Pantheon Report

Generated at 2018-08-31 11:20:42 (UTC).

Data path: GCE Iowa on `ens4` (*local*) →GCE Tokyo on `ens4` (*remote*).

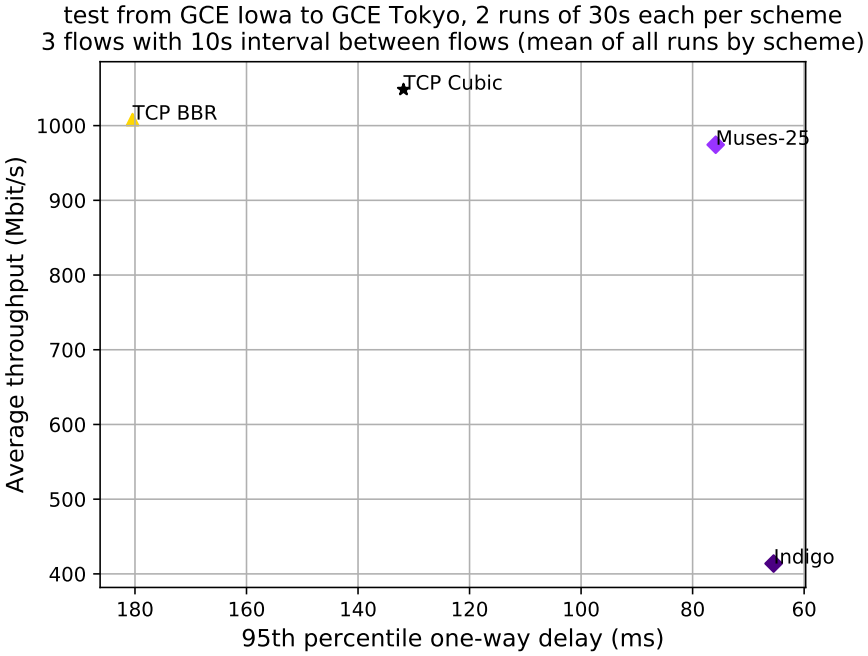
Repeated the test of 4 congestion control schemes twice.

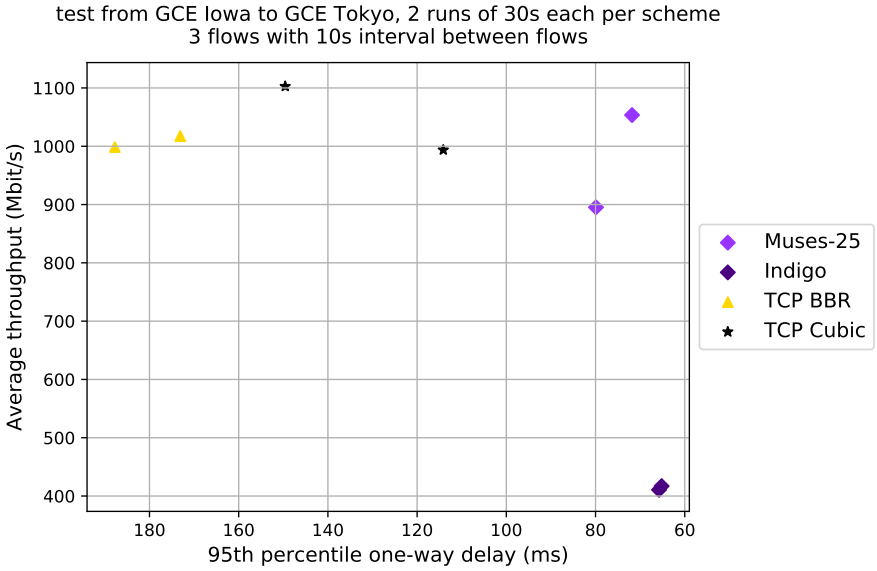
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

