# Pantheon Report

Generated at 2018-09-05 21:58:47 (UTC).

Data path: GCE Sydney on `ens4` (*local*) →GCE Iowa 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.
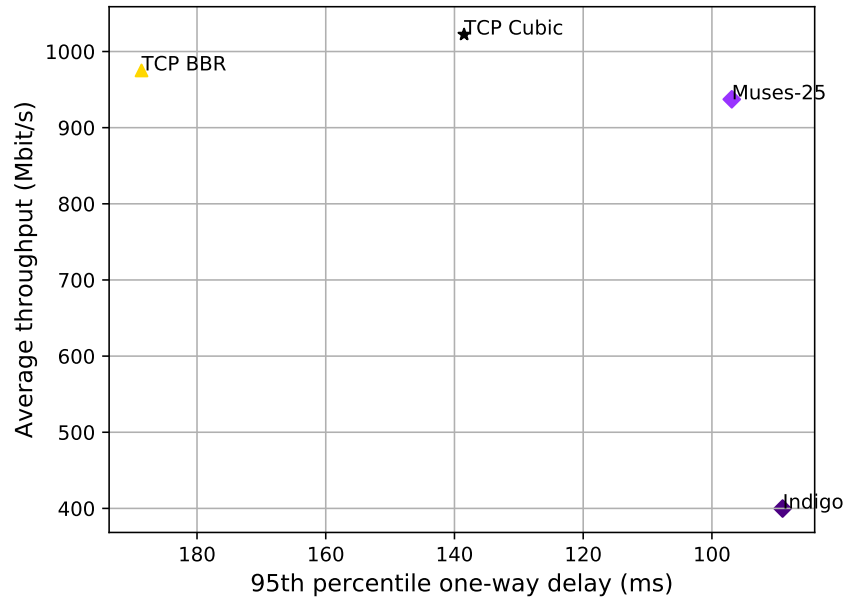
```
System info:
Linux 4.15.0-1018-gcp
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912
```
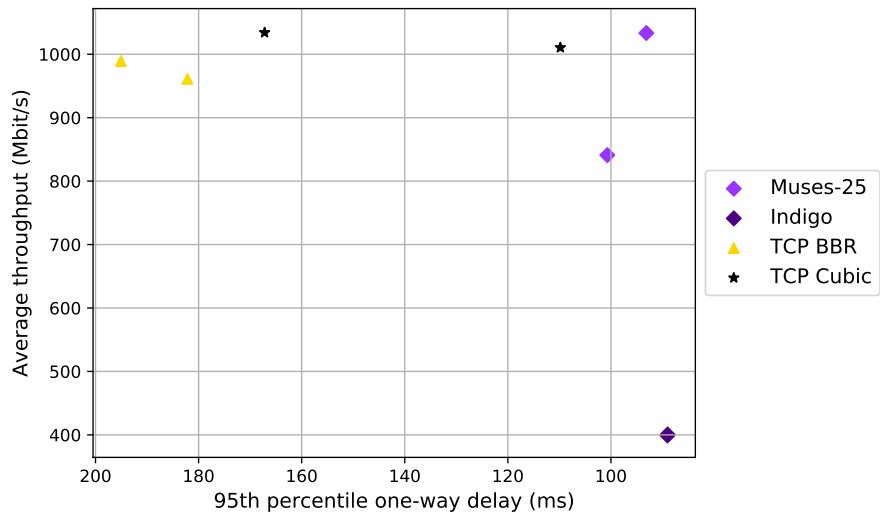
```
Git summary:
branch: muses @ 18b9165265c8ba2915c862e8713fd9ad82c1ac21
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ a28d20fb82a95a965a3da65fd1eb71b8994e9b84
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 Sydney to GCE Iowa, 2 runs of 30s each per scheme
### 3 flows with 10s interval between flows (mean of all runs by scheme)



## test from GCE Sydney to GCE Iowa, 2 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 | 2 | 524.28 | 475.61 | 402.74 | 186.42 | 198.68 | 179.86 | 1.00 | 1.48 | 0.57 |
| TCP Cubic | 2 | 556.75 | 473.23 | 452.20 | 143.03 | 114.83 | 141.55 | 0.06 | 0.03 | 0.07 |
| Indigo | 2 | 209.41 | 203.86 | 172.61 | 88.39 | 89.69 | 89.34 | 0.00 | 0.01 | 0.00 |
