Pantheon Report

Generated at 2018-09-05 07:46:36 (UTC).

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

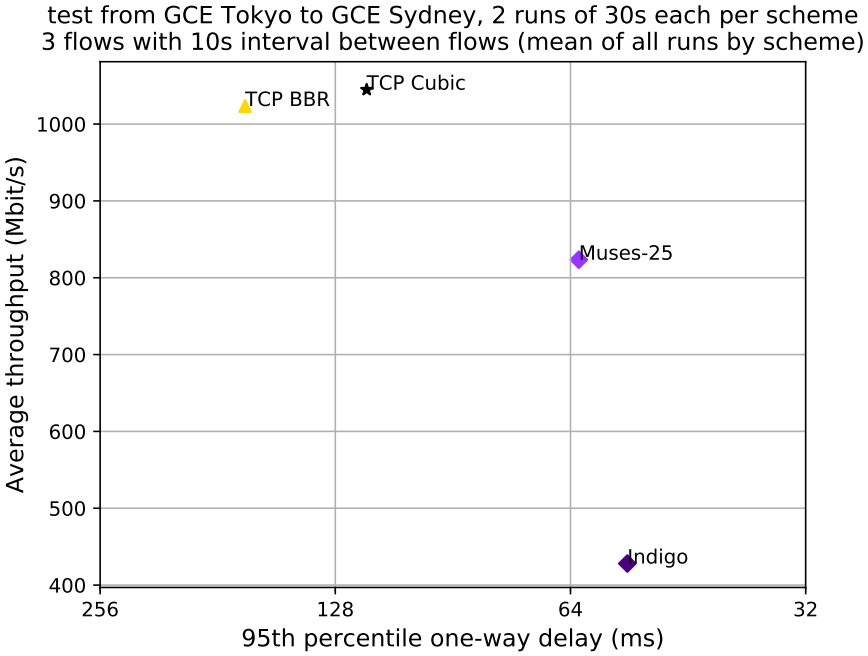
Repeated the test of 4 congestion control schemes twice.

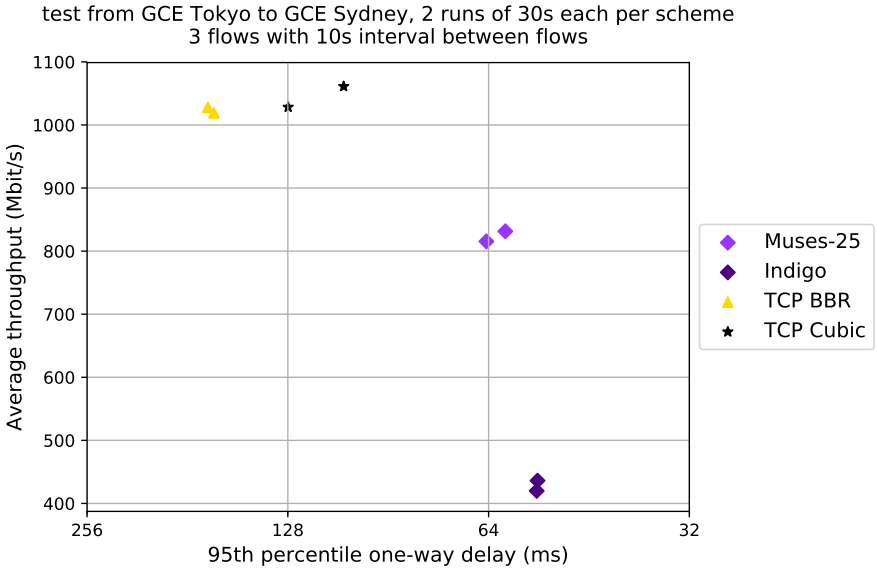
Each test lasted for 30 seconds running 3 flows with 10-second interval between two flows.

