

## Pantheon Report

Generated at 2018-09-03 09:17:50 (UTC).

Data path: AWS California 1 on `ens5` (*local*) → Stanford on `eno1` (*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.

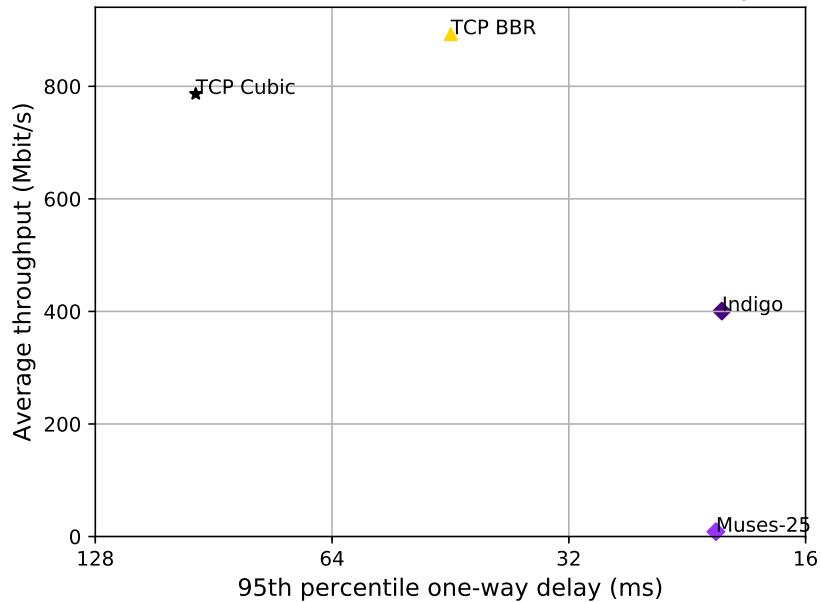
System info:

```
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
```

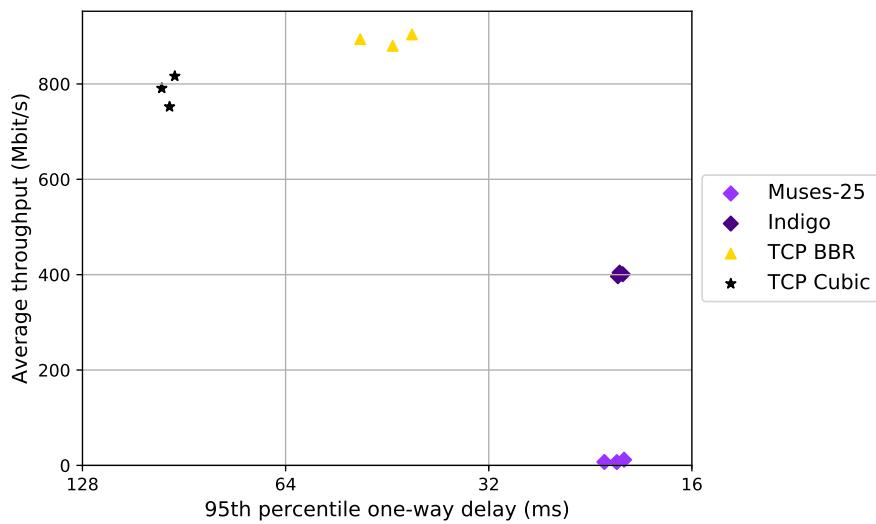
Git summary:

```
branch: muses @ f309f5459e2c5237279a184e52ece7a2b47ef1c9
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdf58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b8d5019b83a3a678804d830fcfe1da7b3a63421b
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 1 to Stanford, 3 runs of 30s each per scheme  
3 flows with 10s interval between flows (mean of all runs by scheme)



test from AWS California 1 to Stanford, 3 runs of 30s each per scheme  
3 flows with 10s interval between flows



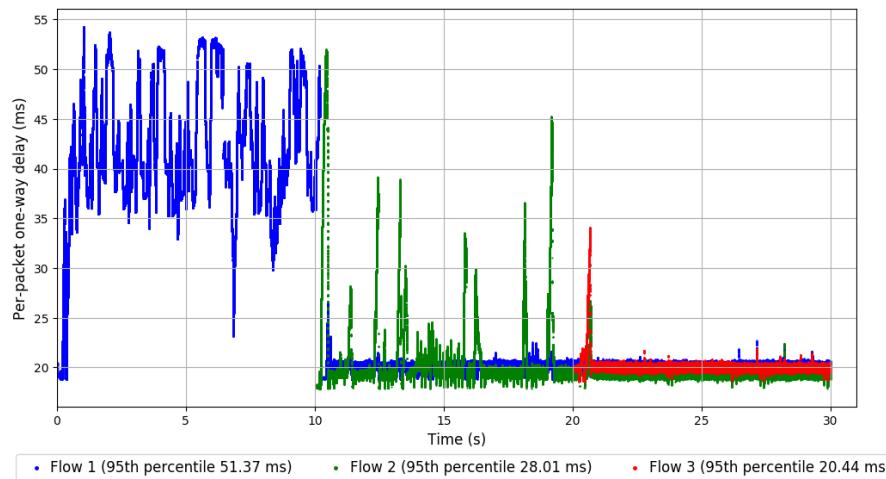
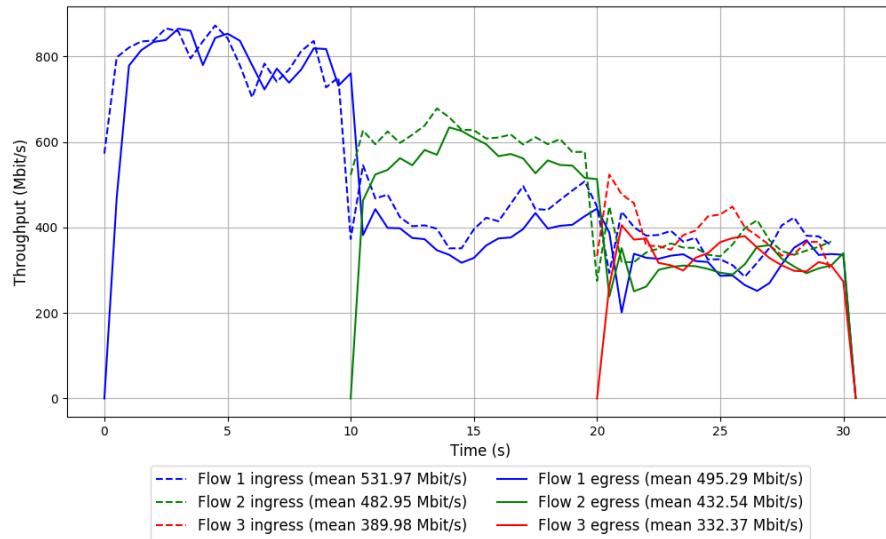
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	498.34	436.40	321.90	46.52	32.02	20.72	6.73	10.66	13.93
TCP Cubic	3	609.40	177.02	177.90	99.00	19.41	19.49	0.06	0.04	0.01
Indigo	3	205.29	199.33	194.81	20.42	20.18	20.87	0.00	0.01	0.01
Muses-25	3	2.48	6.87	5.16	19.14	21.01	21.72	68.06	20.51	20.79

Run 1: Statistics of TCP BBR

