

## Pantheon Report

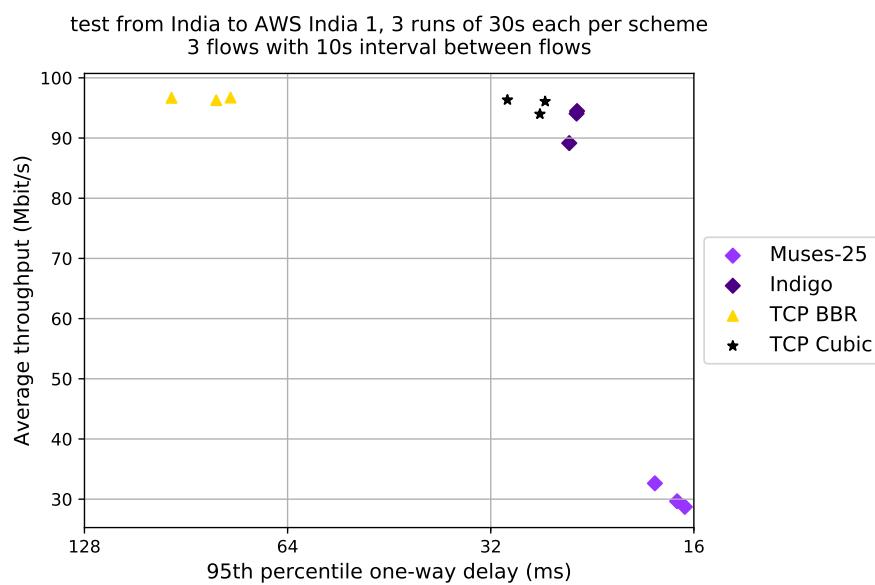
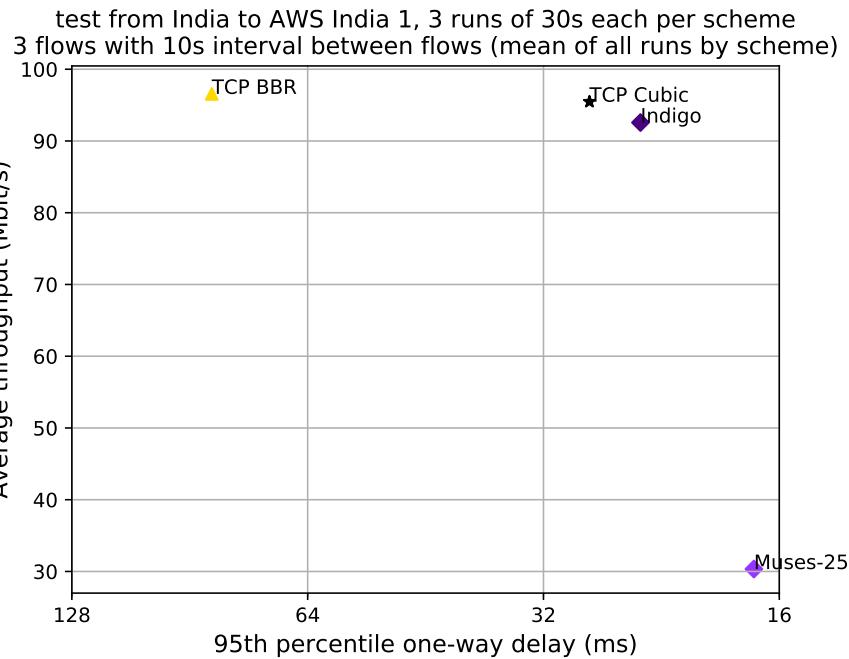
Generated at 2018-09-03 10:01:11 (UTC).  
Data path: India on `em1` (*remote*) → AWS India 1 on `ens5` (*local*).  
Repeated the test of 4 congestion control schemes 3 times.  
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.  
NTP offsets were measured against `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 @ 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
```



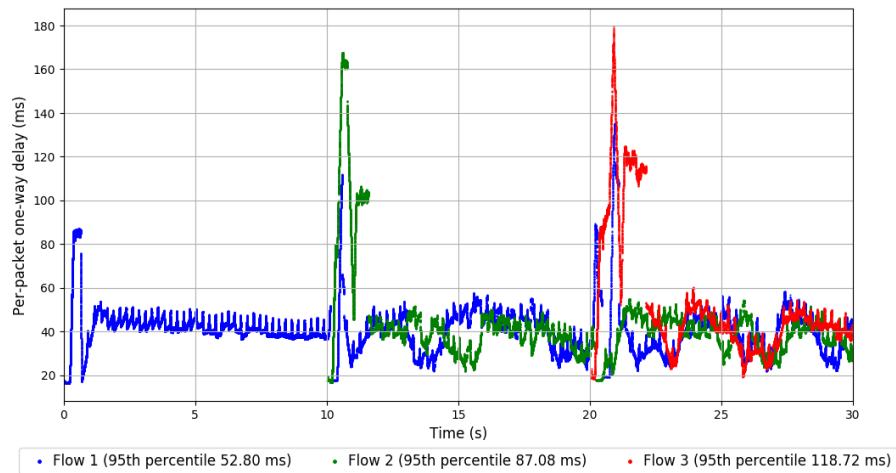
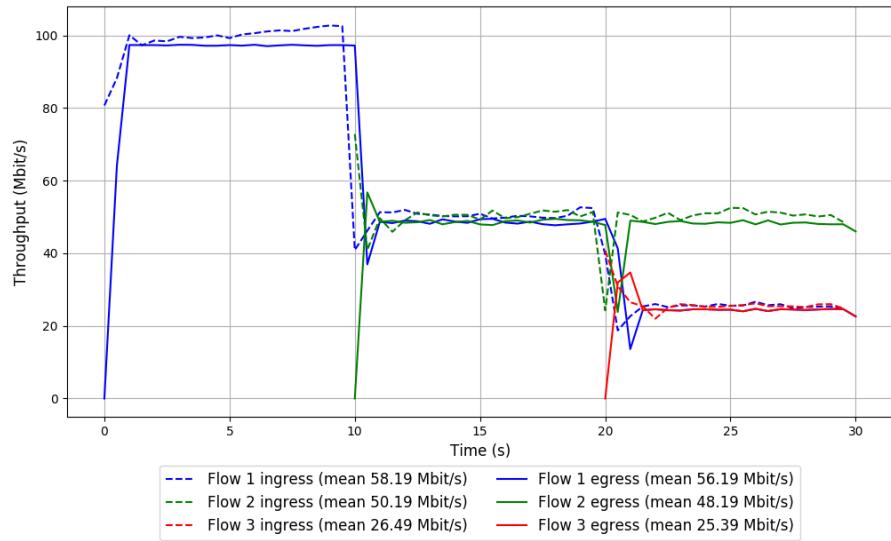
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	3	59.54	41.69	27.89	51.34	99.31	169.51	3.45	4.30	4.01
TCP Cubic	3	60.03	38.62	29.30	27.50	28.43	29.54	0.08	0.16	0.36
Indigo	3	53.60	39.98	37.72	22.91	24.18	24.98	0.06	0.12	0.31
Muses-25	3	13.87	13.70	22.21	17.14	17.17	18.08	0.05	0.07	0.09

Run 1: Statistics of TCP BBR

