Pantheon Report

Generated at 2018-09-05 02:48:06 (UTC).

Data path: AWS India 1 on `ens5` (*local*) →India on `em1` (*remote*).

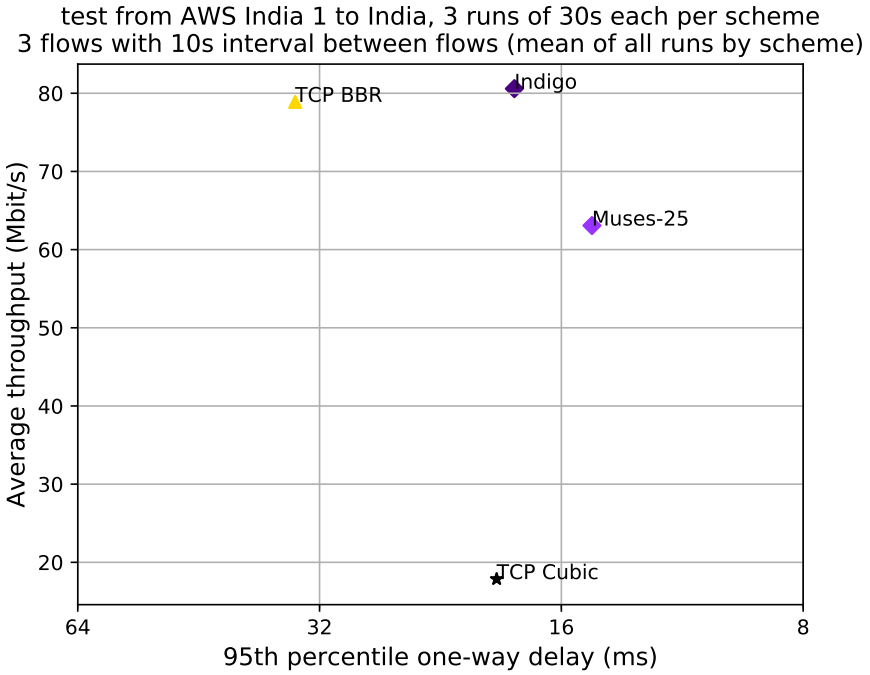
Repeated the test of 4 congestion control schemes 3 times.

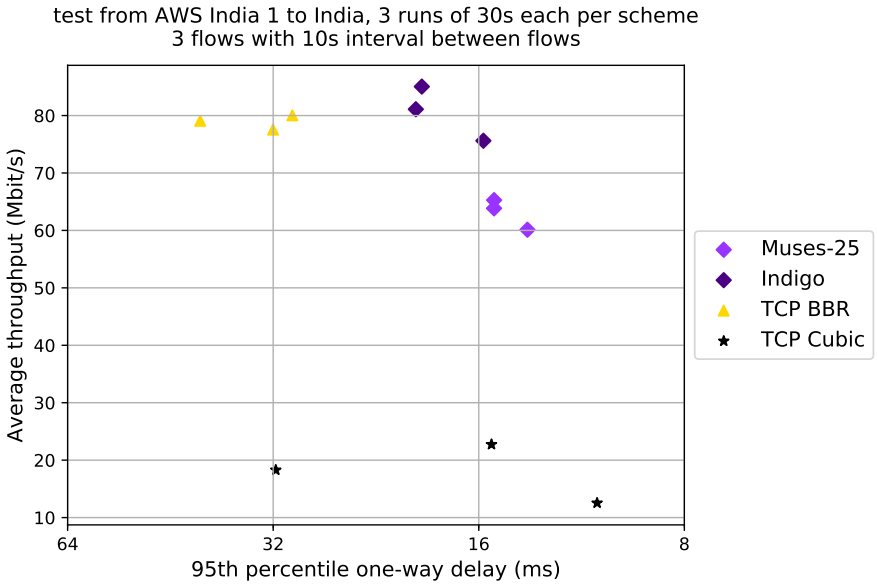
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `nets.org.sg` 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 India 1 to India, 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)
80
70
60
50
40
30
20
64
32
16
8


test from AWS India 1 to India, 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
80
70
60
50
40
30
20
10
64
32
16
8

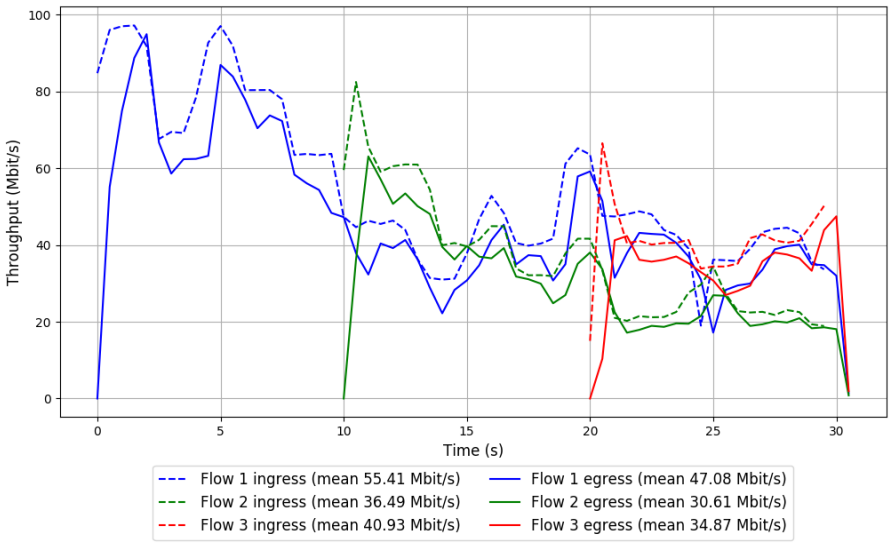
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	49.50	27.99	32.32	28.86	38.77	38.09	13.59	14.67	14.56
TCP Cubic	3	8.82	8.54	10.09	13.33	18.76	19.53	0.98	1.65	1.16
Indigo	3	46.01	37.16	33.05	16.31	18.94	18.36	14.34	13.62	16.17
Muses-25	3	42.79	24.70	11.85	13.22	12.01	13.81	8.22	9.78	9.69

