 ms

# Below is generated by plot.py at 2018-09-05 22:42:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.51 Mbit/s
95th percentile per-packet one-way delay: 9.057 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 59.37 Mbit/s
95th percentile per-packet one-way delay: 6.799 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 40.85 Mbit/s
95th percentile per-packet one-way delay: 8.457 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 32.91 Mbit/s
95th percentile per-packet one-way delay: 10.184 ms
Loss rate: 0.75%
```

Run 3: Report of TCP BBR — Data Link



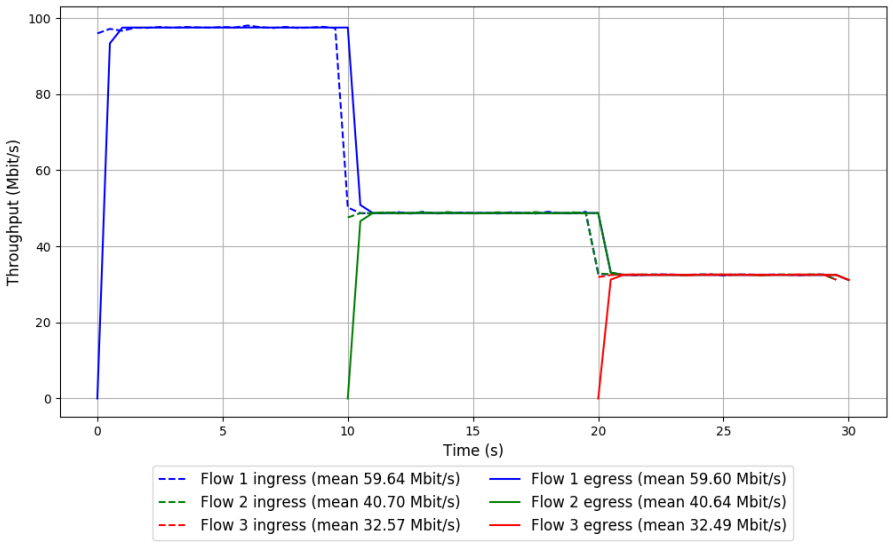


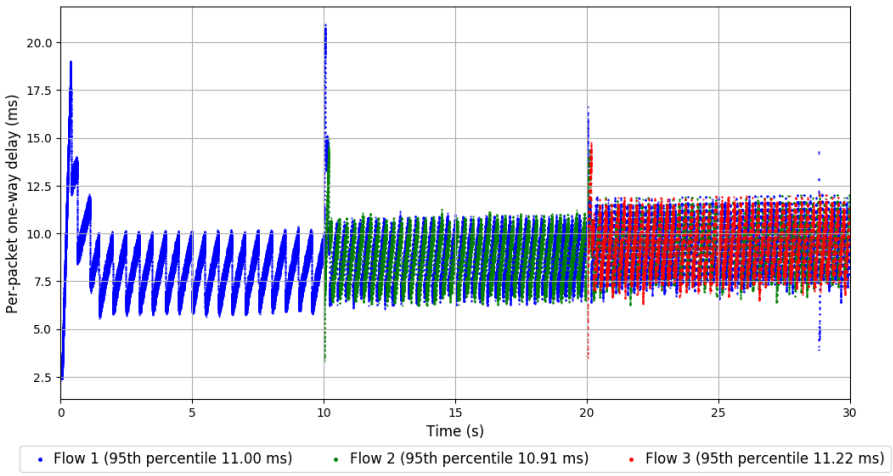
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 22:31:19
End at: 2018-09-05 22:31:49
Local clock offset: 12.787 ms
Remote clock offset: 0.32 ms

# Below is generated by plot.py at 2018-09-05 22:42:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.46 Mbit/s
95th percentile per-packet one-way delay: 11.065 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 59.60 Mbit/s
95th percentile per-packet one-way delay: 10.998 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 40.64 Mbit/s
95th percentile per-packet one-way delay: 10.910 ms
Loss rate: 0.16%
-- Flow 3:
Average throughput: 32.49 Mbit/s
95th percentile per-packet one-way delay: 11.221 ms
Loss rate: 0.27%
```

