Pantheon Report

Generated at 2018-09-05 03:50:03 (UTC).

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

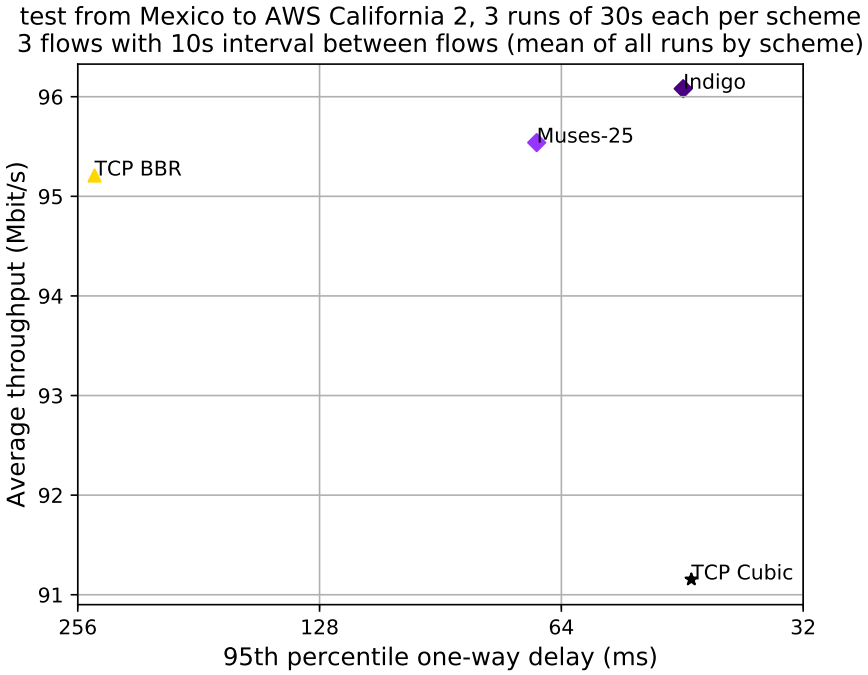
Repeated the test of 4 congestion control schemes 3 times.

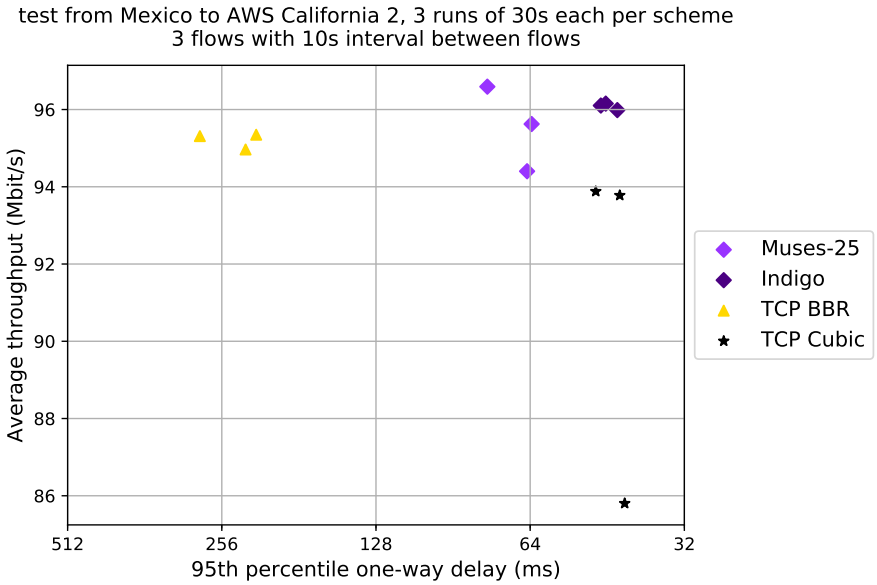
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `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 @ 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 Mexico to AWS California 2, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
Indigo
Muses-25
TCP BBR
TCP Cubic
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
96
95
94
93
92
91
256
128
64
32


test from Mexico to AWS California 2, 3 runs of 30s each per scheme
3 flows with 10s interval between flows
Muses-25
Indigo
TCP BBR
TCP Cubic
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
96
94
92
90
88
86
512
256
128
64
32

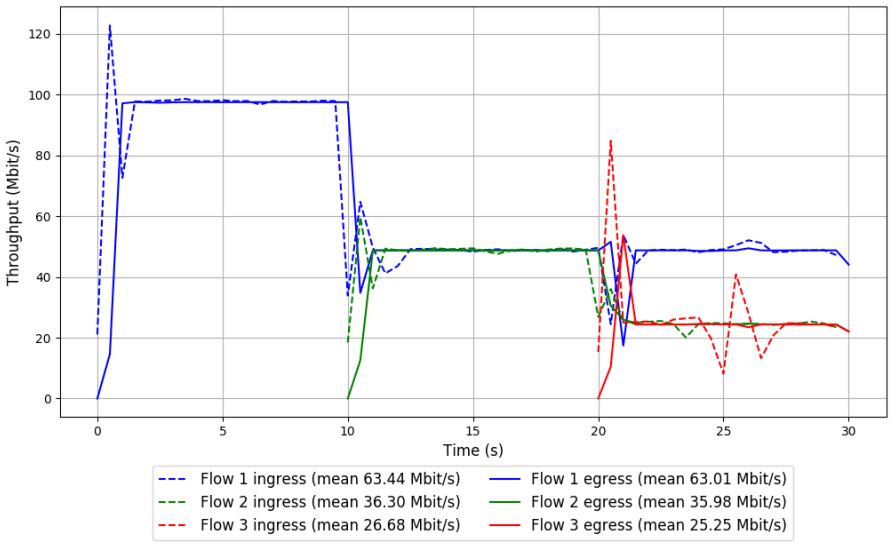
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	58.83	40.97	27.55	184.48	146.57	606.66	0.76	1.09	4.99
TCP Cubic	3	51.40	43.22	33.23	48.91	41.50	57.72	0.12	0.30	0.70
Indigo	3	59.91	41.48	26.33	46.30	45.16	47.00	0.20	0.34	0.74
Muses-25	3	59.89	35.57	36.38	40.06	94.82	87.49	0.12	0.56	0.96