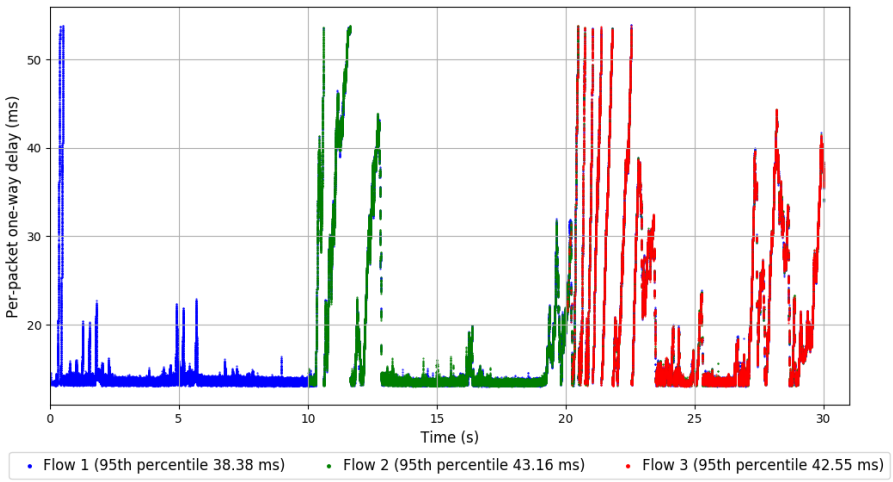
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 02:35:36
End at: 2018-09-05 02:36:06
Local clock offset: -0.468 ms
Remote clock offset: -3.184 ms

# Below is generated by plot.py at 2018-09-05 02:47:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 79.09 Mbit/s
95th percentile per-packet one-way delay: 40.935 ms
Loss rate: 15.23%
-- Flow 1:
Average throughput: 47.08 Mbit/s
95th percentile per-packet one-way delay: 38.383 ms
Loss rate: 14.99%
-- Flow 2:
Average throughput: 30.61 Mbit/s
95th percentile per-packet one-way delay: 43.159 ms
Loss rate: 16.07%
-- Flow 3:
Average throughput: 34.87 Mbit/s
95th percentile per-packet one-way delay: 42.550 ms
Loss rate: 14.75%
```

Run 1: Report of TCP BBR — Data Link



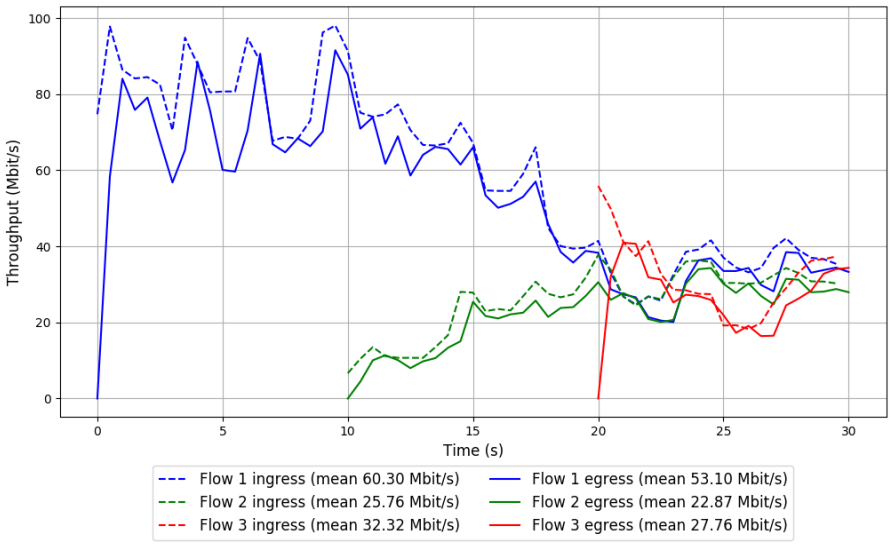


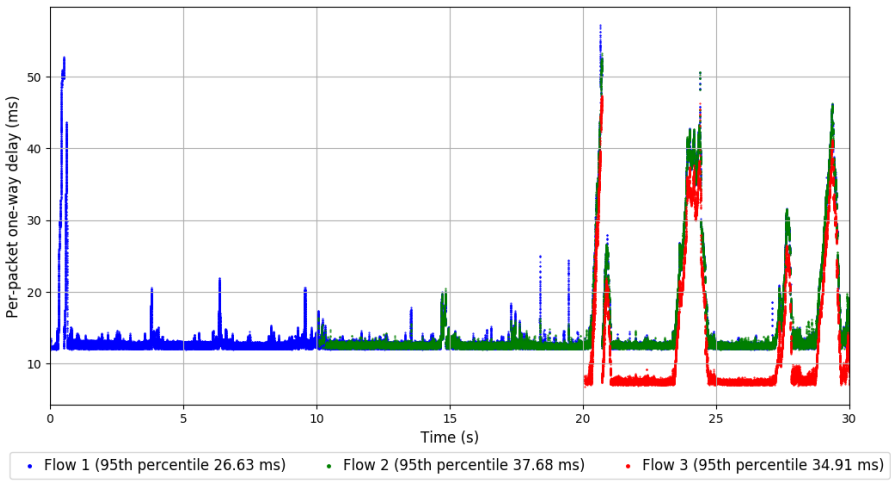
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 02:40:15
End at: 2018-09-05 02:40:45
Local clock offset: 1.233 ms
Remote clock offset: -2.259 ms

# Below is generated by plot.py at 2018-09-05 02:47:58
# Datalink statistics
-- Total of 3 flows:
Average throughput: 77.56 Mbit/s
95th percentile per-packet one-way delay: 32.017 ms
Loss rate: 12.06%
-- Flow 1:
Average throughput: 53.10 Mbit/s
95th percentile per-packet one-way delay: 26.633 ms
Loss rate: 11.94%
-- Flow 2:
Average throughput: 22.87 Mbit/s
95th percentile per-packet one-way delay: 37.679 ms
Loss rate: 11.24%
-- Flow 3:
Average throughput: 27.76 Mbit/s
95th percentile per-packet one-way delay: 34.911 ms
Loss rate: 14.09%
```