```
Start at: 2018-09-03 08:52:03
End at: 2018-09-03 08:52:33
Local clock offset: 5.49 ms
Remote clock offset: 2.987 ms

# Below is generated by plot.py at 2018-09-03 09:17:47
# Datalink statistics
-- Total of 3 flows:
Average throughput: 893.94 Mbit/s
95th percentile per-packet one-way delay: 49.614 ms
Loss rate: 9.09%
-- Flow 1:
Average throughput: 495.29 Mbit/s
95th percentile per-packet one-way delay: 51.370 ms
Loss rate: 6.89%
-- Flow 2:
Average throughput: 432.54 Mbit/s
95th percentile per-packet one-way delay: 28.007 ms
Loss rate: 10.43%
-- Flow 3:
Average throughput: 332.37 Mbit/s
95th percentile per-packet one-way delay: 20.439 ms
Loss rate: 14.77%
```

## Run 1: Report of TCP BBR — Data Link

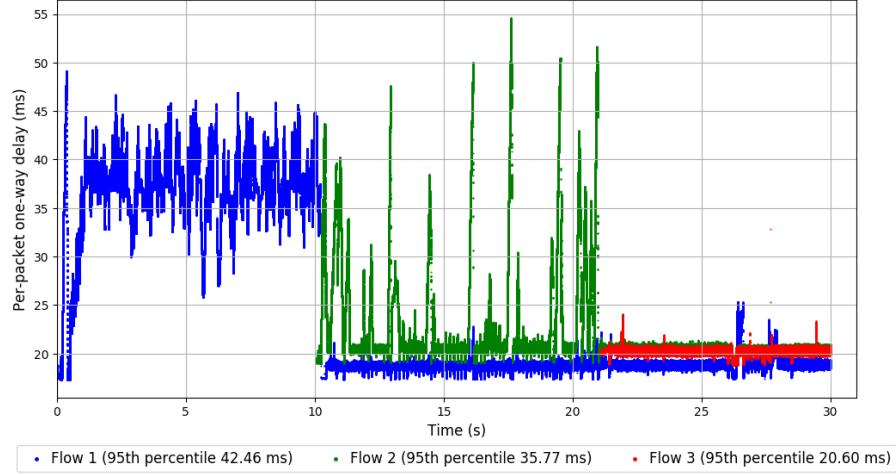
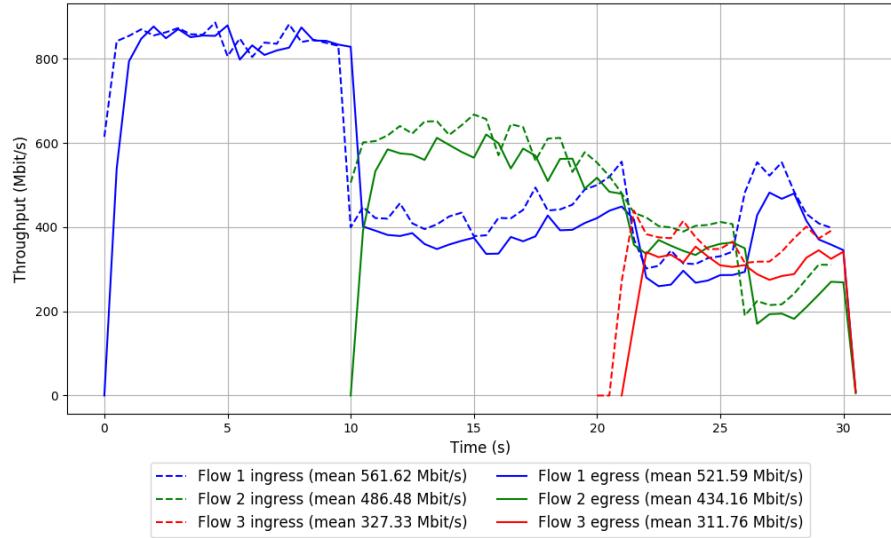


Run 2: Statistics of TCP BBR

