

## Pantheon Report

Generated at 2018-08-28 07:33:37 (UTC).

Data path: GCE Iowa on `ens4` (*remote*) → GCE Sydney on `ens4` (*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.google.com` and have been applied to correct the timestamps in logs.

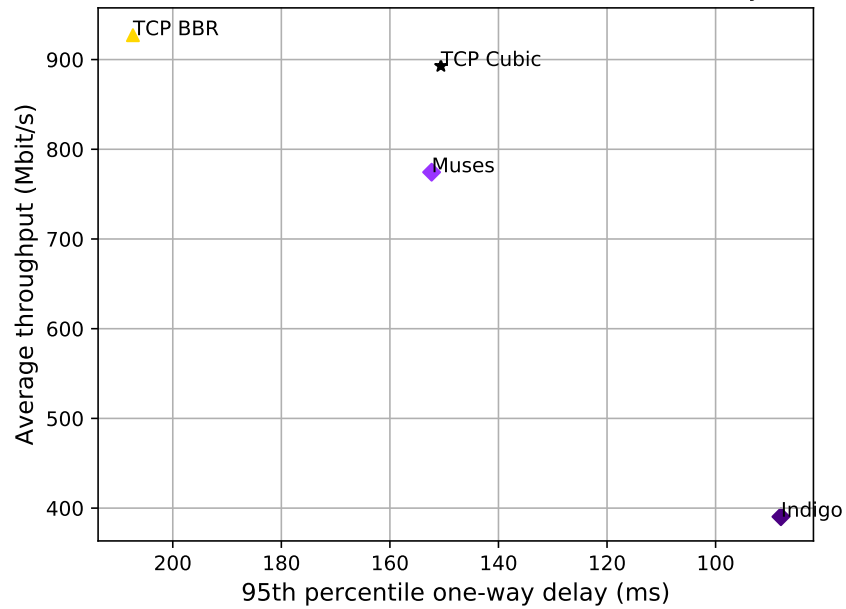
### System info:

```
Linux 4.15.0-1015-gcp
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
```

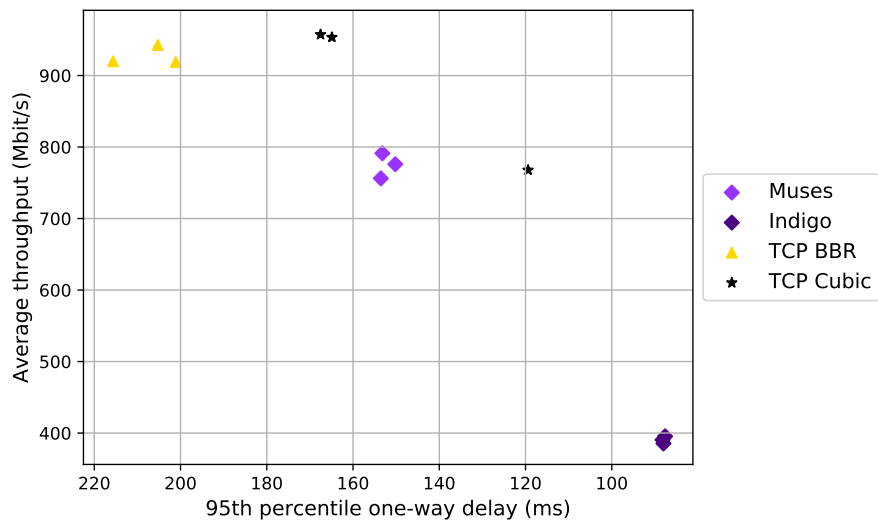
### Git summary:

```
branch: muses @ 86ef433b09b2f4ecae1186d6940af93bcf0969cd
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdf5e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecd90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b261c9e99c63be452bc16f94ce0caa99a4c9d39a
third_party/pantheon-tunnel @ cbfce6db5ff5740dafa1771f813cd646339e1952
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 GCE Iowa to GCE Sydney, 3 runs of 30s each per scheme  
 3 flows with 10s interval between flows (mean of all runs by scheme)



test from GCE Iowa to GCE Sydney, 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	509.72	440.36	381.51	191.23	218.35	167.44	2.37	3.85	3.86
TCP Cubic	3	477.16	428.85	398.52	143.28	122.37	137.45	0.63	0.92	2.53
Indigo	3	208.05	194.84	163.44	87.67	88.32	88.24	0.57	0.93	2.08
Muses	3	473.63	378.62	152.80	152.64	155.63	89.06	1.09	1.75	6.19

Run 1: Statistics of TCP BBR

Start at: 2018-08-28 06:48:56

End at: 2018-08-28 06:49:26