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 @ 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 GCE Tokyo to GCE Sydney, 2 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)
TCP BBR
TCP Cubic
Muses-25
Indigo
Average throughput (Mbit/s)
1000
900
800
700
600
500
400
256
128
64
32
95th percentile one-way delay (ms)


test from GCE Tokyo to GCE Sydney, 2 runs of 30s each per scheme
3 flows with 10s interval between flows
Average throughput (Mbit/s)
1100
1000
900
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500
400
256
128
64
32
95th percentile one-way delay (ms)
Muses-25
Indigo
TCP BBR
TCP Cubic

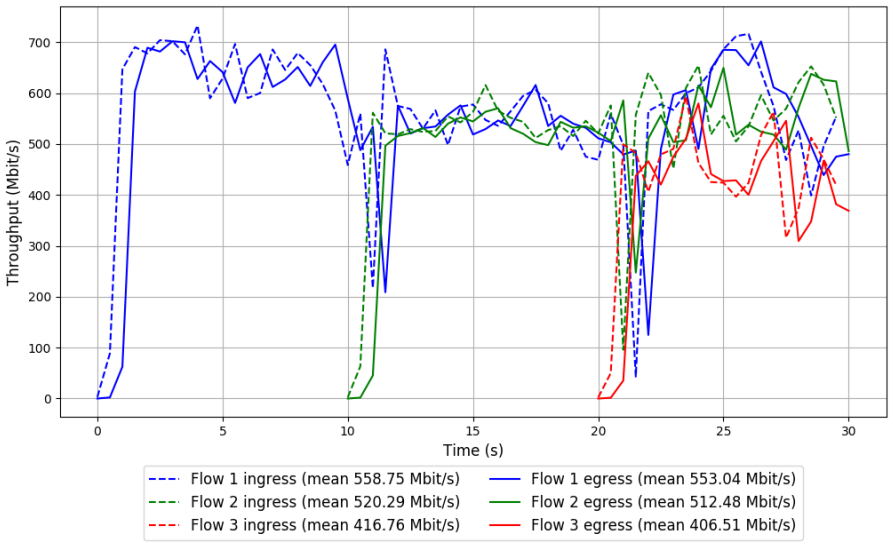
scheme	# runs	mean avg tput (Mbit/s)			mean 95th-%ile delay (ms)			mean loss rate (%)		
		flow 1	flow 2	flow 3	flow 1	flow 2	flow 3	flow 1	flow 2	flow 3
TCP BBR	2	542.29	507.91	434.50	165.55	162.58	172.80	1.49	1.48	3.04
TCP Cubic	2	548.27	515.65	464.93	109.72	99.09	113.69	0.33	0.62	1.66
Indigo	2	225.09	212.53	191.16	52.13	52.51	56.68	0.32	0.58	1.24
Muses-25	2	454.68	369.31	377.77	61.01	66.14	57.91	0.30	0.57	1.36

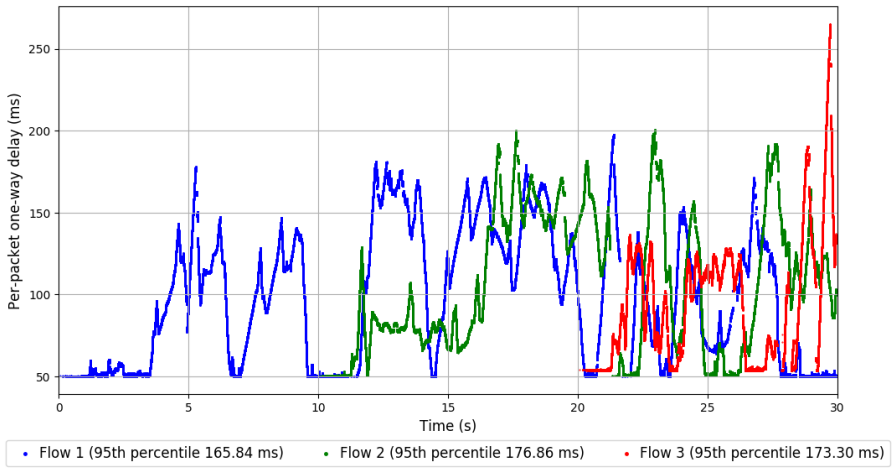
```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 07:16:59
End at: 2018-09-05 07:17:29
Local clock offset: -0.115 ms
Remote clock offset: -0.169 ms

# Below is generated by plot.py at 2018-09-05 07:46:29
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1027.90 Mbit/s
95th percentile per-packet one-way delay: 168.699 ms
Loss rate: 1.87%
-- Flow 1:
Average throughput: 553.04 Mbit/s
95th percentile per-packet one-way delay: 165.841 ms
Loss rate: 1.37%
-- Flow 2:
Average throughput: 512.48 Mbit/s
95th percentile per-packet one-way delay: 176.856 ms
Loss rate: 2.02%
-- Flow 3:
Average throughput: 406.51 Mbit/s
95th percentile per-packet one-way delay: 173.304 ms
Loss rate: 3.54%
```

