Pantheon Report

Generated at 2018-09-05 03:46:46 (UTC).

Data path: China on `eno1` (*remote*) →AWS Korea on `ens5` (*local*).

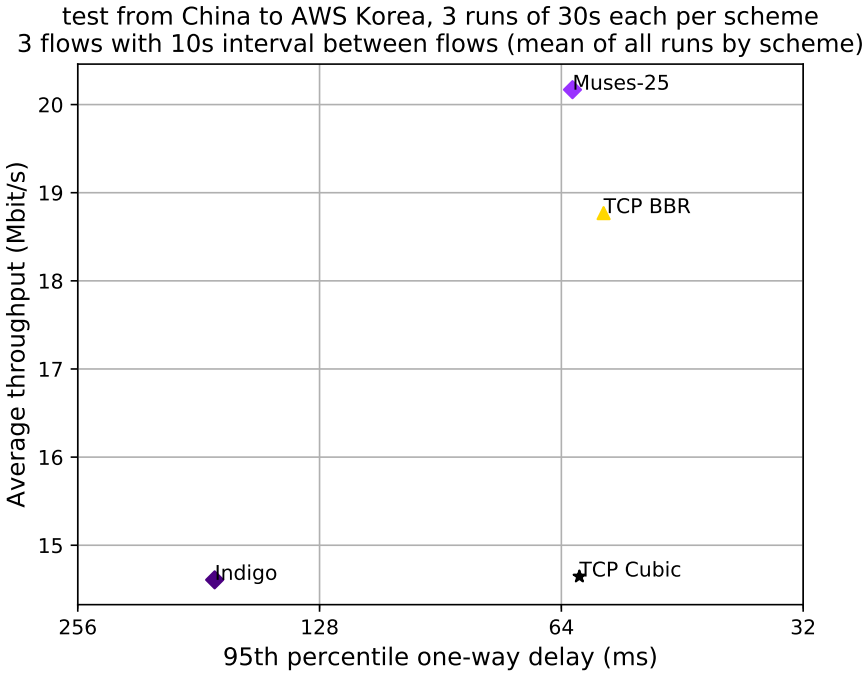
Repeated the test of 4 congestion control schemes 3 times.

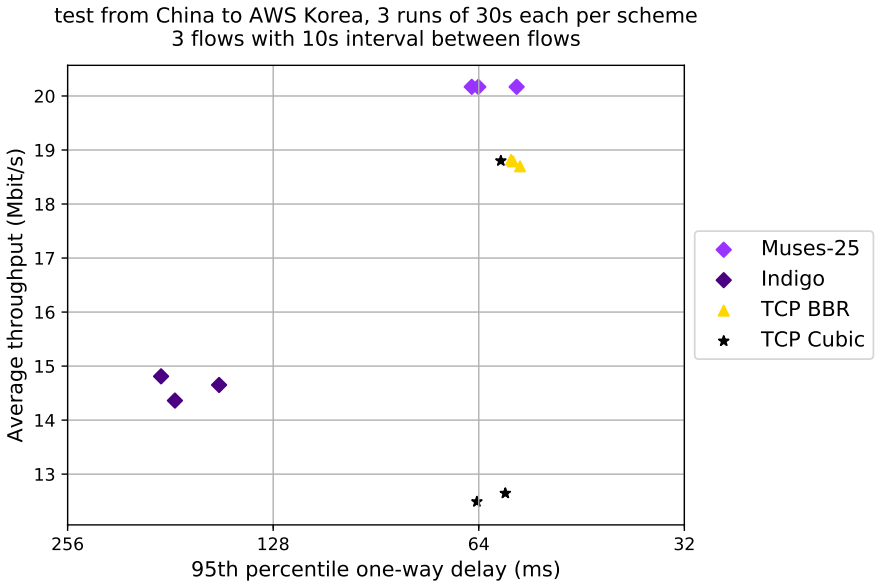
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `ntp.nict.jp` and have been applied to correct the timestamps in logs.

```
System info:
Linux 4.15.0-1010-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 China to AWS Korea, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Muses-25
TCP BBR
Indigo
TCP Cubic
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
20
19
18
17
16
15
256
128
64
32


test from China to AWS Korea, 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
20
19
18
17
16
15
14
13
256
128
64
32

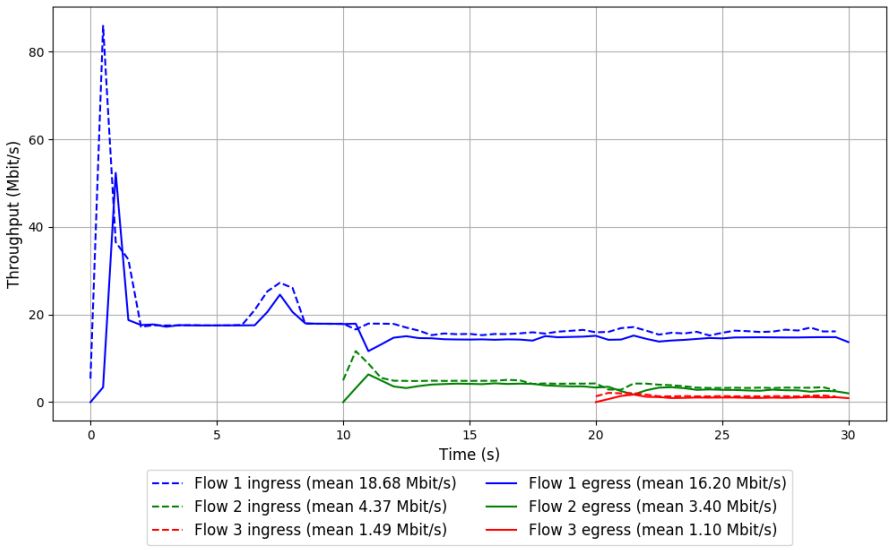
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	15.48	3.48	2.95	57.01	56.50	56.53	14.22	22.85	23.52
TCP Cubic	3	2.83	11.37	12.92	57.62	63.87	56.53	69.29	12.96	8.50
Indigo	3	11.50	6.98	1.85	157.13	150.22	117.45	82.25	90.04	89.81
Muses-25	3	15.23	6.53	1.82	64.29	57.14	56.90	39.55	49.93	52.74

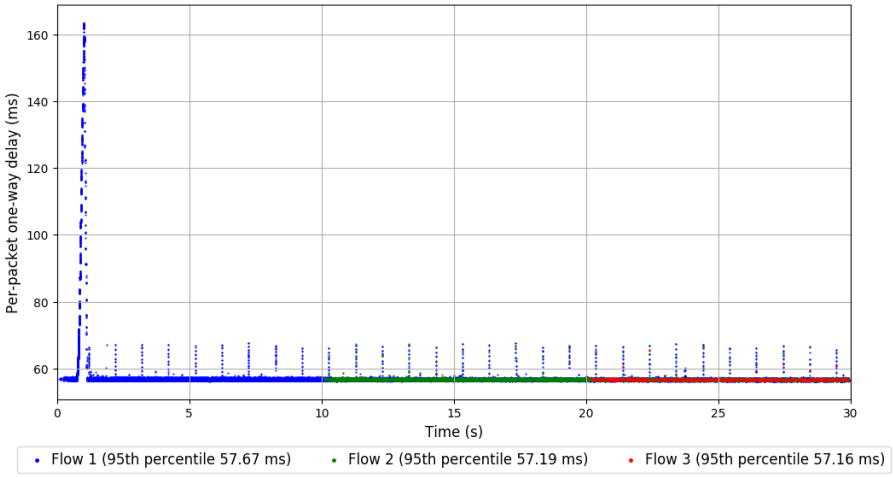
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 03:32:54
End at: 2018-09-05 03:33:24
Local clock offset: 0.193 ms
Remote clock offset: 0.459 ms

# Below is generated by plot.py at 2018-09-05 03:46:31
# Datalink statistics
-- Total of 3 flows:
Average throughput: 18.82 Mbit/s
95th percentile per-packet one-way delay: 57.398 ms
Loss rate: 15.06%
-- Flow 1:
Average throughput: 16.20 Mbit/s
95th percentile per-packet one-way delay: 57.667 ms
Loss rate: 13.57%
-- Flow 2:
Average throughput: 3.40 Mbit/s
95th percentile per-packet one-way delay: 57.191 ms
Loss rate: 22.61%
-- Flow 3:
Average throughput: 1.10 Mbit/s
95th percentile per-packet one-way delay: 57.164 ms
Loss rate: 26.92%
```