NTP offsets were measured against `time.google.com` and have been applied to correct the timestamps in logs.

```
System info:
Linux 4.15.0-1018-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
net.ipv4.tcp_mem = 536870912 536870912 536870912
```

```
Git summary:
branch: muses @ e3c5aa19ca94c3066828fb83f16a8fb6b2731e7a
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b59e0d118c50af3579569c462d33045741c85981
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 GCE Iowa to GCE Tokyo, 2 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
TCP Cubic
TCP BBR
Muses-25
Indigo
Average throughput (Mbit/s)
1000
900
800
700
600
500
400
180
160
140
120
100
80
60
95th percentile one-way delay (ms)


test from GCE Iowa to GCE Tokyo, 2 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
1100
1000
900
800
700
600
500
400
180
160
140
120
100
80
60
95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic

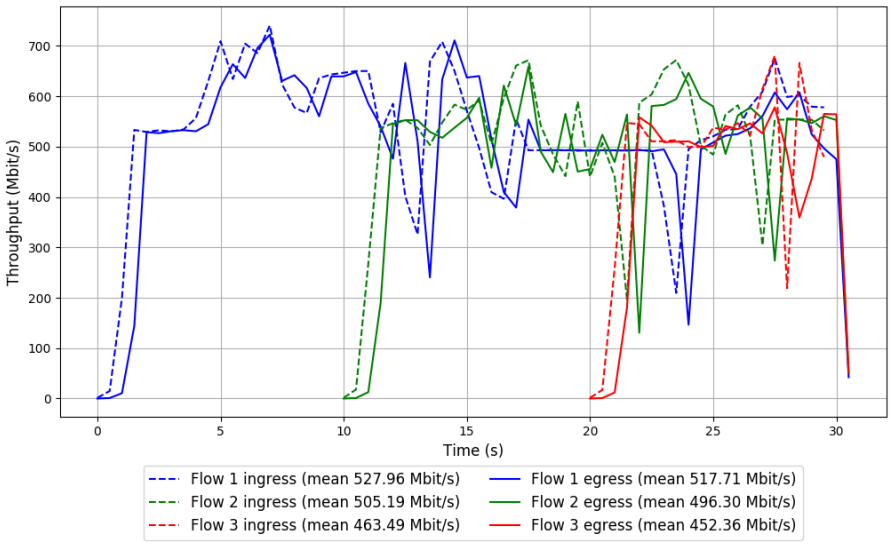
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	2	524.78	500.21	451.89	180.03	184.50	158.31	1.60	1.50	1.50
TCP Cubic	2	570.70	496.52	441.45	123.06	117.82	121.32	0.11	0.07	0.29
Indigo	2	219.06	206.81	178.55	65.42	65.39	66.07	0.01	0.00	0.00
Muses-25	2	519.61	473.25	430.44	72.05	79.90	76.77	0.06	0.03	0.31

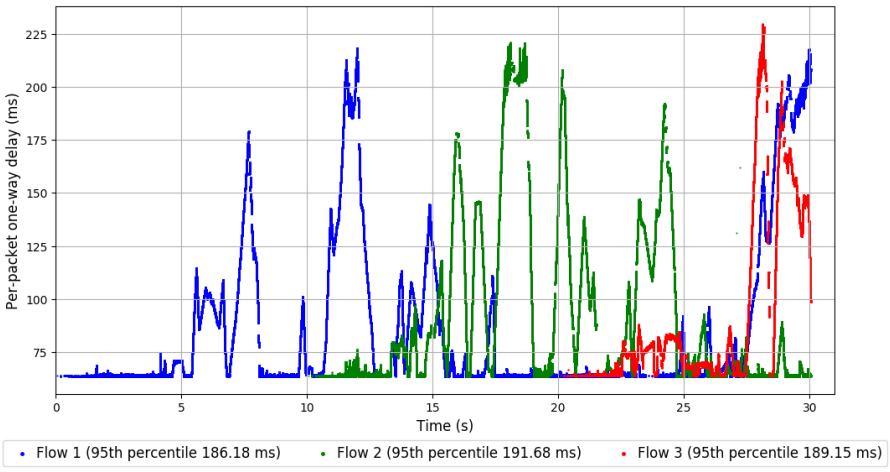
```
Run 1: Statistics of TCP BBR