```
Start at: 2018-09-03 08:58:37
End at: 2018-09-03 08:59:07
Local clock offset: 6.053 ms
Remote clock offset: 3.496 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 903.90 Mbit/s
95th percentile per-packet one-way delay: 41.579 ms
Loss rate: 9.11%
-- Flow 1:
Average throughput: 521.59 Mbit/s
95th percentile per-packet one-way delay: 42.456 ms
Loss rate: 7.12%
-- Flow 2:
Average throughput: 434.16 Mbit/s
95th percentile per-packet one-way delay: 35.771 ms
Loss rate: 10.76%
-- Flow 3:
Average throughput: 311.76 Mbit/s
95th percentile per-packet one-way delay: 20.599 ms
Loss rate: 14.47%
```

## Run 2: Report of TCP BBR — Data Link

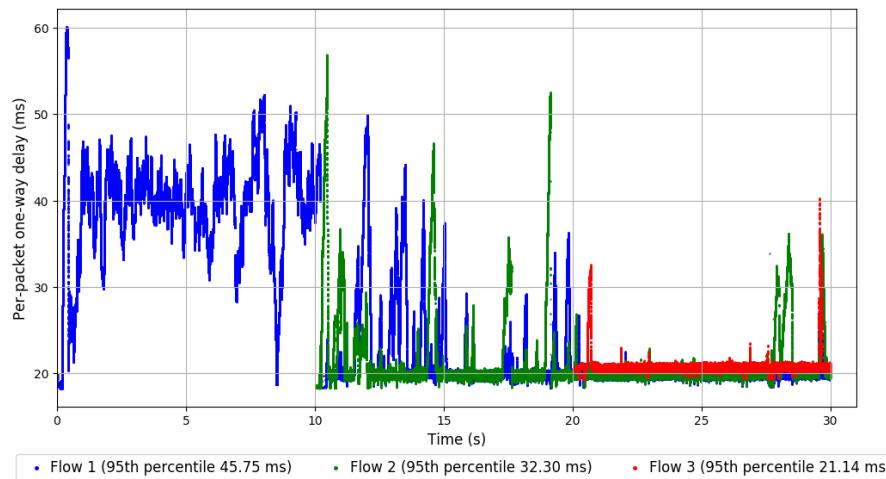
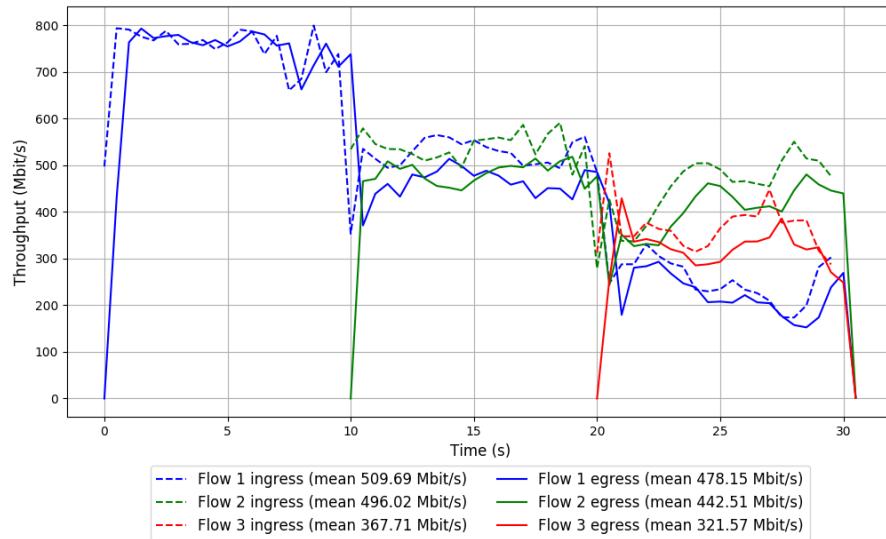


Run 3: Statistics of TCP BBR

```
Start at: 2018-09-03 09:05:11
End at: 2018-09-03 09:05:41
Local clock offset: 7.966 ms
Remote clock offset: 3.884 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 879.88 Mbit/s
95th percentile per-packet one-way delay: 44.410 ms
Loss rate: 8.57%
-- Flow 1:
Average throughput: 478.15 Mbit/s
95th percentile per-packet one-way delay: 45.748 ms
Loss rate: 6.18%
-- Flow 2:
Average throughput: 442.51 Mbit/s
95th percentile per-packet one-way delay: 32.295 ms
Loss rate: 10.78%
-- Flow 3:
Average throughput: 321.57 Mbit/s
95th percentile per-packet one-way delay: 21.135 ms
Loss rate: 12.54%
```

### Run 3: Report of TCP BBR — Data Link

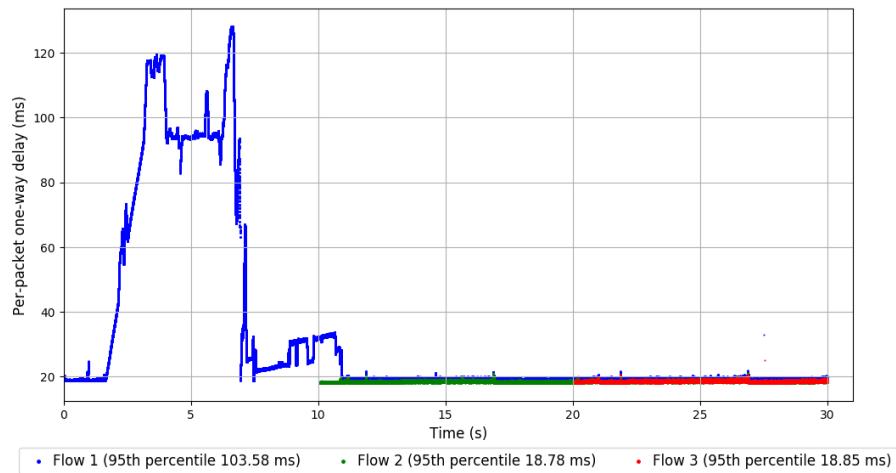
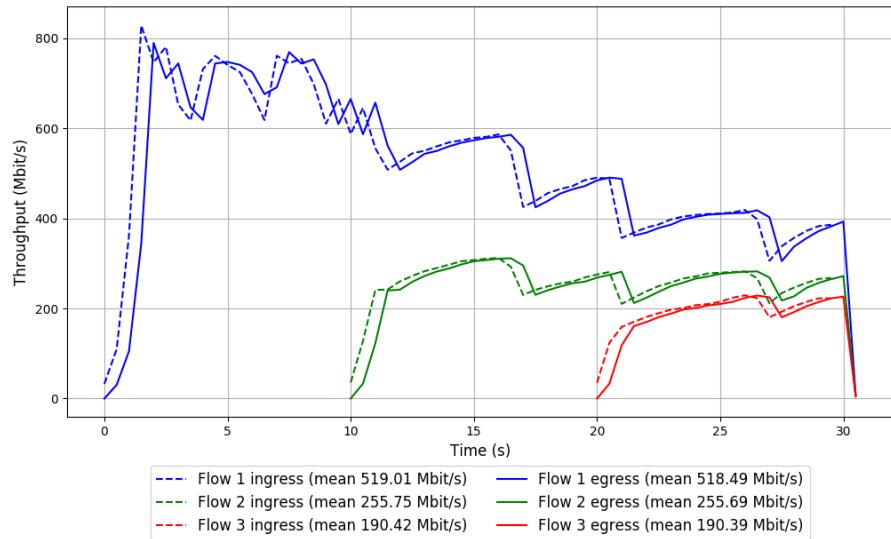


Run 1: Statistics of TCP Cubic