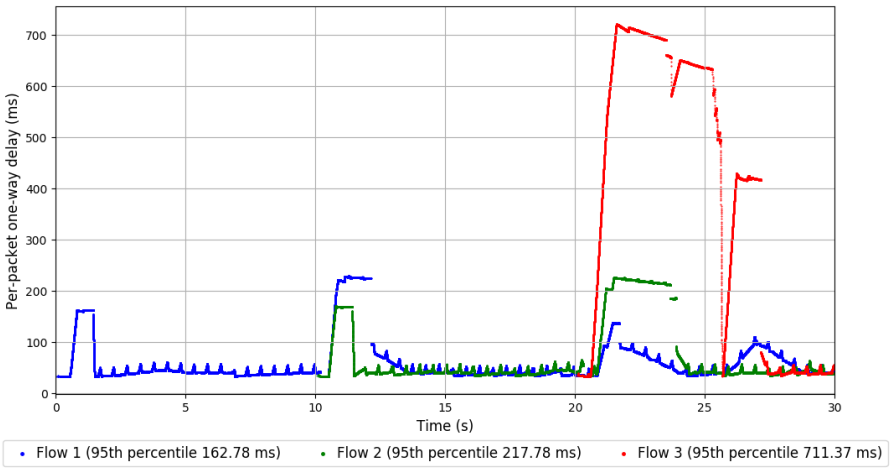
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 03:33:13
End at: 2018-09-05 03:33:43
Local clock offset: 1.522 ms
Remote clock offset: -4.222 ms

# Below is generated by plot.py at 2018-09-05 03:49:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.31 Mbit/s
95th percentile per-packet one-way delay: 282.524 ms
Loss rate: 1.44%
-- Flow 1:
Average throughput: 63.01 Mbit/s
95th percentile per-packet one-way delay: 162.776 ms
Loss rate: 0.89%
-- Flow 2:
Average throughput: 35.98 Mbit/s
95th percentile per-packet one-way delay: 217.779 ms
Loss rate: 1.21%
-- Flow 3:
Average throughput: 25.25 Mbit/s
95th percentile per-packet one-way delay: 711.371 ms
Loss rate: 5.97%
```

Run 1: Report of TCP BBR — Data Link



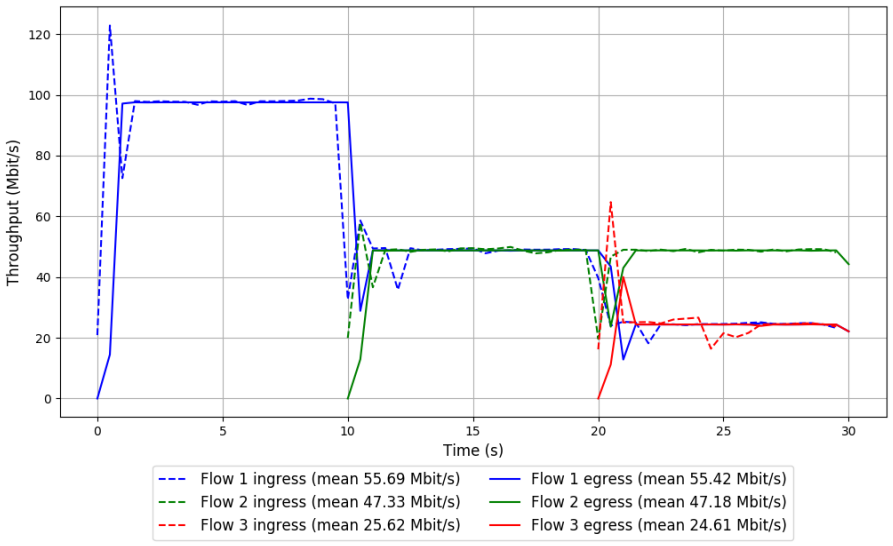


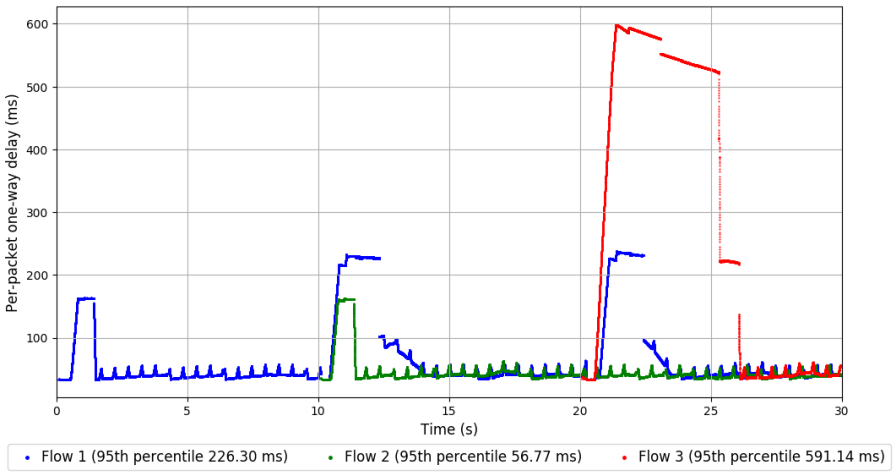
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 03:38:56
End at: 2018-09-05 03:39:26
Local clock offset: 1.56 ms
Remote clock offset: -3.782 ms

# Below is generated by plot.py at 2018-09-05 03:49:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 94.97 Mbit/s
95th percentile per-packet one-way delay: 230.044 ms
Loss rate: 1.03%
-- Flow 1:
Average throughput: 55.42 Mbit/s
95th percentile per-packet one-way delay: 226.298 ms
Loss rate: 0.70%
-- Flow 2:
Average throughput: 47.18 Mbit/s
95th percentile per-packet one-way delay: 56.769 ms
Loss rate: 0.64%
-- Flow 3:
Average throughput: 24.61 Mbit/s
95th percentile per-packet one-way delay: 591.145 ms
Loss rate: 4.57%
```