Run 1: Report of TCP BBR — Data Link



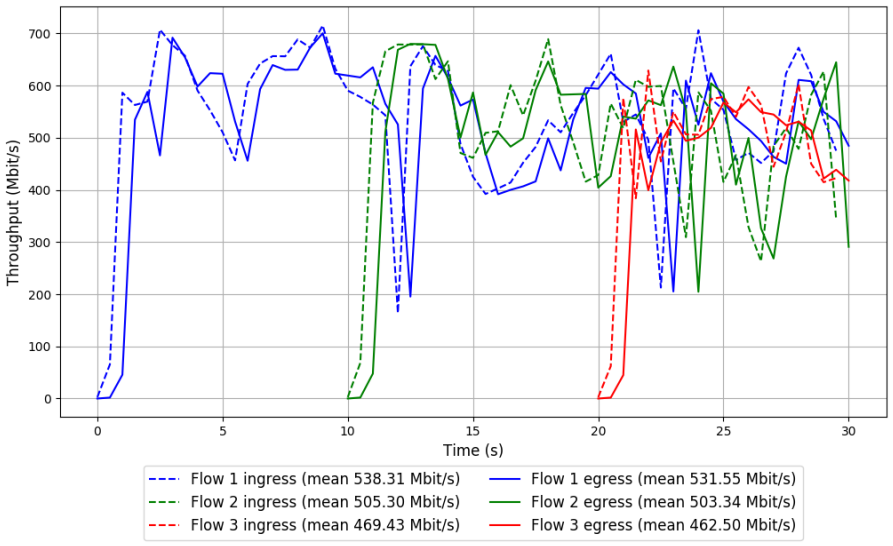


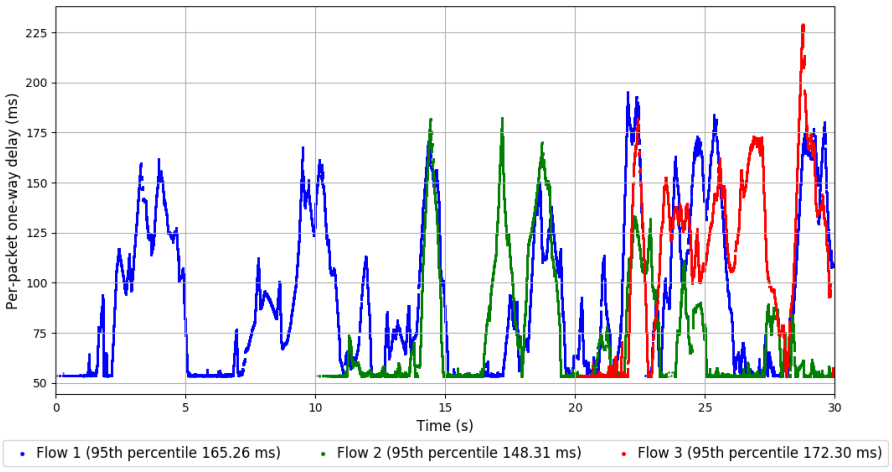
```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 07:24:49
End at: 2018-09-05 07:25:19
Local clock offset: -0.133 ms
Remote clock offset: 0.101 ms

# Below is generated by plot.py at 2018-09-05 07:46:29
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1019.12 Mbit/s
95th percentile per-packet one-way delay: 165.225 ms
Loss rate: 1.53%
-- Flow 1:
Average throughput: 531.55 Mbit/s
95th percentile per-packet one-way delay: 165.260 ms
Loss rate: 1.61%
-- Flow 2:
Average throughput: 503.34 Mbit/s
95th percentile per-packet one-way delay: 148.313 ms
Loss rate: 0.93%
-- Flow 3:
Average throughput: 462.50 Mbit/s
95th percentile per-packet one-way delay: 172.296 ms
Loss rate: 2.55%
```