Start at: 2018-08-31 10:49:13
End at: 2018-08-31 10:49:43
Local clock offset: 2.314 ms
Remote clock offset: 0.668 ms

# Below is generated by plot.py at 2018-08-31 11:18:59
# Datalink statistics
-- Total of 3 flows:
Average throughput: 998.59 Mbit/s
95th percentile per-packet one-way delay: 187.759 ms
Loss rate: 1.95%
-- Flow 1:
Average throughput: 517.71 Mbit/s
95th percentile per-packet one-way delay: 186.182 ms
Loss rate: 1.94%
-- Flow 2:
Average throughput: 496.30 Mbit/s
95th percentile per-packet one-way delay: 191.675 ms
Loss rate: 1.76%
-- Flow 3:
Average throughput: 452.36 Mbit/s
95th percentile per-packet one-way delay: 189.149 ms
Loss rate: 2.40%
```

Run 1: Report of TCP BBR — Data Link



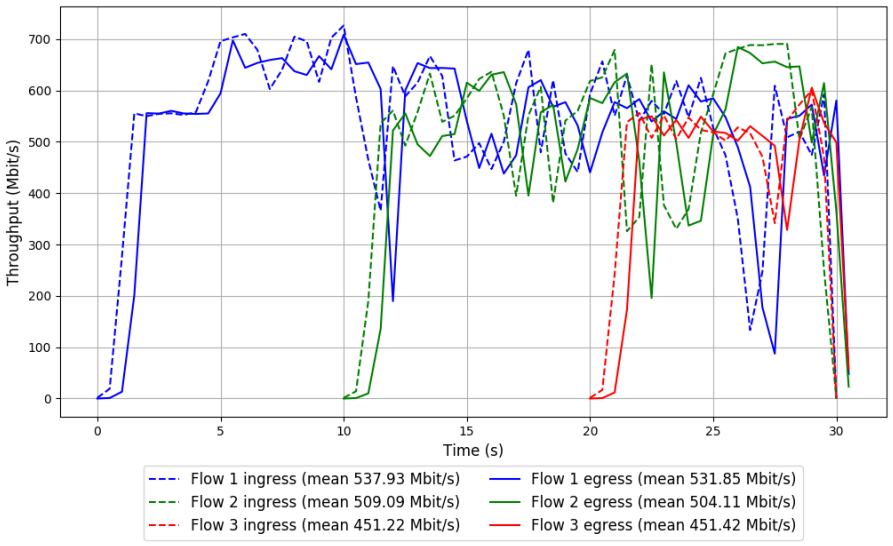


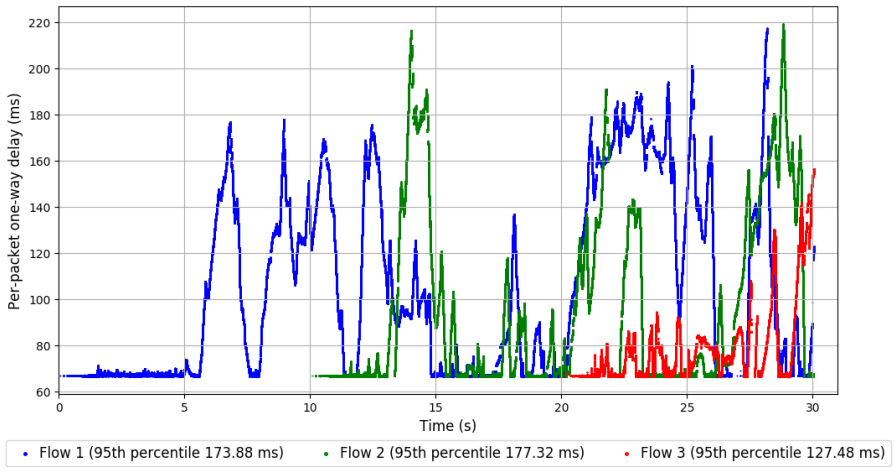
```
Run 2: Statistics of TCP BBR

Start at: 2018-08-31 10:57:07
End at: 2018-08-31 10:57:37
Local clock offset: 1.676 ms
Remote clock offset: 2.071 ms