Run 2: Report of TCP BBR — Data Link



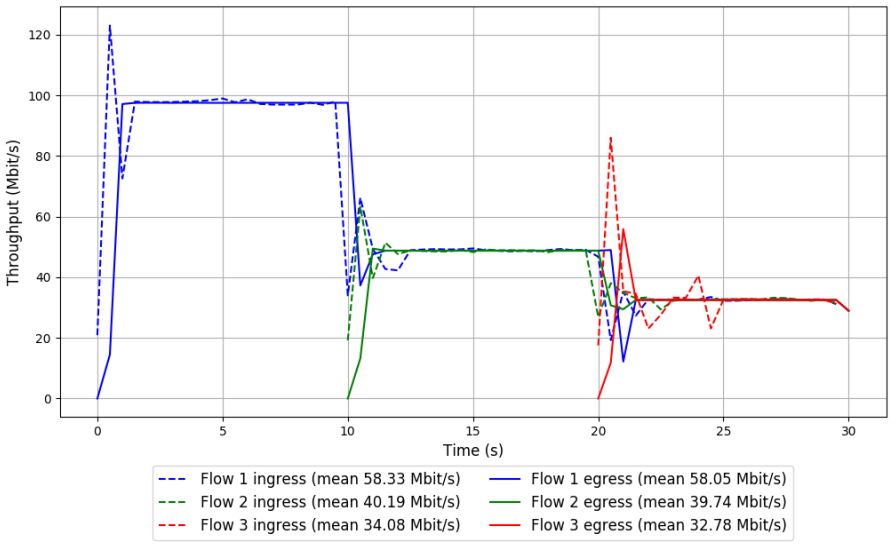


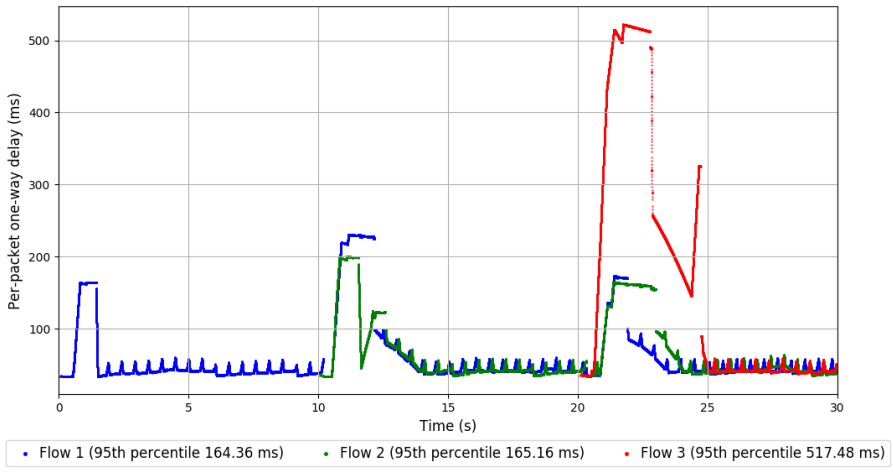
```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 03:44:34
End at: 2018-09-05 03:45:04
Local clock offset: 1.926 ms
Remote clock offset: -3.71 ms

# Below is generated by plot.py at 2018-09-05 03:49:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.35 Mbit/s
95th percentile per-packet one-way delay: 219.322 ms
Loss rate: 1.33%
-- Flow 1:
Average throughput: 58.05 Mbit/s
95th percentile per-packet one-way delay: 164.360 ms
Loss rate: 0.69%
-- Flow 2:
Average throughput: 39.74 Mbit/s
95th percentile per-packet one-way delay: 165.164 ms
Loss rate: 1.43%
-- Flow 3:
Average throughput: 32.78 Mbit/s
95th percentile per-packet one-way delay: 517.475 ms
Loss rate: 4.42%
```