Run 1: Report of TCP Cubic — Data Link



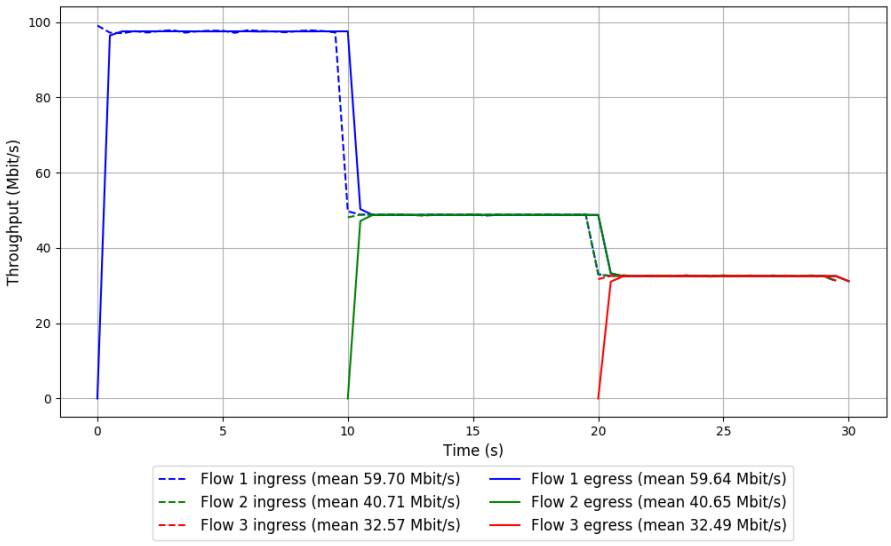


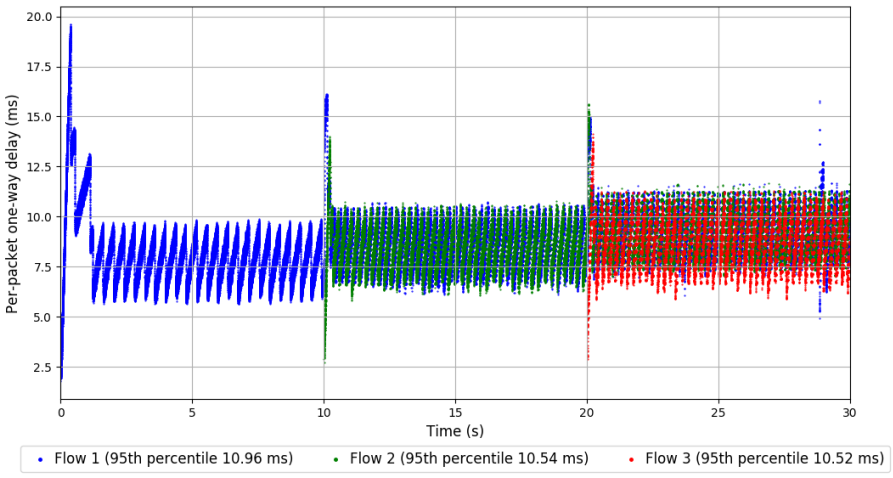
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 22:35:55
End at: 2018-09-05 22:36:25
Local clock offset: 8.299 ms
Remote clock offset: 0.346 ms