# Below is generated by plot.py at 2018-08-31 11:19:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1017.46 Mbit/s
95th percentile per-packet one-way delay: 173.103 ms
Loss rate: 1.17%
-- Flow 1:
Average throughput: 531.85 Mbit/s
95th percentile per-packet one-way delay: 173.878 ms
Loss rate: 1.27%
-- Flow 2:
Average throughput: 504.11 Mbit/s
95th percentile per-packet one-way delay: 177.325 ms
Loss rate: 1.25%
-- Flow 3:
Average throughput: 451.42 Mbit/s
95th percentile per-packet one-way delay: 127.476 ms
Loss rate: 0.61%
```

Run 2: Report of TCP BBR — Data Link



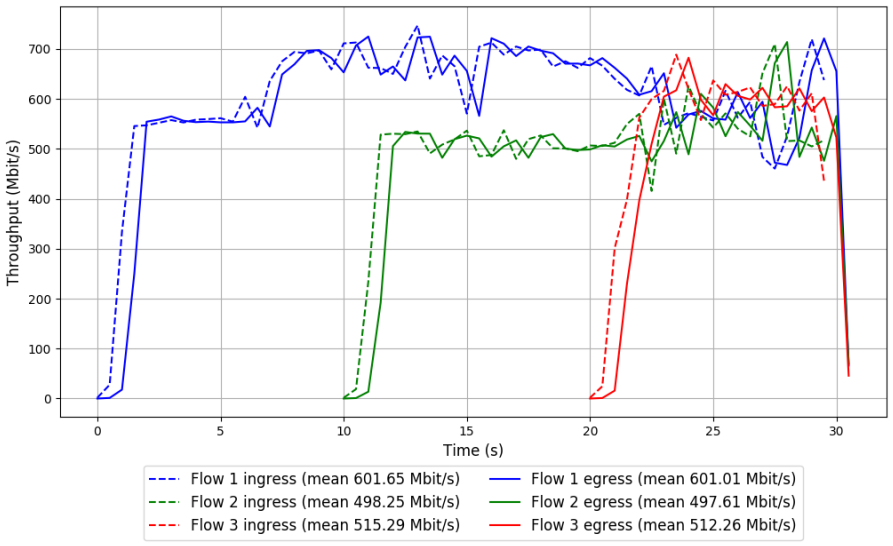


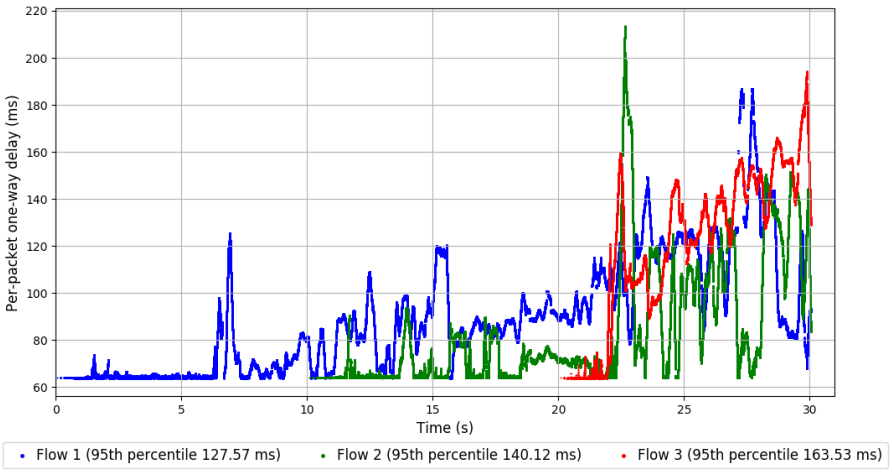
```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-31 10:53:05
End at: 2018-08-31 10:53:35
Local clock offset: 1.893 ms
Remote clock offset: -0.282 ms