Run 3: Report of TCP BBR — Data Link



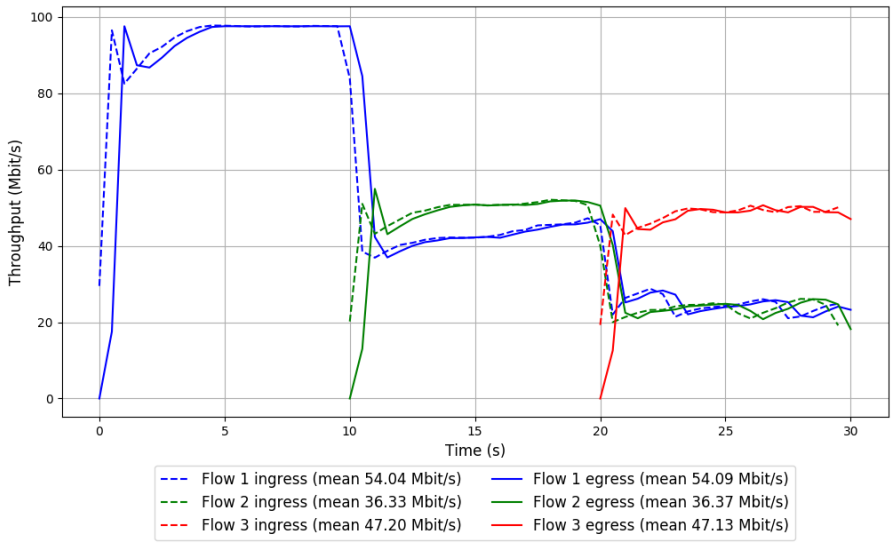


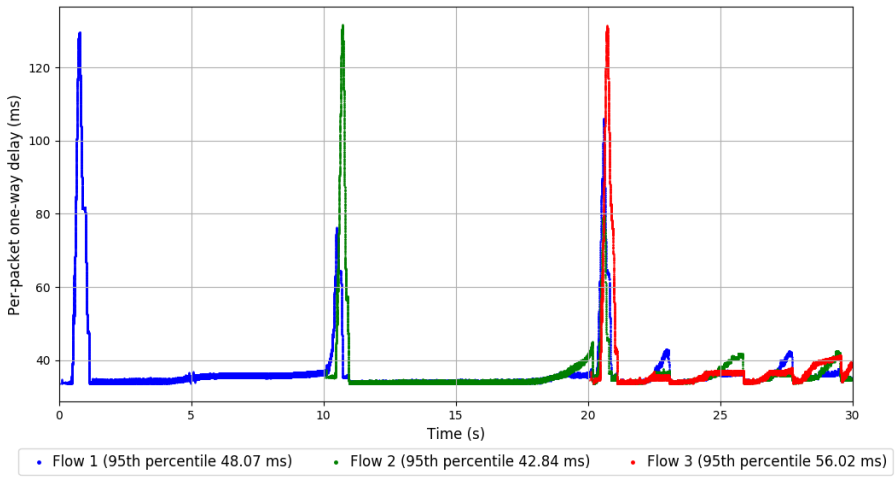
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 03:36:05
End at: 2018-09-05 03:36:35
Local clock offset: 1.567 ms
Remote clock offset: -4.121 ms

# Below is generated by plot.py at 2018-09-05 03:49:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.88 Mbit/s
95th percentile per-packet one-way delay: 47.651 ms
Loss rate: 0.26%
-- Flow 1:
Average throughput: 54.09 Mbit/s
95th percentile per-packet one-way delay: 48.071 ms
Loss rate: 0.13%
-- Flow 2:
Average throughput: 36.37 Mbit/s
95th percentile per-packet one-way delay: 42.843 ms
Loss rate: 0.21%
-- Flow 3:
Average throughput: 47.13 Mbit/s
95th percentile per-packet one-way delay: 56.021 ms
Loss rate: 0.80%
```

Run 1: Report of TCP Cubic — Data Link



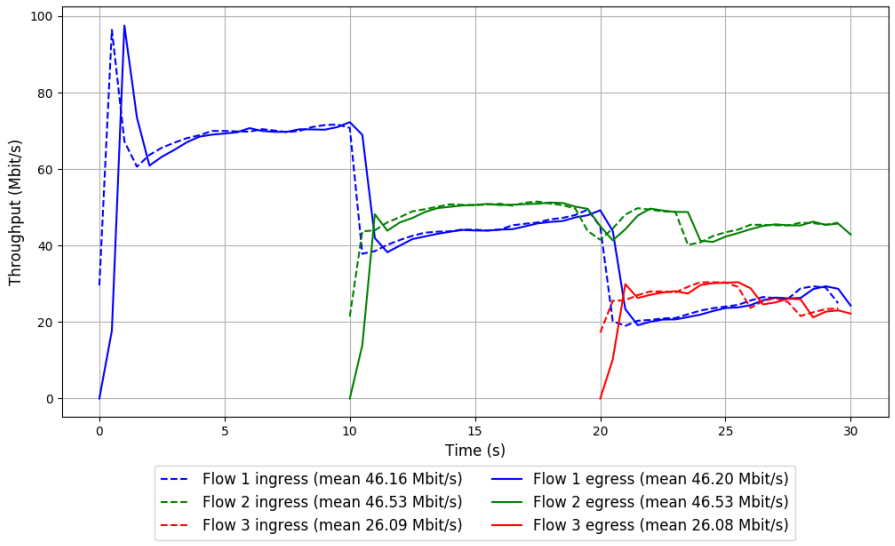


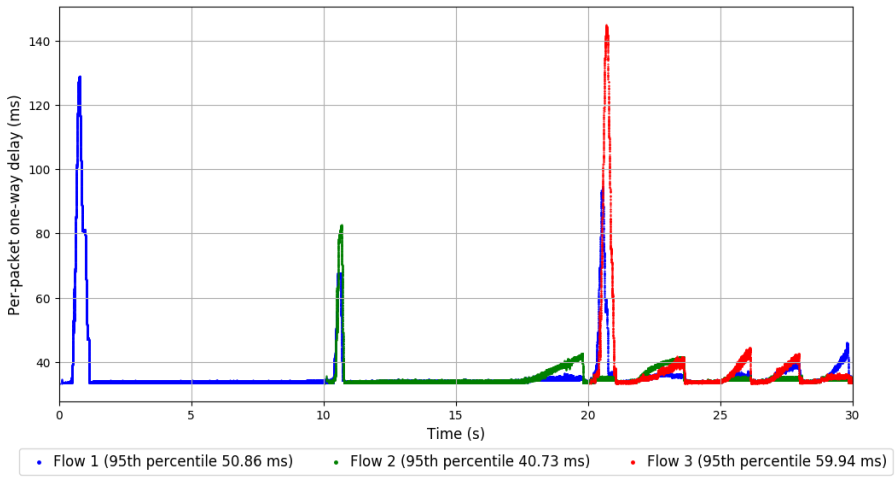
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 03:41:49
End at: 2018-09-05 03:42:19
Local clock offset: 1.785 ms
Remote clock offset: -3.636 ms

# Below is generated by plot.py at 2018-09-05 03:49:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 85.80 Mbit/s
95th percentile per-packet one-way delay: 41.846 ms
Loss rate: 0.26%
-- Flow 1:
Average throughput: 46.20 Mbit/s
95th percentile per-packet one-way delay: 50.860 ms
Loss rate: 0.13%
-- Flow 2:
Average throughput: 46.53 Mbit/s
95th percentile per-packet one-way delay: 40.732 ms
Loss rate: 0.34%
-- Flow 3:
Average throughput: 26.08 Mbit/s
95th percentile per-packet one-way delay: 59.944 ms
Loss rate: 0.66%
```