Run 2: Report of TCP BBR — Data Link



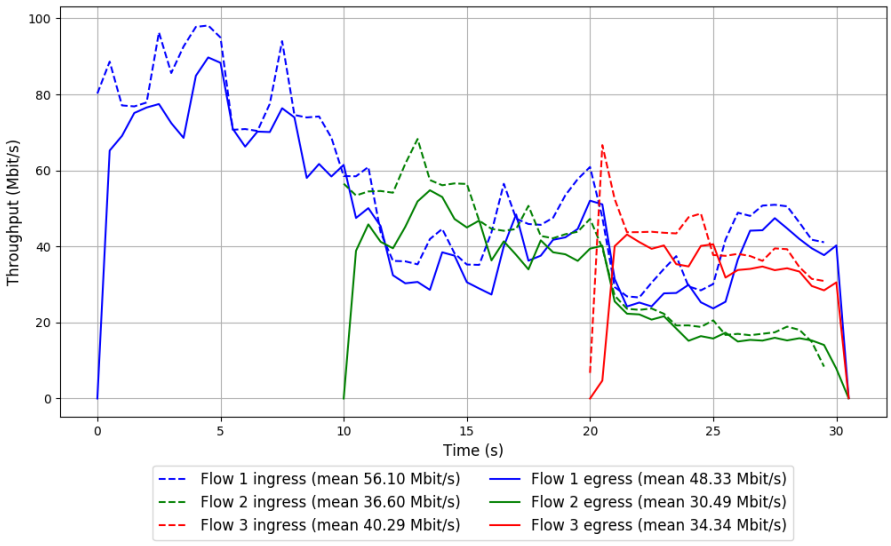


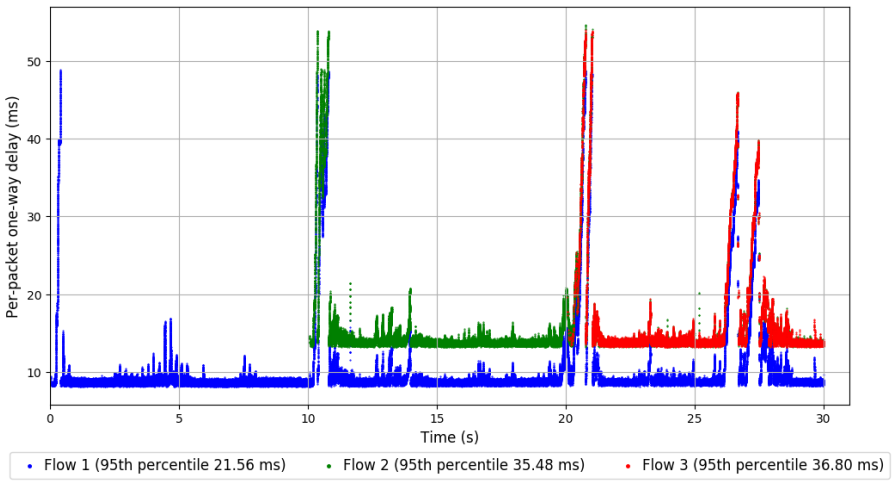
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 02:44:56
End at: 2018-09-05 02:45:26
Local clock offset: -0.697 ms
Remote clock offset: -2.854 ms

# Below is generated by plot.py at 2018-09-05 02:47:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 80.04 Mbit/s
95th percentile per-packet one-way delay: 29.999 ms
Loss rate: 14.73%
-- Flow 1:
Average throughput: 48.33 Mbit/s
95th percentile per-packet one-way delay: 21.562 ms
Loss rate: 13.85%
-- Flow 2:
Average throughput: 30.49 Mbit/s
95th percentile per-packet one-way delay: 35.482 ms
Loss rate: 16.70%
-- Flow 3:
Average throughput: 34.34 Mbit/s
95th percentile per-packet one-way delay: 36.796 ms
Loss rate: 14.85%
```

Run 3: Report of TCP BBR — Data Link



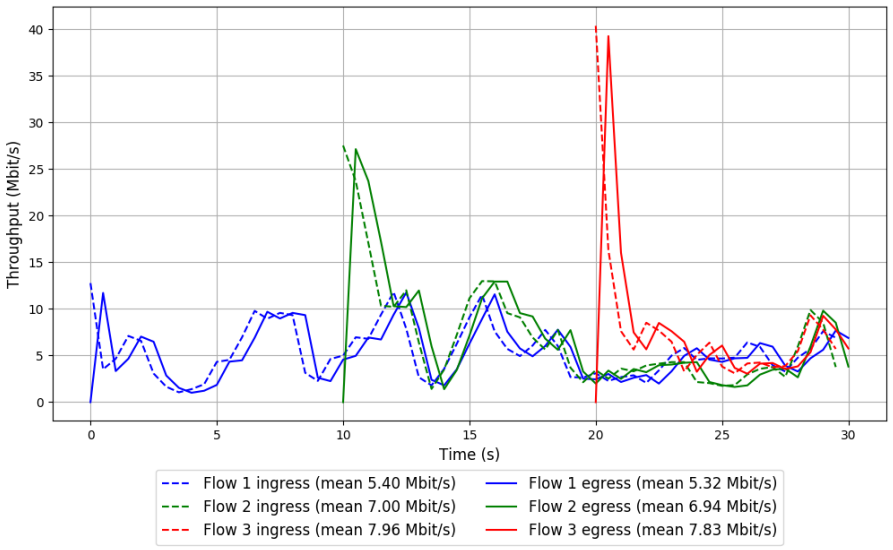


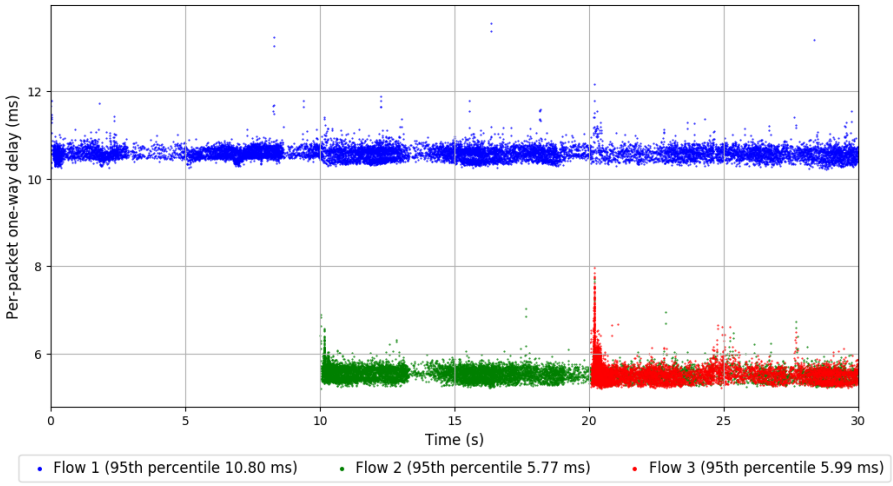
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 02:33:13
End at: 2018-09-05 02:33:43
Local clock offset: 1.992 ms
Remote clock offset: -3.595 ms

# Below is generated by plot.py at 2018-09-05 02:47:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 12.55 Mbit/s
95th percentile per-packet one-way delay: 10.736 ms
Loss rate: 1.32%
-- Flow 1:
Average throughput: 5.32 Mbit/s
95th percentile per-packet one-way delay: 10.805 ms
Loss rate: 1.50%
-- Flow 2:
Average throughput: 6.94 Mbit/s
95th percentile per-packet one-way delay: 5.773 ms
Loss rate: 0.95%
-- Flow 3:
Average throughput: 7.83 Mbit/s
95th percentile per-packet one-way delay: 5.991 ms
Loss rate: 1.60%
```