| Muses-25 | 2 | 500.71 | 463.40 | 399.03 | 100.66 | 93.67 | 92.78 | 0.01 | 0.00 | 0.00 |

```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 21:29:27
End at: 2018-09-05 21:29:57
Local clock offset: 20.344 ms
Remote clock offset: 9.987 ms


# Below is generated by plot.py at 2018-09-05 21:58:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 961.04 Mbit/s
95th percentile per-packet one-way delay: 182.155 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 530.53 Mbit/s
95th percentile per-packet one-way delay: 179.390 ms
Loss rate: 0.51%
-- Flow 2:
Average throughput: 445.32 Mbit/s
95th percentile per-packet one-way delay: 198.982 ms
Loss rate: 0.75%
-- Flow 3:
Average throughput: 402.32 Mbit/s
95th percentile per-packet one-way delay: 175.825 ms
Loss rate: 0.83%
```
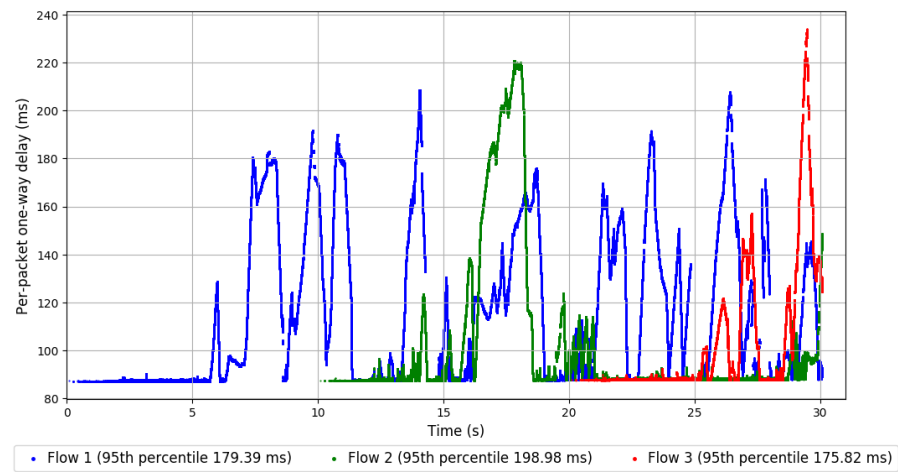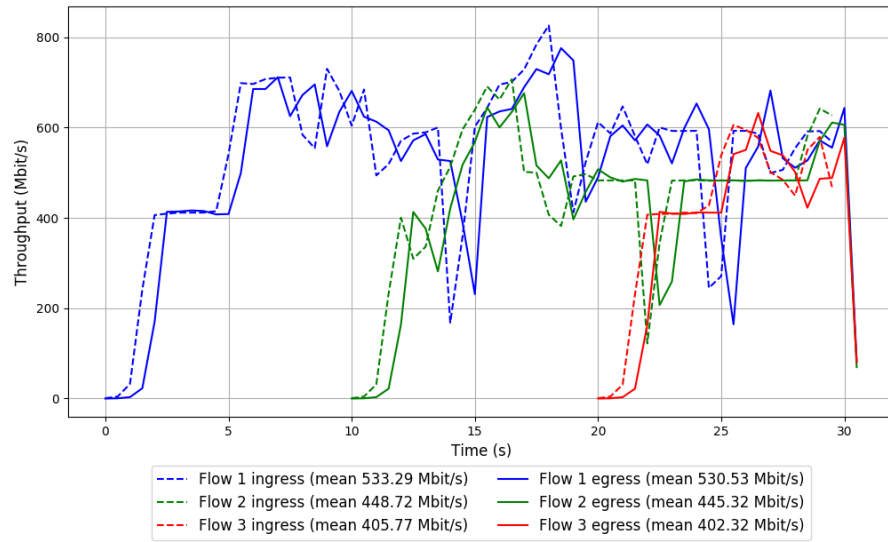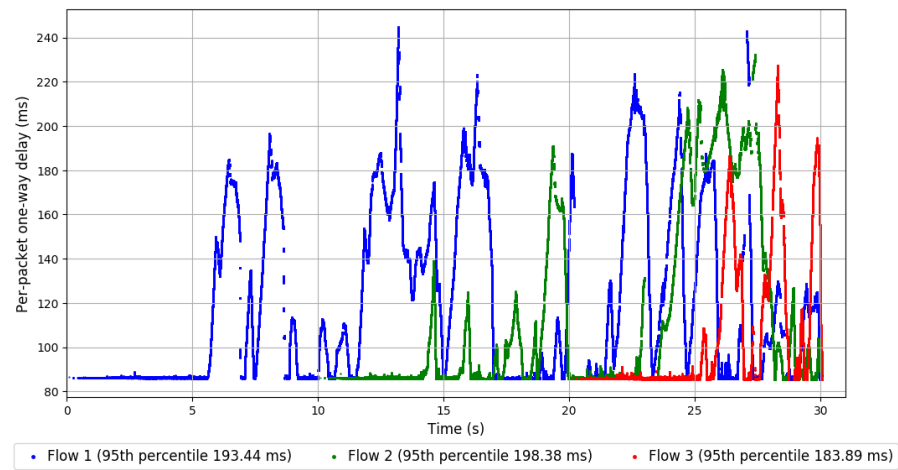
Run 1: Report of TCP BBR — Data Link



- - - Flow 1 ingress (mean 533.29 Mbit/s)     —— Flow 1 egress (mean 530.53 Mbit/s)
- - - Flow 2 ingress (mean 448.72 Mbit/s)     —— Flow 2 egress (mean 445.32 Mbit/s)