```
Start at: 2018-09-03 08:48:45
End at: 2018-09-03 08:49:15
Local clock offset: 4.873 ms
Remote clock offset: 2.515 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 752.18 Mbit/s
95th percentile per-packet one-way delay: 95.091 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 518.49 Mbit/s
95th percentile per-packet one-way delay: 103.579 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 255.69 Mbit/s
95th percentile per-packet one-way delay: 18.780 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 190.39 Mbit/s
95th percentile per-packet one-way delay: 18.853 ms
Loss rate: 0.01%
```

## Run 1: Report of TCP Cubic — Data Link

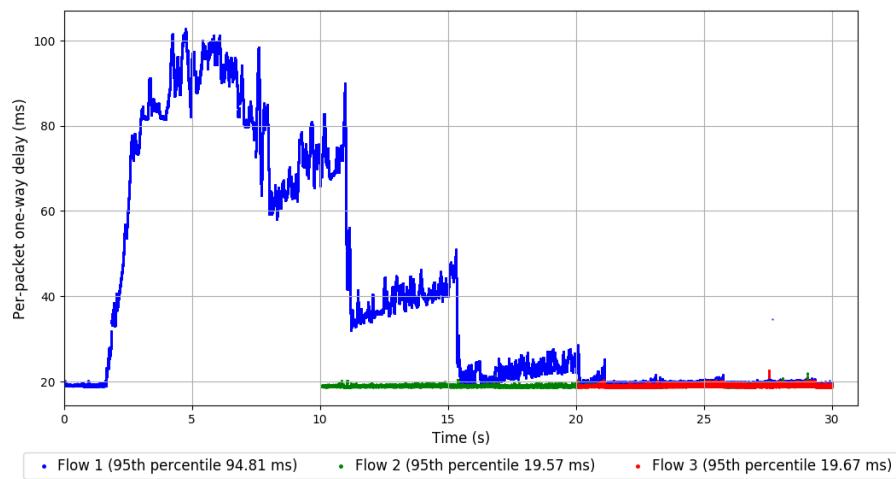
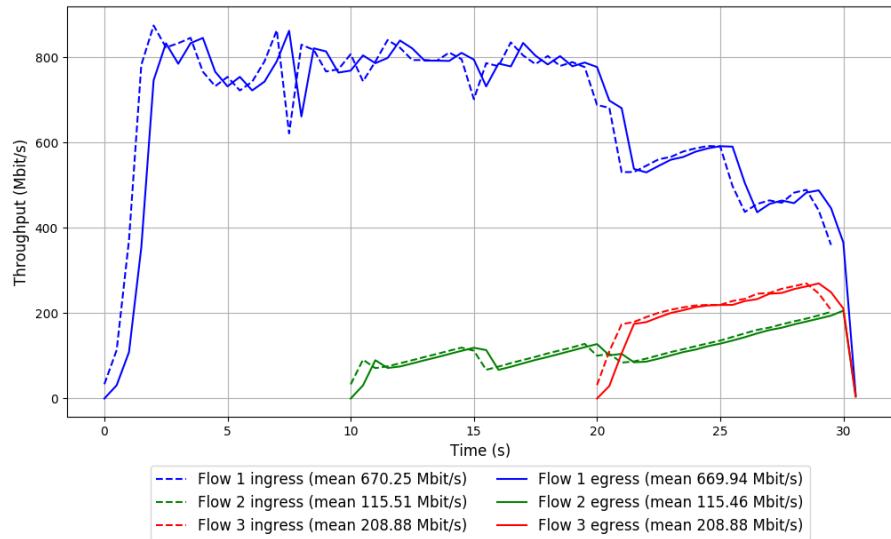


Run 2: Statistics of TCP Cubic