```
Start at: 2018-09-03 09:47:17
End at: 2018-09-03 09:47:47
Local clock offset: -26.252 ms
Remote clock offset: -4.45 ms

# Below is generated by plot.py at 2018-09-03 10:00:56
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.72 Mbit/s
95th percentile per-packet one-way delay: 77.753 ms
Loss rate: 3.81%
-- Flow 1:
Average throughput: 56.19 Mbit/s
95th percentile per-packet one-way delay: 52.797 ms
Loss rate: 3.53%
-- Flow 2:
Average throughput: 48.19 Mbit/s
95th percentile per-packet one-way delay: 87.081 ms
Loss rate: 4.13%
-- Flow 3:
Average throughput: 25.39 Mbit/s
95th percentile per-packet one-way delay: 118.719 ms
Loss rate: 4.41%
```

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

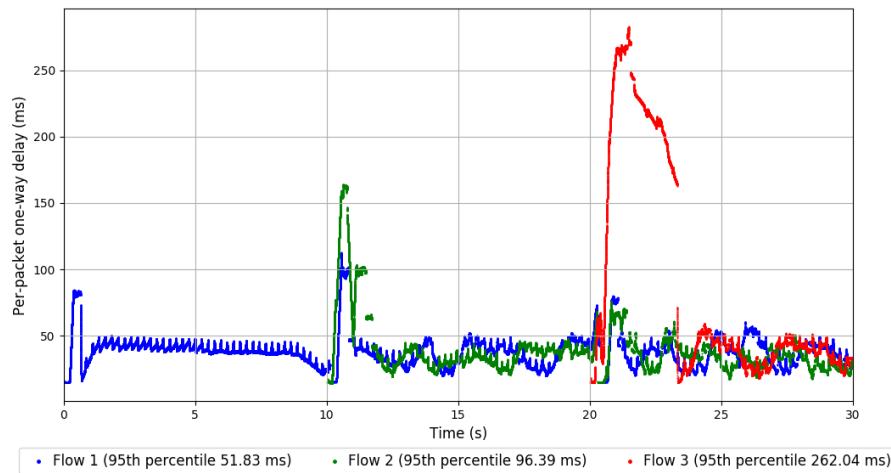
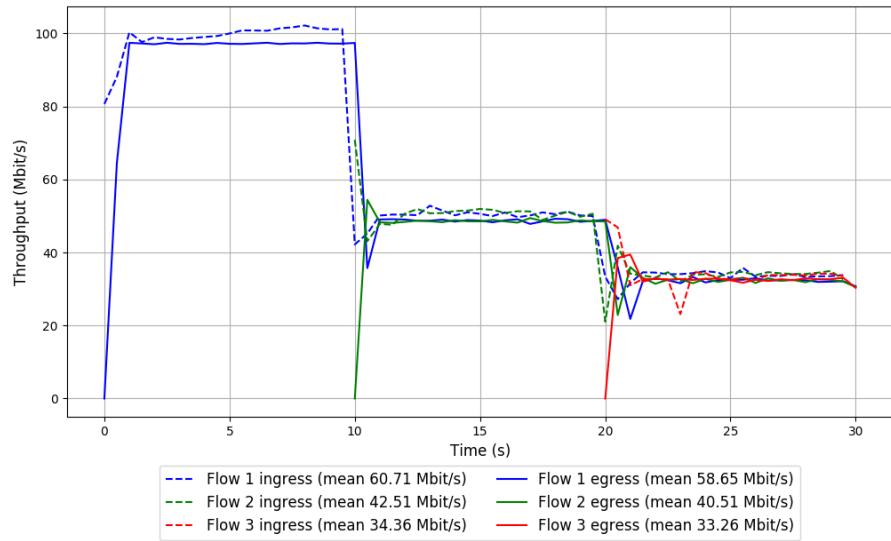


Run 2: Statistics of TCP BBR