Run 2: Report of TCP BBR — Data Link



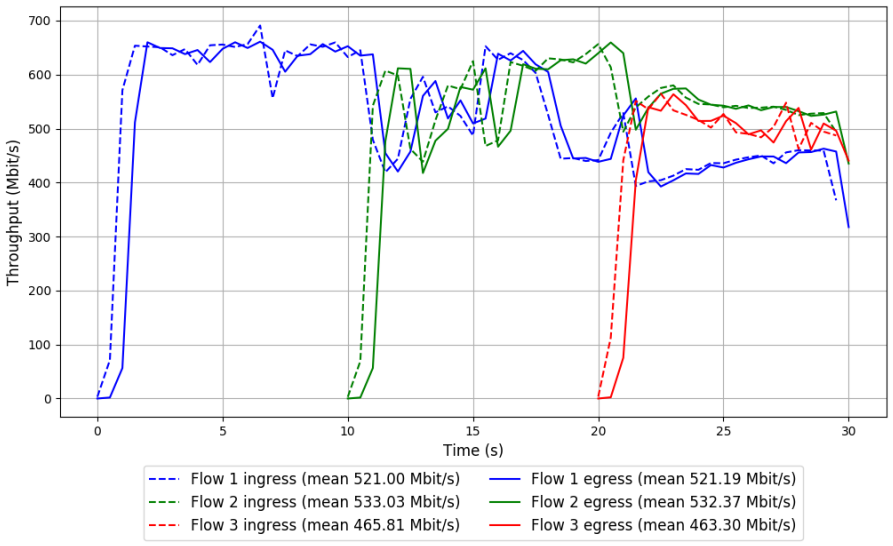


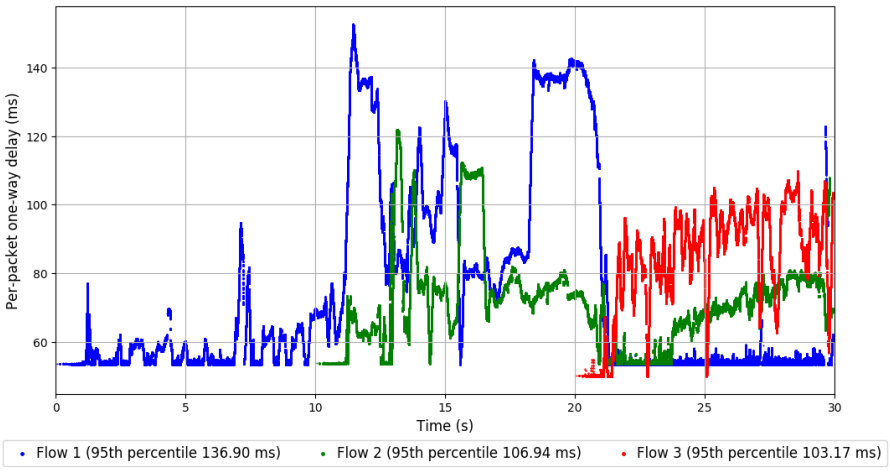
```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 07:19:06
End at: 2018-09-05 07:19:36
Local clock offset: -0.2 ms
Remote clock offset: -0.085 ms

# Below is generated by plot.py at 2018-09-05 07:46:29
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1028.31 Mbit/s
95th percentile per-packet one-way delay: 127.842 ms
Loss rate: 0.62%
-- Flow 1:
Average throughput: 521.19 Mbit/s
95th percentile per-packet one-way delay: 136.899 ms
Loss rate: 0.32%
-- Flow 2:
Average throughput: 532.37 Mbit/s
95th percentile per-packet one-way delay: 106.935 ms
Loss rate: 0.66%
-- Flow 3:
Average throughput: 463.30 Mbit/s
95th percentile per-packet one-way delay: 103.173 ms
Loss rate: 1.54%
```