```
Start at: 2018-09-03 08:55:17
End at: 2018-09-03 08:55:47
Local clock offset: 5.529 ms
Remote clock offset: 3.241 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 816.31 Mbit/s
95th percentile per-packet one-way delay: 93.414 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 669.94 Mbit/s
95th percentile per-packet one-way delay: 94.805 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 115.46 Mbit/s
95th percentile per-packet one-way delay: 19.571 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 208.88 Mbit/s
95th percentile per-packet one-way delay: 19.669 ms
Loss rate: 0.00%
```

## Run 2: Report of TCP Cubic — Data Link

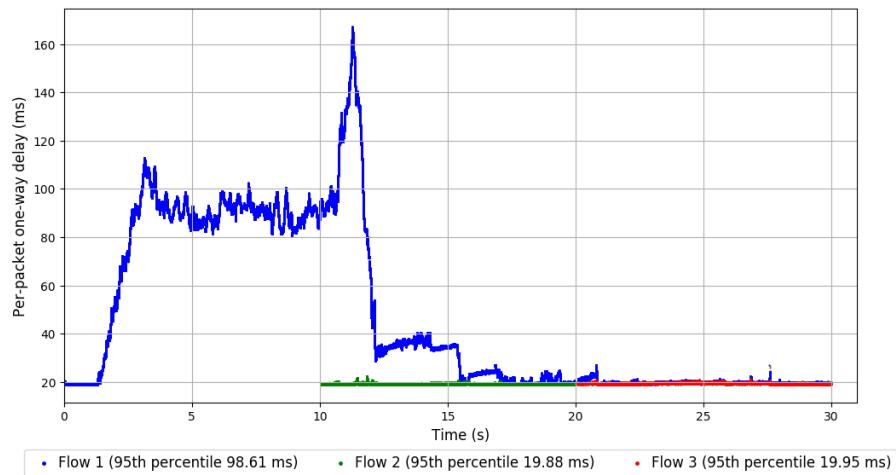
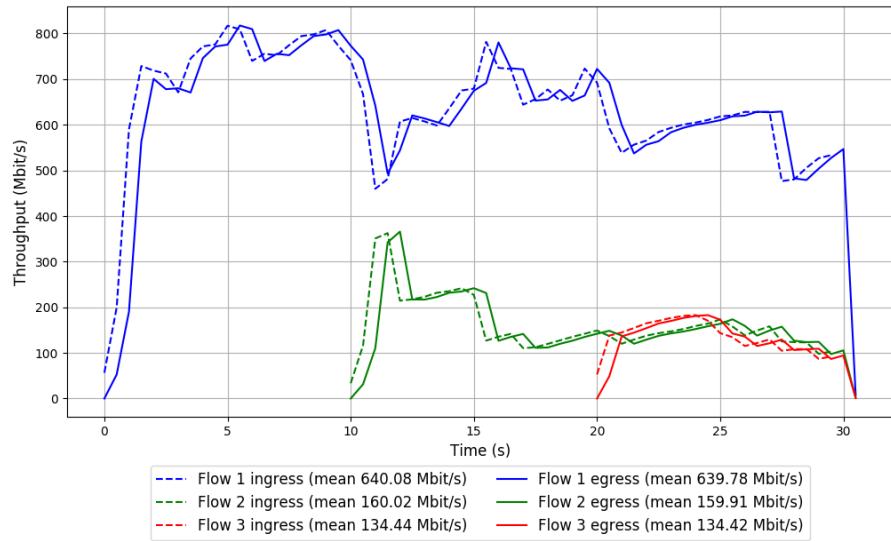


Run 3: Statistics of TCP Cubic

```
Start at: 2018-09-03 09:01:51
End at: 2018-09-03 09:02:21
Local clock offset: 6.901 ms
Remote clock offset: 3.769 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 791.01 Mbit/s
95th percentile per-packet one-way delay: 97.656 ms
Loss rate: 0.05%
-- Flow 1:
Average throughput: 639.78 Mbit/s
95th percentile per-packet one-way delay: 98.610 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 159.91 Mbit/s
95th percentile per-packet one-way delay: 19.875 ms
Loss rate: 0.07%
-- Flow 3:
Average throughput: 134.42 Mbit/s
95th percentile per-packet one-way delay: 19.954 ms
Loss rate: 0.02%
```

### Run 3: Report of TCP Cubic — Data Link

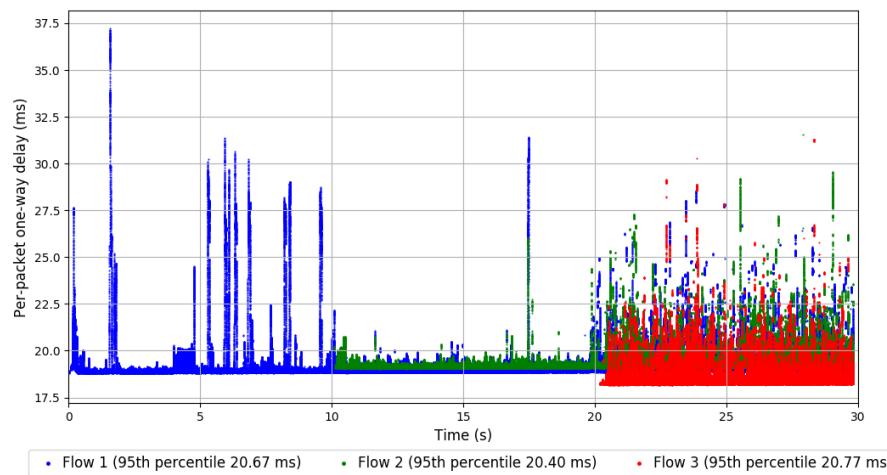
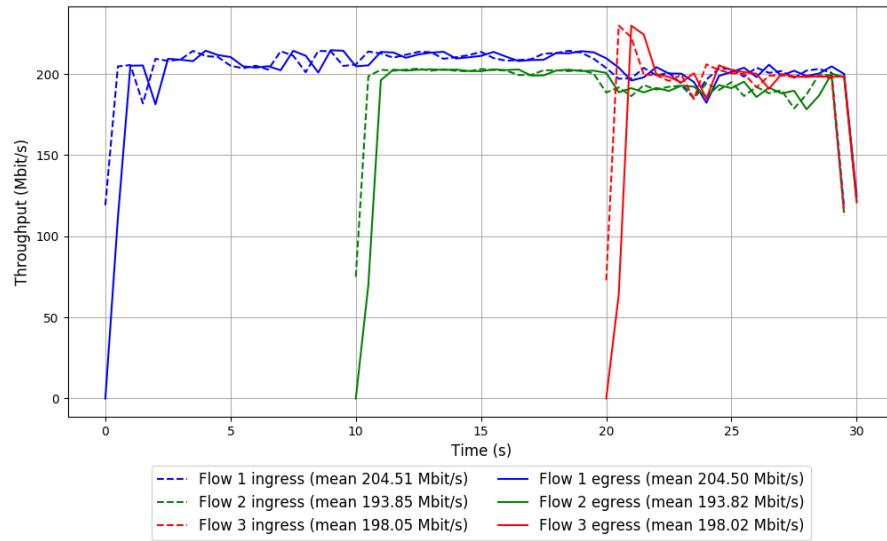


Run 1: Statistics of Indigo