# Below is generated by plot.py at 2018-09-05 22:42:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.51 Mbit/s
95th percentile per-packet one-way delay: 10.759 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 59.64 Mbit/s
95th percentile per-packet one-way delay: 10.957 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 40.65 Mbit/s
95th percentile per-packet one-way delay: 10.538 ms
Loss rate: 0.17%
-- Flow 3:
Average throughput: 32.49 Mbit/s
95th percentile per-packet one-way delay: 10.520 ms
Loss rate: 0.25%
```

Run 2: Report of TCP Cubic — Data Link



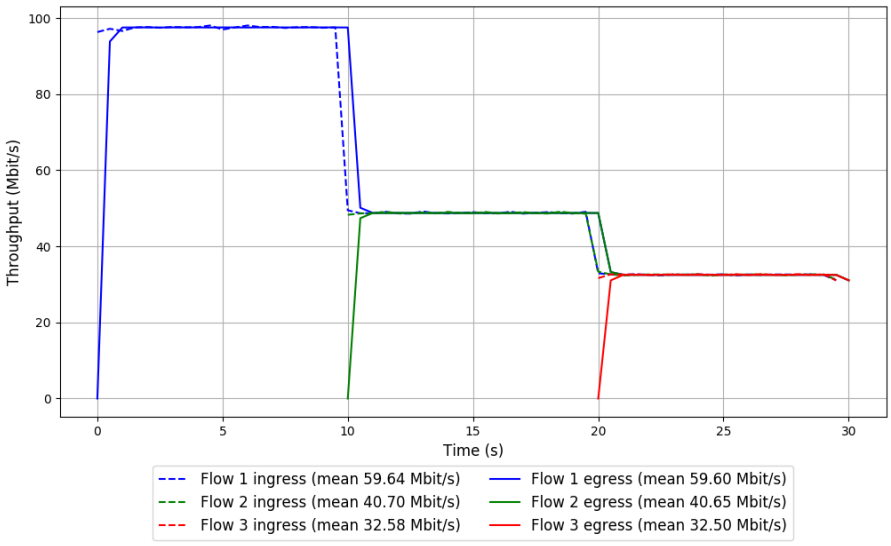


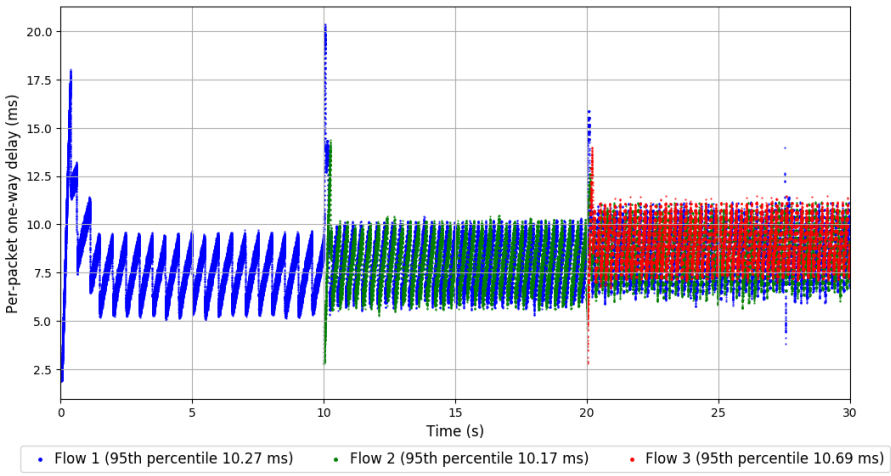
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 22:40:33
End at: 2018-09-05 22:41:03
Local clock offset: 6.047 ms
Remote clock offset: 0.371 ms

# Below is generated by plot.py at 2018-09-05 22:42:36
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.47 Mbit/s
95th percentile per-packet one-way delay: 10.346 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 59.60 Mbit/s
95th percentile per-packet one-way delay: 10.266 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 40.65 Mbit/s
95th percentile per-packet one-way delay: 10.172 ms
Loss rate: 0.15%
-- Flow 3:
Average throughput: 32.50 Mbit/s
95th percentile per-packet one-way delay: 10.694 ms
Loss rate: 0.27%
```