Run 1: Report of TCP Cubic — Data Link



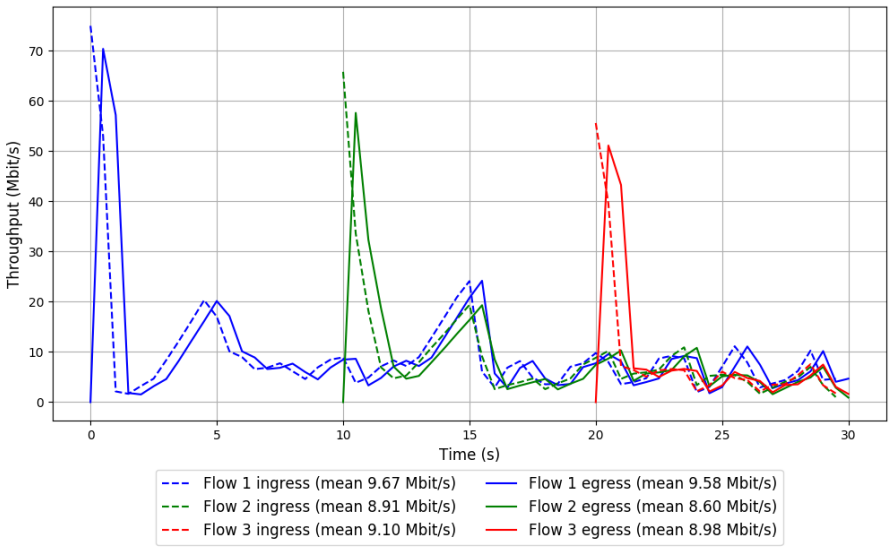


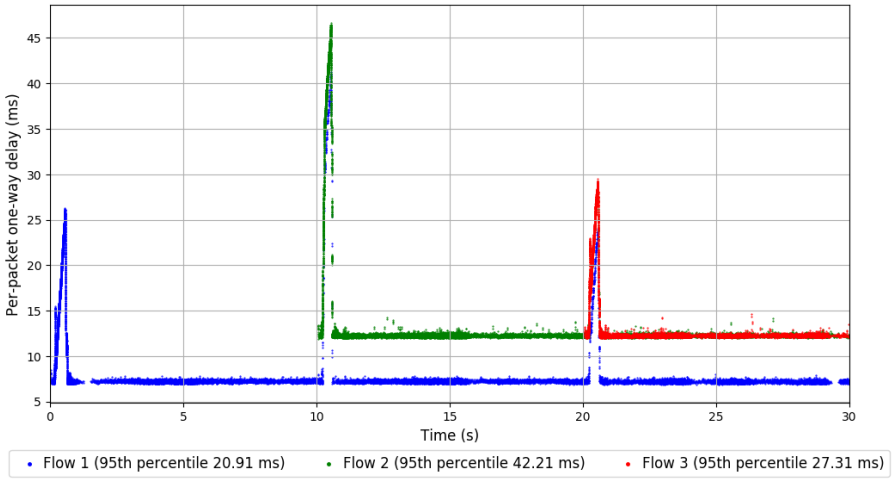
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 02:37:56
End at: 2018-09-05 02:38:26
Local clock offset: 0.431 ms
Remote clock offset: -3.199 ms