```
Start at: 2018-09-03 08:50:28
End at: 2018-09-03 08:50:58
Local clock offset: 5.13 ms
Remote clock offset: 2.785 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 396.70 Mbit/s
95th percentile per-packet one-way delay: 20.595 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 204.50 Mbit/s
95th percentile per-packet one-way delay: 20.667 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 193.82 Mbit/s
95th percentile per-packet one-way delay: 20.402 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 198.02 Mbit/s
95th percentile per-packet one-way delay: 20.766 ms
Loss rate: 0.01%
```

## Run 1: Report of Indigo — Data Link

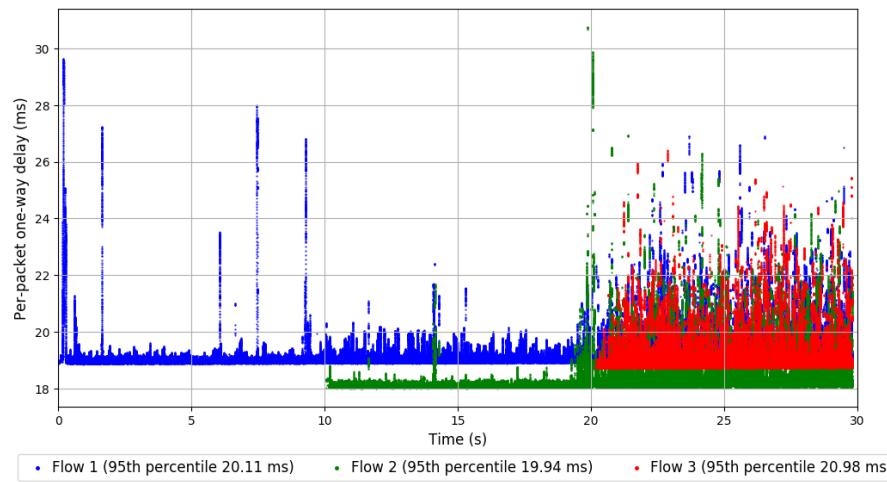
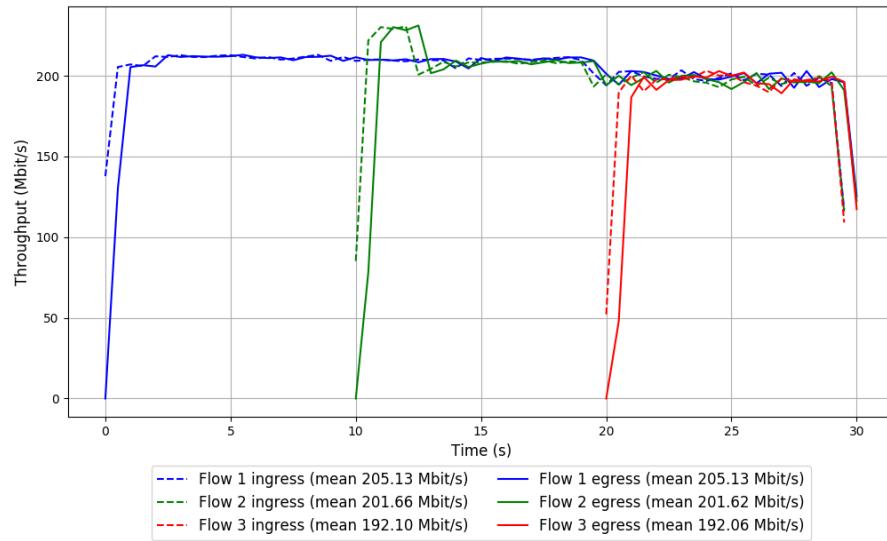


Run 2: Statistics of Indigo