Local clock offset: -0.035 ms

Remote clock offset: 0.179 ms

# Below is generated by plot.py at 2018-08-28 07:26:47

# Datalink statistics

-- Total of 3 flows:

Average throughput: 918.95 Mbit/s

95th percentile per-packet one-way delay: 201.122 ms

Loss rate: 3.13%

-- Flow 1:

Average throughput: 523.12 Mbit/s

95th percentile per-packet one-way delay: 200.871 ms

Loss rate: 3.34%

-- Flow 2:

Average throughput: 430.30 Mbit/s

95th percentile per-packet one-way delay: 206.212 ms

Loss rate: 3.12%

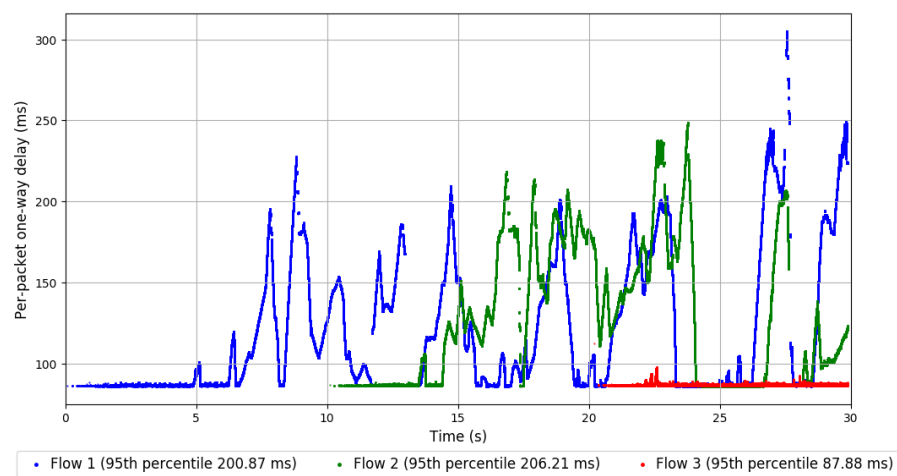
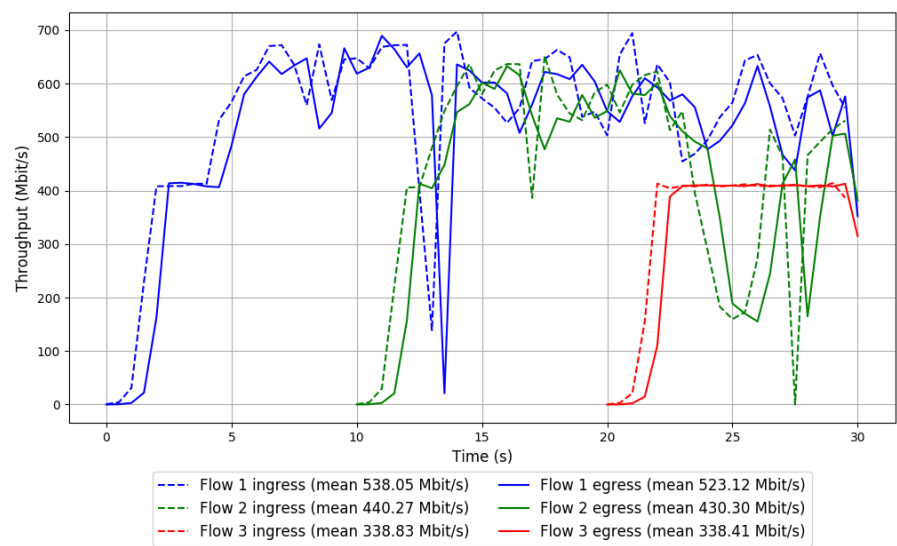
-- Flow 3:

Average throughput: 338.41 Mbit/s

95th percentile per-packet one-way delay: 87.879 ms

Loss rate: 2.13%

Run 1: Report of TCP BBR — Data Link



Run 2: Statistics of TCP BBR

Start at: 2018-08-28 06:56:50

End at: 2018-08-28 06:57:20

Local clock offset: -0.06 ms

Remote clock offset: 0.196 ms

# Below is generated by plot.py at 2018-08-28 07:26:51

# Datalink statistics

-- Total of 3 flows:

Average throughput: 919.96 Mbit/s

95th percentile per-packet one-way delay: 215.648 ms

Loss rate: 3.26%

-- Flow 1:

Average throughput: 472.63 Mbit/s

95th percentile per-packet one-way delay: 177.594 ms

Loss rate: 1.39%

-- Flow 2:

Average throughput: 466.81 Mbit/s

95th percentile per-packet one-way delay: 231.679 ms

Loss rate: 5.24%

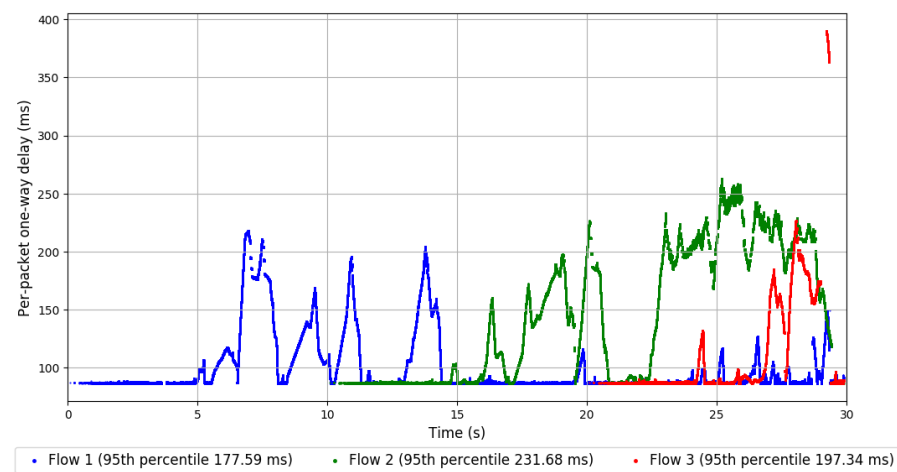
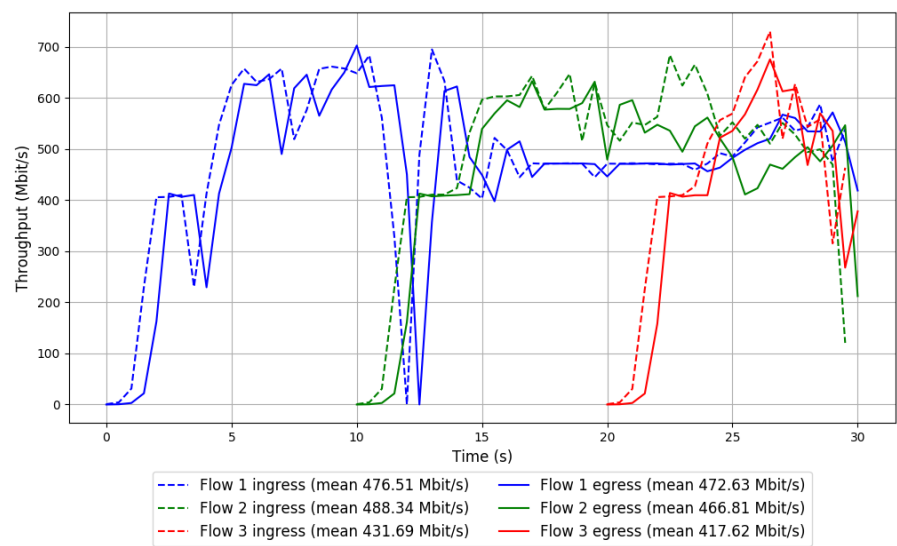