# Below is generated by plot.py at 2018-09-05 02:47:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 18.28 Mbit/s
95th percentile per-packet one-way delay: 31.721 ms
Loss rate: 1.83%
-- Flow 1:
Average throughput: 9.58 Mbit/s
95th percentile per-packet one-way delay: 20.907 ms
Loss rate: 0.96%
-- Flow 2:
Average throughput: 8.60 Mbit/s
95th percentile per-packet one-way delay: 42.206 ms
Loss rate: 3.46%
-- Flow 3:
Average throughput: 8.98 Mbit/s
95th percentile per-packet one-way delay: 27.306 ms
Loss rate: 1.39%
```

Run 2: Report of TCP Cubic — Data Link



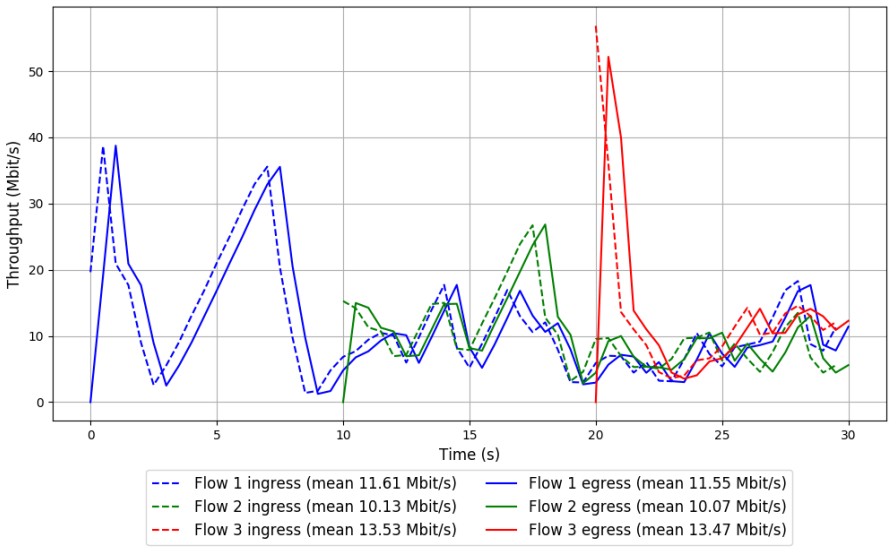


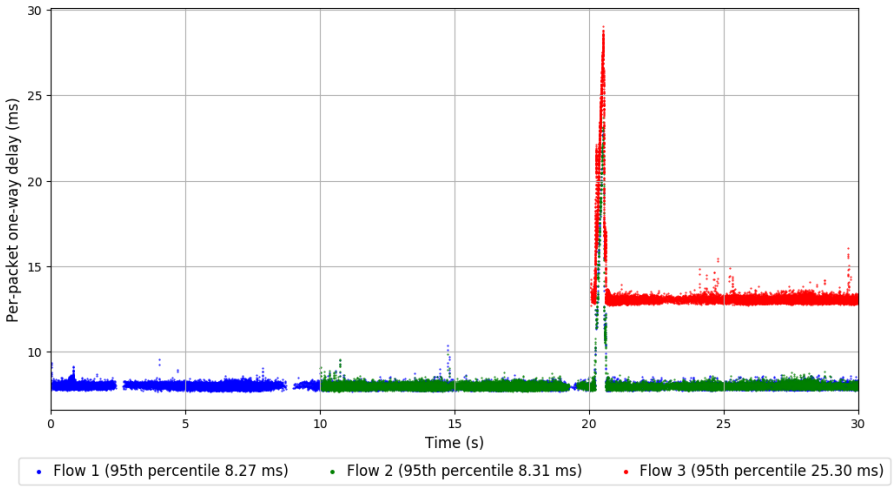
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 02:42:36
End at: 2018-09-05 02:43:06
Local clock offset: -0.168 ms
Remote clock offset: -2.77 ms

# Below is generated by plot.py at 2018-09-05 02:47:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 22.74 Mbit/s
95th percentile per-packet one-way delay: 15.328 ms
Loss rate: 0.50%
-- Flow 1:
Average throughput: 11.55 Mbit/s
95th percentile per-packet one-way delay: 8.265 ms
Loss rate: 0.48%
-- Flow 2:
Average throughput: 10.07 Mbit/s
95th percentile per-packet one-way delay: 8.311 ms
Loss rate: 0.55%
-- Flow 3:
Average throughput: 13.47 Mbit/s
95th percentile per-packet one-way delay: 25.301 ms
Loss rate: 0.48%
```