Run 1: Report of TCP BBR — Data Link



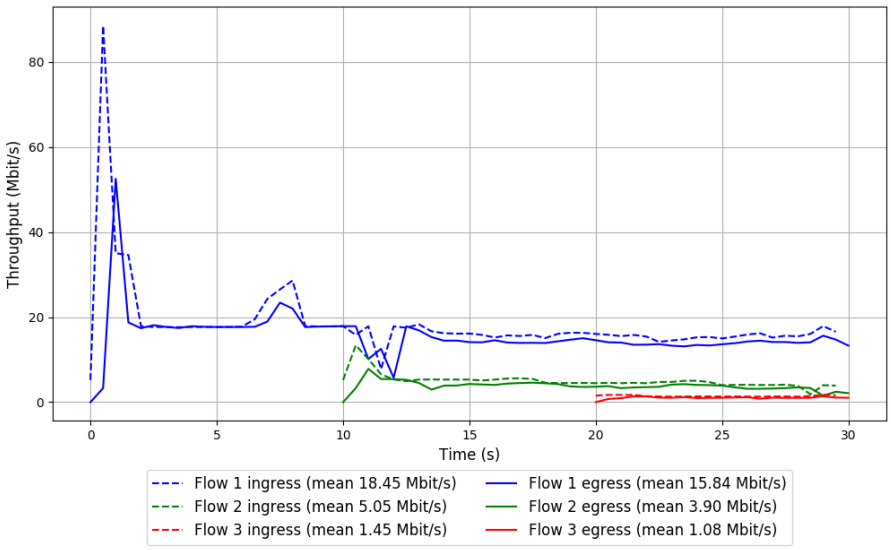


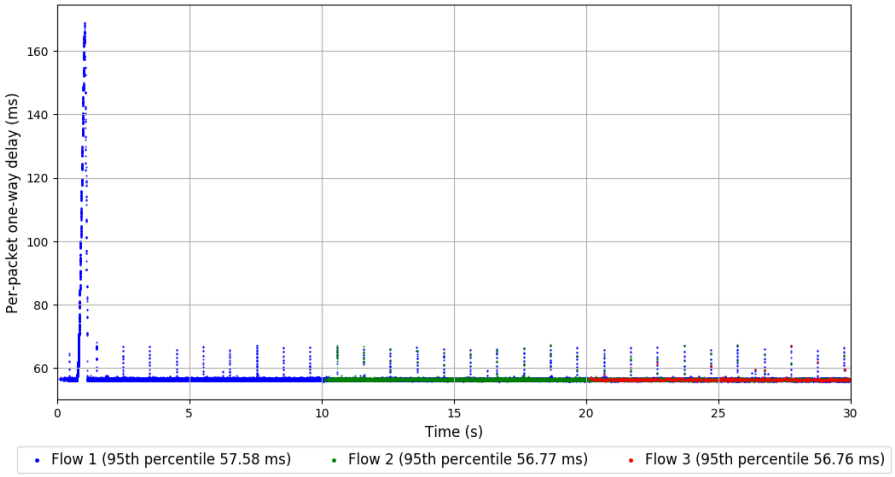
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 03:37:51
End at: 2018-09-05 03:38:21
Local clock offset: -0.025 ms
Remote clock offset: -1.1 ms