Run 3: Report of TCP Cubic — Data Link



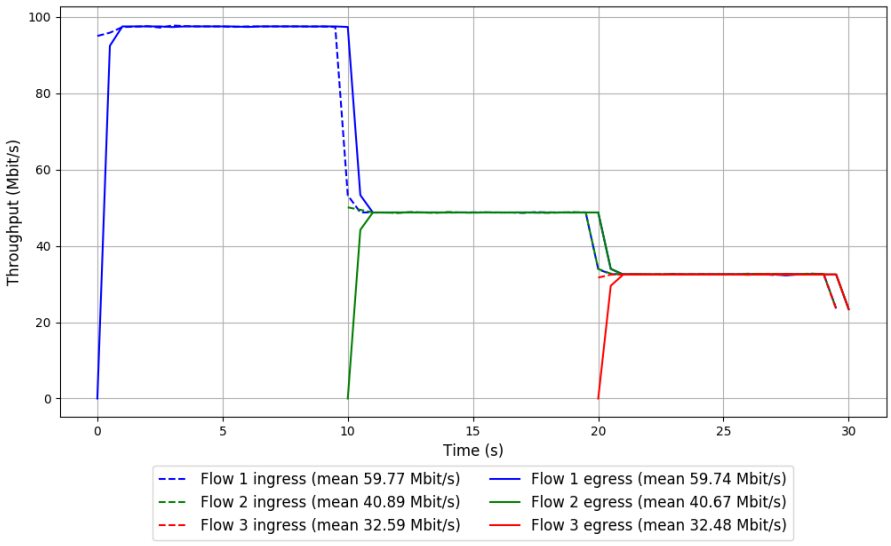


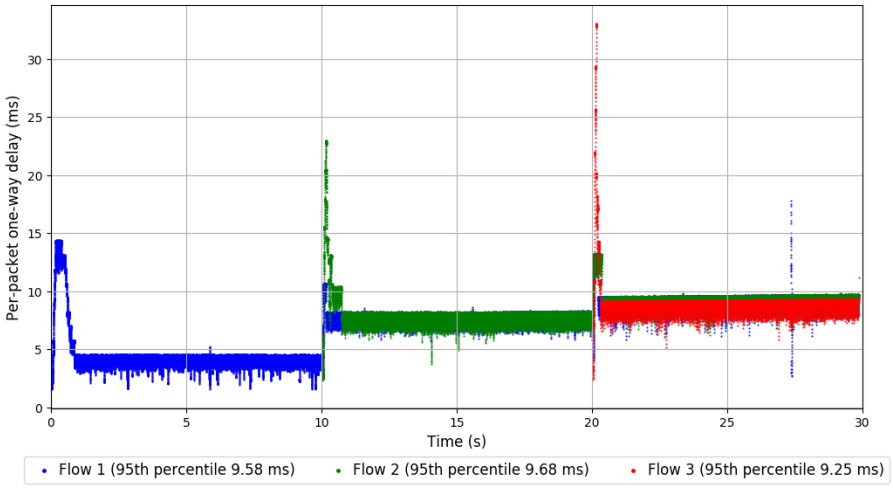
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 22:30:08
End at: 2018-09-05 22:30:38
Local clock offset: 13.083 ms
Remote clock offset: 0.383 ms