-- Flow 3:

Average throughput: 417.62 Mbit/s

95th percentile per-packet one-way delay: 197.343 ms

Loss rate: 4.96%

Run 2: Report of TCP BBR — Data Link



Run 3: Statistics of TCP BBR

Start at: 2018-08-28 07:04:36

End at: 2018-08-28 07:05:06

Local clock offset: 0.086 ms

Remote clock offset: 0.235 ms

# Below is generated by plot.py at 2018-08-28 07:27:05

# Datalink statistics

-- Total of 3 flows:

Average throughput: 942.60 Mbit/s

95th percentile per-packet one-way delay: 205.251 ms

Loss rate: 2.91%

-- Flow 1:

Average throughput: 533.42 Mbit/s

95th percentile per-packet one-way delay: 195.236 ms

Loss rate: 2.37%

-- Flow 2:

Average throughput: 423.97 Mbit/s

95th percentile per-packet one-way delay: 217.147 ms

Loss rate: 3.20%

-- Flow 3:

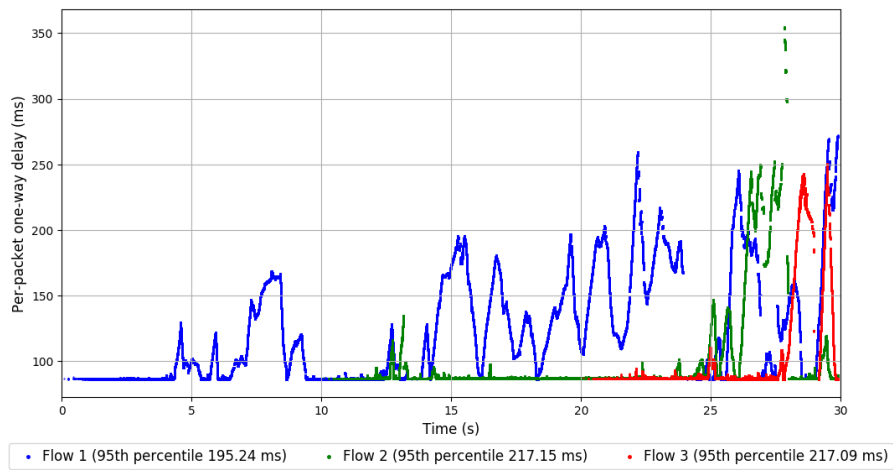
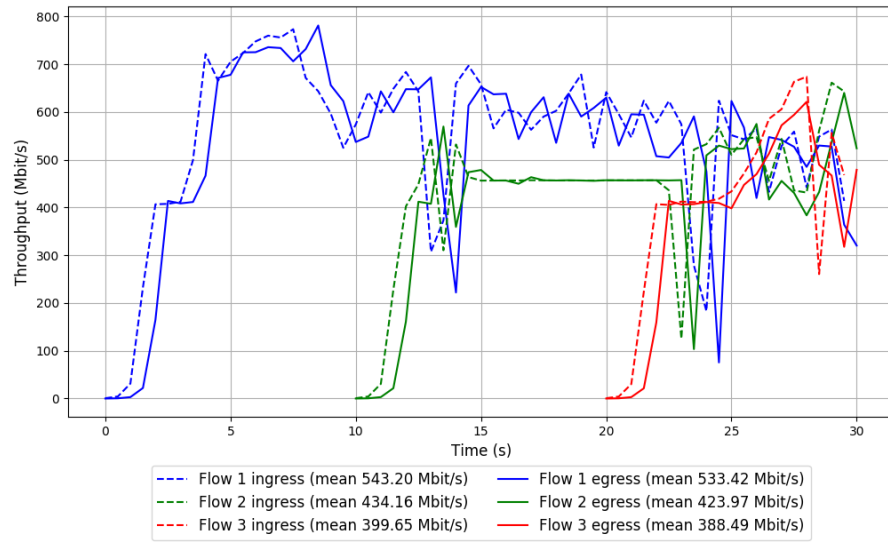
Average throughput: 388.49 Mbit/s

95th percentile per-packet one-way delay: 217.090 ms

Loss rate: 4.50%



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



Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 06:51:02

End at: 2018-08-28 06:51:32

Local clock offset: 0.057 ms

Remote clock offset: 0.192 ms

# Below is generated by plot.py at 2018-08-28 07:27:10

# Datalink statistics

-- Total of 3 flows:

Average throughput: 953.46 Mbit/s

95th percentile per-packet one-way delay: 164.900 ms

Loss rate: 1.01%

-- Flow 1:

Average throughput: 537.81 Mbit/s