Run 2: Report of TCP Cubic — Data Link



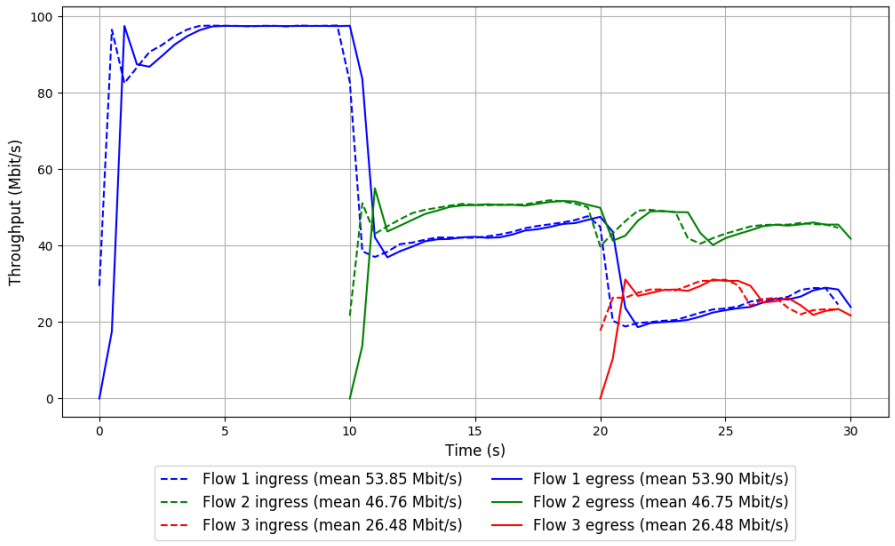


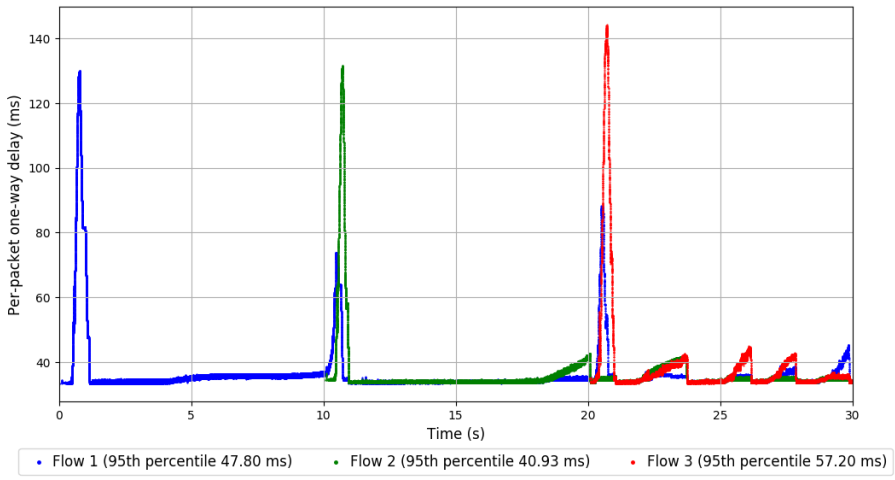
```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 03:47:22
End at: 2018-09-05 03:47:52
Local clock offset: 1.51 ms
Remote clock offset: -3.488 ms

# Below is generated by plot.py at 2018-09-05 03:49:27
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.78 Mbit/s
95th percentile per-packet one-way delay: 42.782 ms
Loss rate: 0.24%
-- Flow 1:
Average throughput: 53.90 Mbit/s
95th percentile per-packet one-way delay: 47.797 ms
Loss rate: 0.11%
-- Flow 2:
Average throughput: 46.75 Mbit/s
95th percentile per-packet one-way delay: 40.933 ms
Loss rate: 0.34%
-- Flow 3:
Average throughput: 26.48 Mbit/s
95th percentile per-packet one-way delay: 57.197 ms
Loss rate: 0.65%
```

