Pantheon Report

Generated at 2018-08-31 04:58:48 (UTC).

Data path: AWS California 2 on `ens5` (*local*) →Mexico on `em1` (*remote*).

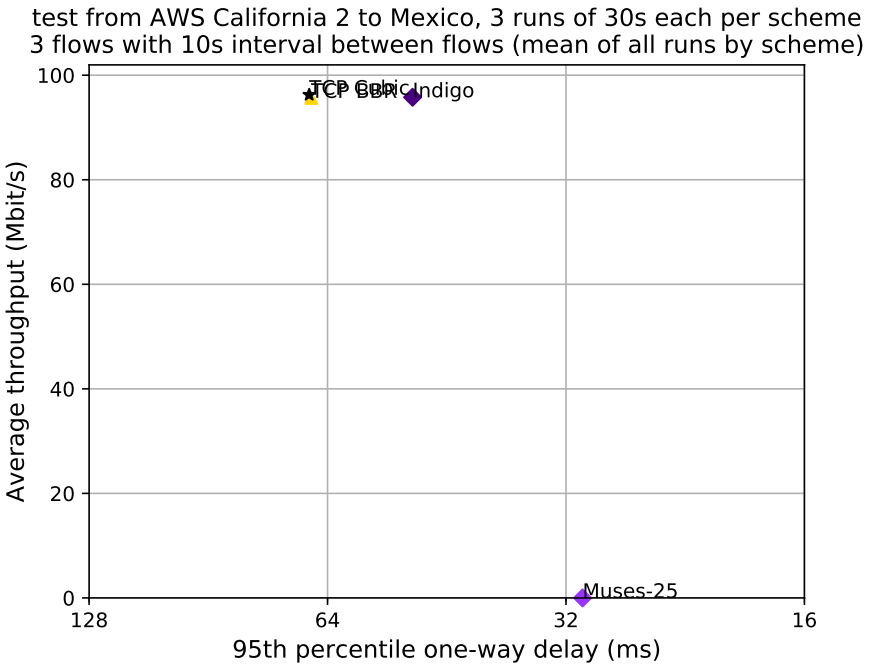
Repeated the test of 4 congestion control schemes 3 times.

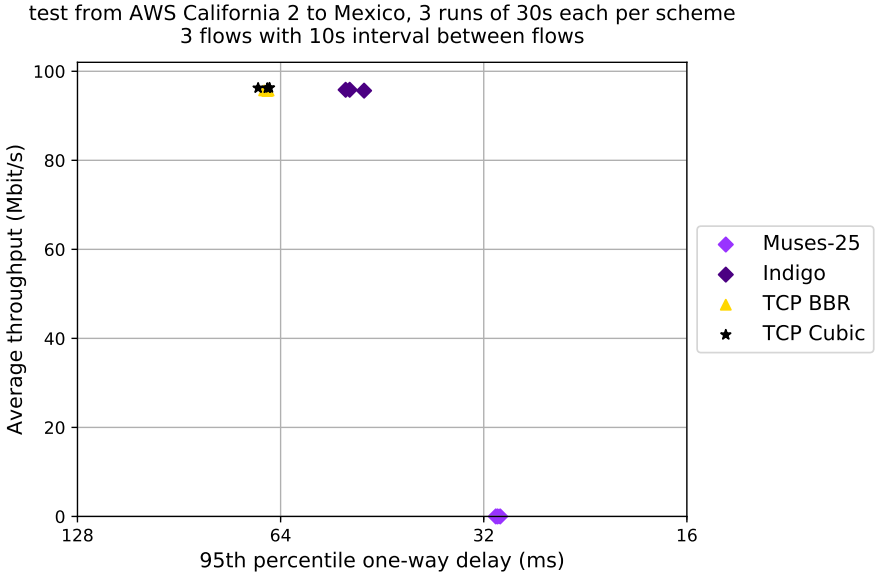
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `time.stanford.edu` 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 @ 2de97ca91a065473c29a25fffe63fb137c97a67c
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b59e0d118c50af3579569c462d33045741c85981
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 California 2 to Mexico, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
TCP Cubic
TCP BBR
Indigo
Muses-25
100
80
60
40
20
0
128
64
32
16


test from AWS California 2 to Mexico, 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
100
80
60
40
20
0
128
64
32
16

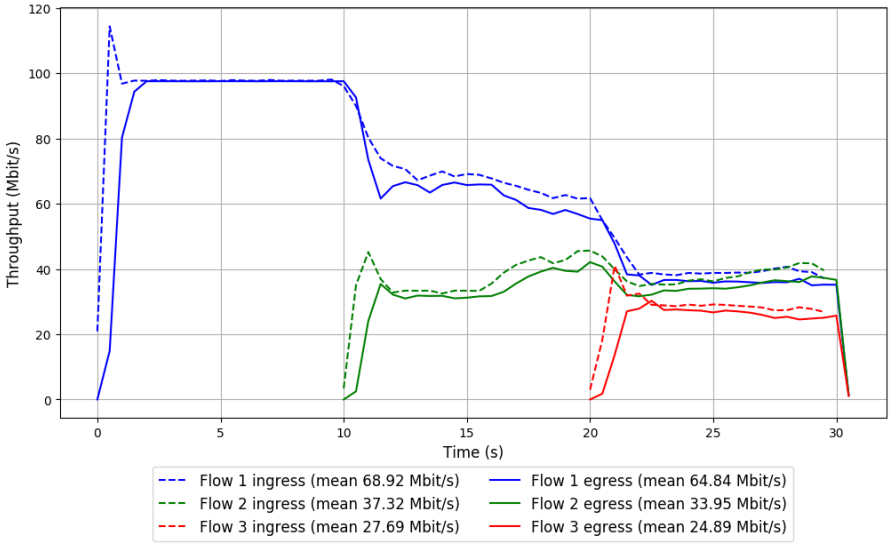
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	63.14	31.60	34.58	66.09	67.92	68.57	6.57	10.48	12.92
TCP Cubic	3	72.58	27.66	15.82	67.40	67.81	66.48	0.93	0.64	0.69
Indigo	3	65.08	30.89	31.22	46.95	52.39	55.69	0.04	0.10	0.22
Muses-25	3	0.00	0.00	0.00	30.45	30.48	30.43	0.00	0.00	0.00