# Below is generated by plot.py at 2018-09-05 03:46:31
# Datalink statistics
-- Total of 3 flows:
Average throughput: 18.79 Mbit/s
95th percentile per-packet one-way delay: 57.013 ms
Loss rate: 15.97%
-- Flow 1:
Average throughput: 15.84 Mbit/s
95th percentile per-packet one-way delay: 57.582 ms
Loss rate: 14.40%
-- Flow 2:
Average throughput: 3.90 Mbit/s
95th percentile per-packet one-way delay: 56.767 ms
Loss rate: 23.13%
-- Flow 3:
Average throughput: 1.08 Mbit/s
95th percentile per-packet one-way delay: 56.757 ms
Loss rate: 25.79%
```

Run 2: Report of TCP BBR — Data Link



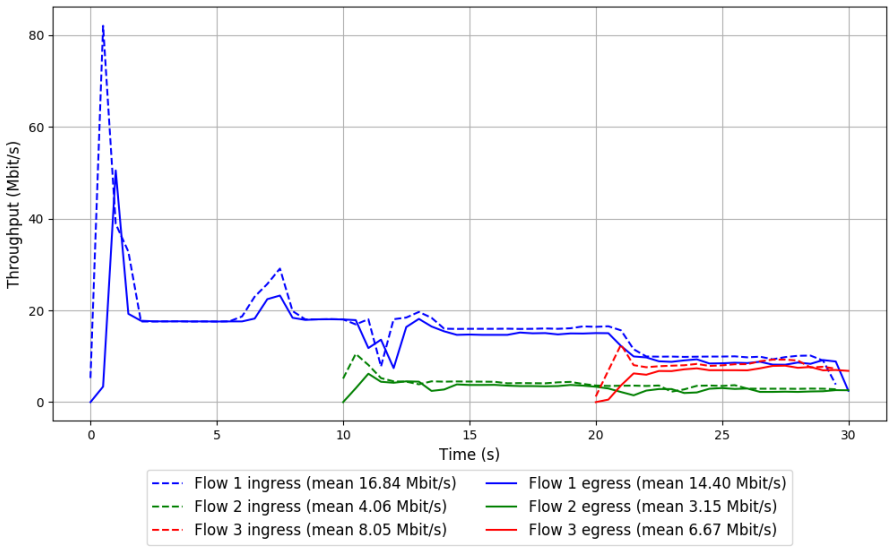


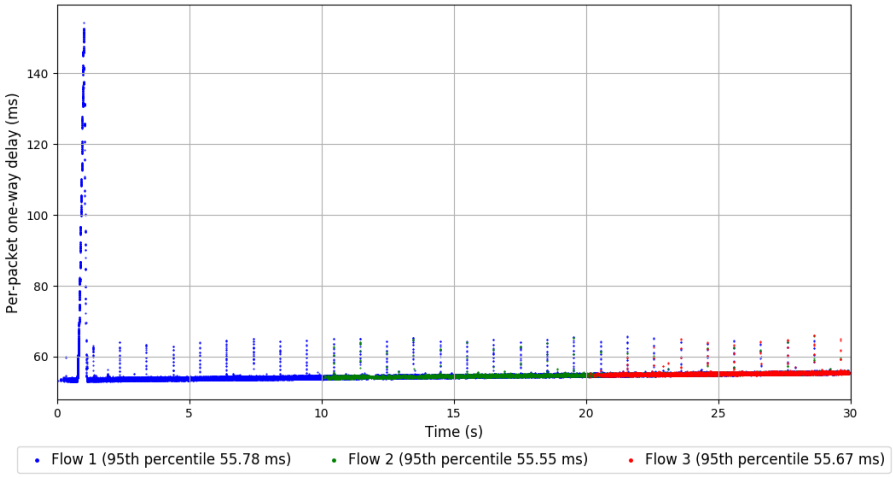
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 03:42:55
End at: 2018-09-05 03:43:25
Local clock offset: -0.057 ms
Remote clock offset: 1.613 ms

# Below is generated by plot.py at 2018-09-05 03:46:31
# Datalink statistics
-- Total of 3 flows:
Average throughput: 18.70 Mbit/s
95th percentile per-packet one-way delay: 55.696 ms
Loss rate: 16.07%
-- Flow 1:
Average throughput: 14.40 Mbit/s
95th percentile per-packet one-way delay: 55.782 ms
Loss rate: 14.70%
-- Flow 2:
Average throughput: 3.15 Mbit/s
95th percentile per-packet one-way delay: 55.548 ms
Loss rate: 22.81%
-- Flow 3:
Average throughput: 6.67 Mbit/s
95th percentile per-packet one-way delay: 55.675 ms
Loss rate: 17.84%
```