Run 3: Report of TCP Cubic — Data Link



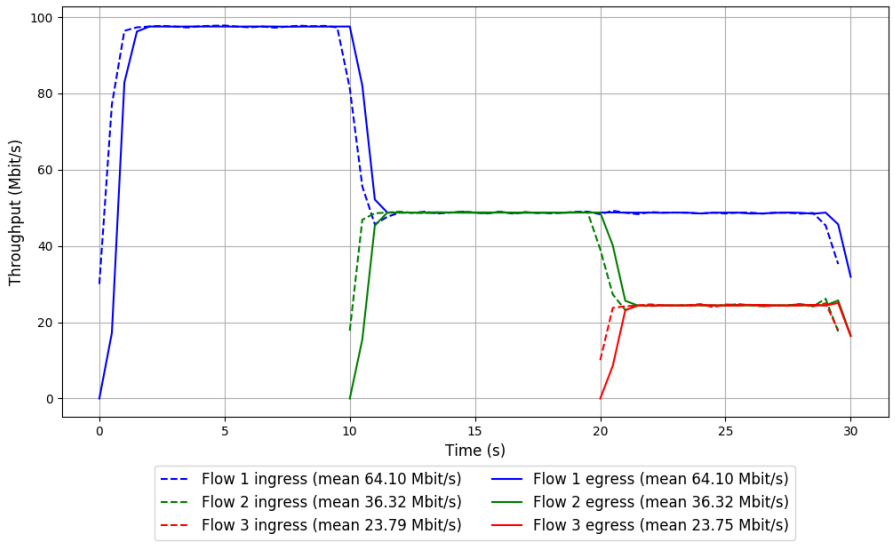


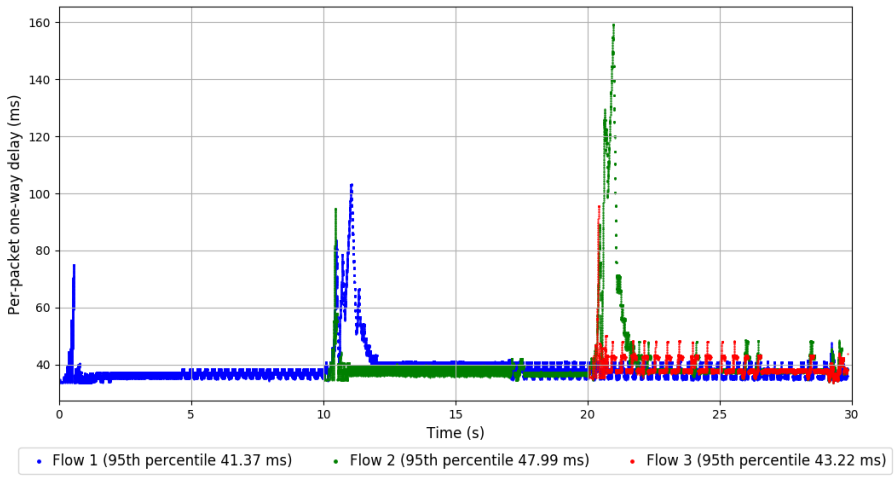
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 03:34:38
End at: 2018-09-05 03:35:08
Local clock offset: 1.535 ms
Remote clock offset: -4.261 ms

# Below is generated by plot.py at 2018-09-05 03:49:28
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.99 Mbit/s
95th percentile per-packet one-way delay: 43.254 ms
Loss rate: 0.29%
-- Flow 1:
Average throughput: 64.10 Mbit/s
95th percentile per-packet one-way delay: 41.372 ms
Loss rate: 0.23%
-- Flow 2:
Average throughput: 36.32 Mbit/s
95th percentile per-packet one-way delay: 47.986 ms
Loss rate: 0.31%
-- Flow 3:
Average throughput: 23.75 Mbit/s
95th percentile per-packet one-way delay: 43.220 ms
Loss rate: 0.78%
```

Run 1: Report of Indigo — Data Link



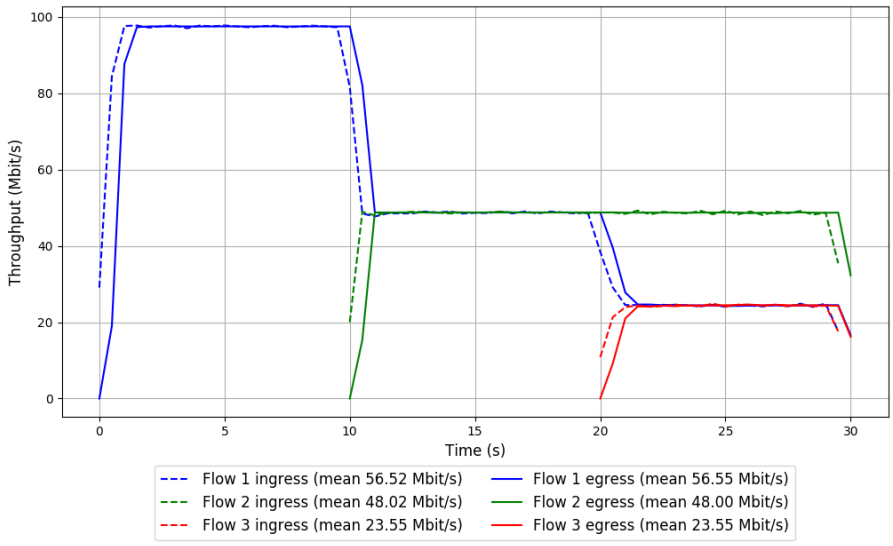


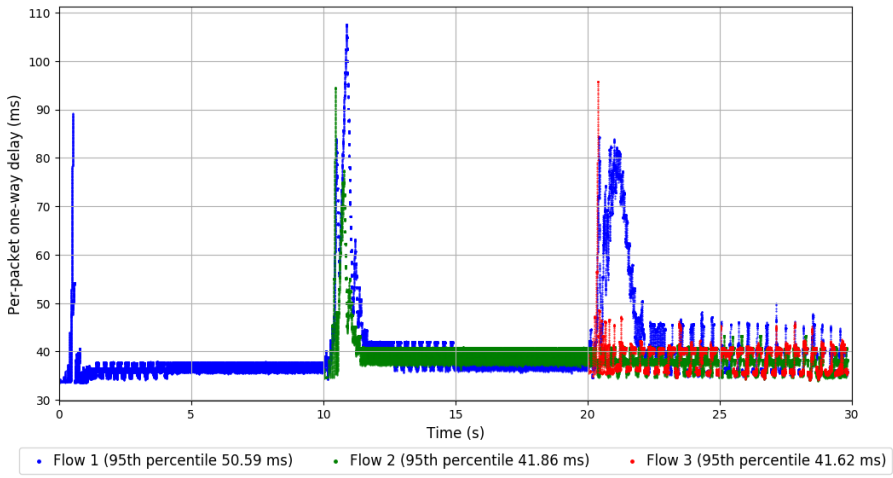
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 03:40:23
End at: 2018-09-05 03:40:53
Local clock offset: 1.711 ms
Remote clock offset: -3.839 ms

# Below is generated by plot.py at 2018-09-05 03:49:28
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.15 Mbit/s
95th percentile per-packet one-way delay: 45.567 ms
Loss rate: 0.28%
-- Flow 1:
Average throughput: 56.55 Mbit/s
95th percentile per-packet one-way delay: 50.592 ms
Loss rate: 0.17%
-- Flow 2:
Average throughput: 48.00 Mbit/s
95th percentile per-packet one-way delay: 41.859 ms
Loss rate: 0.37%
-- Flow 3:
Average throughput: 23.55 Mbit/s
95th percentile per-packet one-way delay: 41.623 ms
Loss rate: 0.69%
```