```
Start at: 2018-09-03 08:57:02
End at: 2018-09-03 08:57:32
Local clock offset: 5.724 ms
Remote clock offset: 3.33 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 400.88 Mbit/s
95th percentile per-packet one-way delay: 20.257 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 205.13 Mbit/s
95th percentile per-packet one-way delay: 20.106 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 201.62 Mbit/s
95th percentile per-packet one-way delay: 19.939 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 192.06 Mbit/s
95th percentile per-packet one-way delay: 20.979 ms
Loss rate: 0.00%
```

## Run 2: Report of Indigo — Data Link

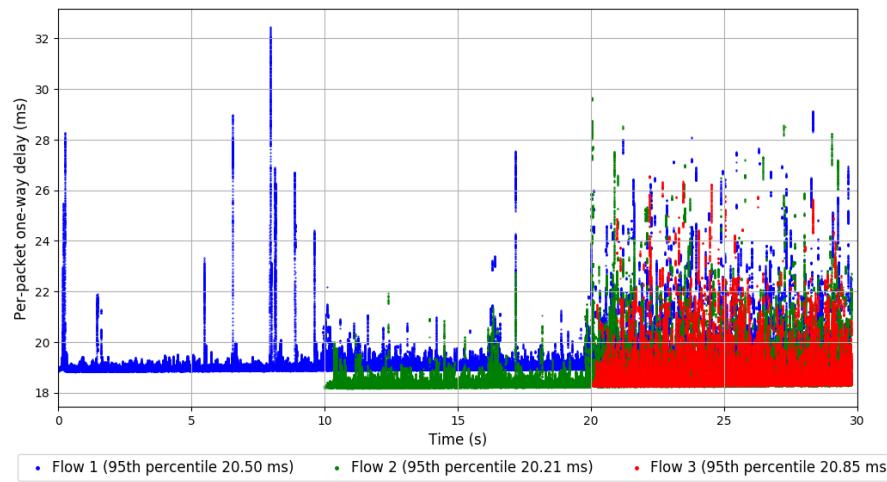
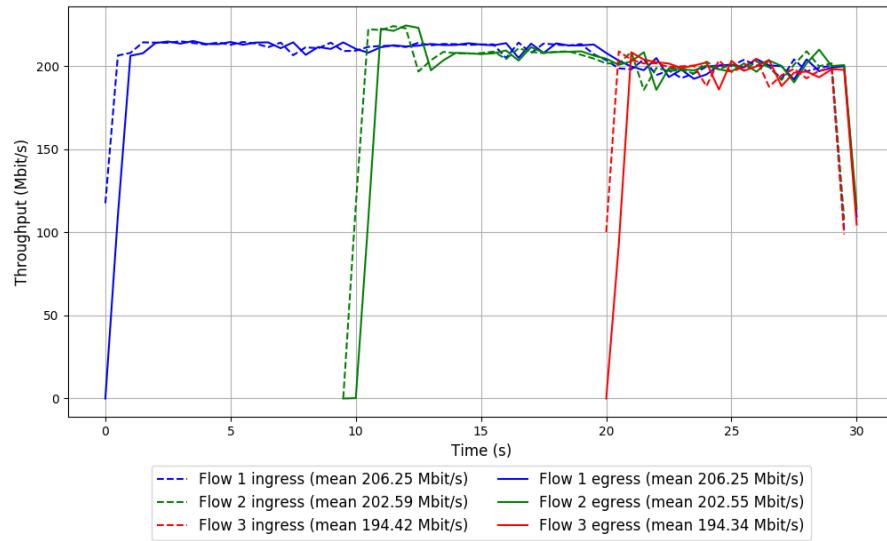


Run 3: Statistics of Indigo

```
Start at: 2018-09-03 09:03:35
End at: 2018-09-03 09:04:05
Local clock offset: 7.533 ms
Remote clock offset: 3.858 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 404.32 Mbit/s
95th percentile per-packet one-way delay: 20.475 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 206.25 Mbit/s
95th percentile per-packet one-way delay: 20.497 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 202.55 Mbit/s
95th percentile per-packet one-way delay: 20.213 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 194.34 Mbit/s
95th percentile per-packet one-way delay: 20.854 ms
Loss rate: 0.03%
```

Run 3: Report of Indigo — Data Link

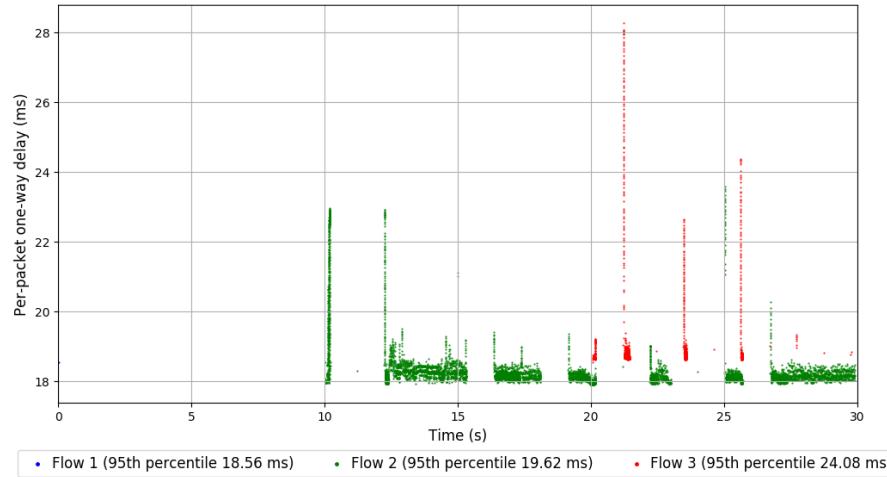
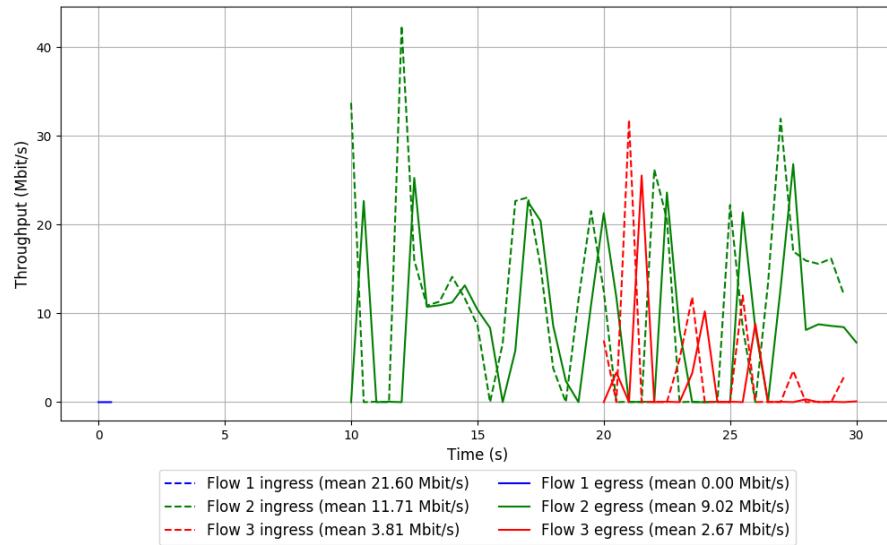


Run 1: Statistics of Muses-25