Run 3: Report of TCP BBR — Data Link



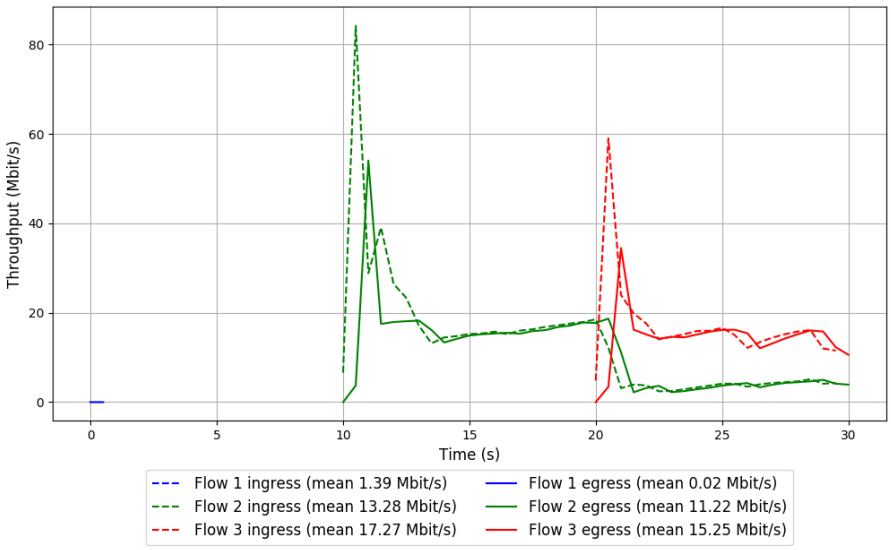


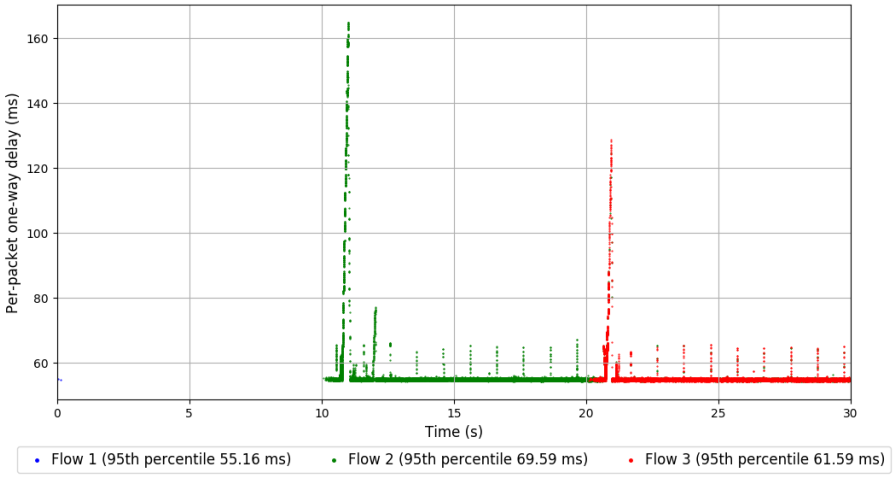
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 03:31:41
End at: 2018-09-05 03:32:11
Local clock offset: 0.256 ms
Remote clock offset: 2.829 ms

# Below is generated by plot.py at 2018-09-05 03:46:31
# Datalink statistics
-- Total of 3 flows:
Average throughput: 12.49 Mbit/s
95th percentile per-packet one-way delay: 64.410 ms
Loss rate: 14.56%
-- Flow 1:
Average throughput: 0.02 Mbit/s
95th percentile per-packet one-way delay: 55.161 ms
Loss rate: 98.79%
-- Flow 2:
Average throughput: 11.22 Mbit/s
95th percentile per-packet one-way delay: 69.590 ms
Loss rate: 15.89%
-- Flow 3:
Average throughput: 15.25 Mbit/s
95th percentile per-packet one-way delay: 61.592 ms
Loss rate: 12.45%
```

Run 1: Report of TCP Cubic — Data Link



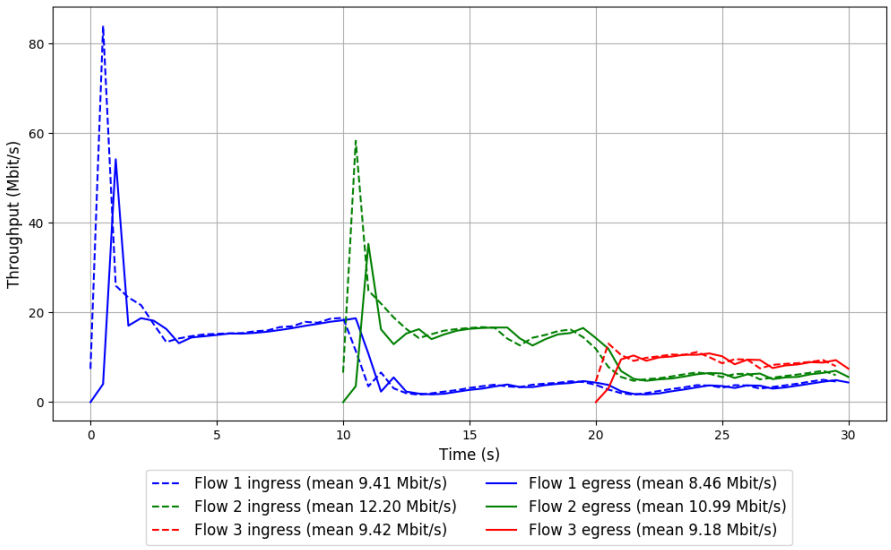


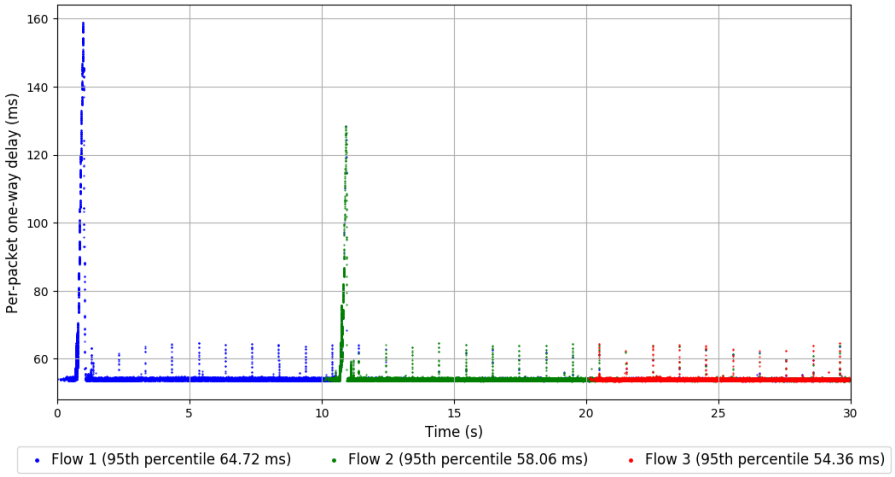
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 03:36:38
End at: 2018-09-05 03:37:08
Local clock offset: -0.114 ms
Remote clock offset: 1.601 ms

# Below is generated by plot.py at 2018-09-05 03:46:31
# Datalink statistics
-- Total of 3 flows:
Average throughput: 18.80 Mbit/s
95th percentile per-packet one-way delay: 59.410 ms
Loss rate: 9.28%
-- Flow 1:
Average throughput: 8.46 Mbit/s
95th percentile per-packet one-way delay: 64.718 ms
Loss rate: 10.30%
-- Flow 2:
Average throughput: 10.99 Mbit/s
95th percentile per-packet one-way delay: 58.059 ms
Loss rate: 10.35%
-- Flow 3:
Average throughput: 9.18 Mbit/s
95th percentile per-packet one-way delay: 54.362 ms
Loss rate: 3.45%
```