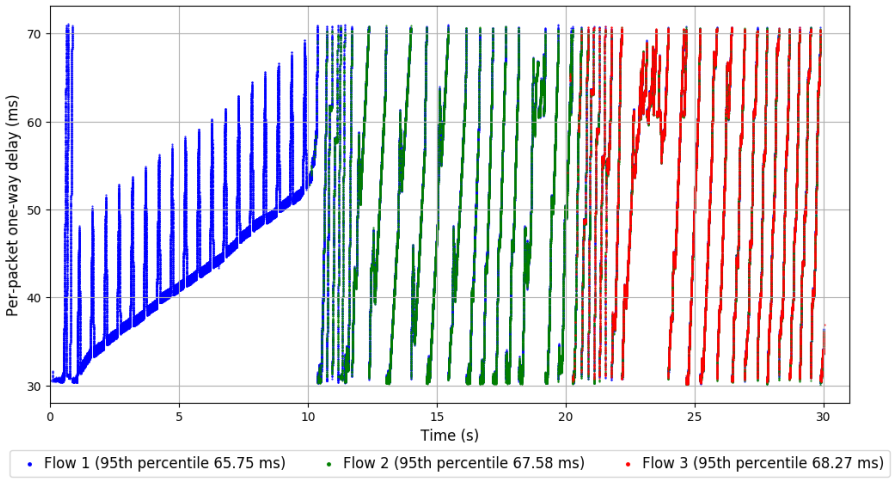
```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 04:44:36
End at: 2018-08-31 04:45:06
Local clock offset: -8.553 ms
Remote clock offset: -2.625 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.68 Mbit/s
95th percentile per-packet one-way delay: 66.673 ms
Loss rate: 7.07%
-- Flow 1:
Average throughput: 64.84 Mbit/s
95th percentile per-packet one-way delay: 65.747 ms
Loss rate: 5.90%
-- Flow 2:
Average throughput: 33.95 Mbit/s
95th percentile per-packet one-way delay: 67.581 ms
Loss rate: 9.10%
-- Flow 3:
Average throughput: 24.89 Mbit/s
95th percentile per-packet one-way delay: 68.267 ms
Loss rate: 10.27%
```

Run 1: Report of TCP BBR — Data Link



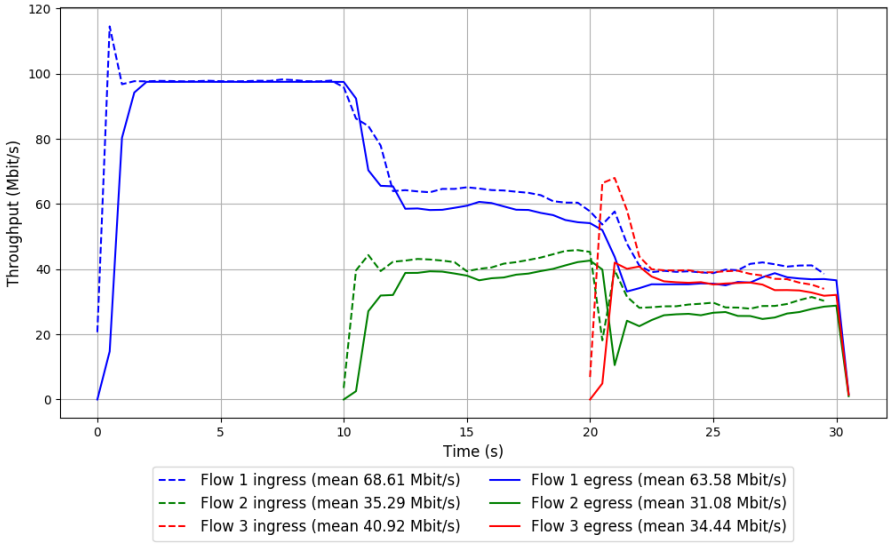


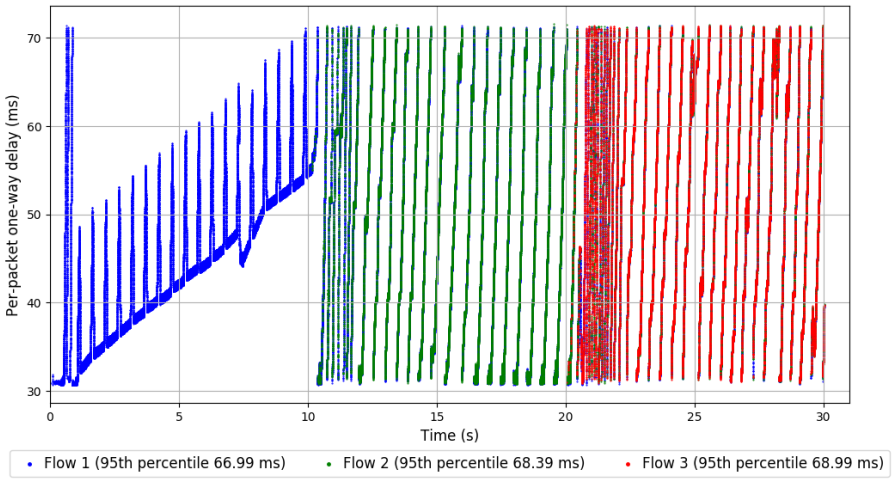
```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 04:49:58
End at: 2018-08-31 04:50:28
Local clock offset: -8.66 ms
Remote clock offset: -2.759 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.71 Mbit/s
95th percentile per-packet one-way delay: 67.698 ms
Loss rate: 9.43%
-- Flow 1:
Average throughput: 63.58 Mbit/s
95th percentile per-packet one-way delay: 66.990 ms
Loss rate: 7.30%
-- Flow 2:
Average throughput: 31.08 Mbit/s
95th percentile per-packet one-way delay: 68.389 ms
Loss rate: 11.99%
-- Flow 3:
Average throughput: 34.44 Mbit/s
95th percentile per-packet one-way delay: 68.986 ms
Loss rate: 15.76%
```