Run 1: Report of TCP Cubic — Data Link



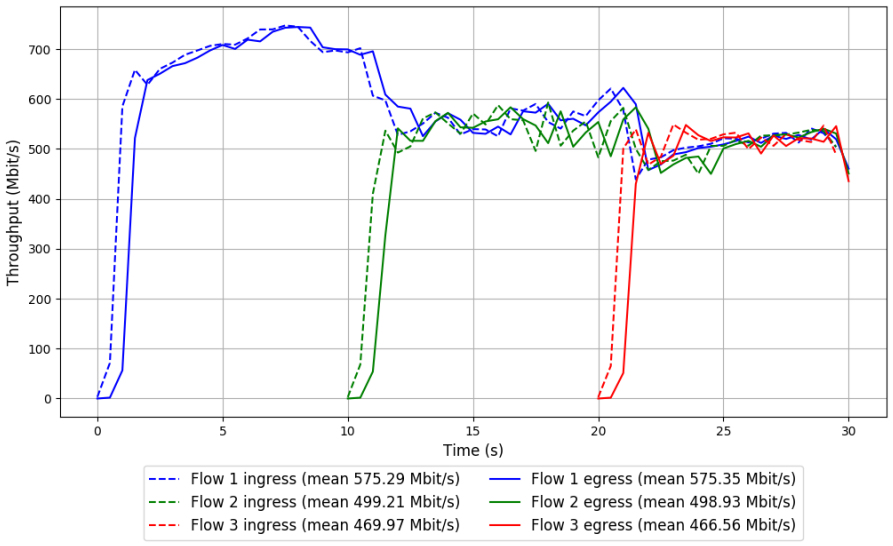


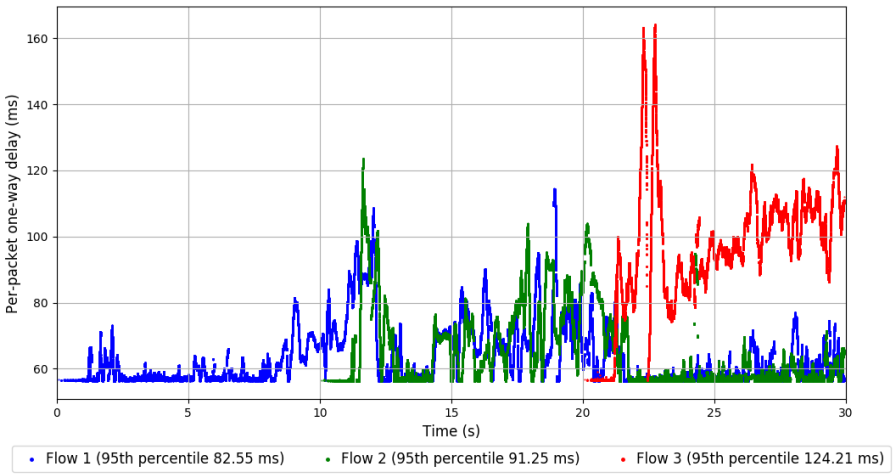
```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 07:26:58
End at: 2018-09-05 07:27:28
Local clock offset: -0.16 ms
Remote clock offset: -3.002 ms

# Below is generated by plot.py at 2018-09-05 07:46:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1061.12 Mbit/s
95th percentile per-packet one-way delay: 105.560 ms
Loss rate: 0.64%
-- Flow 1:
Average throughput: 575.35 Mbit/s
95th percentile per-packet one-way delay: 82.551 ms
Loss rate: 0.35%
-- Flow 2:
Average throughput: 498.93 Mbit/s
95th percentile per-packet one-way delay: 91.254 ms
Loss rate: 0.59%
-- Flow 3:
Average throughput: 466.56 Mbit/s
95th percentile per-packet one-way delay: 124.214 ms
Loss rate: 1.78%
```