Run 2: Report of TCP Cubic — Data Link



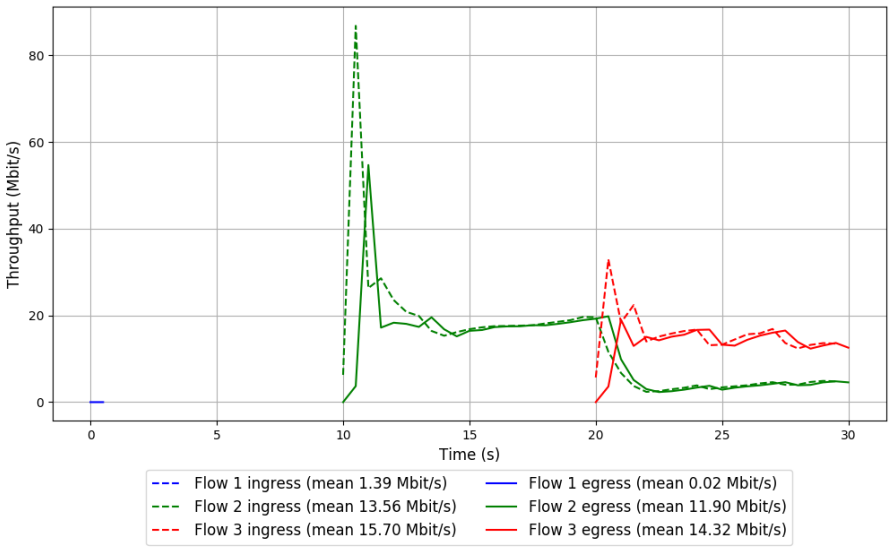


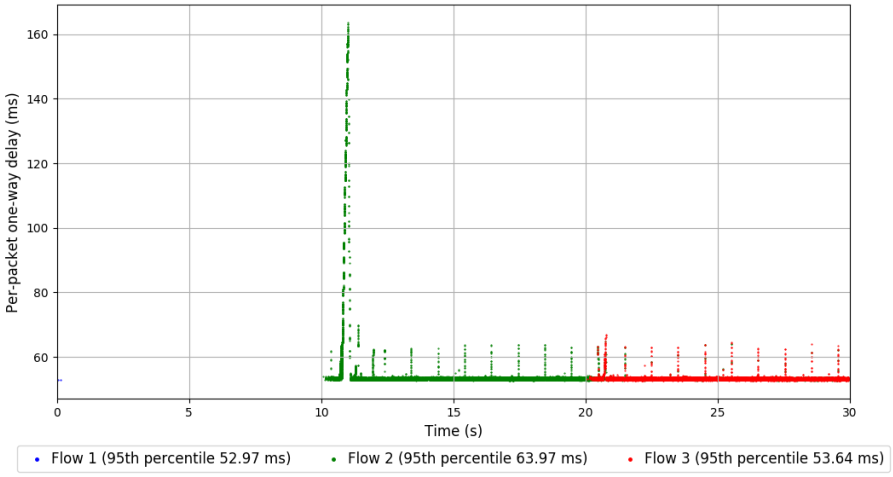
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 03:41:42
End at: 2018-09-05 03:42:12
Local clock offset: -0.232 ms
Remote clock offset: 0.535 ms

# Below is generated by plot.py at 2018-09-05 03:46:31
# Datalink statistics
-- Total of 3 flows:
Average throughput: 12.65 Mbit/s
95th percentile per-packet one-way delay: 58.516 ms
Loss rate: 11.54%
-- Flow 1:
Average throughput: 0.02 Mbit/s
95th percentile per-packet one-way delay: 52.970 ms
Loss rate: 98.79%
-- Flow 2:
Average throughput: 11.90 Mbit/s
95th percentile per-packet one-way delay: 63.974 ms
Loss rate: 12.64%
-- Flow 3:
Average throughput: 14.32 Mbit/s
95th percentile per-packet one-way delay: 53.643 ms
Loss rate: 9.59%
```

Run 3: Report of TCP Cubic — Data Link



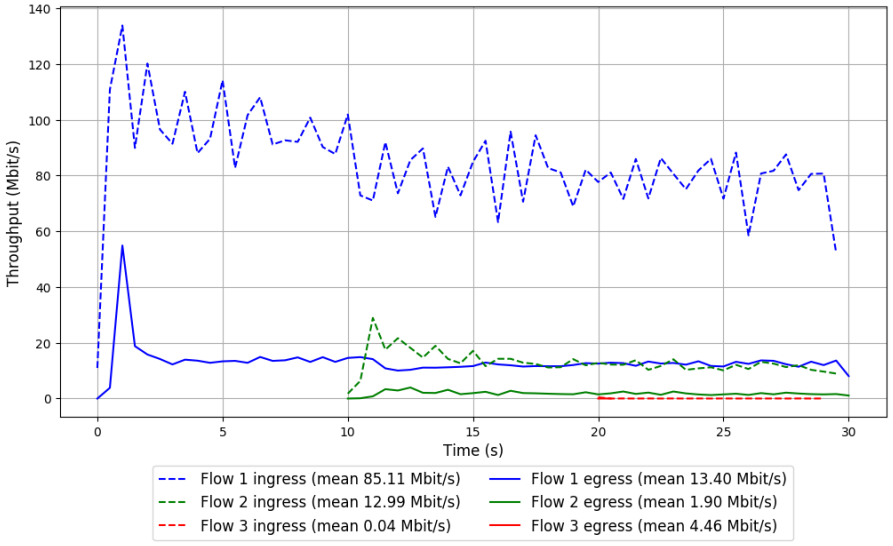


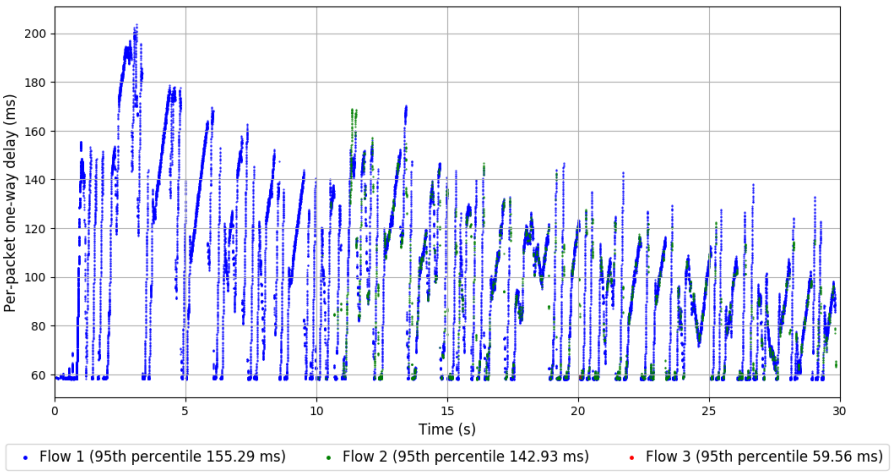
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 03:34:08
End at: 2018-09-05 03:34:38
Local clock offset: 0.041 ms
Remote clock offset: -1.798 ms

# Below is generated by plot.py at 2018-09-05 03:46:40
# Datalink statistics
-- Total of 3 flows:
Average throughput: 14.65 Mbit/s
95th percentile per-packet one-way delay: 153.628 ms
Loss rate: 84.42%
-- Flow 1:
Average throughput: 13.40 Mbit/s
95th percentile per-packet one-way delay: 155.287 ms
Loss rate: 84.31%
-- Flow 2:
Average throughput: 1.90 Mbit/s
95th percentile per-packet one-way delay: 142.927 ms
Loss rate: 85.46%
-- Flow 3:
Average throughput: 4.46 Mbit/s
95th percentile per-packet one-way delay: 59.561 ms
Loss rate: 96.26%
```