Run 2: Report of TCP BBR — Data Link



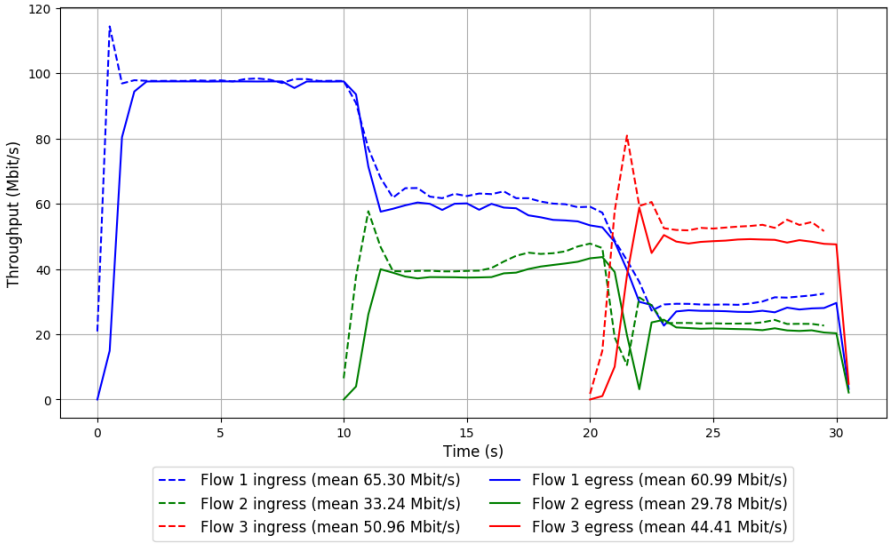


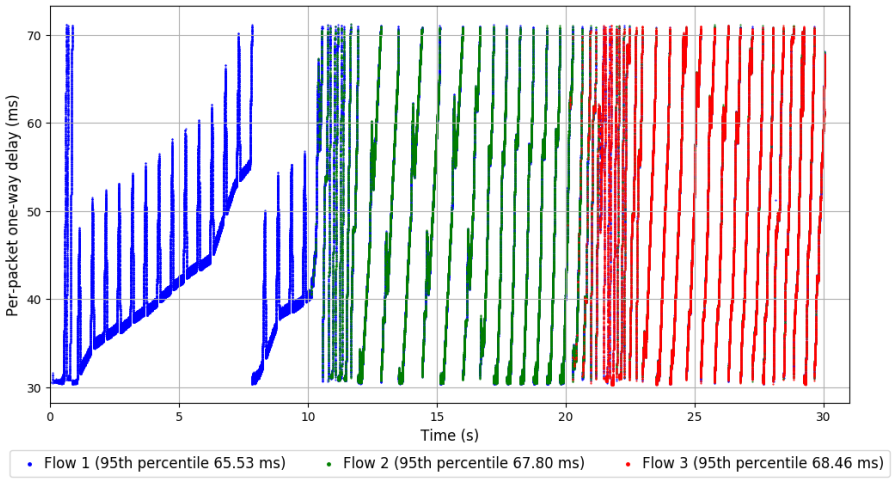
```
Run 3: Statistics of TCP BBR

Start at: 2018-08-31 04:55:20
End at: 2018-08-31 04:55:50
Local clock offset: -8.882 ms
Remote clock offset: -2.82 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.59 Mbit/s
95th percentile per-packet one-way delay: 66.988 ms
Loss rate: 8.33%
-- Flow 1:
Average throughput: 60.99 Mbit/s
95th percentile per-packet one-way delay: 65.533 ms
Loss rate: 6.51%
-- Flow 2:
Average throughput: 29.78 Mbit/s
95th percentile per-packet one-way delay: 67.799 ms
Loss rate: 10.35%
-- Flow 3:
Average throughput: 44.41 Mbit/s
95th percentile per-packet one-way delay: 68.464 ms
Loss rate: 12.74%
```