Run 2: Report of TCP Cubic — Data Link



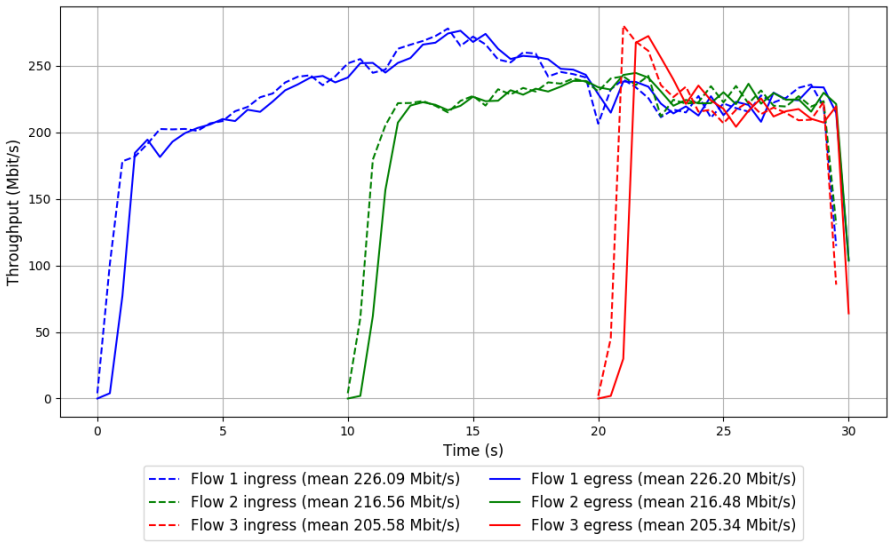


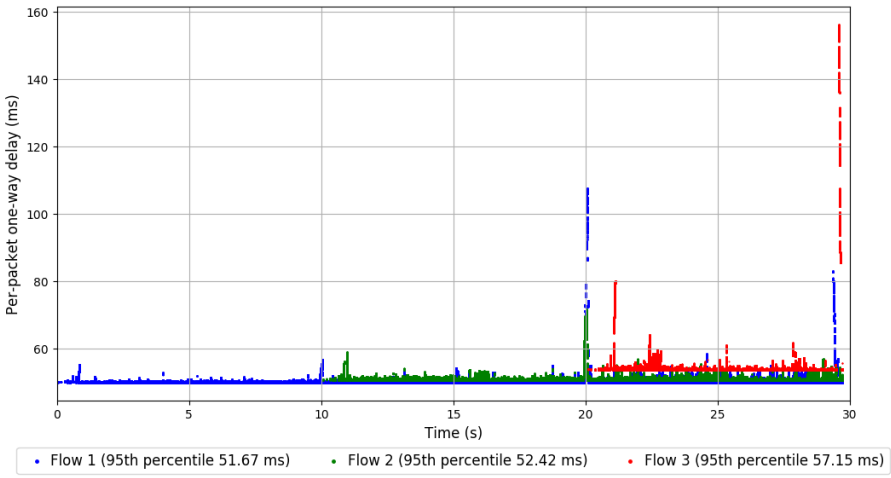
```
Run 1: Statistics of Indigo

Start at: 2018-09-05 07:13:16
End at: 2018-09-05 07:13:46
Local clock offset: 0.038 ms
Remote clock offset: -0.096 ms

# Below is generated by plot.py at 2018-09-05 07:46:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 436.10 Mbit/s
95th percentile per-packet one-way delay: 54.051 ms
Loss rate: 0.53%
-- Flow 1:
Average throughput: 226.20 Mbit/s
95th percentile per-packet one-way delay: 51.672 ms
Loss rate: 0.30%
-- Flow 2:
Average throughput: 216.48 Mbit/s
95th percentile per-packet one-way delay: 52.421 ms
Loss rate: 0.57%
-- Flow 3:
Average throughput: 205.34 Mbit/s
95th percentile per-packet one-way delay: 57.148 ms
Loss rate: 1.20%
```