# Below is generated by plot.py at 2018-09-05 22:42:38
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.44 Mbit/s
95th percentile per-packet one-way delay: 9.598 ms
Loss rate: 0.23%
-- Flow 1:
Average throughput: 59.74 Mbit/s
95th percentile per-packet one-way delay: 9.576 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 40.67 Mbit/s
95th percentile per-packet one-way delay: 9.682 ms
Loss rate: 0.54%
-- Flow 3:
Average throughput: 32.48 Mbit/s
95th percentile per-packet one-way delay: 9.253 ms
Loss rate: 0.37%
```

Run 1: Report of Indigo — Data Link



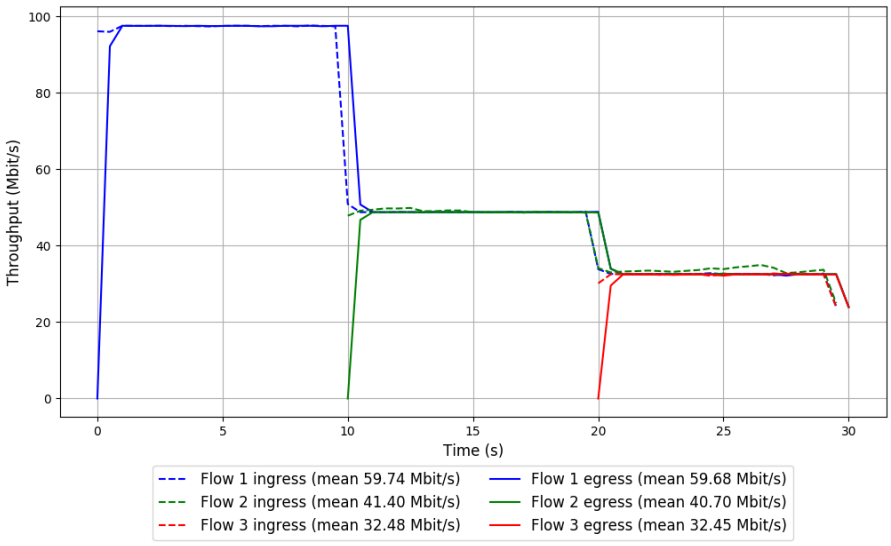


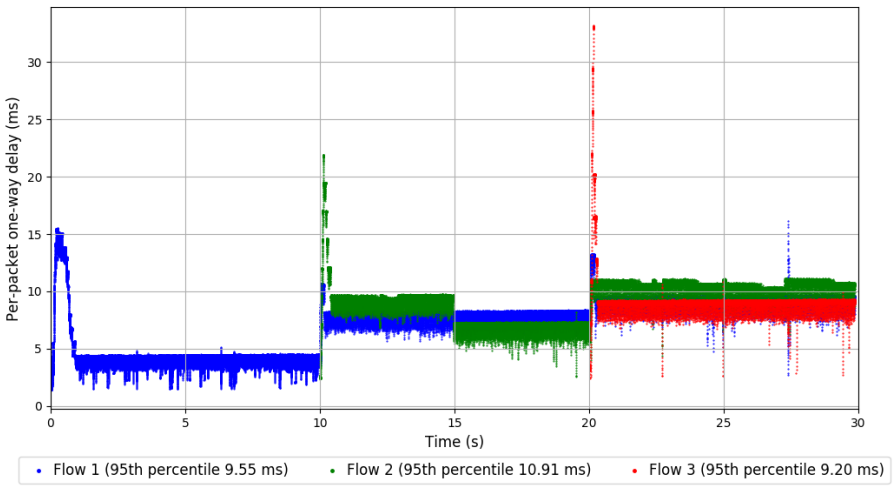
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 22:34:45
End at: 2018-09-05 22:35:15
Local clock offset: 8.572 ms
Remote clock offset: 0.316 ms

# Below is generated by plot.py at 2018-09-05 22:42:38
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.43 Mbit/s
95th percentile per-packet one-way delay: 10.670 ms
Loss rate: 0.55%
-- Flow 1:
Average throughput: 59.68 Mbit/s
95th percentile per-packet one-way delay: 9.552 ms
Loss rate: 0.11%
-- Flow 2:
Average throughput: 40.70 Mbit/s
95th percentile per-packet one-way delay: 10.914 ms
Loss rate: 1.69%
-- Flow 3:
Average throughput: 32.45 Mbit/s
95th percentile per-packet one-way delay: 9.204 ms
Loss rate: 0.11%
```