Run 3: Report of TCP BBR — Data Link



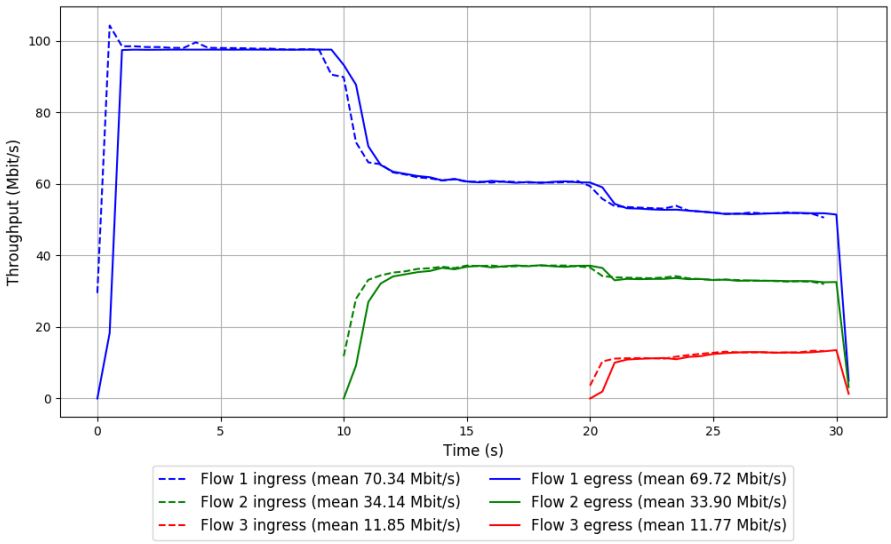


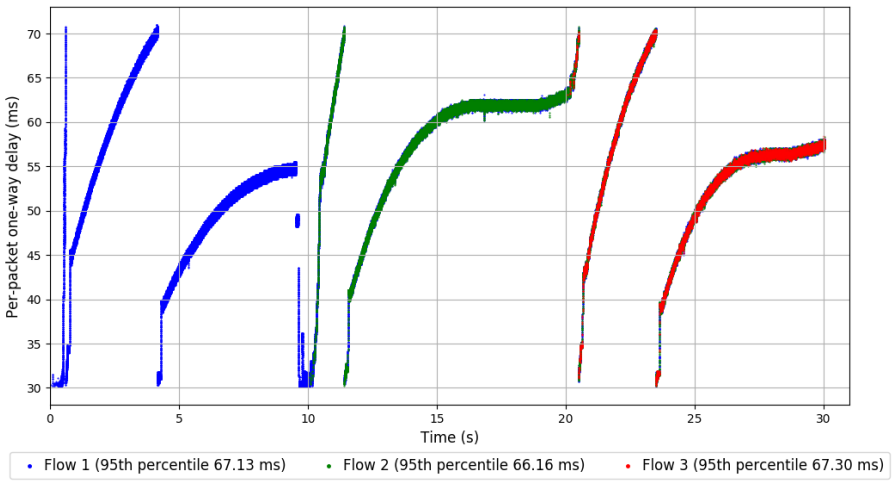
```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 04:43:14
End at: 2018-08-31 04:43:44
Local clock offset: -7.73 ms
Remote clock offset: -2.705 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.22 Mbit/s
95th percentile per-packet one-way delay: 66.972 ms
Loss rate: 0.73%
-- Flow 1:
Average throughput: 69.72 Mbit/s
95th percentile per-packet one-way delay: 67.133 ms
Loss rate: 0.78%
-- Flow 2:
Average throughput: 33.90 Mbit/s
95th percentile per-packet one-way delay: 66.163 ms
Loss rate: 0.56%
-- Flow 3:
Average throughput: 11.77 Mbit/s
95th percentile per-packet one-way delay: 67.297 ms
Loss rate: 0.77%
```