Run 1: Report of Indigo — Data Link



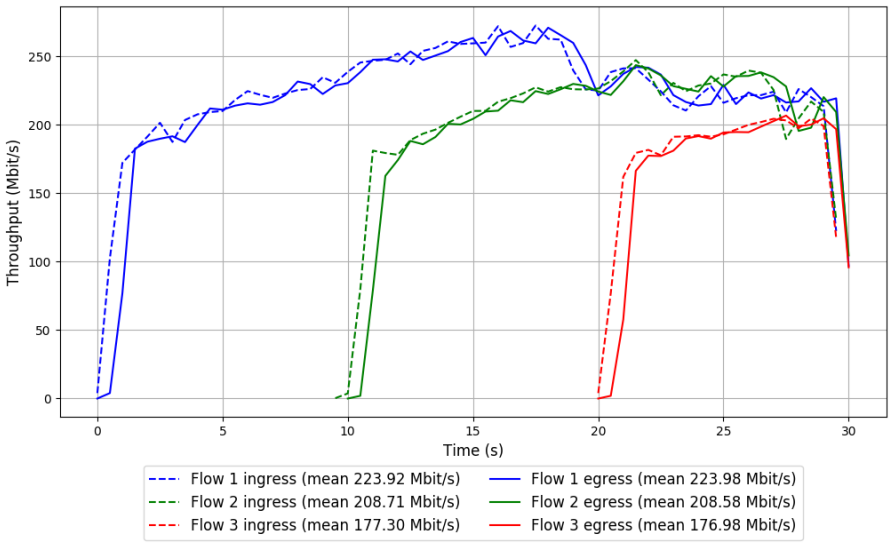


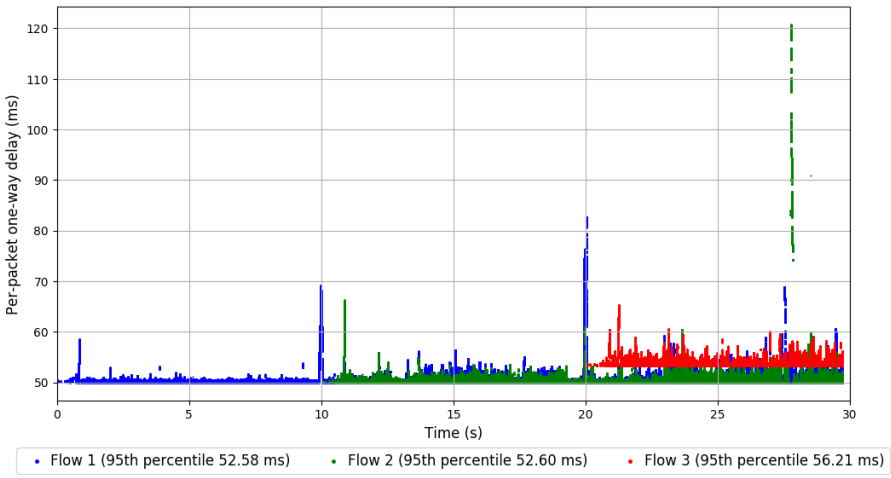
```
Run 2: Statistics of Indigo

Start at: 2018-09-05 07:21:08
End at: 2018-09-05 07:21:38
Local clock offset: -0.346 ms
Remote clock offset: -0.159 ms

# Below is generated by plot.py at 2018-09-05 07:46:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 419.93 Mbit/s
95th percentile per-packet one-way delay: 54.206 ms
Loss rate: 0.55%
-- Flow 1:
Average throughput: 223.98 Mbit/s
95th percentile per-packet one-way delay: 52.582 ms
Loss rate: 0.33%
-- Flow 2:
Average throughput: 208.58 Mbit/s
95th percentile per-packet one-way delay: 52.602 ms
Loss rate: 0.59%
-- Flow 3:
Average throughput: 176.98 Mbit/s
95th percentile per-packet one-way delay: 56.209 ms
Loss rate: 1.28%
```