Run 1: Report of Indigo — Data Link



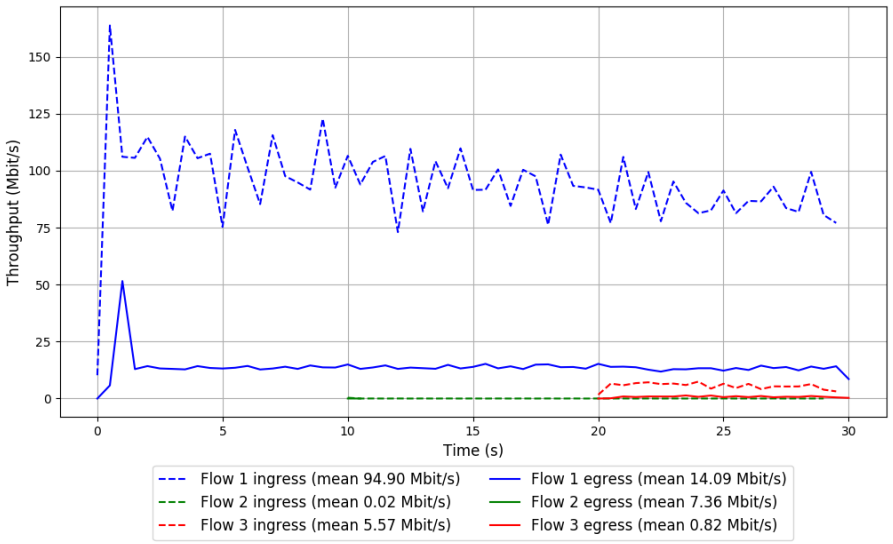


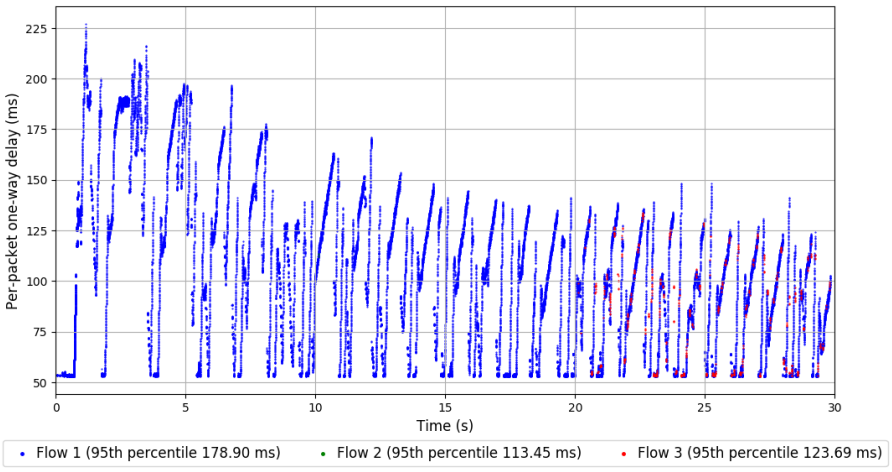
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 03:39:05
End at: 2018-09-05 03:39:35
Local clock offset: -0.149 ms
Remote clock offset: 1.342 ms