Run 1: Report of TCP Cubic — Data Link



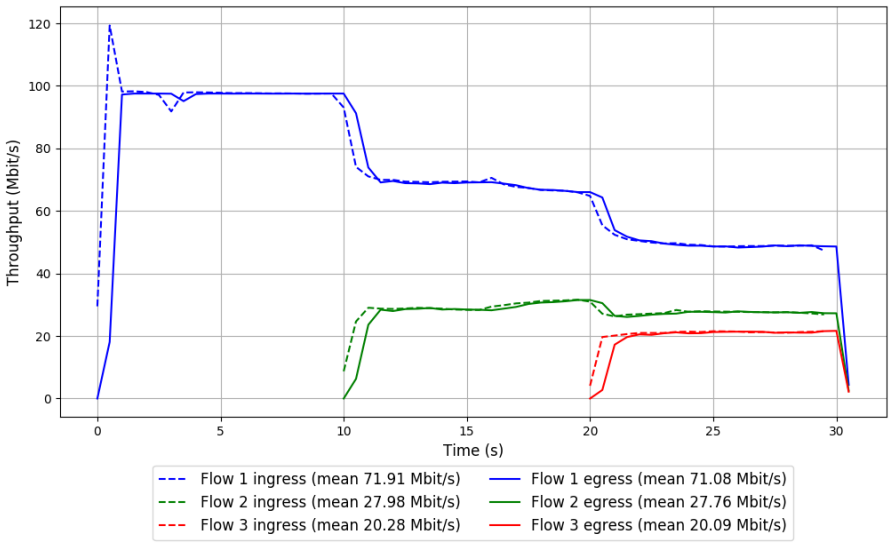


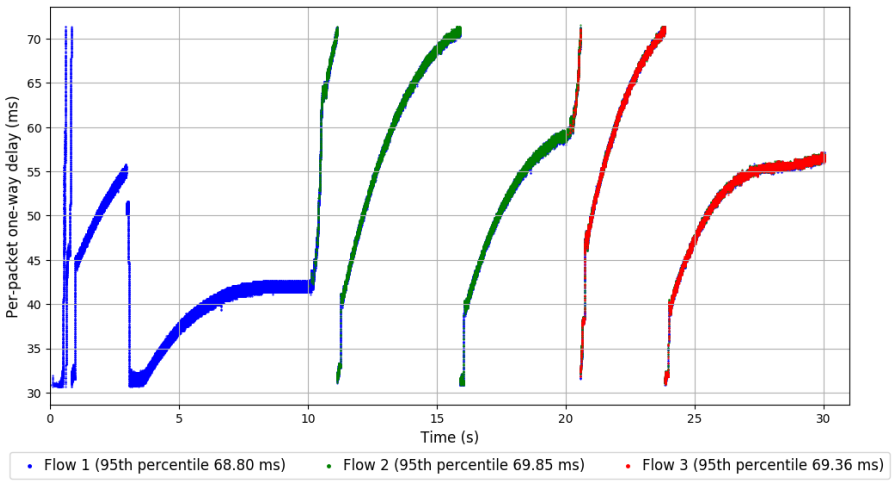
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 04:48:37
End at: 2018-08-31 04:49:07
Local clock offset: -9.084 ms
Remote clock offset: -2.932 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.25 Mbit/s
95th percentile per-packet one-way delay: 69.100 ms
Loss rate: 0.99%
-- Flow 1:
Average throughput: 71.08 Mbit/s
95th percentile per-packet one-way delay: 68.796 ms
Loss rate: 1.06%
-- Flow 2:
Average throughput: 27.76 Mbit/s
95th percentile per-packet one-way delay: 69.850 ms
Loss rate: 0.71%
-- Flow 3:
Average throughput: 20.09 Mbit/s
95th percentile per-packet one-way delay: 69.358 ms
Loss rate: 0.95%
```

Run 2: Report of TCP Cubic — Data Link



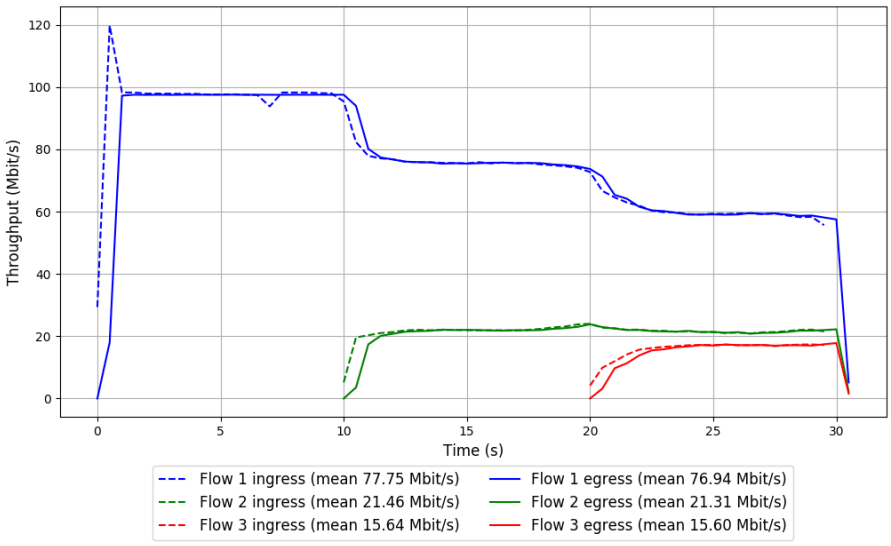


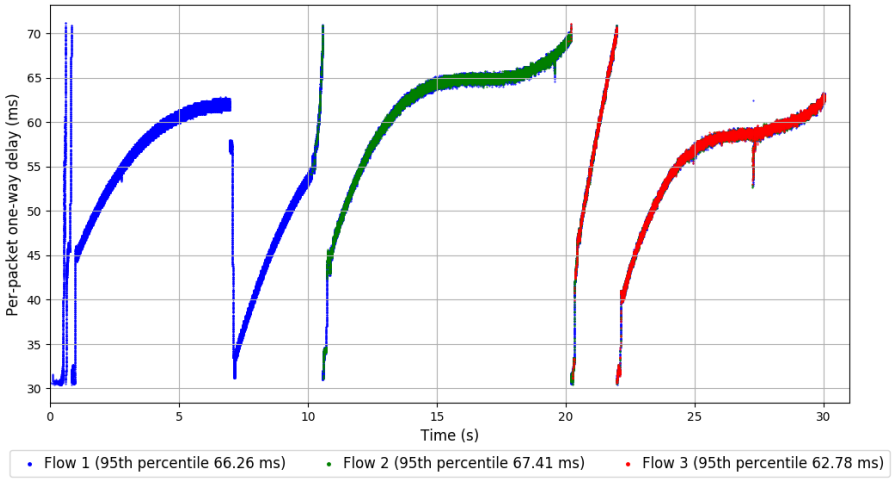
```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-31 04:53:59
End at: 2018-08-31 04:54:29
Local clock offset: -8.746 ms
Remote clock offset: -2.969 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.29 Mbit/s
95th percentile per-packet one-way delay: 66.471 ms
Loss rate: 0.87%
-- Flow 1:
Average throughput: 76.94 Mbit/s
95th percentile per-packet one-way delay: 66.262 ms
Loss rate: 0.94%
-- Flow 2:
Average throughput: 21.31 Mbit/s
95th percentile per-packet one-way delay: 67.408 ms
Loss rate: 0.64%
-- Flow 3:
Average throughput: 15.60 Mbit/s
95th percentile per-packet one-way delay: 62.783 ms
Loss rate: 0.34%
```

Run 3: Report of TCP Cubic — Data Link



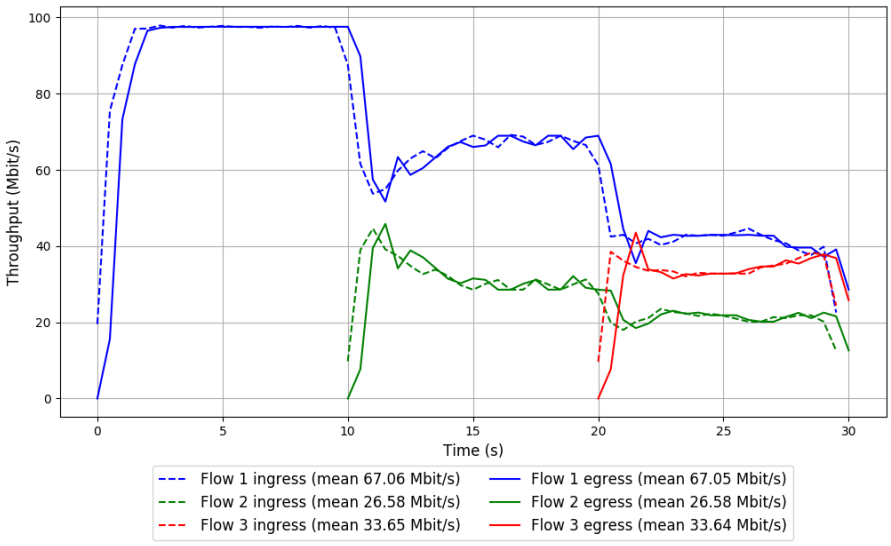


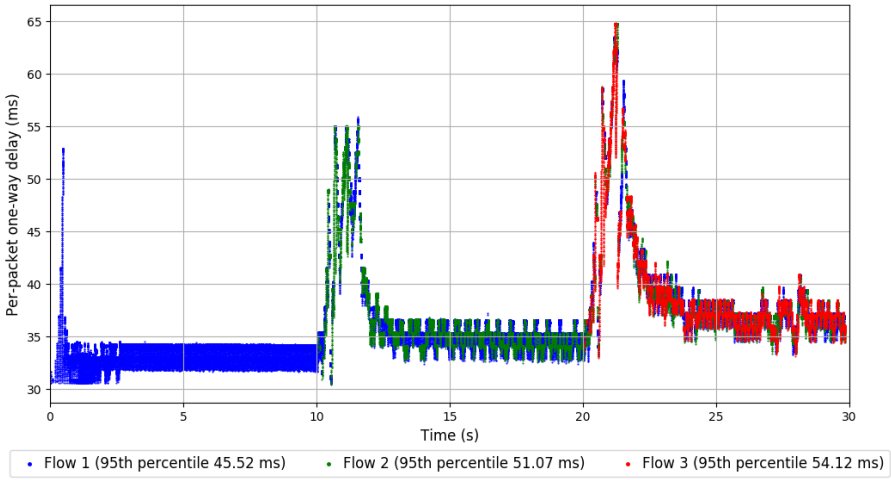
```
Run 1: Statistics of Indigo