Run 3: Report of TCP Cubic — Data Link



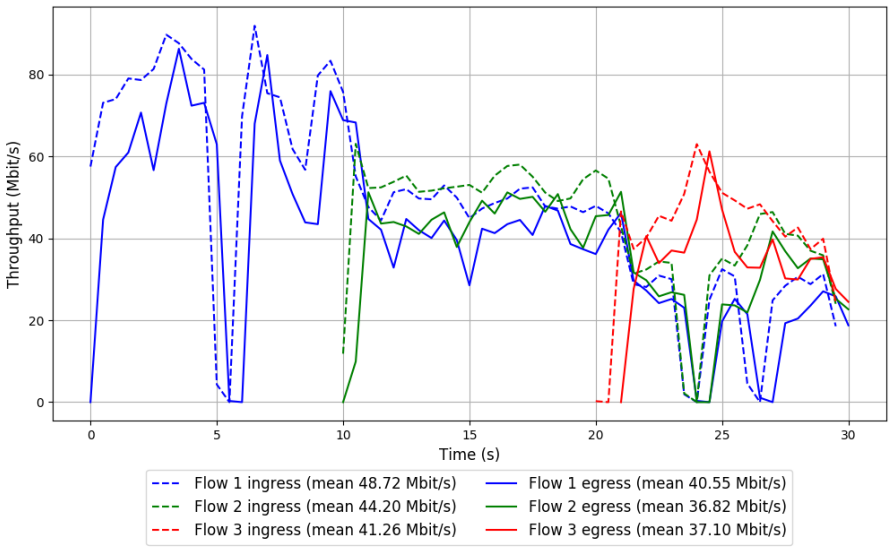


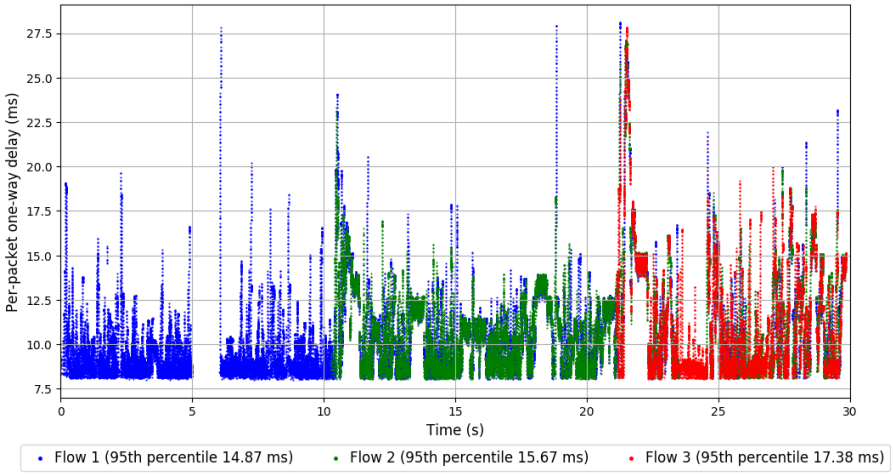
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 02:34:25
End at: 2018-09-05 02:34:55
Local clock offset: -0.22 ms
Remote clock offset: -2.924 ms

# Below is generated by plot.py at 2018-09-05 02:47:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 75.61 Mbit/s
95th percentile per-packet one-way delay: 15.753 ms
Loss rate: 17.10%
-- Flow 1:
Average throughput: 40.55 Mbit/s
95th percentile per-packet one-way delay: 14.869 ms
Loss rate: 16.76%
-- Flow 2:
Average throughput: 36.82 Mbit/s
95th percentile per-packet one-way delay: 15.673 ms
Loss rate: 16.67%
-- Flow 3:
Average throughput: 37.10 Mbit/s
95th percentile per-packet one-way delay: 17.381 ms
Loss rate: 19.24%
```

Run 1: Report of Indigo — Data Link



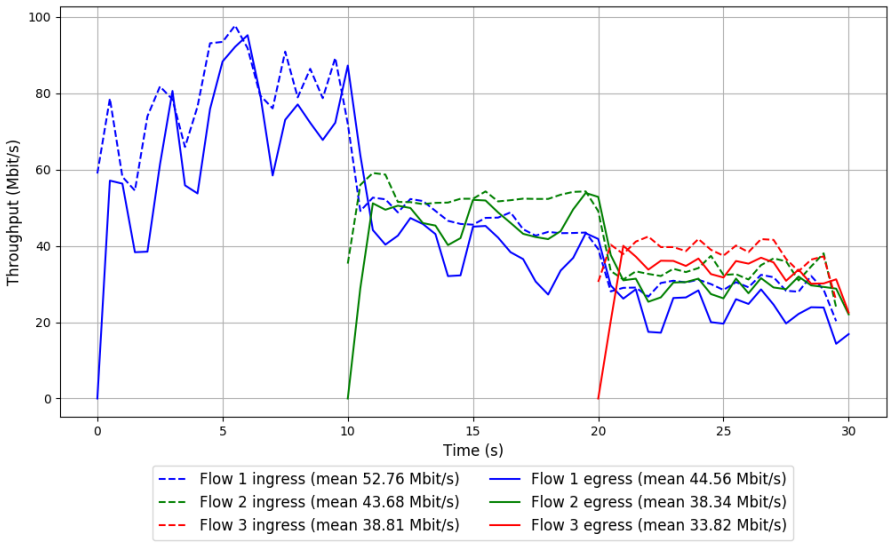


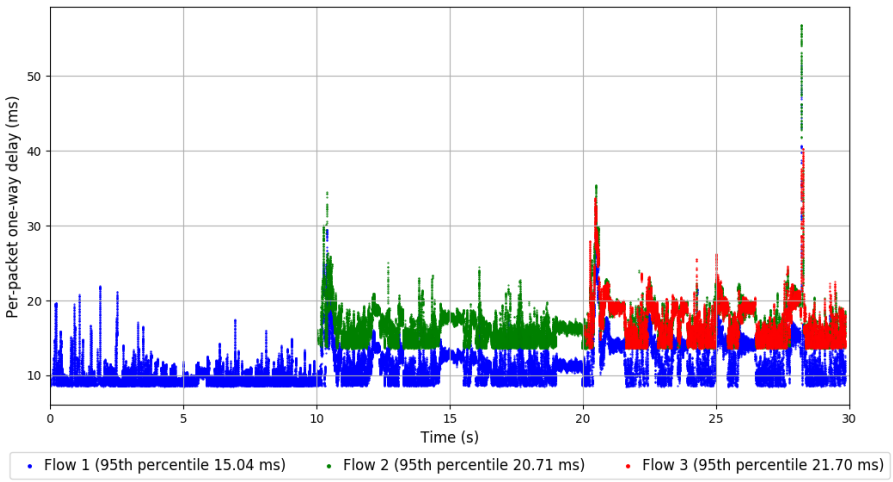
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 02:39:04
End at: 2018-09-05 02:39:34
Local clock offset: -0.216 ms
Remote clock offset: -2.205 ms

# Below is generated by plot.py at 2018-09-05 02:47:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 81.10 Mbit/s
95th percentile per-packet one-way delay: 19.782 ms
Loss rate: 14.16%
-- Flow 1:
Average throughput: 44.56 Mbit/s
95th percentile per-packet one-way delay: 15.042 ms
Loss rate: 15.53%
-- Flow 2:
Average throughput: 38.34 Mbit/s
95th percentile per-packet one-way delay: 20.714 ms
Loss rate: 12.22%
-- Flow 3:
Average throughput: 33.82 Mbit/s
95th percentile per-packet one-way delay: 21.699 ms
Loss rate: 12.87%
```