95th percentile per-packet one-way delay: 171.141 ms

Loss rate: 0.63%

-- Flow 2:

Average throughput: 421.92 Mbit/s

95th percentile per-packet one-way delay: 94.184 ms

Loss rate: 1.00%

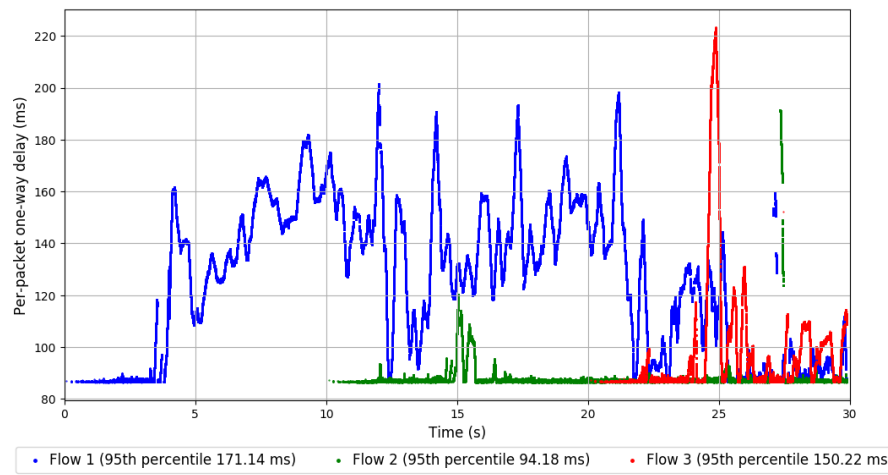
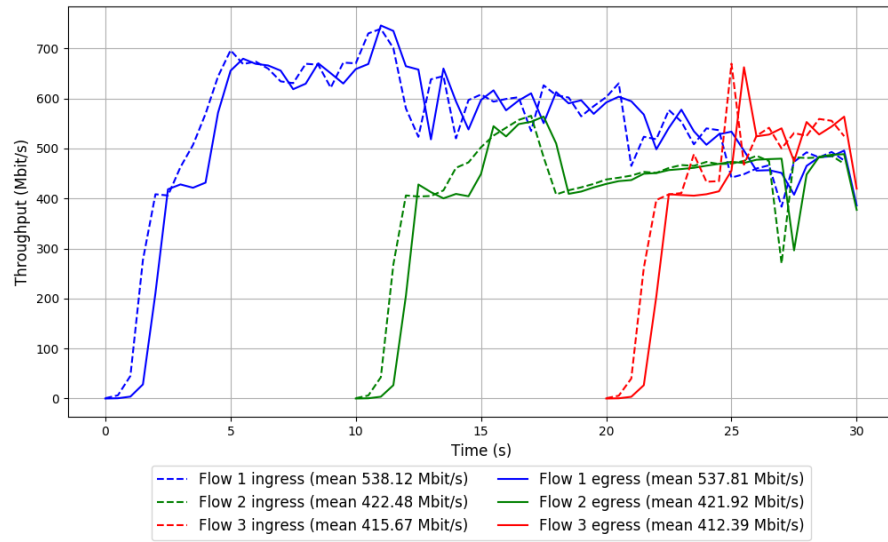
-- Flow 3:

Average throughput: 412.39 Mbit/s

95th percentile per-packet one-way delay: 150.217 ms

Loss rate: 2.51%

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



Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 06:58:57

End at: 2018-08-28 06:59:27

Local clock offset: -0.113 ms

Remote clock offset: 0.16 ms

# Below is generated by plot.py at 2018-08-28 07:27:10

# Datalink statistics

-- Total of 3 flows:

Average throughput: 767.82 Mbit/s

95th percentile per-packet one-way delay: 119.405 ms

Loss rate: 1.04%

-- Flow 1:

Average throughput: 349.95 Mbit/s

95th percentile per-packet one-way delay: 87.016 ms

Loss rate: 0.65%

-- Flow 2:

Average throughput: 440.19 Mbit/s

95th percentile per-packet one-way delay: 142.777 ms

Loss rate: 0.85%

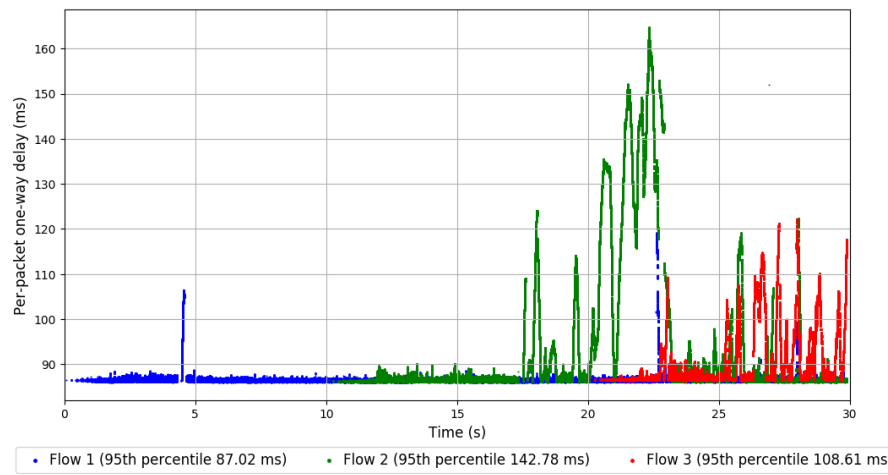
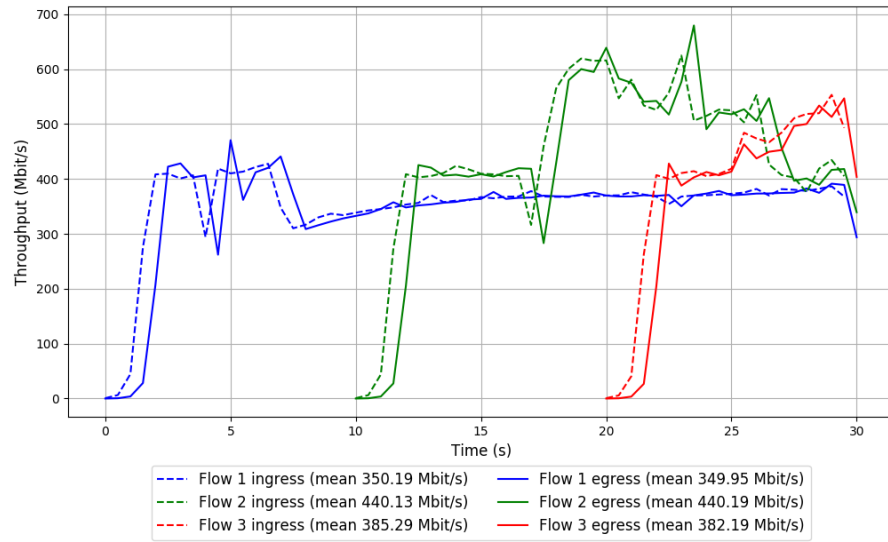
-- Flow 3:

Average throughput: 382.19 Mbit/s

95th percentile per-packet one-way delay: 108.606 ms

Loss rate: 2.55%

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



Run 3: Statistics of TCP Cubic

Start at: 2018-08-28 07:06:43

End at: 2018-08-28 07:07:13

Local clock offset: -0.044 ms