```
Start at: 2018-09-03 09:51:56
End at: 2018-09-03 09:52:26
Local clock offset: -28.207 ms
Remote clock offset: -3.23 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.68 Mbit/s
95th percentile per-packet one-way delay: 95.105 ms
Loss rate: 3.85%
-- Flow 1:
Average throughput: 58.65 Mbit/s
95th percentile per-packet one-way delay: 51.827 ms
Loss rate: 3.47%
-- Flow 2:
Average throughput: 40.51 Mbit/s
95th percentile per-packet one-way delay: 96.389 ms
Loss rate: 4.82%
-- Flow 3:
Average throughput: 33.26 Mbit/s
95th percentile per-packet one-way delay: 262.035 ms
Loss rate: 3.45%
```

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

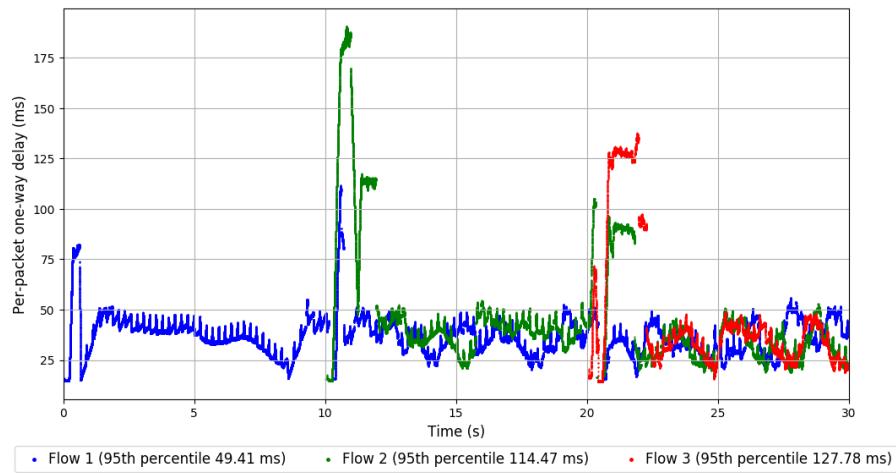
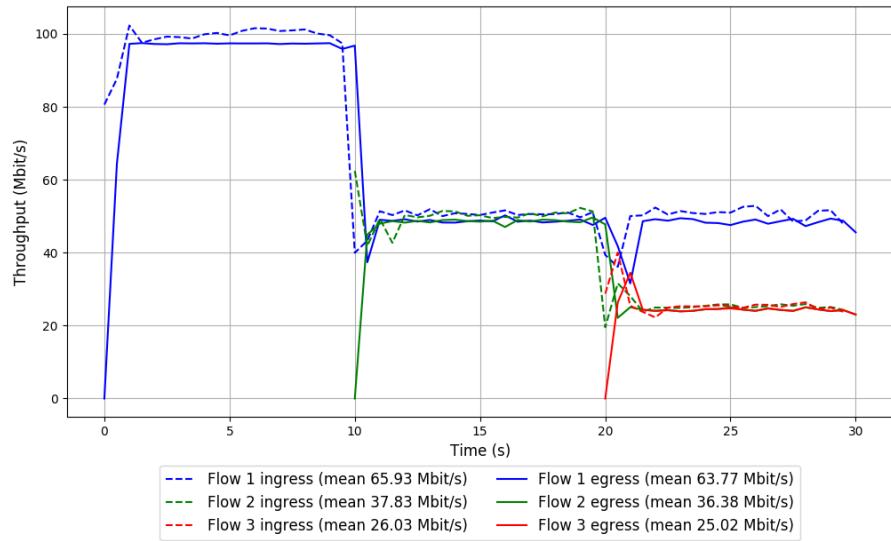


Run 3: Statistics of TCP BBR

```
Start at: 2018-09-03 09:56:34
End at: 2018-09-03 09:57:04
Local clock offset: -20.453 ms
Remote clock offset: -3.357 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.30 Mbit/s
95th percentile per-packet one-way delay: 81.645 ms
Loss rate: 3.58%
-- Flow 1:
Average throughput: 63.77 Mbit/s
95th percentile per-packet one-way delay: 49.408 ms
Loss rate: 3.36%
-- Flow 2:
Average throughput: 36.38 Mbit/s
95th percentile per-packet one-way delay: 114.470 ms
Loss rate: 3.95%
-- Flow 3:
Average throughput: 25.02 Mbit/s
95th percentile per-packet one-way delay: 127.781 ms
Loss rate: 4.16%
```

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

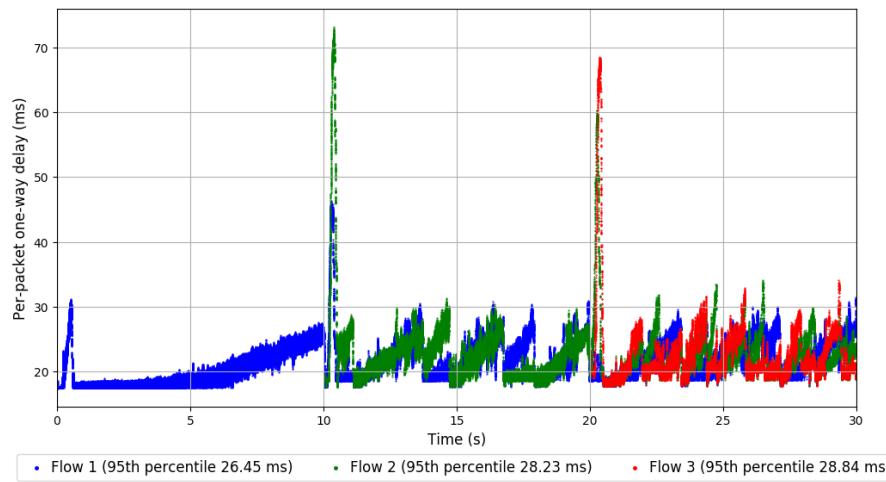
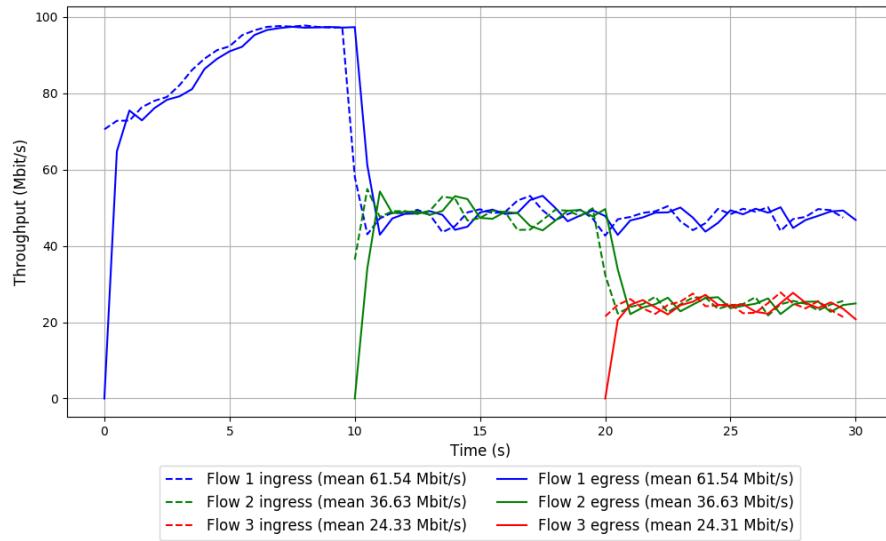