Run 2: Report of Indigo — Data Link



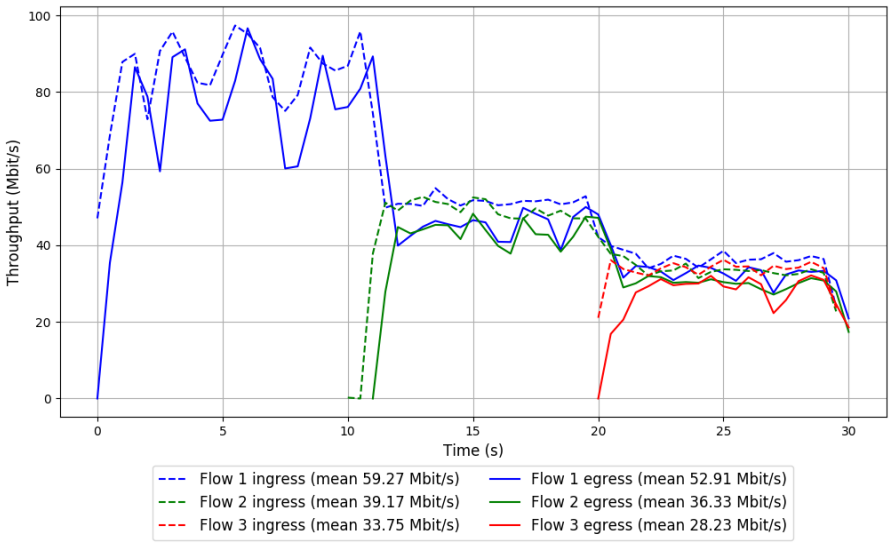


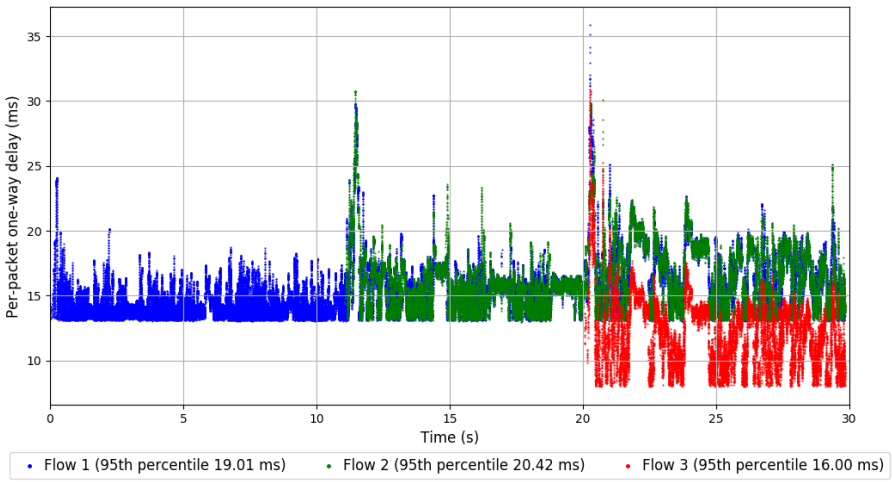
```
Run 3: Statistics of Indigo

Start at: 2018-09-05 02:43:44
End at: 2018-09-05 02:44:14
Local clock offset: -0.644 ms
Remote clock offset: -2.927 ms

# Below is generated by plot.py at 2018-09-05 02:48:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 85.04 Mbit/s
95th percentile per-packet one-way delay: 19.388 ms
Loss rate: 11.71%
-- Flow 1:
Average throughput: 52.91 Mbit/s
95th percentile per-packet one-way delay: 19.009 ms
Loss rate: 10.73%
-- Flow 2:
Average throughput: 36.33 Mbit/s
95th percentile per-packet one-way delay: 20.422 ms
Loss rate: 11.96%
-- Flow 3:
Average throughput: 28.23 Mbit/s
95th percentile per-packet one-way delay: 16.003 ms
Loss rate: 16.40%
```

Run 3: Report of Indigo — Data Link



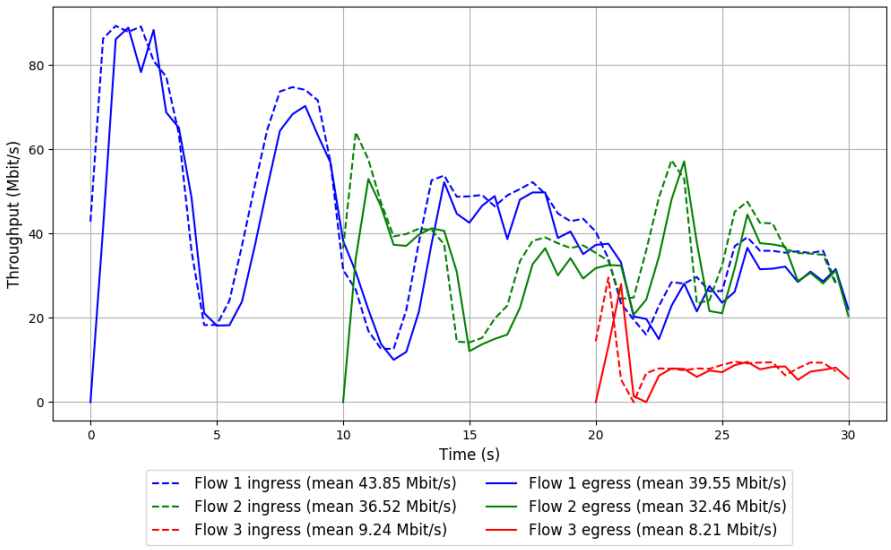


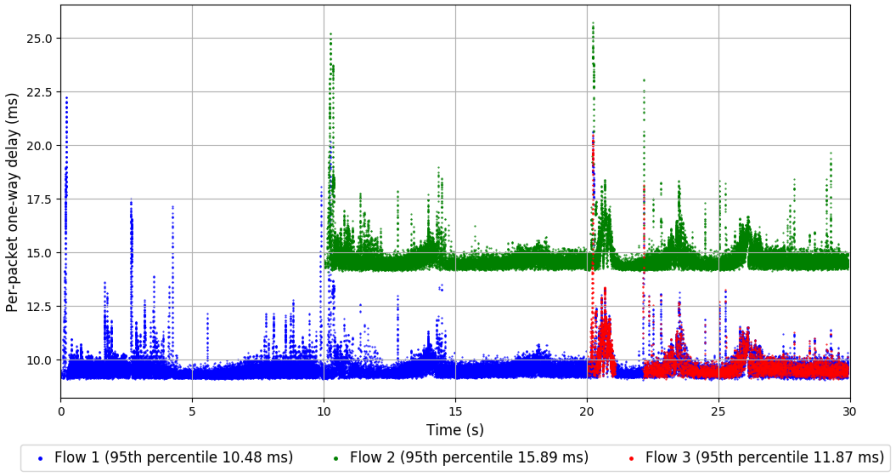
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 02:36:47
End at: 2018-09-05 02:37:17
Local clock offset: -0.878 ms
Remote clock offset: -2.363 ms