# Below is generated by plot.py at 2018-08-31 11:20:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1102.76 Mbit/s
95th percentile per-packet one-way delay: 149.567 ms
Loss rate: 0.18%
-- Flow 1:
Average throughput: 601.01 Mbit/s
95th percentile per-packet one-way delay: 127.566 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 497.61 Mbit/s
95th percentile per-packet one-way delay: 140.125 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 512.26 Mbit/s
95th percentile per-packet one-way delay: 163.533 ms
Loss rate: 0.58%
```

Run 1: Report of TCP Cubic — Data Link



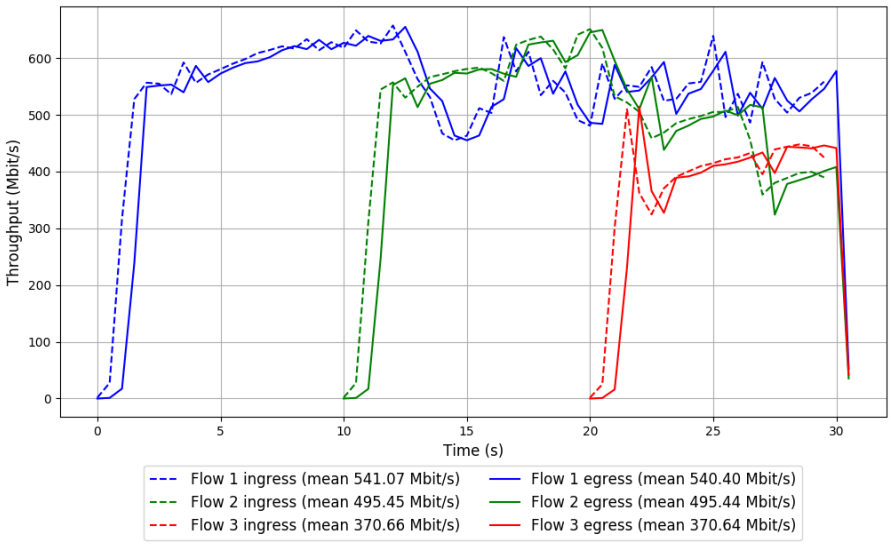


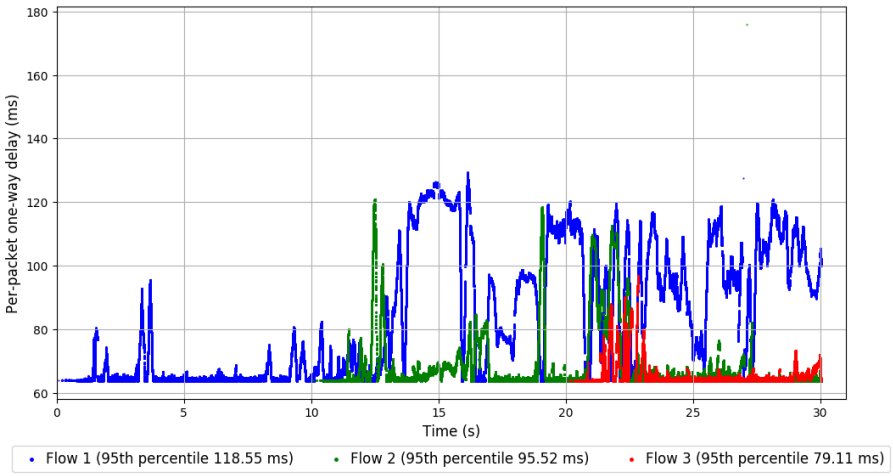
```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-31 11:01:01
End at: 2018-08-31 11:01:31
Local clock offset: 1.67 ms
Remote clock offset: -1.008 ms