```
Run 1: Statistics of TCP Cubic
```

```
Start at: 2018-09-03 09:46:07
End at: 2018-09-03 09:46:37
Local clock offset: -25.606 ms
Remote clock offset: -5.655 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.98 Mbit/s
95th percentile per-packet one-way delay: 27.058 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 61.54 Mbit/s
95th percentile per-packet one-way delay: 26.447 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 36.63 Mbit/s
95th percentile per-packet one-way delay: 28.232 ms
Loss rate: 0.14%
-- Flow 3:
Average throughput: 24.31 Mbit/s
95th percentile per-packet one-way delay: 28.844 ms
Loss rate: 0.34%
```

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

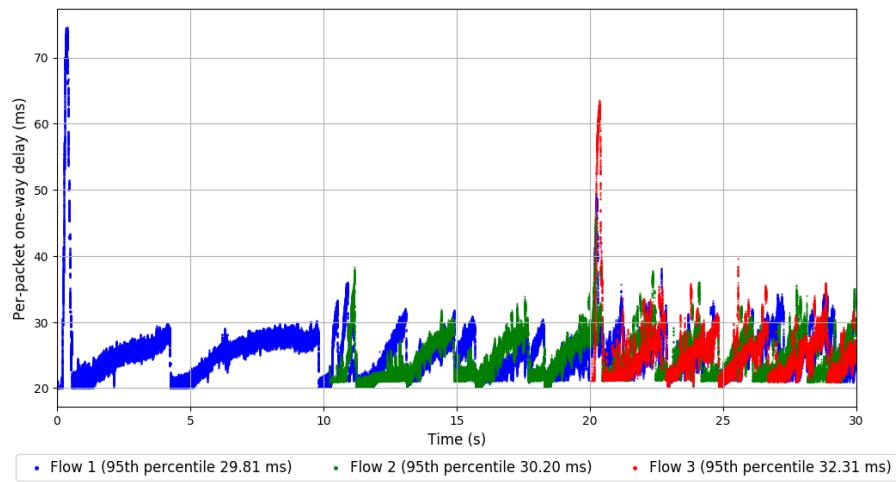
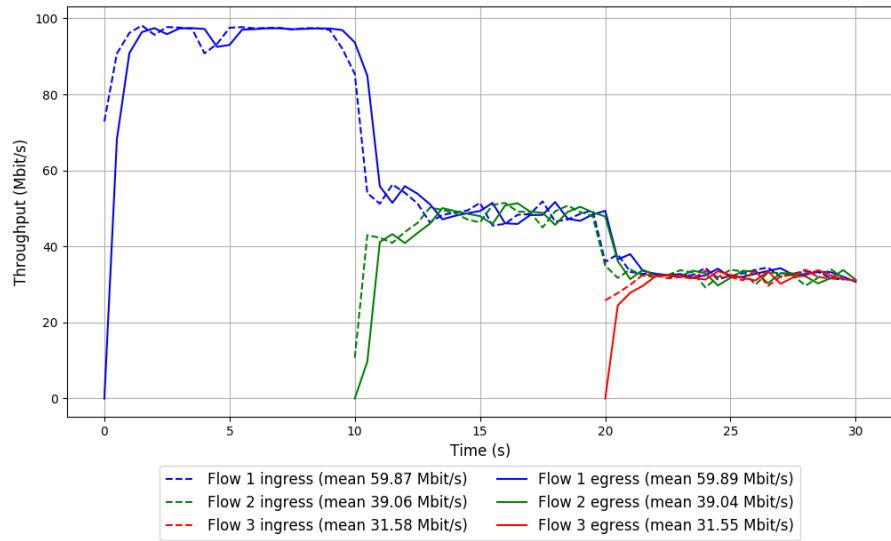


Run 2: Statistics of TCP Cubic