# Below is generated by plot.py at 2018-09-05 02:48:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 63.84 Mbit/s
95th percentile per-packet one-way delay: 15.197 ms
Loss rate: 10.33%
-- Flow 1:
Average throughput: 39.55 Mbit/s
95th percentile per-packet one-way delay: 10.483 ms
Loss rate: 9.83%
-- Flow 2:
Average throughput: 32.46 Mbit/s
95th percentile per-packet one-way delay: 15.888 ms
Loss rate: 11.12%
-- Flow 3:
Average throughput: 8.21 Mbit/s
95th percentile per-packet one-way delay: 11.866 ms
Loss rate: 11.14%
```

Run 1: Report of Muses-25 — Data Link



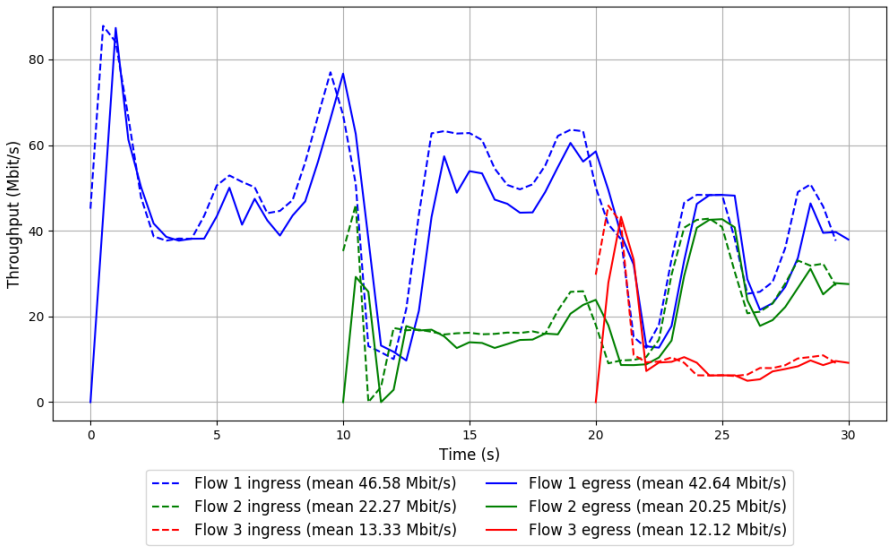


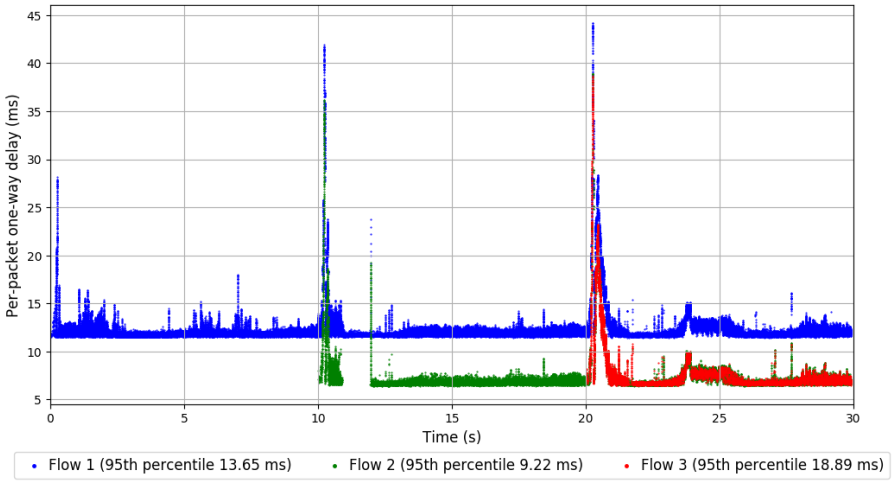
```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 02:41:27
End at: 2018-09-05 02:41:57
Local clock offset: 0.502 ms
Remote clock offset: -3.408 ms

# Below is generated by plot.py at 2018-09-05 02:48:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 60.12 Mbit/s
95th percentile per-packet one-way delay: 13.579 ms
Loss rate: 8.65%
-- Flow 1:
Average throughput: 42.64 Mbit/s
95th percentile per-packet one-way delay: 13.649 ms
Loss rate: 8.48%
-- Flow 2:
Average throughput: 20.25 Mbit/s
95th percentile per-packet one-way delay: 9.222 ms
Loss rate: 9.05%
-- Flow 3:
Average throughput: 12.12 Mbit/s
95th percentile per-packet one-way delay: 18.892 ms
Loss rate: 9.10%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 02:46:09
End at: 2018-09-05 02:46:39
Local clock offset: -0.038 ms
Remote clock offset: -1.958 ms

# Below is generated by plot.py at 2018-09-05 02:48:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 65.27 Mbit/s
95th percentile per-packet one-way delay: 15.195 ms
Loss rate: 7.16%
-- Flow 1:
Average throughput: 46.19 Mbit/s
95th percentile per-packet one-way delay: 15.535 ms
Loss rate: 6.34%
-- Flow 2:
Average throughput: 21.40 Mbit/s
95th percentile per-packet one-way delay: 10.927 ms
Loss rate: 9.18%
-- Flow 3:
Average throughput: 15.22 Mbit/s
95th percentile per-packet one-way delay: 10.668 ms
Loss rate: 8.84%
```

Run 3: Report of Muses-25 — Data Link