# Below is generated by plot.py at 2018-08-31 11:20:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 993.67 Mbit/s
95th percentile per-packet one-way delay: 114.130 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 540.40 Mbit/s
95th percentile per-packet one-way delay: 118.547 ms
Loss rate: 0.12%
-- Flow 2:
Average throughput: 495.44 Mbit/s
95th percentile per-packet one-way delay: 95.520 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 370.64 Mbit/s
95th percentile per-packet one-way delay: 79.111 ms
Loss rate: 0.00%
```

Run 2: Report of TCP Cubic — Data Link



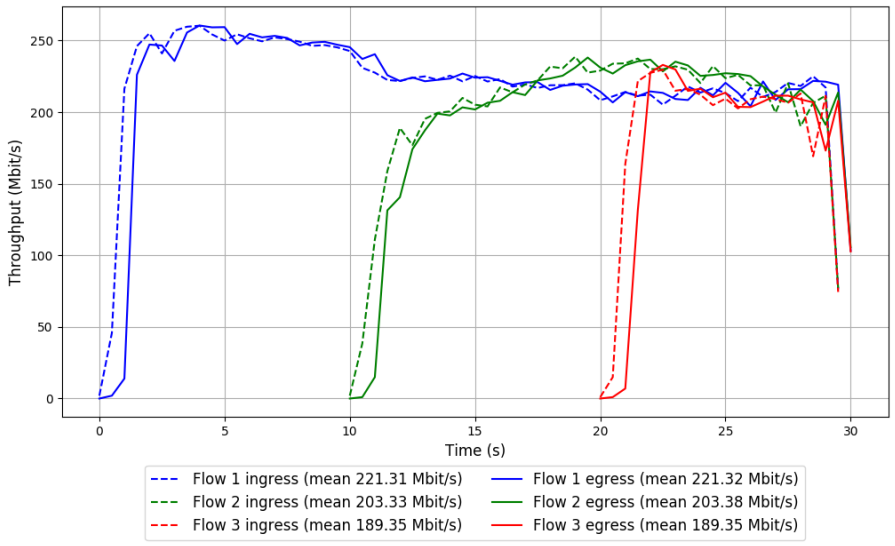


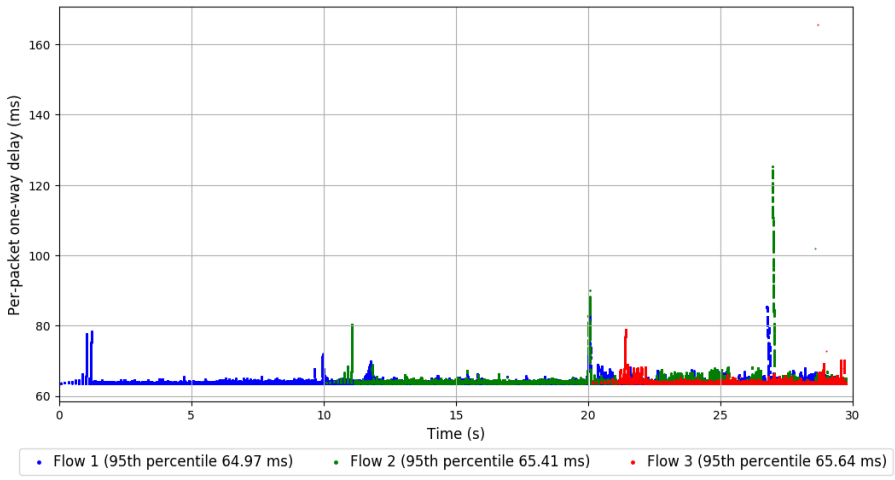
```
Run 1: Statistics of Indigo

Start at: 2018-08-31 10:51:18
End at: 2018-08-31 10:51:48
Local clock offset: 2.042 ms
Remote clock offset: 0.019 ms

# Below is generated by plot.py at 2018-08-31 11:20:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 417.00 Mbit/s
95th percentile per-packet one-way delay: 65.182 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 221.32 Mbit/s
95th percentile per-packet one-way delay: 64.965 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 203.38 Mbit/s
95th percentile per-packet one-way delay: 65.407 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 189.35 Mbit/s
95th percentile per-packet one-way delay: 65.644 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link