```
Start at: 2018-09-03 09:50:46
End at: 2018-09-03 09:51:16
Local clock offset: -25.858 ms
Remote clock offset: -5.005 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.34 Mbit/s
95th percentile per-packet one-way delay: 30.227 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 59.89 Mbit/s
95th percentile per-packet one-way delay: 29.807 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 39.04 Mbit/s
95th percentile per-packet one-way delay: 30.204 ms
Loss rate: 0.18%
-- Flow 3:
Average throughput: 31.55 Mbit/s
95th percentile per-packet one-way delay: 32.311 ms
Loss rate: 0.37%
```

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

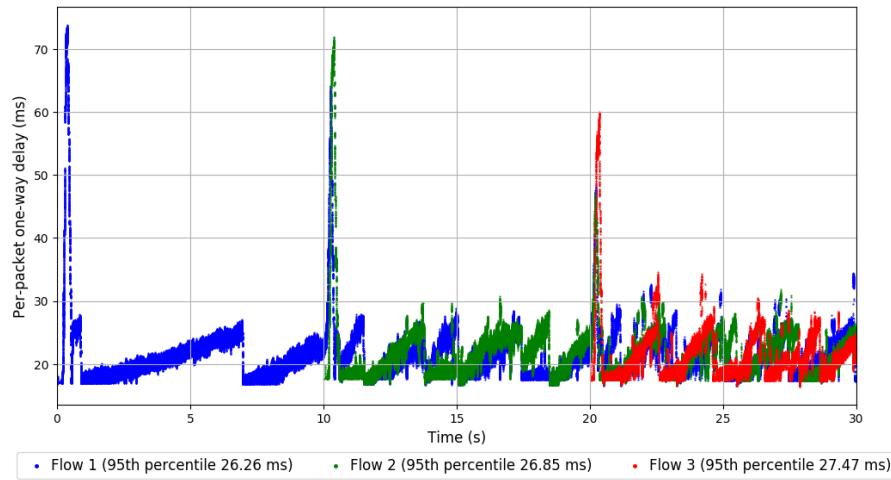
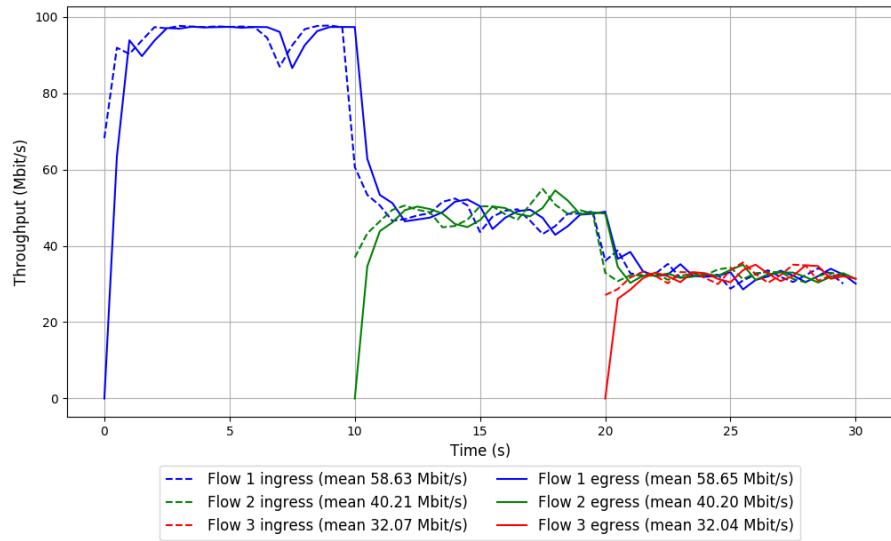


```
Run 3: Statistics of TCP Cubic
```

```
Start at: 2018-09-03 09:55:24
End at: 2018-09-03 09:55:54
Local clock offset: -19.742 ms
Remote clock offset: -3.544 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.08 Mbit/s
95th percentile per-packet one-way delay: 26.577 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 58.65 Mbit/s
95th percentile per-packet one-way delay: 26.259 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 40.20 Mbit/s
95th percentile per-packet one-way delay: 26.848 ms
Loss rate: 0.16%
-- Flow 3:
Average throughput: 32.04 Mbit/s
95th percentile per-packet one-way delay: 27.468 ms
Loss rate: 0.37%
```

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

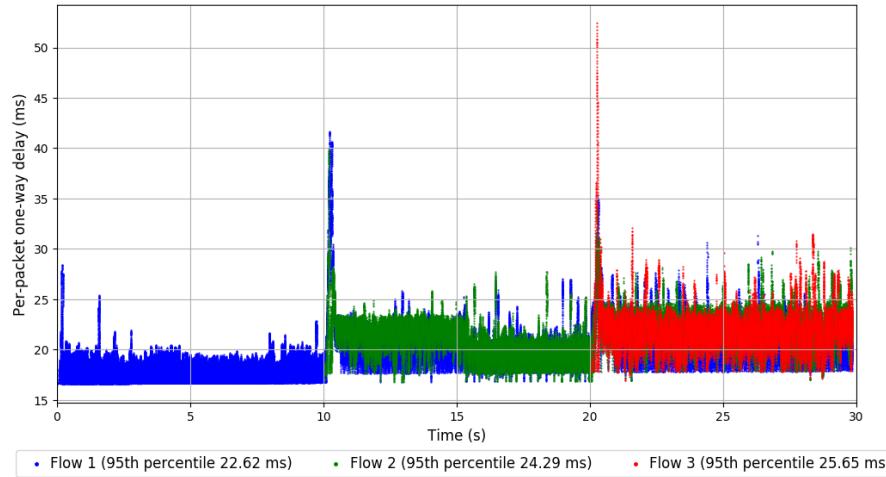
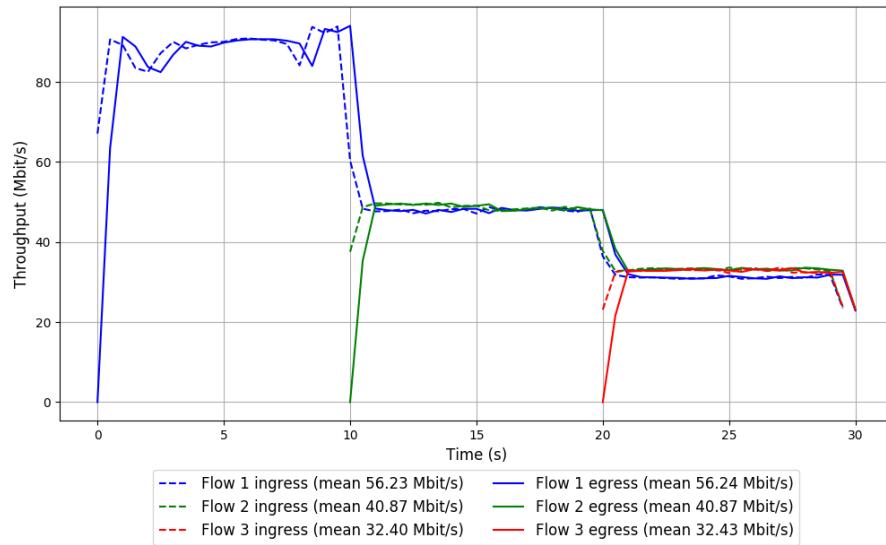