Start at: 2018-08-31 04:41:51
End at: 2018-08-31 04:42:21
Local clock offset: -7.135 ms
Remote clock offset: -2.571 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.65 Mbit/s
95th percentile per-packet one-way delay: 48.135 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 67.05 Mbit/s
95th percentile per-packet one-way delay: 45.523 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 26.58 Mbit/s
95th percentile per-packet one-way delay: 51.066 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 33.64 Mbit/s
95th percentile per-packet one-way delay: 54.123 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link



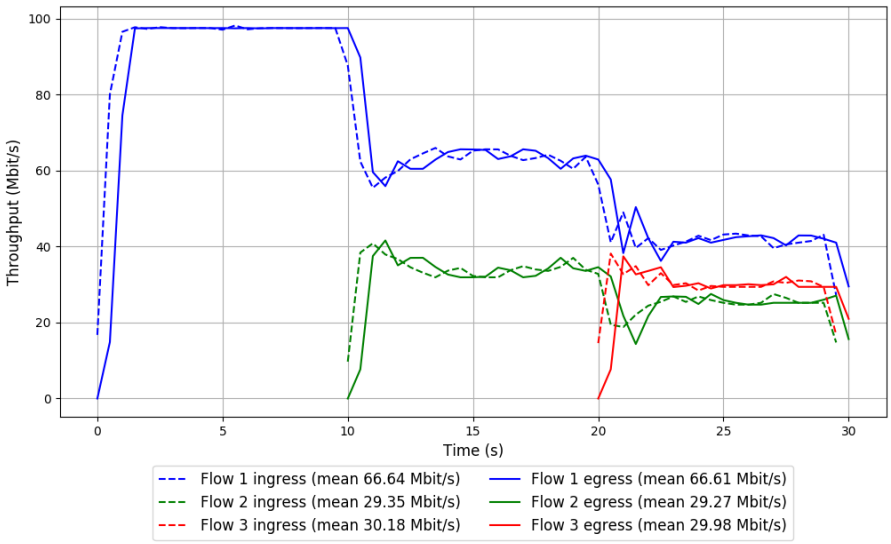


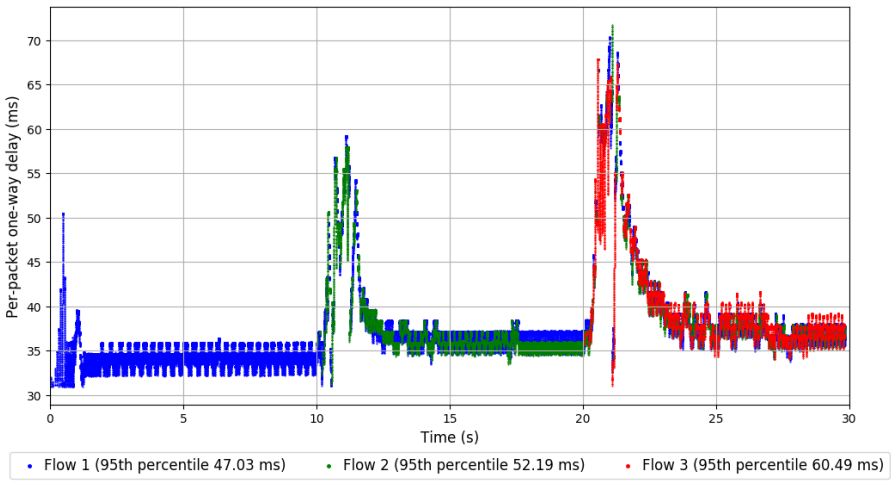
```
Run 2: Statistics of Indigo

Start at: 2018-08-31 04:47:14
End at: 2018-08-31 04:47:44
Local clock offset: -9.548 ms
Remote clock offset: -2.649 ms

# Below is generated by plot.py at 2018-08-31 04:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.84 Mbit/s
95th percentile per-packet one-way delay: 50.560 ms
Loss rate: 0.14%
-- Flow 1:
Average throughput: 66.61 Mbit/s
95th percentile per-packet one-way delay: 47.026 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 29.27 Mbit/s
95th percentile per-packet one-way delay: 52.194 ms
Loss rate: 0.28%
-- Flow 3:
Average throughput: 29.98 Mbit/s
95th percentile per-packet one-way delay: 60.492 ms
Loss rate: 0.66%
```