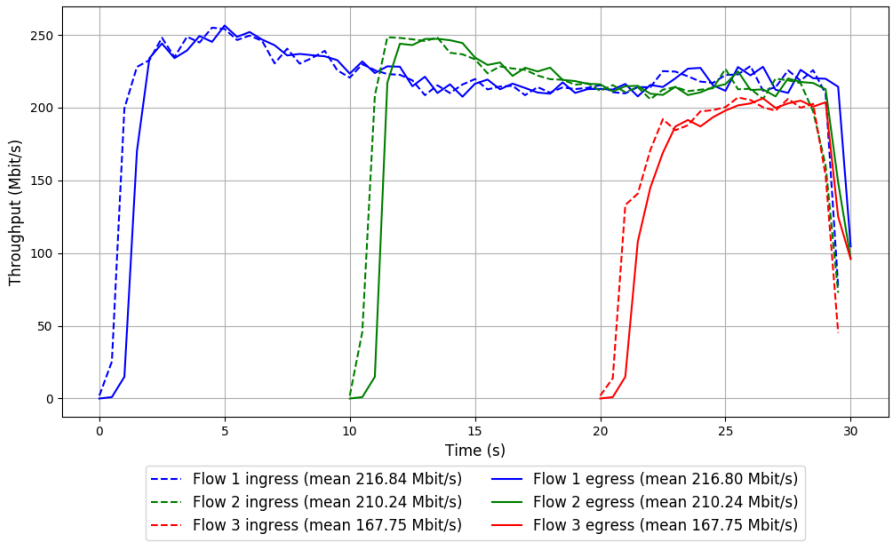


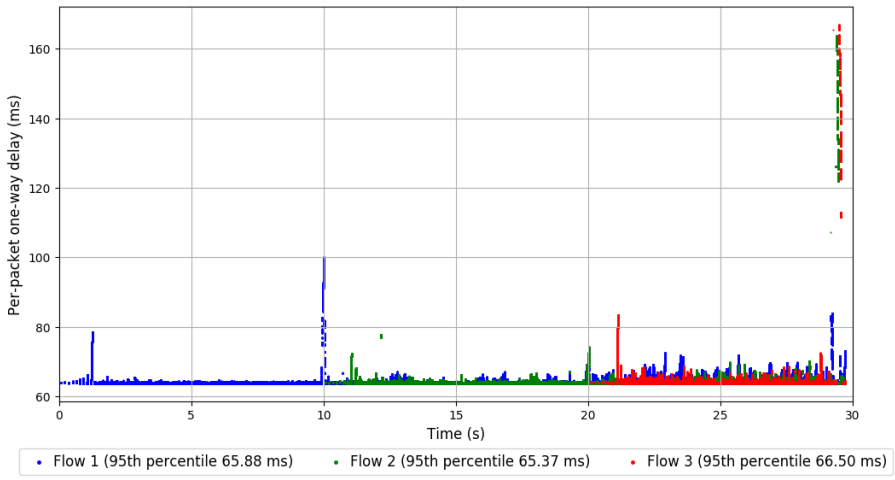
```
Run 2: Statistics of Indigo

Start at: 2018-08-31 10:59:14
End at: 2018-08-31 10:59:44
Local clock offset: 1.712 ms
Remote clock offset: -0.807 ms

# Below is generated by plot.py at 2018-08-31 11:20:01
# Datalink statistics
-- Total of 3 flows:
Average throughput: 410.64 Mbit/s
95th percentile per-packet one-way delay: 65.770 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 216.80 Mbit/s
95th percentile per-packet one-way delay: 65.882 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 210.24 Mbit/s
95th percentile per-packet one-way delay: 65.368 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 167.75 Mbit/s
95th percentile per-packet one-way delay: 66.495 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link



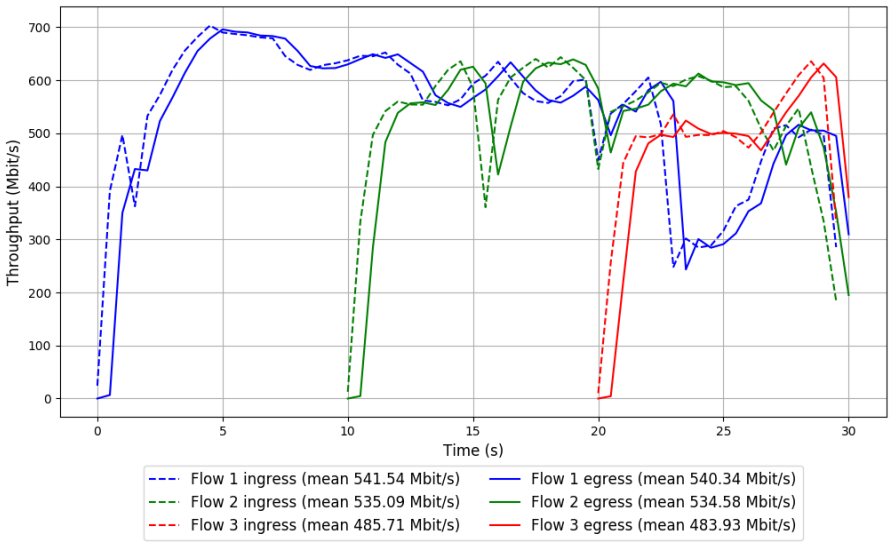


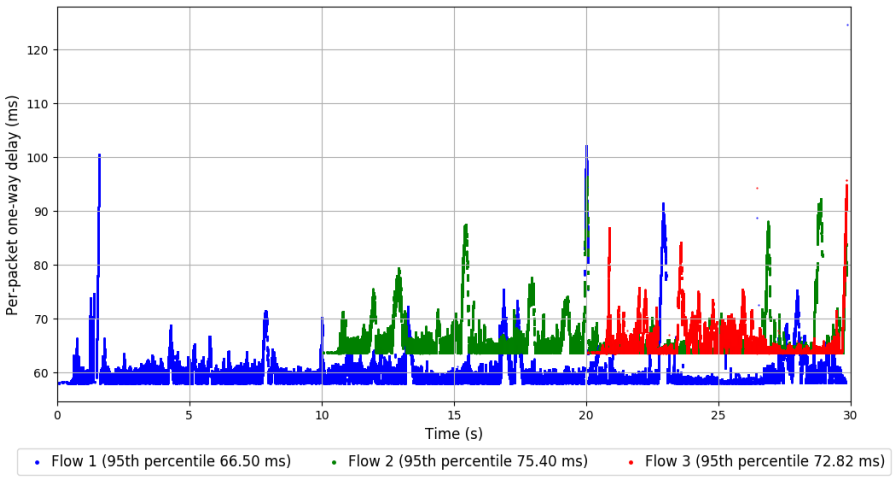
```
Run 1: Statistics of Muses-25