Remote clock offset: 0.2 ms

# Below is generated by plot.py at 2018-08-28 07:27:15

# Datalink statistics

-- Total of 3 flows:

Average throughput: 957.32 Mbit/s

95th percentile per-packet one-way delay: 167.533 ms

Loss rate: 0.96%

-- Flow 1:

Average throughput: 543.71 Mbit/s

95th percentile per-packet one-way delay: 171.681 ms

Loss rate: 0.60%

-- Flow 2:

Average throughput: 424.43 Mbit/s

95th percentile per-packet one-way delay: 130.138 ms

Loss rate: 0.91%

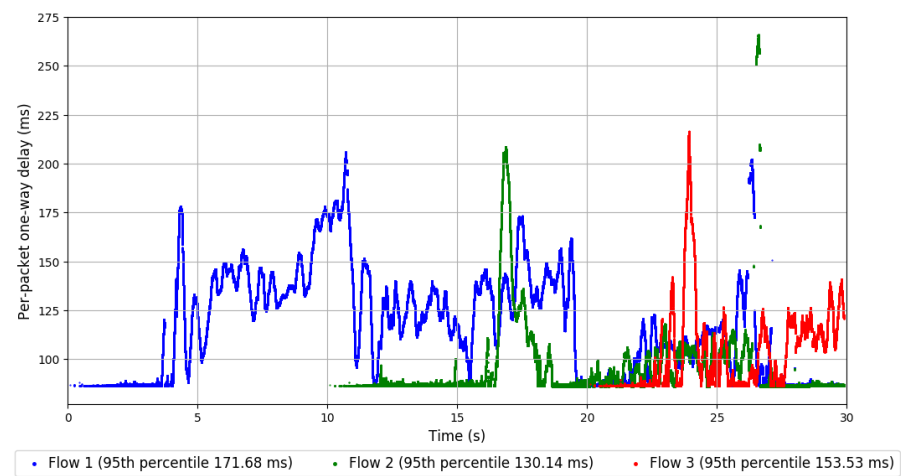
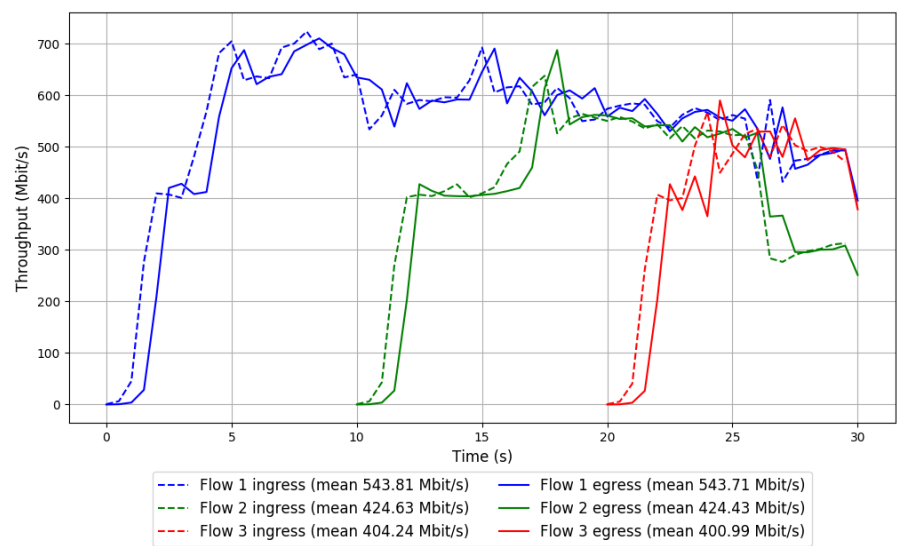
-- Flow 3:

Average throughput: 400.99 Mbit/s

95th percentile per-packet one-way delay: 153.532 ms

Loss rate: 2.53%

Run 3: Report of TCP Cubic — Data Link



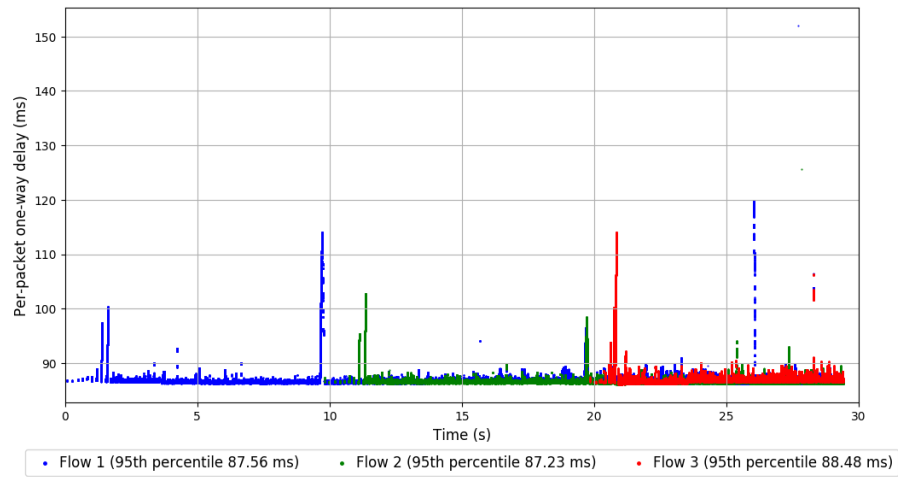
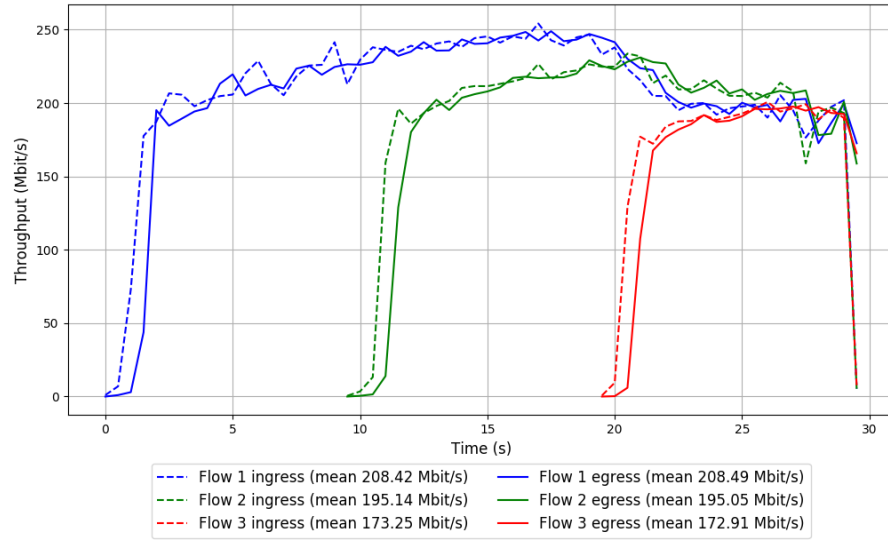
```
Run 1: Statistics of Indigo

Start at: 2018-08-28 06:45:08
End at: 2018-08-28 06:45:38
Local clock offset: 0.27 ms
Remote clock offset: 0.203 ms

# Below is generated by plot.py at 2018-08-28 07:27:15
# Datalink statistics
-- Total of 3 flows:
Average throughput: 395.37 Mbit/s
95th percentile per-packet one-way delay: 87.645 ms
Loss rate: 0.88%
-- Flow 1:
Average throughput: 208.49 Mbit/s
95th percentile per-packet one-way delay: 87.555 ms
Loss rate: 0.56%
-- Flow 2:
Average throughput: 195.05 Mbit/s
95th percentile per-packet one-way delay: 87.233 ms
Loss rate: 0.92%
-- Flow 3:
Average throughput: 172.91 Mbit/s