```
Start at: 2018-09-03 08:53:59
End at: 2018-09-03 08:54:29
Local clock offset: 5.45 ms
Remote clock offset: 3.104 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 6.87 Mbit/s
95th percentile per-packet one-way delay: 20.672 ms
Loss rate: 23.96%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 18.558 ms
Loss rate: 97.24%
-- Flow 2:
Average throughput: 9.02 Mbit/s
95th percentile per-packet one-way delay: 19.619 ms
Loss rate: 22.99%
-- Flow 3:
Average throughput: 2.67 Mbit/s
95th percentile per-packet one-way delay: 24.076 ms
Loss rate: 29.97%
```

Run 1: Report of Muses-25 — Data Link

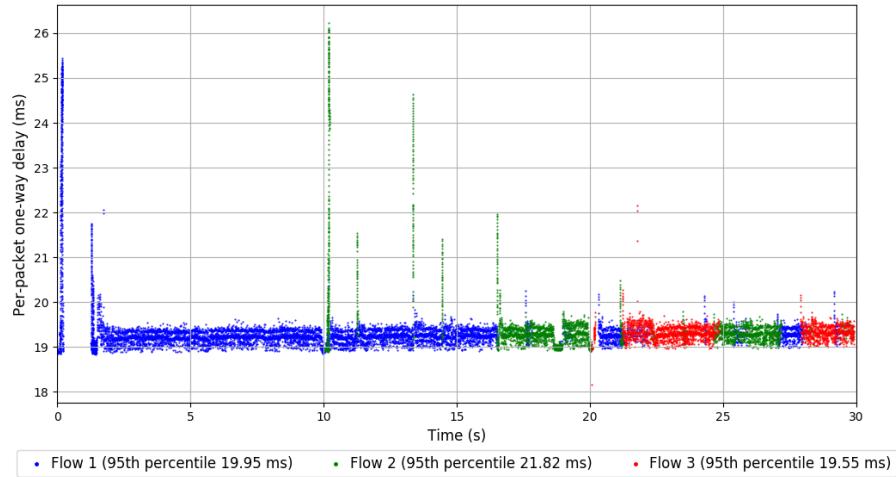
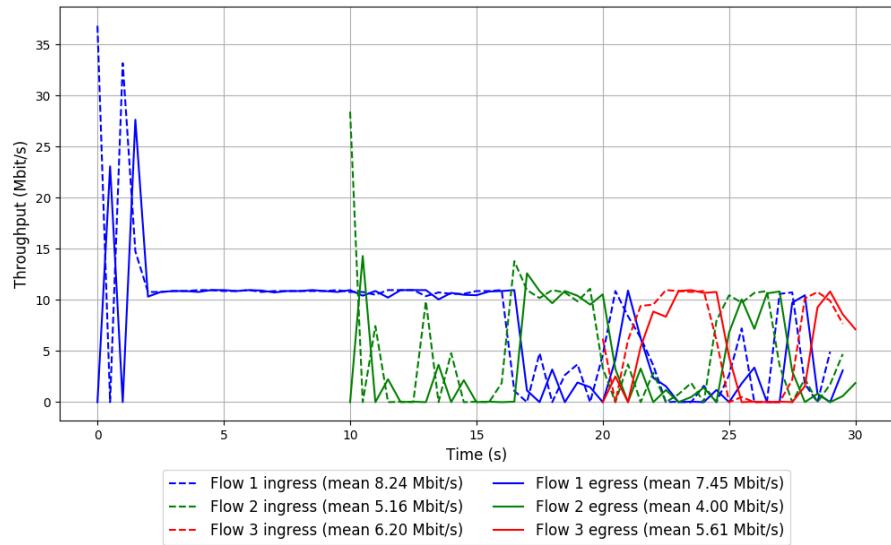


Run 2: Statistics of Muses-25

```
Start at: 2018-09-03 09:00:33
End at: 2018-09-03 09:01:03
Local clock offset: 6.512 ms
Remote clock offset: 3.628 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 11.82 Mbit/s
95th percentile per-packet one-way delay: 20.165 ms
Loss rate: 12.94%
-- Flow 1:
Average throughput: 7.45 Mbit/s
95th percentile per-packet one-way delay: 19.954 ms
Loss rate: 9.70%
-- Flow 2:
Average throughput: 4.00 Mbit/s
95th percentile per-packet one-way delay: 21.824 ms
Loss rate: 22.57%
-- Flow 3:
Average throughput: 5.61 Mbit/s
95th percentile per-packet one-way delay: 19.553 ms
Loss rate: 9.62%
```

Run 2: Report of Muses-25 — Data Link



Run 3: Statistics of Muses-25

```
Start at: 2018-09-03 09:07:05
End at: 2018-09-03 09:07:35
Local clock offset: 8.804 ms
Remote clock offset: 4.093 ms

# Below is generated by plot.py at 2018-09-03 09:17:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 7.18 Mbit/s
95th percentile per-packet one-way delay: 21.568 ms
Loss rate: 18.37%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 18.907 ms
Loss rate: 97.24%
-- Flow 2:
Average throughput: 7.59 Mbit/s
95th percentile per-packet one-way delay: 21.589 ms
Loss rate: 15.98%
-- Flow 3:
Average throughput: 7.21 Mbit/s
95th percentile per-packet one-way delay: 21.524 ms
Loss rate: 22.79%
```

Run 3: Report of Muses-25 — Data Link