Run 2: Report of Indigo — Data Link



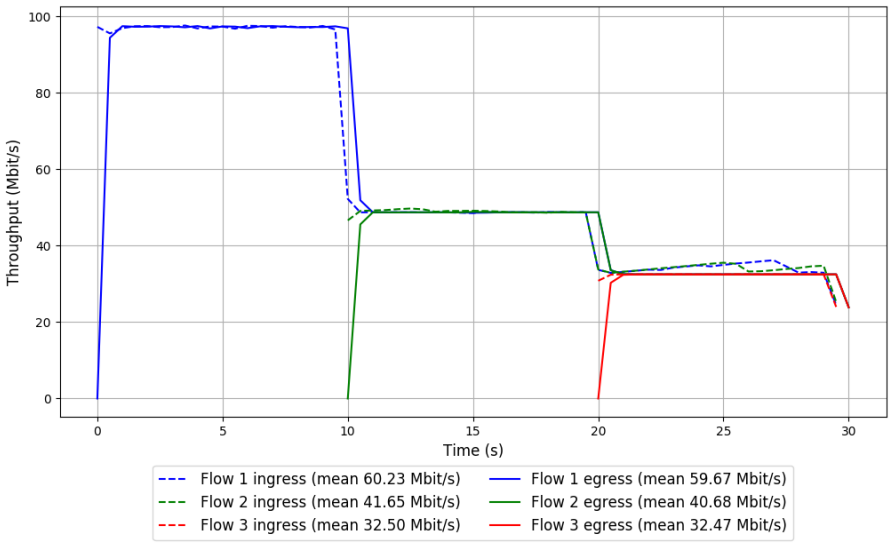


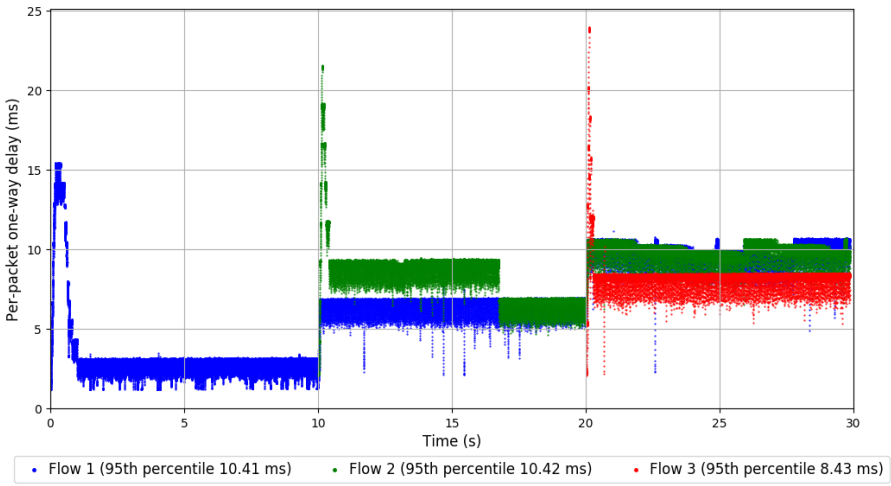
```
Run 3: Statistics of Indigo

Start at: 2018-09-05 22:39:23
End at: 2018-09-05 22:39:53
Local clock offset: 5.732 ms
Remote clock offset: 0.379 ms

# Below is generated by plot.py at 2018-09-05 22:43:07
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.41 Mbit/s
95th percentile per-packet one-way delay: 10.383 ms
Loss rate: 1.23%
-- Flow 1:
Average throughput: 59.67 Mbit/s
95th percentile per-packet one-way delay: 10.408 ms
Loss rate: 0.93%
-- Flow 2:
Average throughput: 40.68 Mbit/s
95th percentile per-packet one-way delay: 10.421 ms
Loss rate: 2.33%
-- Flow 3:
Average throughput: 32.47 Mbit/s
95th percentile per-packet one-way delay: 8.427 ms
Loss rate: 0.11%
```