Run 2: Report of Indigo — Data Link



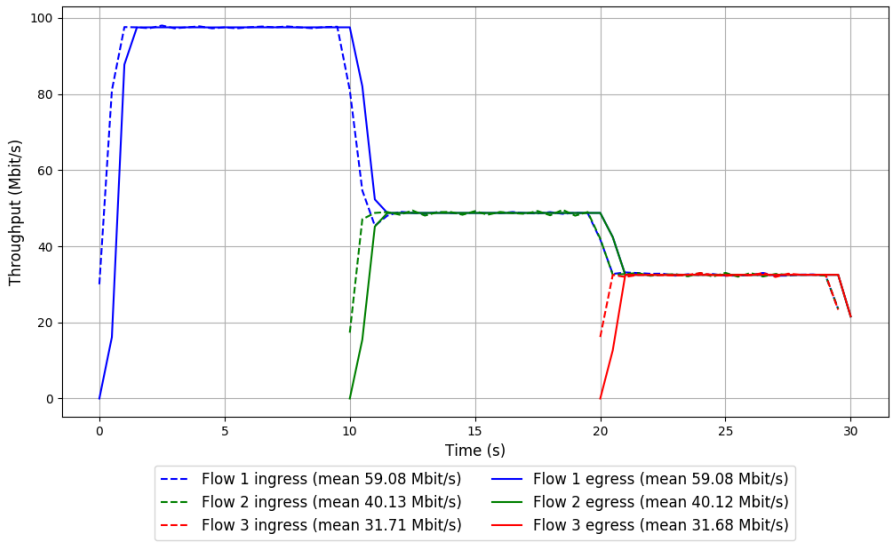


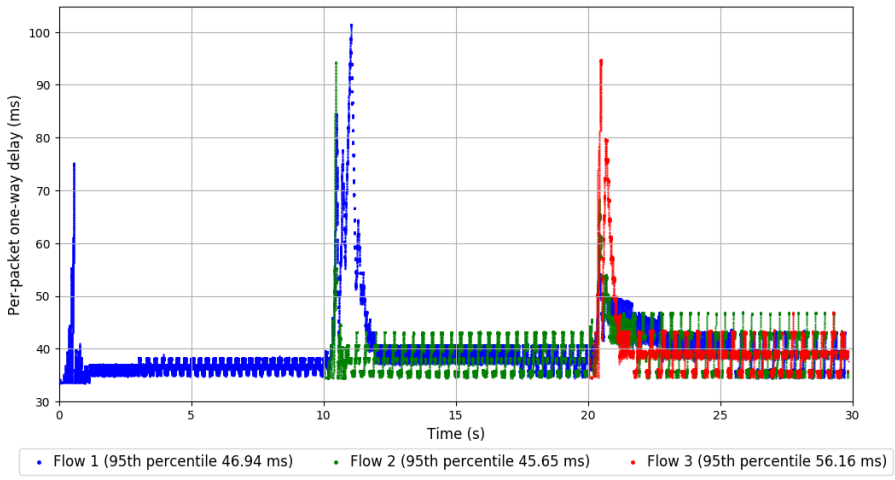
```
Run 3: Statistics of Indigo

Start at: 2018-09-05 03:45:58
End at: 2018-09-05 03:46:28
Local clock offset: 1.7 ms
Remote clock offset: -3.511 ms

# Below is generated by plot.py at 2018-09-05 03:49:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.10 Mbit/s
95th percentile per-packet one-way delay: 46.581 ms
Loss rate: 0.31%
-- Flow 1:
Average throughput: 59.08 Mbit/s
95th percentile per-packet one-way delay: 46.943 ms
Loss rate: 0.21%
-- Flow 2:
Average throughput: 40.12 Mbit/s
95th percentile per-packet one-way delay: 45.648 ms
Loss rate: 0.35%
-- Flow 3:
Average throughput: 31.68 Mbit/s
95th percentile per-packet one-way delay: 56.160 ms
Loss rate: 0.75%
```

Run 3: Report of Indigo — Data Link



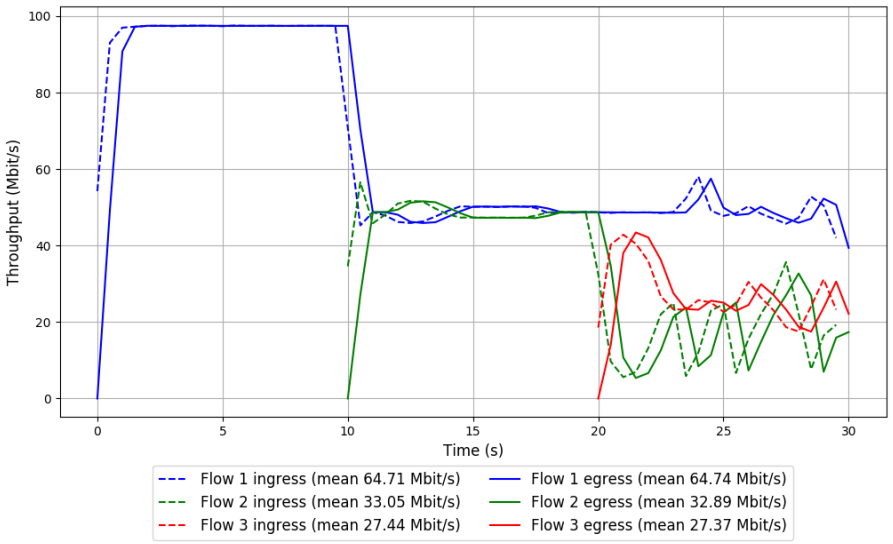


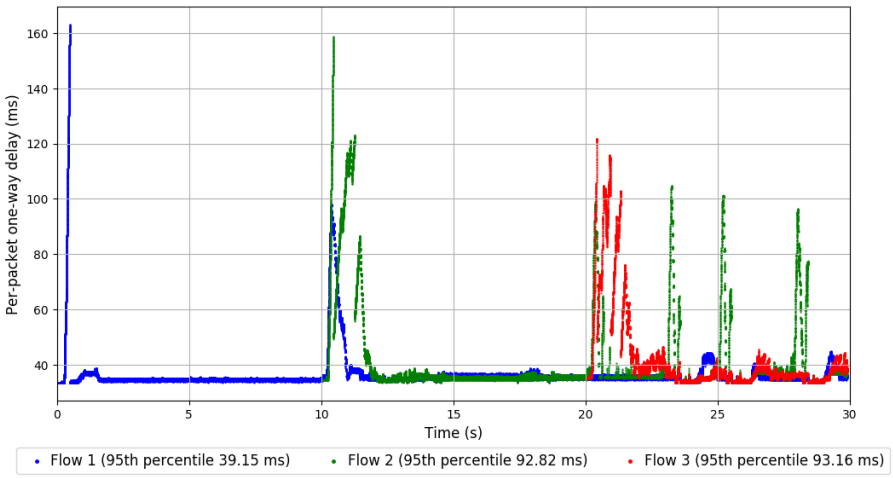
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 03:31:49
End at: 2018-09-05 03:32:19
Local clock offset: 1.515 ms
Remote clock offset: -4.407 ms