# Below is generated by plot.py at 2018-09-05 03:46:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 14.36 Mbit/s
95th percentile per-packet one-way delay: 178.289 ms
Loss rate: 85.20%
-- Flow 1:
Average throughput: 14.09 Mbit/s
95th percentile per-packet one-way delay: 178.896 ms
Loss rate: 85.19%
-- Flow 2:
Average throughput: 7.36 Mbit/s
95th percentile per-packet one-way delay: 113.448 ms
Loss rate: 96.93%
-- Flow 3:
Average throughput: 0.82 Mbit/s
95th percentile per-packet one-way delay: 123.693 ms
Loss rate: 85.52%
```

Run 2: Report of Indigo — Data Link



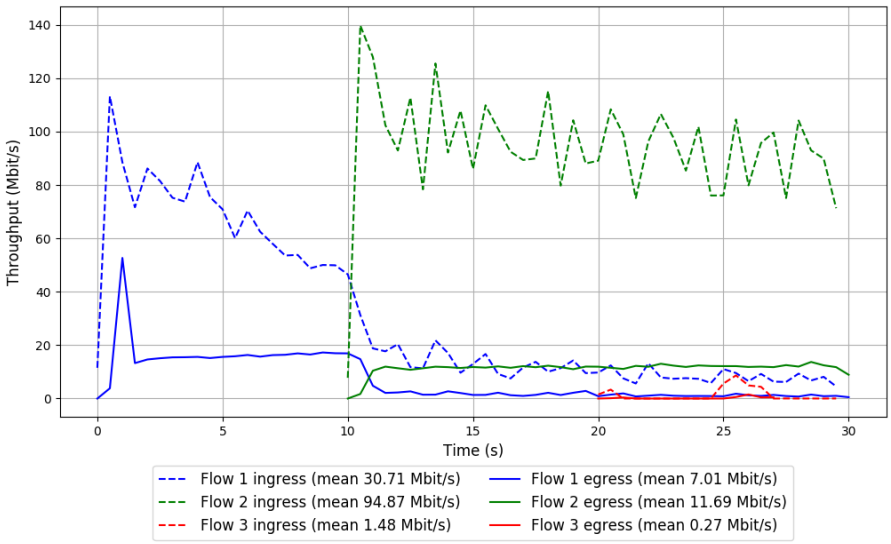


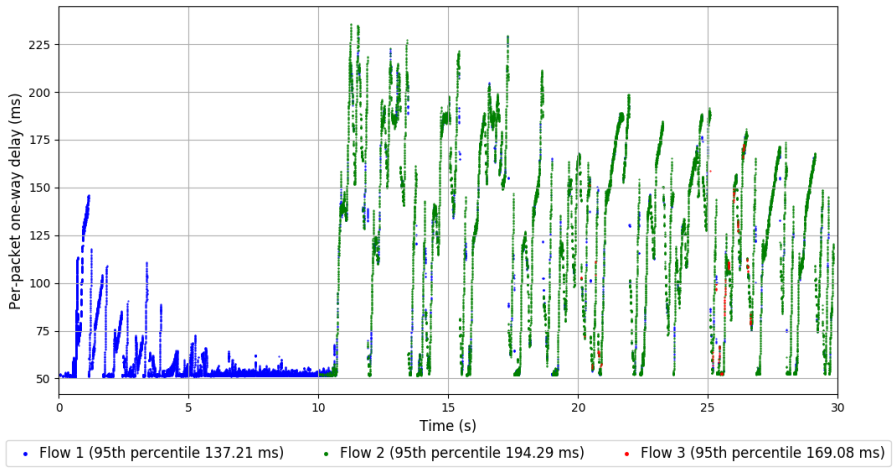
```
Run 3: Statistics of Indigo

Start at: 2018-09-05 03:44:08
End at: 2018-09-05 03:44:38
Local clock offset: -0.175 ms
Remote clock offset: 7.996 ms

# Below is generated by plot.py at 2018-09-05 03:46:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 14.81 Mbit/s
95th percentile per-packet one-way delay: 186.806 ms
Loss rate: 84.32%
-- Flow 1:
Average throughput: 7.01 Mbit/s
95th percentile per-packet one-way delay: 137.208 ms
Loss rate: 77.24%
-- Flow 2:
Average throughput: 11.69 Mbit/s
95th percentile per-packet one-way delay: 194.290 ms
Loss rate: 87.73%
-- Flow 3:
Average throughput: 0.27 Mbit/s
95th percentile per-packet one-way delay: 169.084 ms
Loss rate: 87.66%
```

Run 3: Report of Indigo — Data Link



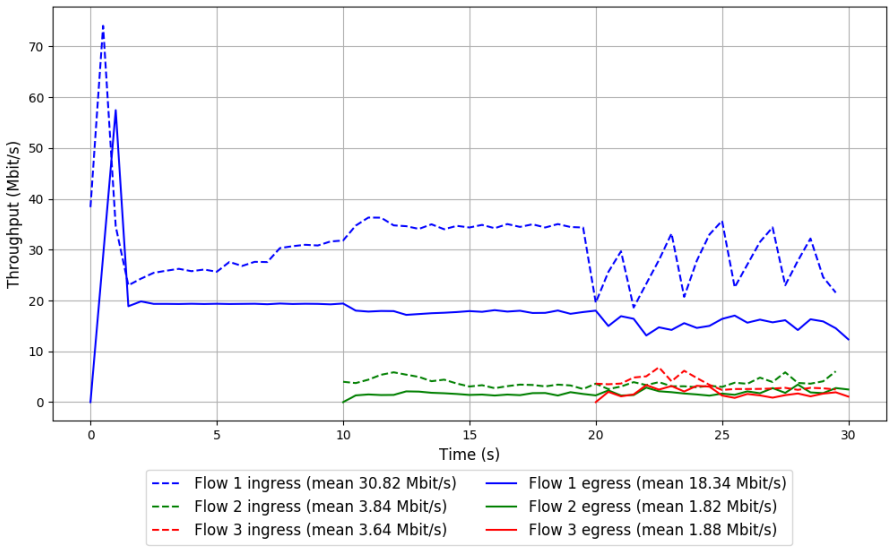


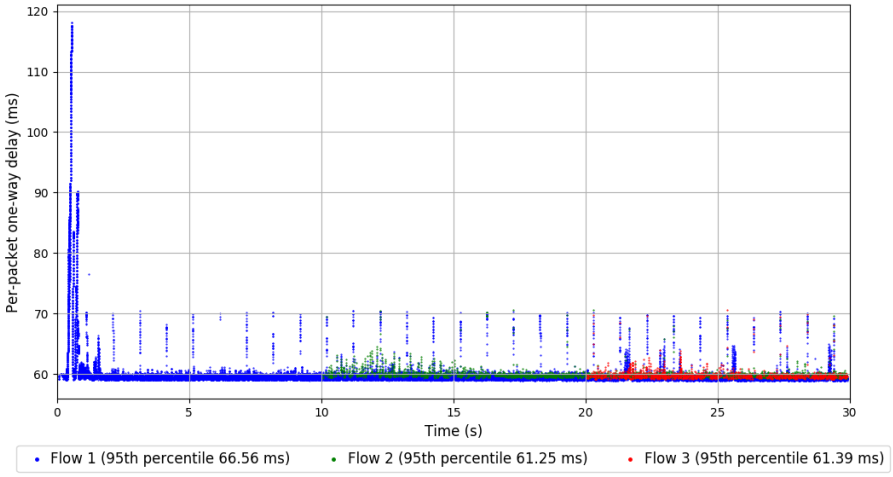
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 03:35:25
End at: 2018-09-05 03:35:55
Local clock offset: 0.172 ms
Remote clock offset: -2.867 ms

# Below is generated by plot.py at 2018-09-05 03:46:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 20.17 Mbit/s
95th percentile per-packet one-way delay: 65.535 ms
Loss rate: 41.85%
-- Flow 1:
Average throughput: 18.34 Mbit/s
95th percentile per-packet one-way delay: 66.562 ms
Loss rate: 40.68%
-- Flow 2:
Average throughput: 1.82 Mbit/s
95th percentile per-packet one-way delay: 61.247 ms
Loss rate: 52.75%
-- Flow 3:
Average throughput: 1.88 Mbit/s
95th percentile per-packet one-way delay: 61.387 ms
Loss rate: 48.82%
```