```
Run 1: Statistics of Indigo
```

```
Start at: 2018-09-03 09:48:29
End at: 2018-09-03 09:48:59
Local clock offset: -27.001 ms
Remote clock offset: -4.513 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 94.06 Mbit/s
95th percentile per-packet one-way delay: 23.875 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 56.24 Mbit/s
95th percentile per-packet one-way delay: 22.616 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 40.87 Mbit/s
95th percentile per-packet one-way delay: 24.289 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 32.43 Mbit/s
95th percentile per-packet one-way delay: 25.646 ms
Loss rate: 0.32%
```

## Run 1: Report of Indigo — Data Link

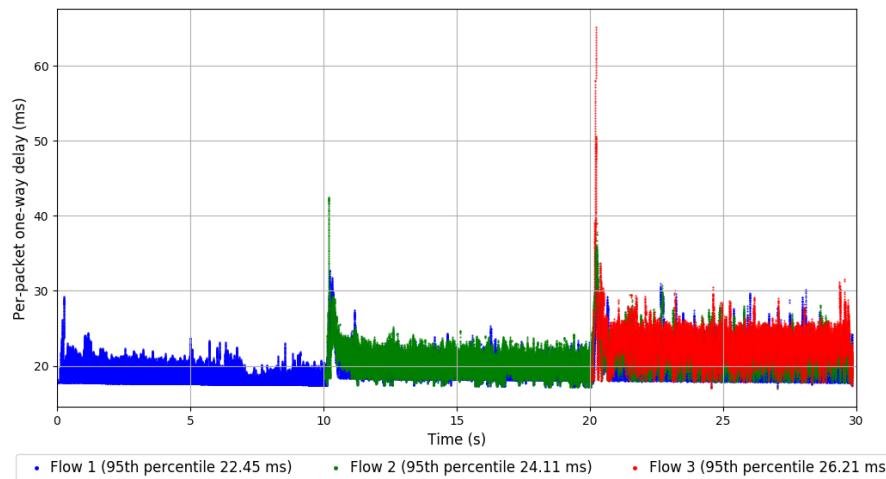
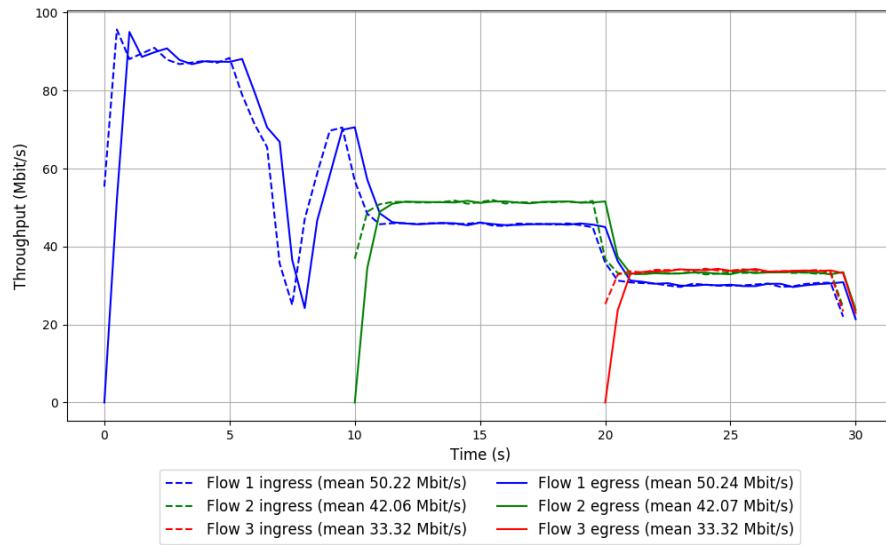


Run 2: Statistics of Indigo

```
Start at: 2018-09-03 09:53:07
End at: 2018-09-03 09:53:37
Local clock offset: -23.513 ms
Remote clock offset: -4.465 ms