95th percentile per-packet one-way delay: 88.476 ms
Loss rate: 1.98%
```



## Run 1: Report of Indigo — Data Link



Run 2: Statistics of Indigo

Start at: 2018-08-28 06:53:04

End at: 2018-08-28 06:53:34

Local clock offset: -0.009 ms

Remote clock offset: 0.149 ms

# Below is generated by plot.py at 2018-08-28 07:27:15

# Datalink statistics

-- Total of 3 flows:

Average throughput: 385.42 Mbit/s

95th percentile per-packet one-way delay: 88.016 ms

Loss rate: 0.89%

-- Flow 1:

Average throughput: 208.02 Mbit/s

95th percentile per-packet one-way delay: 87.592 ms

Loss rate: 0.58%

-- Flow 2:

Average throughput: 194.31 Mbit/s

95th percentile per-packet one-way delay: 88.769 ms

Loss rate: 0.93%

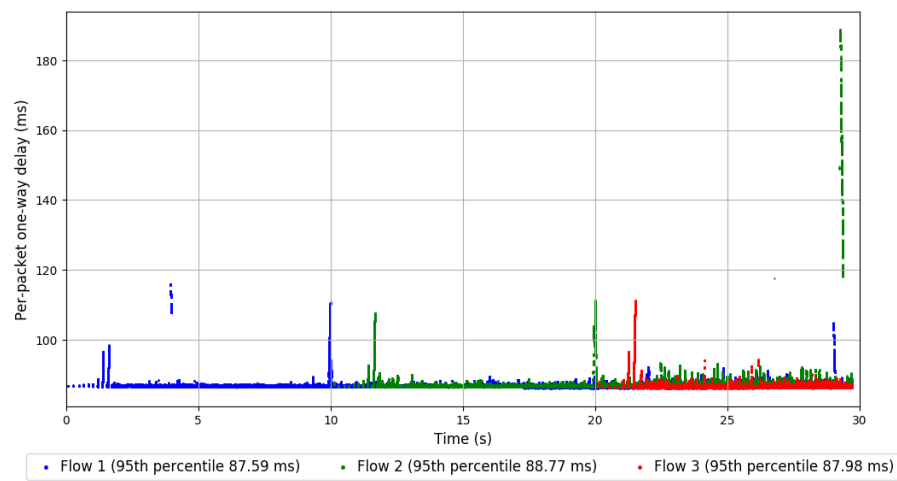
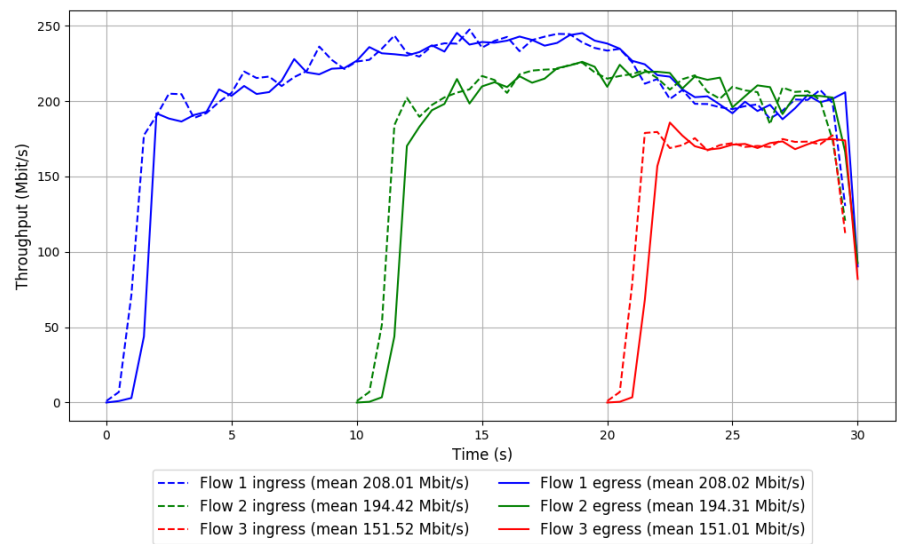
-- Flow 3:

Average throughput: 151.01 Mbit/s

95th percentile per-packet one-way delay: 87.983 ms

Loss rate: 2.11%

Run 2: Report of Indigo — Data Link



Run 3: Statistics of Indigo

Start at: 2018-08-28 07:00:49

End at: 2018-08-28 07:01:19

Local clock offset: -0.213 ms

Remote clock offset: 0.204 ms

# Below is generated by plot.py at 2018-08-28 07:30:39

# Datalink statistics

-- Total of 3 flows:

Average throughput: 390.48 Mbit/s

95th percentile per-packet one-way delay: 88.237 ms

Loss rate: 0.91%

-- Flow 1:

Average throughput: 207.64 Mbit/s

95th percentile per-packet one-way delay: 87.867 ms