Run 2: Report of Indigo — Data Link



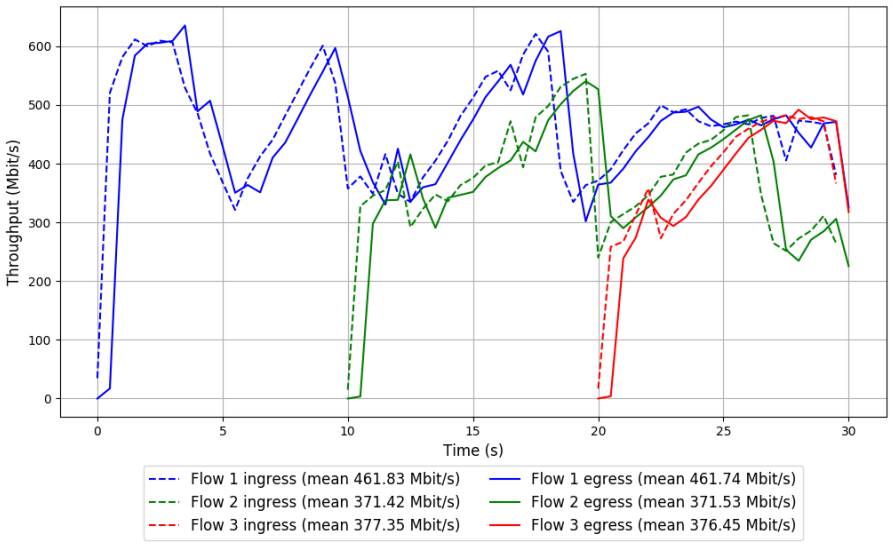


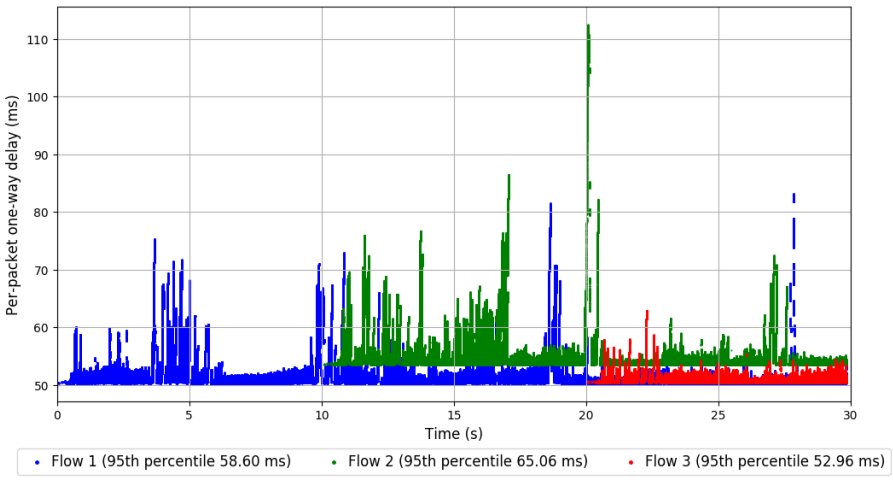
```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 07:15:07
End at: 2018-09-05 07:15:37
Local clock offset: 0.003 ms
Remote clock offset: 0.003 ms

# Below is generated by plot.py at 2018-09-05 07:46:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 831.46 Mbit/s
95th percentile per-packet one-way delay: 60.401 ms
Loss rate: 0.55%
-- Flow 1:
Average throughput: 461.74 Mbit/s
95th percentile per-packet one-way delay: 58.605 ms
Loss rate: 0.37%
-- Flow 2:
Average throughput: 371.53 Mbit/s
95th percentile per-packet one-way delay: 65.061 ms
Loss rate: 0.51%
-- Flow 3:
Average throughput: 376.45 Mbit/s
95th percentile per-packet one-way delay: 52.957 ms
Loss rate: 1.30%
```

Run 1: Report of Muses-25 — Data Link





```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 07:22:58
End at: 2018-09-05 07:23:28
Local clock offset: -0.022 ms
Remote clock offset: -3.083 ms

# Below is generated by plot.py at 2018-09-05 07:46:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 815.45 Mbit/s
95th percentile per-packet one-way delay: 64.487 ms
Loss rate: 0.53%
-- Flow 1:
Average throughput: 447.62 Mbit/s
95th percentile per-packet one-way delay: 63.421 ms
Loss rate: 0.23%
-- Flow 2:
Average throughput: 367.09 Mbit/s
95th percentile per-packet one-way delay: 67.213 ms
Loss rate: 0.63%
-- Flow 3:
Average throughput: 379.09 Mbit/s
95th percentile per-packet one-way delay: 62.861 ms
Loss rate: 1.43%
```

Run 2: Report of Muses-25 — Data Link