# Below is generated by plot.py at 2018-09-03 10:00:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 89.16 Mbit/s
95th percentile per-packet one-way delay: 24.480 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 50.24 Mbit/s
95th percentile per-packet one-way delay: 22.447 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 42.07 Mbit/s
95th percentile per-packet one-way delay: 24.114 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 33.32 Mbit/s
95th percentile per-packet one-way delay: 26.210 ms
Loss rate: 0.31%
```

## Run 2: Report of Indigo — Data Link

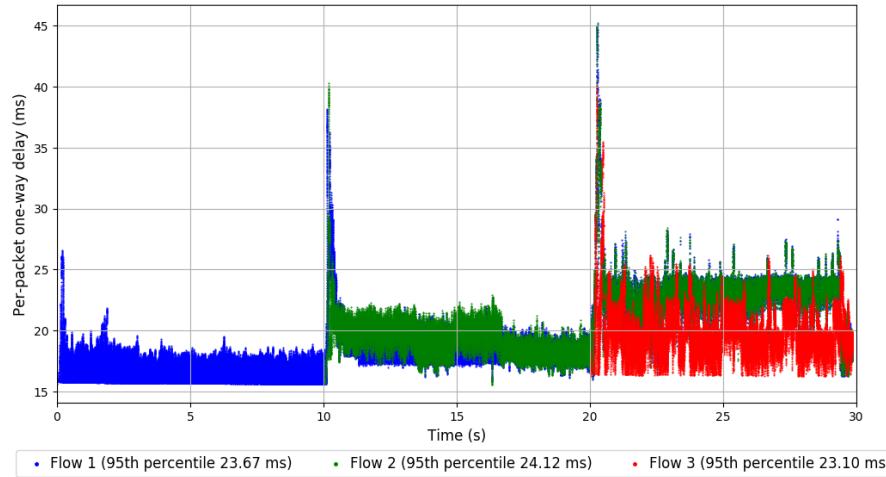
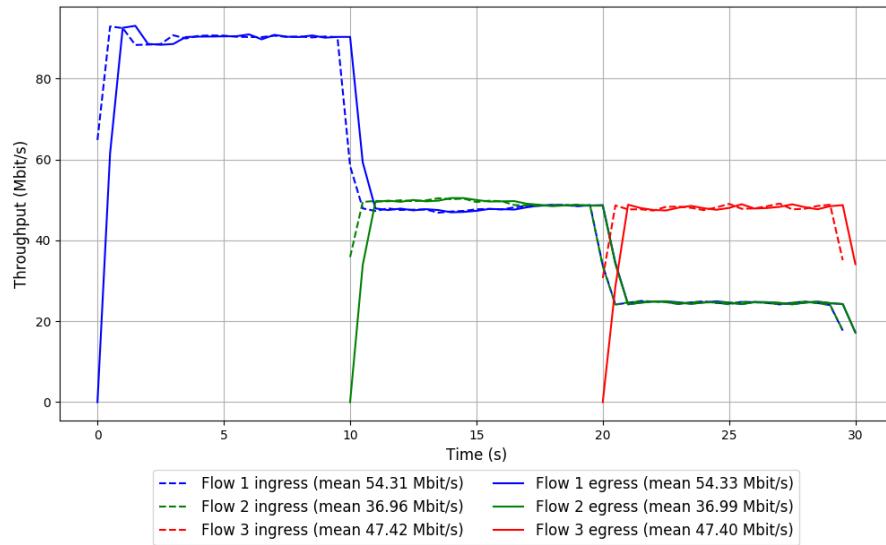


Run 3: Statistics of Indigo

```
Start at: 2018-09-03 09:57:45
End at: 2018-09-03 09:58:15
Local clock offset: -18.436 ms
Remote clock offset: -3.445 ms

# Below is generated by plot.py at 2018-09-03 10:01:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 94.48 Mbit/s
95th percentile per-packet one-way delay: 23.836 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 54.33 Mbit/s
95th percentile per-packet one-way delay: 23.671 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 36.99 Mbit/s
95th percentile per-packet one-way delay: 24.122 ms
Loss rate: 0.10%
-- Flow 3:
Average throughput: 47.40 Mbit/s
95th percentile per-packet one-way delay: 23.099 ms
Loss rate: 0.31%
```

### Run 3: Report of Indigo — Data Link

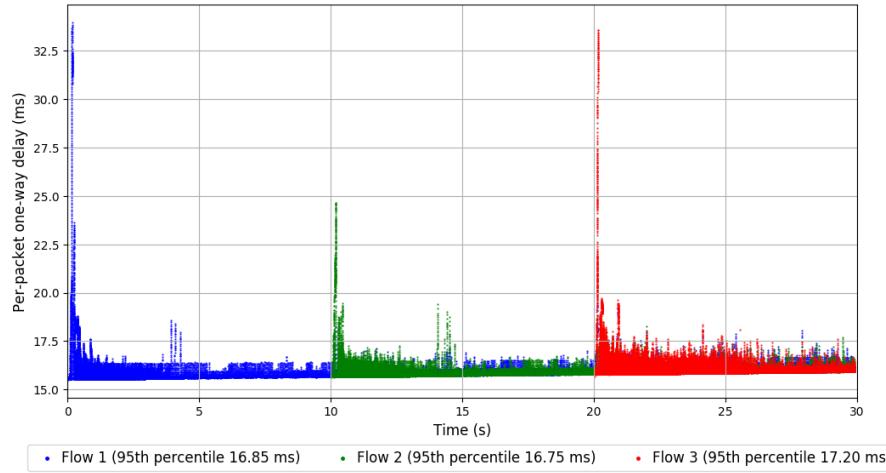
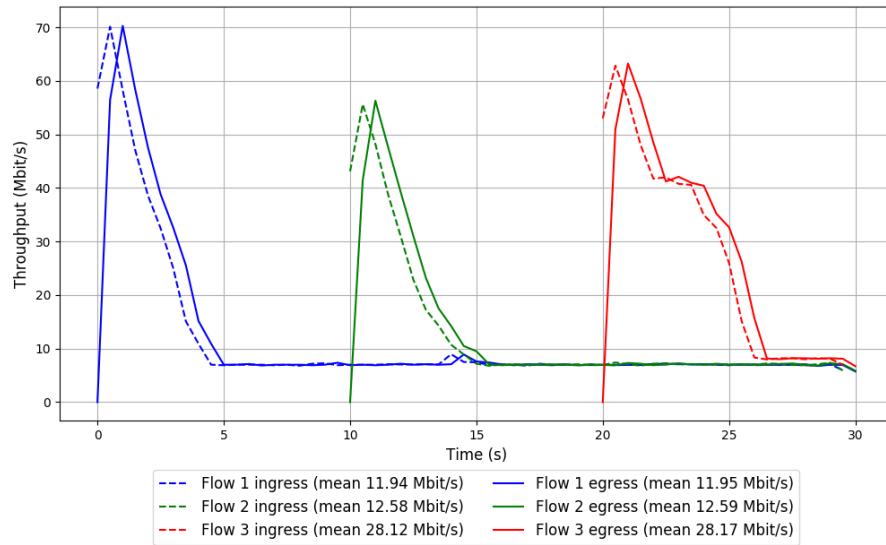


Run 1: Statistics of Muses-25