Run 1: Report of Muses-25 — Data Link



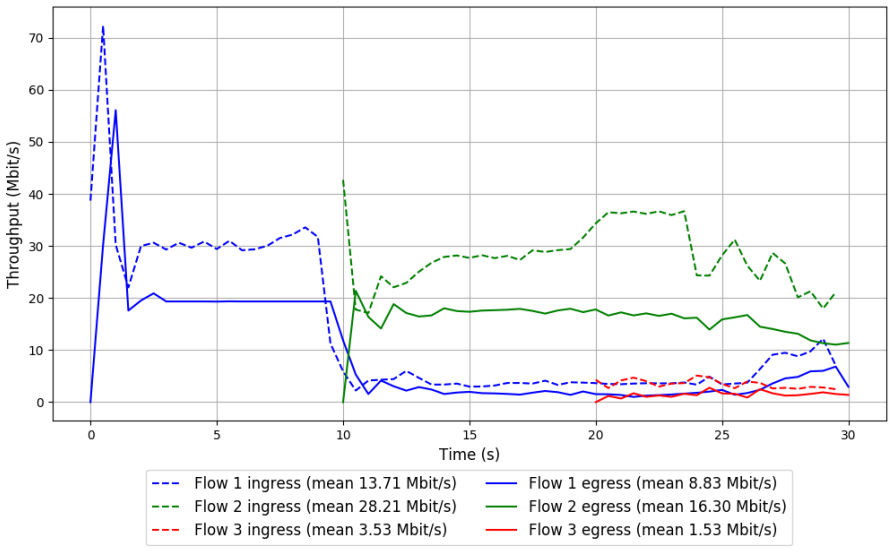


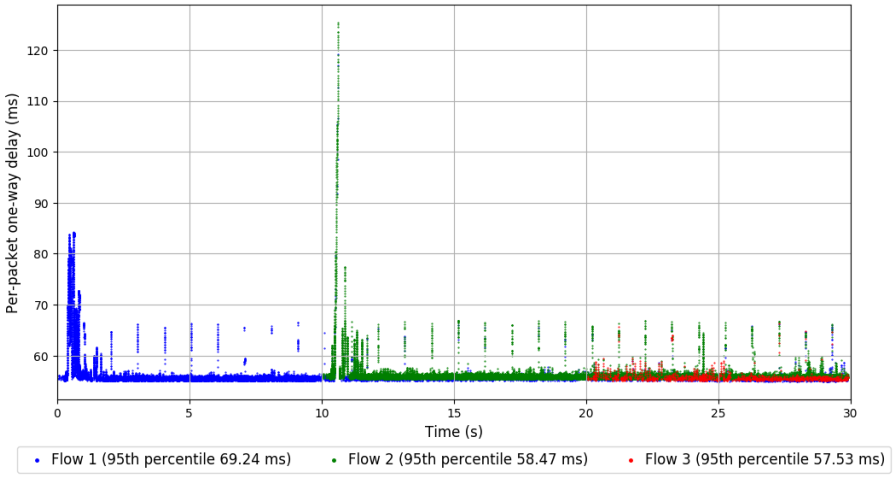
```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 03:40:29
End at: 2018-09-05 03:40:59
Local clock offset: -0.064 ms
Remote clock offset: -1.258 ms

# Below is generated by plot.py at 2018-09-05 03:46:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 20.17 Mbit/s
95th percentile per-packet one-way delay: 64.103 ms
Loss rate: 40.25%
-- Flow 1:
Average throughput: 8.83 Mbit/s
95th percentile per-packet one-way delay: 69.239 ms
Loss rate: 35.79%
-- Flow 2:
Average throughput: 16.30 Mbit/s
95th percentile per-packet one-way delay: 58.469 ms
Loss rate: 42.45%
-- Flow 3:
Average throughput: 1.53 Mbit/s
95th percentile per-packet one-way delay: 57.530 ms
Loss rate: 57.14%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 03:45:32
End at: 2018-09-05 03:46:02
Local clock offset: 0.893 ms
Remote clock offset: 14.524 ms

# Below is generated by plot.py at 2018-09-05 03:46:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 20.17 Mbit/s
95th percentile per-packet one-way delay: 56.327 ms
Loss rate: 43.33%
-- Flow 1:
Average throughput: 18.52 Mbit/s
95th percentile per-packet one-way delay: 57.055 ms
Loss rate: 42.18%
-- Flow 2:
Average throughput: 1.48 Mbit/s
95th percentile per-packet one-way delay: 51.691 ms
Loss rate: 54.59%
-- Flow 3:
Average throughput: 2.04 Mbit/s
95th percentile per-packet one-way delay: 51.794 ms
Loss rate: 52.26%
```

Run 3: Report of Muses-25 — Data Link