Loss rate: 0.57%

-- Flow 2:

Average throughput: 195.15 Mbit/s

95th percentile per-packet one-way delay: 88.949 ms

Loss rate: 0.95%

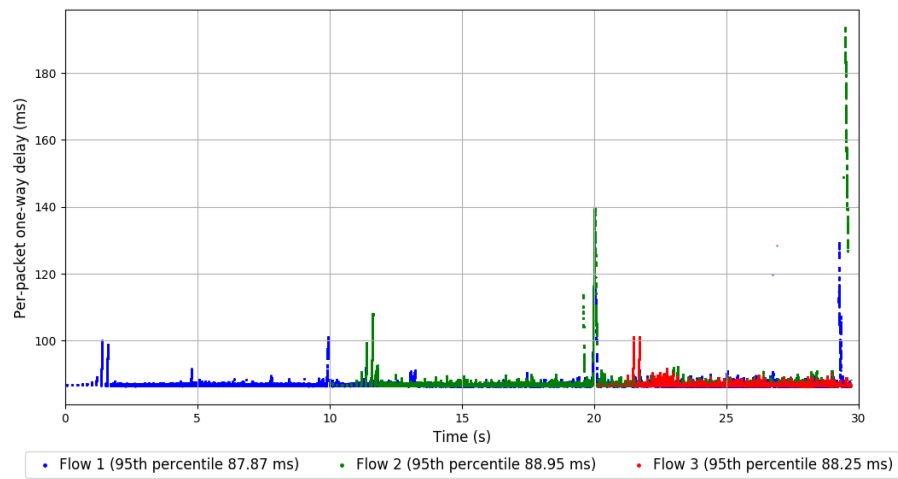
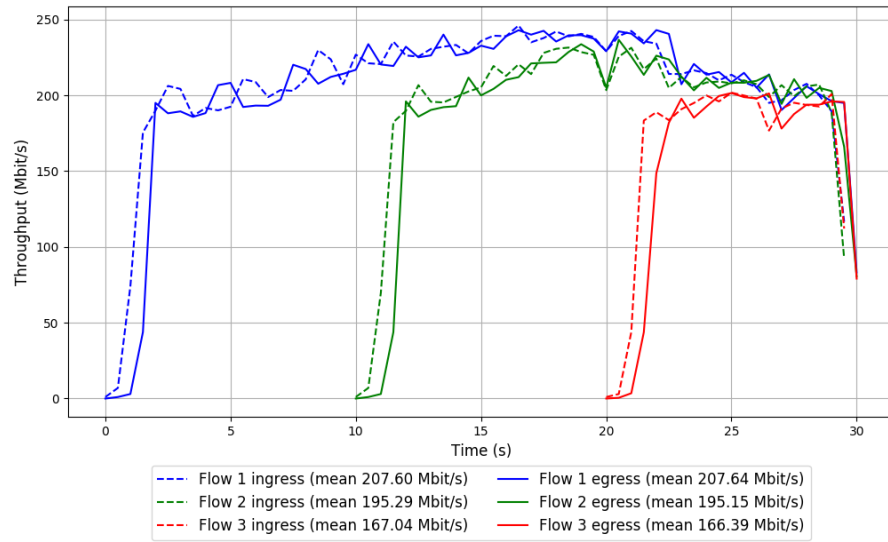
-- Flow 3:

Average throughput: 166.39 Mbit/s

95th percentile per-packet one-way delay: 88.254 ms

Loss rate: 2.16%

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



Run 1: Statistics of Muses

Start at: 2018-08-28 06:46:58

End at: 2018-08-28 06:47:28

Local clock offset: 0.035 ms

Remote clock offset: 0.204 ms

# Below is generated by plot.py at 2018-08-28 07:33:20

# Datalink statistics

-- Total of 3 flows:

Average throughput: 791.24 Mbit/s

95th percentile per-packet one-way delay: 153.196 ms

Loss rate: 1.75%

-- Flow 1:

Average throughput: 482.57 Mbit/s

95th percentile per-packet one-way delay: 155.456 ms

Loss rate: 1.31%

-- Flow 2:

Average throughput: 391.17 Mbit/s

95th percentile per-packet one-way delay: 151.064 ms

Loss rate: 1.68%

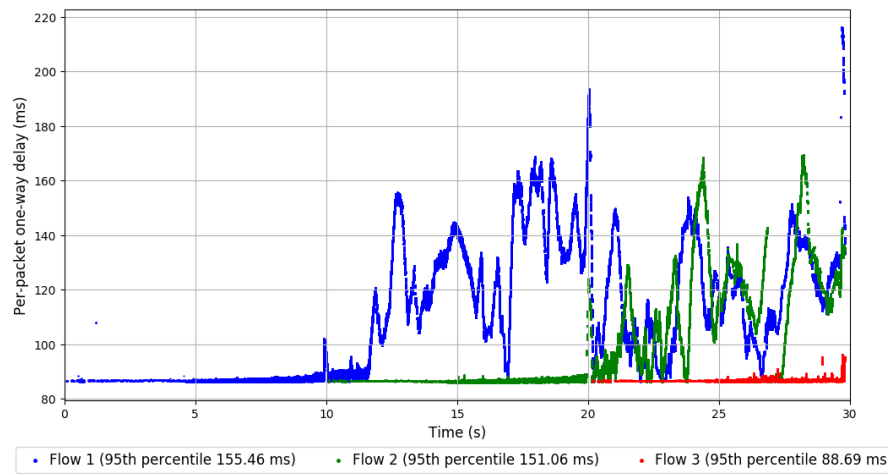
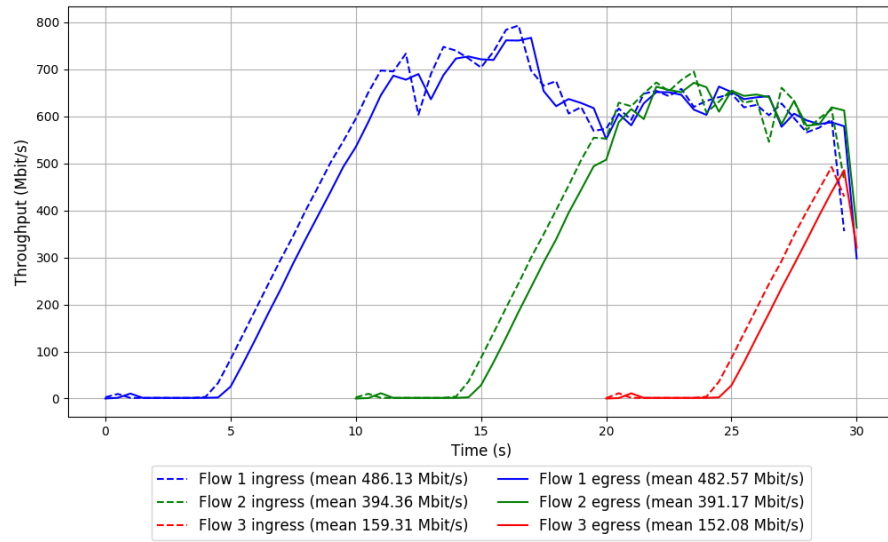
-- Flow 3:

Average throughput: 152.08 Mbit/s

95th percentile per-packet one-way delay: 88.687 ms

Loss rate: 6.24%

## Run 1: Report of Muses — Data Link



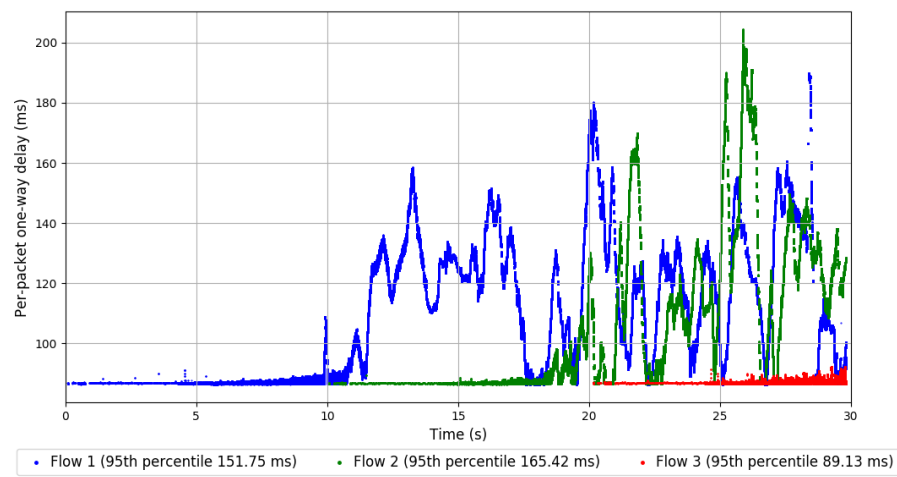
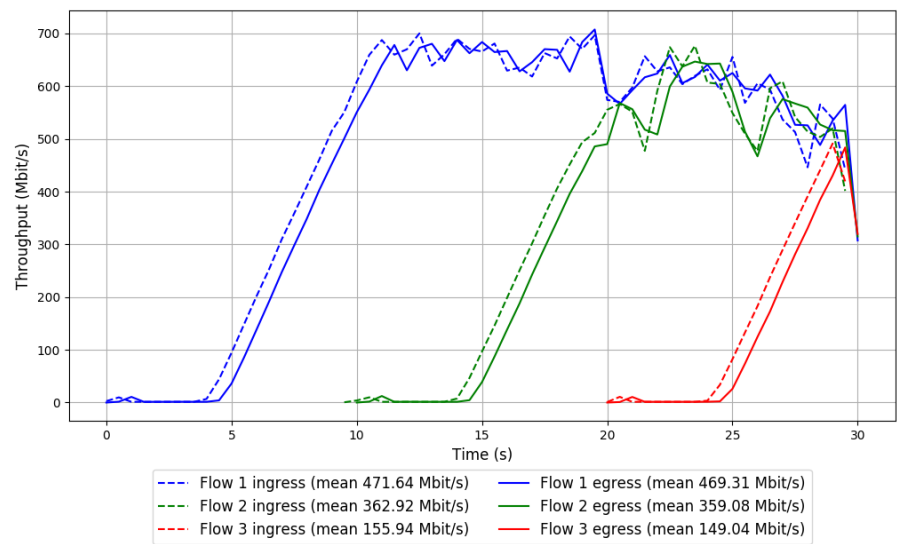
Run 2: Statistics of Muses

Start at: 2018-08-28 06:54:54  
End at: 2018-08-28 06:55:25  