Start at: 2018-08-31 10:47:07
End at: 2018-08-31 10:47:37
Local clock offset: 2.697 ms
Remote clock offset: 1.267 ms

# Below is generated by plot.py at 2018-08-31 11:20:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1053.50 Mbit/s
95th percentile per-packet one-way delay: 71.818 ms
Loss rate: 0.12%
-- Flow 1:
Average throughput: 540.34 Mbit/s
95th percentile per-packet one-way delay: 66.502 ms
Loss rate: 0.11%
-- Flow 2:
Average throughput: 534.58 Mbit/s
95th percentile per-packet one-way delay: 75.404 ms
Loss rate: 0.03%
-- Flow 3:
Average throughput: 483.93 Mbit/s
95th percentile per-packet one-way delay: 72.816 ms
Loss rate: 0.34%
```

Run 1: Report of Muses-25 — Data Link





```
Run 2: Statistics of Muses-25

Start at: 2018-08-31 10:55:10
End at: 2018-08-31 10:55:40
Local clock offset: 1.725 ms
Remote clock offset: 2.118 ms

# Below is generated by plot.py at 2018-08-31 11:20:41
# Datalink statistics
-- Total of 3 flows:
Average throughput: 895.29 Mbit/s
95th percentile per-packet one-way delay: 79.904 ms
Loss rate: 0.05%
-- Flow 1:
Average throughput: 498.87 Mbit/s
95th percentile per-packet one-way delay: 77.591 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 411.91 Mbit/s
95th percentile per-packet one-way delay: 84.393 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 376.94 Mbit/s
95th percentile per-packet one-way delay: 80.718 ms
Loss rate: 0.28%
```

Run 2: Report of Muses-25 — Data Link