Run 2: Report of Indigo — Data Link



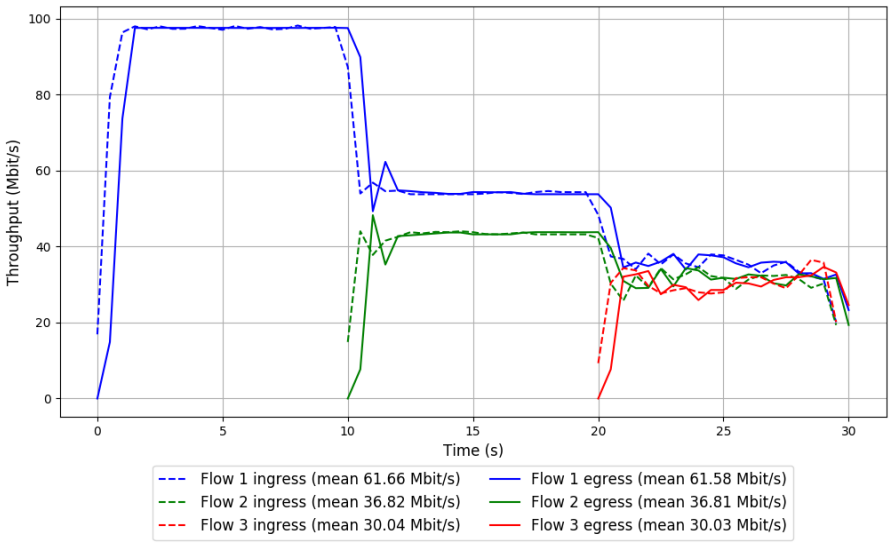


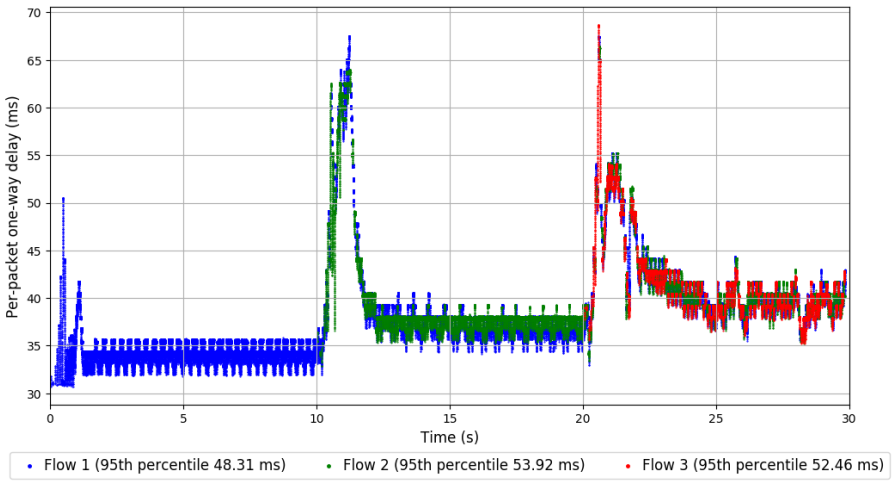
```
Run 3: Statistics of Indigo

Start at: 2018-08-31 04:52:36
End at: 2018-08-31 04:53:06
Local clock offset: -8.633 ms
Remote clock offset: -2.782 ms

# Below is generated by plot.py at 2018-08-31 04:58:47
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.84 Mbit/s
95th percentile per-packet one-way delay: 51.264 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 61.58 Mbit/s
95th percentile per-packet one-way delay: 48.315 ms
Loss rate: 0.09%
-- Flow 2:
Average throughput: 36.81 Mbit/s
95th percentile per-packet one-way delay: 53.924 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 30.03 Mbit/s
95th percentile per-packet one-way delay: 52.464 ms
Loss rate: 0.00%
```