```
Start at: 2018-09-03 09:49:40
End at: 2018-09-03 09:50:10
Local clock offset: -27.953 ms
Remote clock offset: -3.489 ms

# Below is generated by plot.py at 2018-09-03 10:01:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 29.65 Mbit/s
95th percentile per-packet one-way delay: 16.943 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 11.95 Mbit/s
95th percentile per-packet one-way delay: 16.846 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 12.59 Mbit/s
95th percentile per-packet one-way delay: 16.746 ms
Loss rate: 0.08%
-- Flow 3:
Average throughput: 28.17 Mbit/s
95th percentile per-packet one-way delay: 17.204 ms
Loss rate: 0.08%
```

Run 1: Report of Muses-25 — Data Link

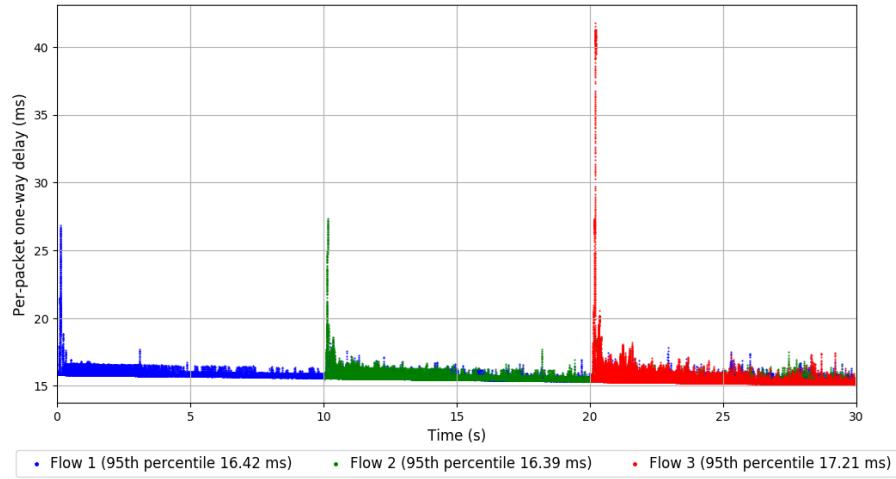
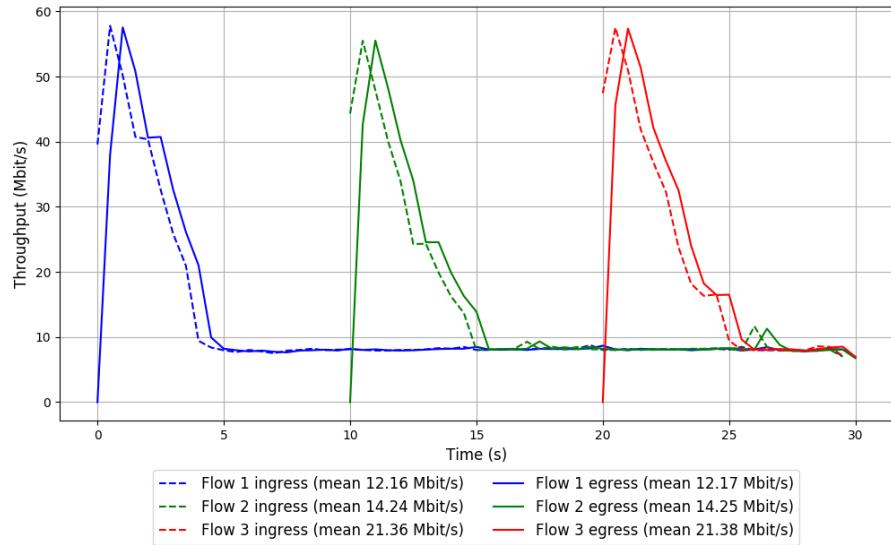


Run 2: Statistics of Muses-25

```
Start at: 2018-09-03 09:54:18
End at: 2018-09-03 09:54:48
Local clock offset: -23.183 ms
Remote clock offset: -4.235 ms

# Below is generated by plot.py at 2018-09-03 10:01:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 28.72 Mbit/s
95th percentile per-packet one-way delay: 16.501 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 12.17 Mbit/s
95th percentile per-packet one-way delay: 16.420 ms
Loss rate: 0.06%
-- Flow 2:
Average throughput: 14.25 Mbit/s
95th percentile per-packet one-way delay: 16.387 ms
Loss rate: 0.08%
-- Flow 3:
Average throughput: 21.38 Mbit/s
95th percentile per-packet one-way delay: 17.215 ms
Loss rate: 0.09%
```

Run 2: Report of Muses-25 — Data Link



Run 3: Statistics of Muses-25

```
Start at: 2018-09-03 09:58:57
End at: 2018-09-03 09:59:27
Local clock offset: -16.721 ms
Remote clock offset: -4.344 ms

# Below is generated by plot.py at 2018-09-03 10:01:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 32.63 Mbit/s
95th percentile per-packet one-way delay: 18.277 ms
Loss rate: 0.05%
-- Flow 1:
Average throughput: 17.50 Mbit/s
95th percentile per-packet one-way delay: 18.139 ms
Loss rate: 0.04%
-- Flow 2:
Average throughput: 14.27 Mbit/s
95th percentile per-packet one-way delay: 18.385 ms
Loss rate: 0.04%
-- Flow 3:
Average throughput: 17.09 Mbit/s
95th percentile per-packet one-way delay: 19.825 ms
Loss rate: 0.11%
```

Run 3: Report of Muses-25 — Data Link