Run 3: Report of Indigo — Data Link



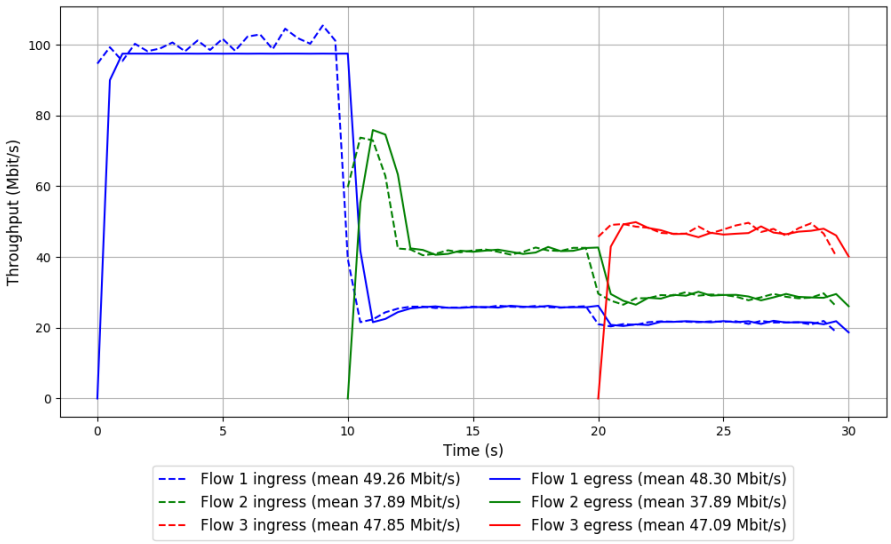


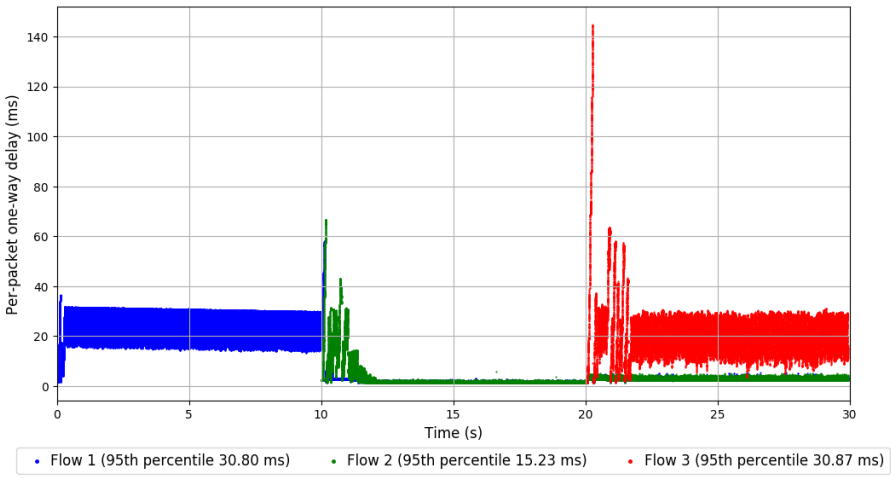
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 22:27:50
End at: 2018-09-05 22:28:20
Local clock offset: 12.656 ms
Remote clock offset: 0.434 ms