# Below is generated by plot.py at 2018-09-05 03:50:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.62 Mbit/s
95th percentile per-packet one-way delay: 63.577 ms
Loss rate: 0.39%
-- Flow 1:
Average throughput: 64.74 Mbit/s
95th percentile per-packet one-way delay: 39.152 ms
Loss rate: 0.17%
-- Flow 2:
Average throughput: 32.89 Mbit/s
95th percentile per-packet one-way delay: 92.818 ms
Loss rate: 0.82%
-- Flow 3:
Average throughput: 27.37 Mbit/s
95th percentile per-packet one-way delay: 93.160 ms
Loss rate: 0.91%
```

Run 1: Report of Muses-25 — Data Link



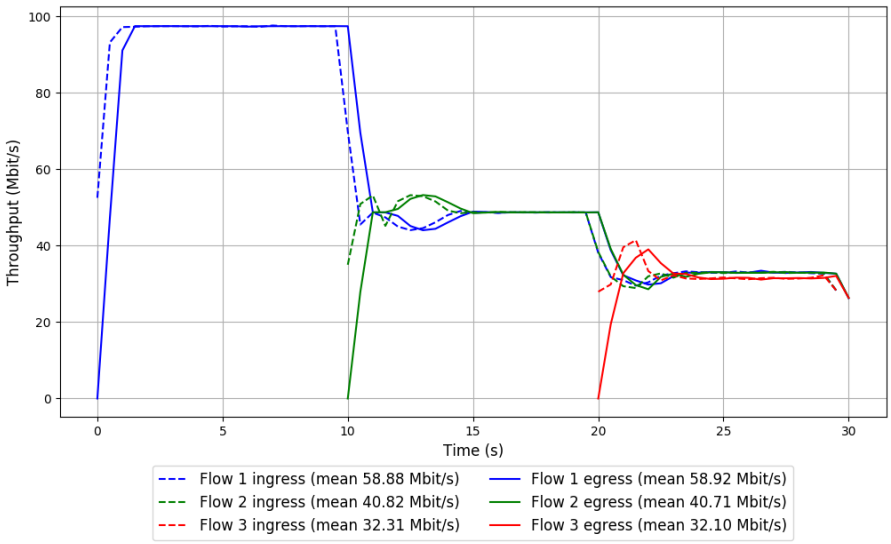


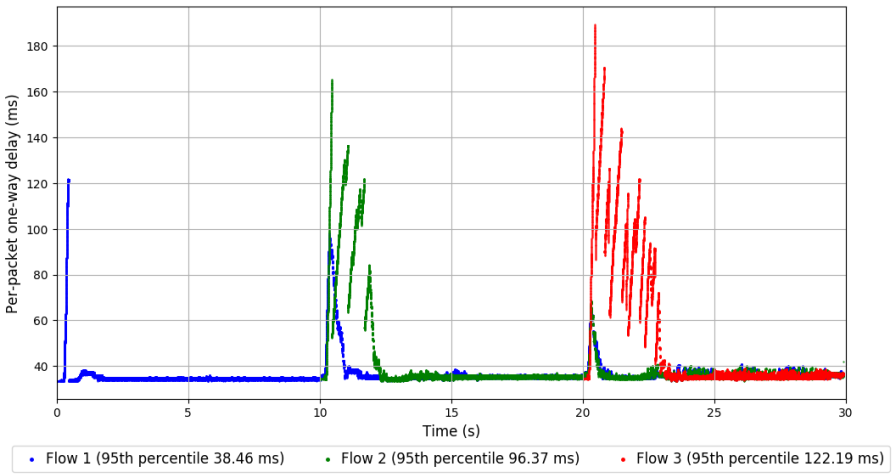
```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 03:37:29
End at: 2018-09-05 03:37:59
Local clock offset: 1.611 ms
Remote clock offset: -3.863 ms

# Below is generated by plot.py at 2018-09-05 03:50:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.59 Mbit/s
95th percentile per-packet one-way delay: 77.586 ms
Loss rate: 0.39%
-- Flow 1:
Average throughput: 58.92 Mbit/s
95th percentile per-packet one-way delay: 38.459 ms
Loss rate: 0.14%
-- Flow 2:
Average throughput: 40.71 Mbit/s
95th percentile per-packet one-way delay: 96.369 ms
Loss rate: 0.58%
-- Flow 3:
Average throughput: 32.10 Mbit/s
95th percentile per-packet one-way delay: 122.194 ms
Loss rate: 1.31%
```

Run 2: Report of Muses-25 — Data Link





```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 03:43:11
End at: 2018-09-05 03:43:41
Local clock offset: 1.846 ms
Remote clock offset: -3.585 ms

# Below is generated by plot.py at 2018-09-05 03:50:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 94.40 Mbit/s
95th percentile per-packet one-way delay: 64.895 ms
Loss rate: 0.22%
-- Flow 1:
Average throughput: 56.01 Mbit/s
95th percentile per-packet one-way delay: 42.578 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 33.11 Mbit/s
95th percentile per-packet one-way delay: 95.267 ms
Loss rate: 0.27%
-- Flow 3:
Average throughput: 49.67 Mbit/s
95th percentile per-packet one-way delay: 47.124 ms
Loss rate: 0.67%
```

Run 3: Report of Muses-25 — Data Link