Run 3: Report of Indigo — Data Link



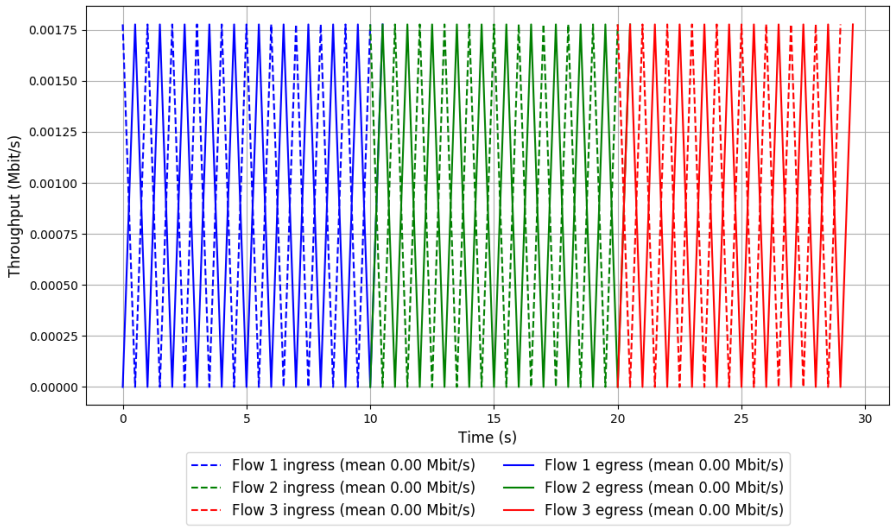


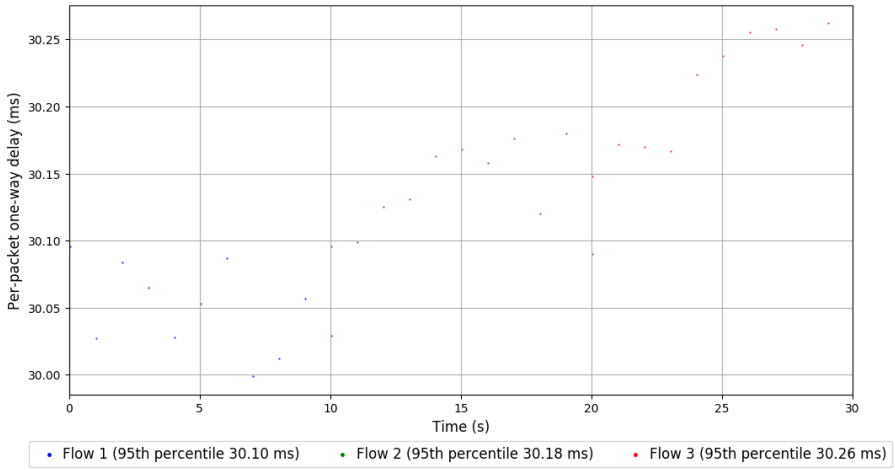
```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 04:45:57
End at: 2018-08-31 04:46:27
Local clock offset: -9.295 ms
Remote clock offset: -2.725 ms

# Below is generated by plot.py at 2018-08-31 04:58:47
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.255 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.096 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.180 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.262 ms
Loss rate: 0.00%
```

Run 1: Report of Muses-25 — Data Link



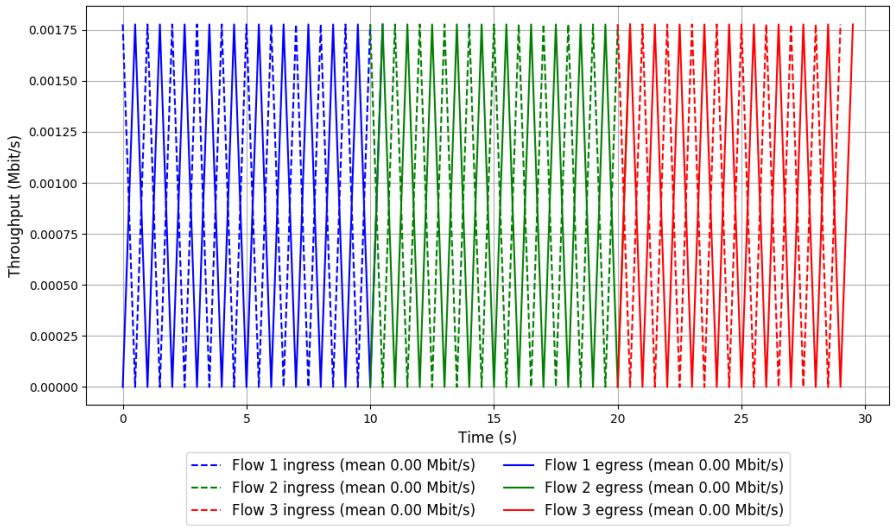


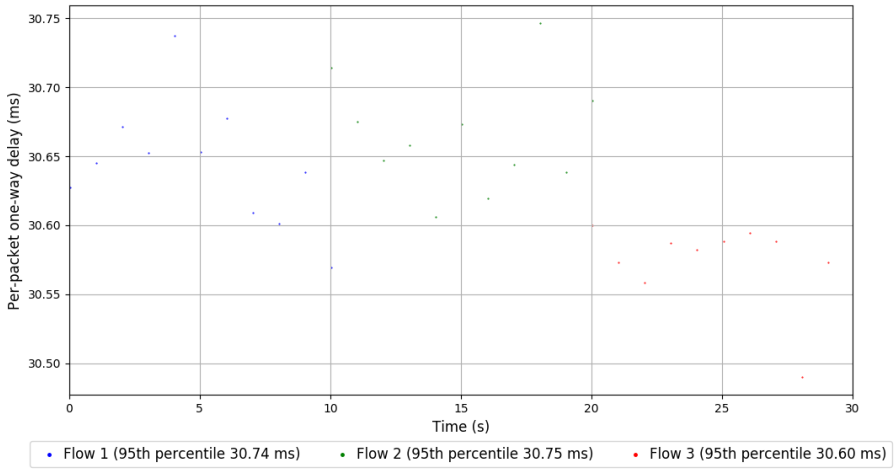
```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 04:51:19
End at: 2018-08-31 04:51:50
Local clock offset: -8.508 ms
Remote clock offset: -2.728 ms

# Below is generated by plot.py at 2018-08-31 04:58:47
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.714 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.737 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.746 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.600 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-08-31 04:56:41
End at: 2018-08-31 04:57:11
Local clock offset: -9.316 ms
Remote clock offset: -2.852 ms

# Below is generated by plot.py at 2018-08-31 04:58:47
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.518 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.522 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.529 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 30.431 ms
Loss rate: 0.00%
```

Run 3: Report of Muses-25 — Data Link