# Below is generated by plot.py at 2018-09-05 22:43:07
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.11 Mbit/s
95th percentile per-packet one-way delay: 30.591 ms
Loss rate: 1.34%
-- Flow 1:
Average throughput: 48.30 Mbit/s
95th percentile per-packet one-way delay: 30.801 ms
Loss rate: 1.96%
-- Flow 2:
Average throughput: 37.89 Mbit/s
95th percentile per-packet one-way delay: 15.227 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 47.09 Mbit/s
95th percentile per-packet one-way delay: 30.874 ms
Loss rate: 1.53%
```

Run 1: Report of Muses-25 — Data Link



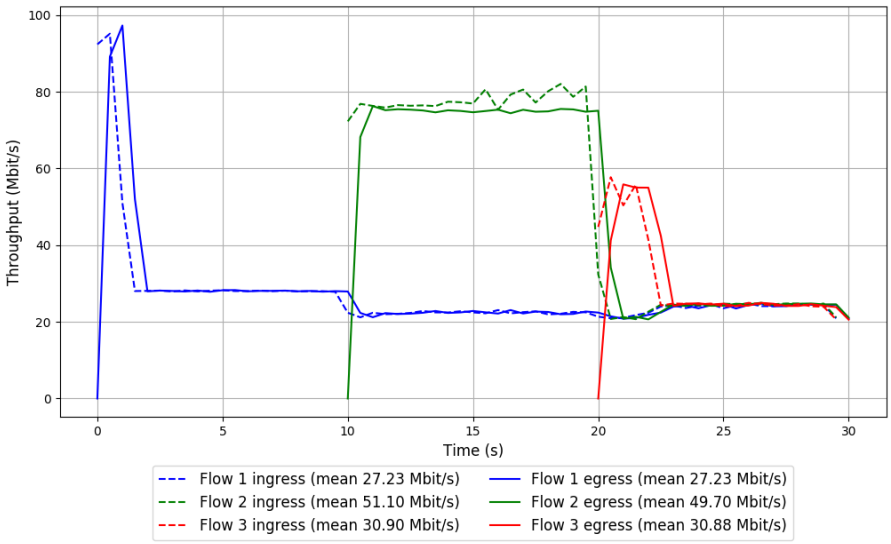


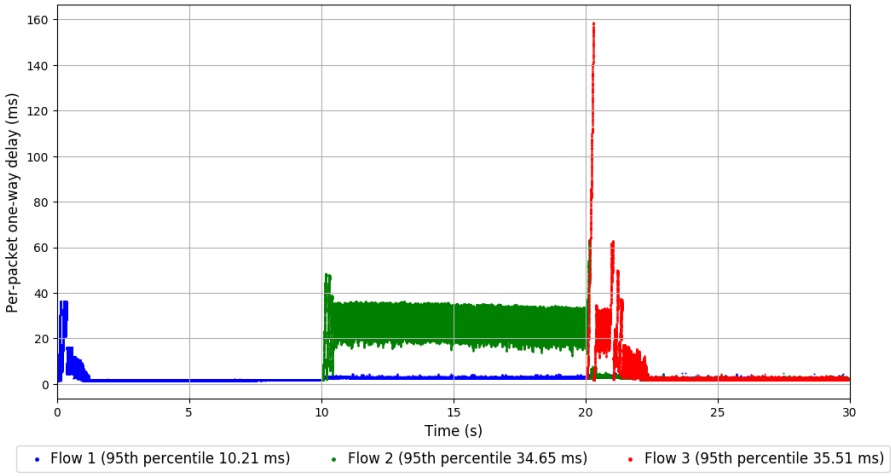
```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 22:32:28
End at: 2018-09-05 22:32:58
Local clock offset: 10.608 ms
Remote clock offset: 0.291 ms

# Below is generated by plot.py at 2018-09-05 22:43:07
# Datalink statistics
-- Total of 3 flows:
Average throughput: 70.52 Mbit/s
95th percentile per-packet one-way delay: 34.181 ms
Loss rate: 1.34%
-- Flow 1:
Average throughput: 27.23 Mbit/s
95th percentile per-packet one-way delay: 10.205 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 49.70 Mbit/s
95th percentile per-packet one-way delay: 34.647 ms
Loss rate: 2.77%
-- Flow 3:
Average throughput: 30.88 Mbit/s
95th percentile per-packet one-way delay: 35.505 ms
Loss rate: 0.10%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 22:37:05
End at: 2018-09-05 22:37:35
Local clock offset: 6.772 ms
Remote clock offset: 0.368 ms

# Below is generated by plot.py at 2018-09-05 22:43:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 97.35 Mbit/s
95th percentile per-packet one-way delay: 33.210 ms
Loss rate: 1.25%
-- Flow 1:
Average throughput: 60.53 Mbit/s
95th percentile per-packet one-way delay: 11.096 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 36.24 Mbit/s
95th percentile per-packet one-way delay: 35.591 ms
Loss rate: 4.74%
-- Flow 3:
Average throughput: 38.36 Mbit/s
95th percentile per-packet one-way delay: 20.067 ms
Loss rate: 0.19%
```

Run 3: Report of Muses-25 — Data Link