Local clock offset: -0.003 ms  
Remote clock offset: 0.181 ms

# Below is generated by plot.py at 2018-08-28 07:33:20  
# Datalink statistics  
-- Total of 3 flows:  
Average throughput: 756.15 Mbit/s  
95th percentile per-packet one-way delay: 153.551 ms  
Loss rate: 1.68%  
-- Flow 1:  
Average throughput: 469.31 Mbit/s  
95th percentile per-packet one-way delay: 151.745 ms  
Loss rate: 1.07%  
-- Flow 2:  
Average throughput: 359.08 Mbit/s  
95th percentile per-packet one-way delay: 165.422 ms  
Loss rate: 1.93%  
-- Flow 3:  
Average throughput: 149.04 Mbit/s  
95th percentile per-packet one-way delay: 89.131 ms  
Loss rate: 6.12%



Run 2: Report of Muses — Data Link



Run 3: Statistics of Muses

Start at: 2018-08-28 07:02:39

End at: 2018-08-28 07:03:09

Local clock offset: -0.021 ms

Remote clock offset: 0.178 ms

# Below is generated by plot.py at 2018-08-28 07:33:36

# Datalink statistics

-- Total of 3 flows:

Average throughput: 775.94 Mbit/s

95th percentile per-packet one-way delay: 150.201 ms

Loss rate: 1.51%

-- Flow 1:

Average throughput: 469.01 Mbit/s

95th percentile per-packet one-way delay: 150.708 ms

Loss rate: 0.90%

-- Flow 2:

Average throughput: 385.61 Mbit/s

95th percentile per-packet one-way delay: 150.394 ms

Loss rate: 1.64%

-- Flow 3:

Average throughput: 157.27 Mbit/s

95th percentile per-packet one-way delay: 89.373 ms

Loss rate: 6.20%

Run 3: Report of Muses — Data Link