- - - Flow 3 ingress (mean 405.77 Mbit/s)     —— Flow 3 egress (mean 402.32 Mbit/s)



• Flow 1 (95th percentile 179.39 ms)    • Flow 2 (95th percentile 198.98 ms)    • Flow 3 (95th percentile 175.82 ms)

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```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 21:37:37
End at: 2018-09-05 21:38:07
Local clock offset: 22.824 ms
Remote clock offset: 8.054 ms


# Below is generated by plot.py at 2018-09-05 21:58:29
# Datalink statistics
-- Total of 3 flows:
Average throughput: 989.24 Mbit/s
95th percentile per-packet one-way delay: 195.087 ms
Loss rate: 1.58%
-- Flow 1:
Average throughput: 518.04 Mbit/s
95th percentile per-packet one-way delay: 193.442 ms
Loss rate: 1.50%
-- Flow 2:
Average throughput: 505.89 Mbit/s
95th percentile per-packet one-way delay: 198.377 ms
Loss rate: 2.20%
-- Flow 3:
Average throughput: 403.16 Mbit/s
95th percentile per-packet one-way delay: 183.890 ms
Loss rate: 0.32%
```
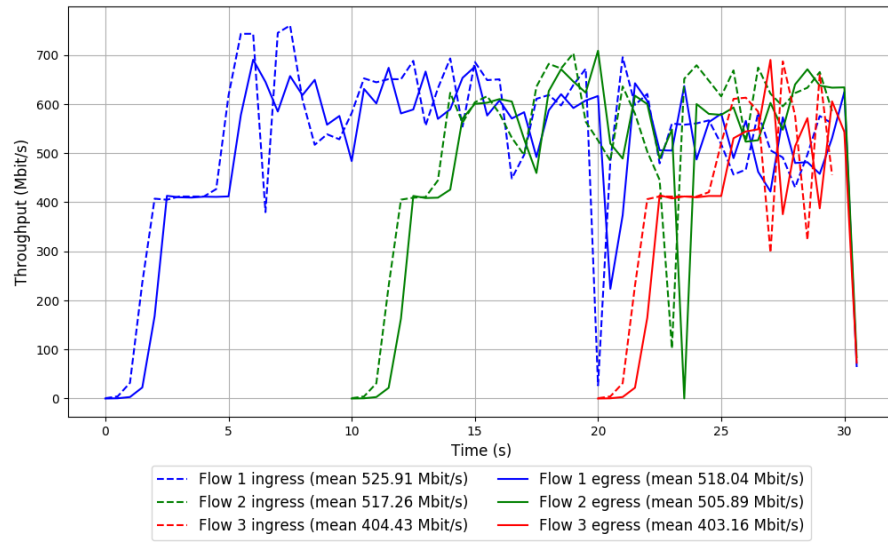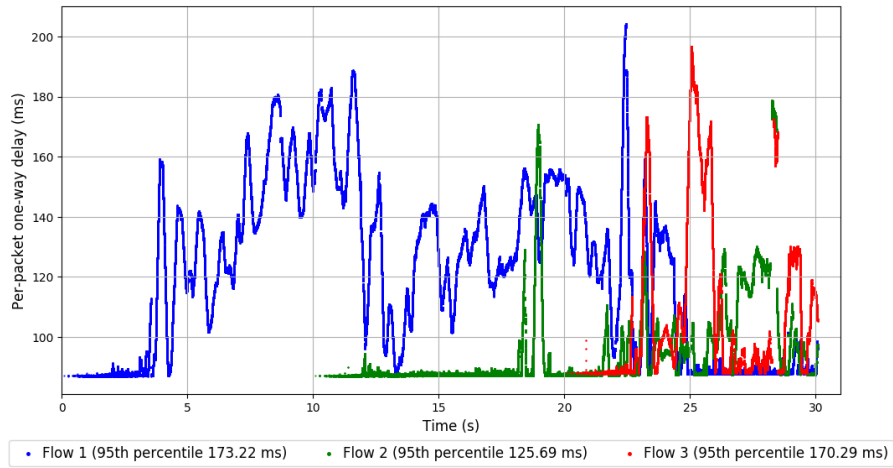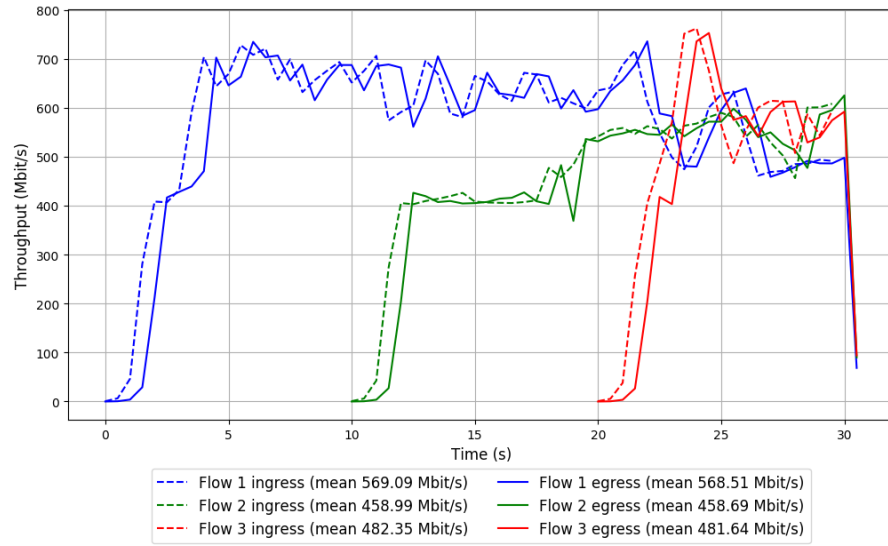
Run 2: Report of TCP BBR — Data Link



Flow 1 ingress (mean 525.91 Mbit/s) --- Flow 1 egress (mean 518.04 Mbit/s)
Flow 2 ingress (mean 517.26 Mbit/s) --- Flow 2 egress (mean 505.89 Mbit/s)
Flow 3 ingress (mean 404.43 Mbit/s) --- Flow 3 egress (mean 403.16 Mbit/s)



Flow 1 (95th percentile 193.44 ms)   Flow 2 (95th percentile 198.38 ms)   Flow 3 (95th percentile 183.89 ms)

```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 21:27:19
End at: 2018-09-05 21:27:49
Local clock offset: 17.751 ms
Remote clock offset: 11.379 ms


# Below is generated by plot.py at 2018-09-05 21:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1034.13 Mbit/s
95th percentile per-packet one-way delay: 167.191 ms
Loss rate: 0.09%
-- Flow 1:
Average throughput: 568.51 Mbit/s
95th percentile per-packet one-way delay: 173.221 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 458.69 Mbit/s
95th percentile per-packet one-way delay: 125.687 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 481.64 Mbit/s
95th percentile per-packet one-way delay: 170.289 ms
Loss rate: 0.14%
```
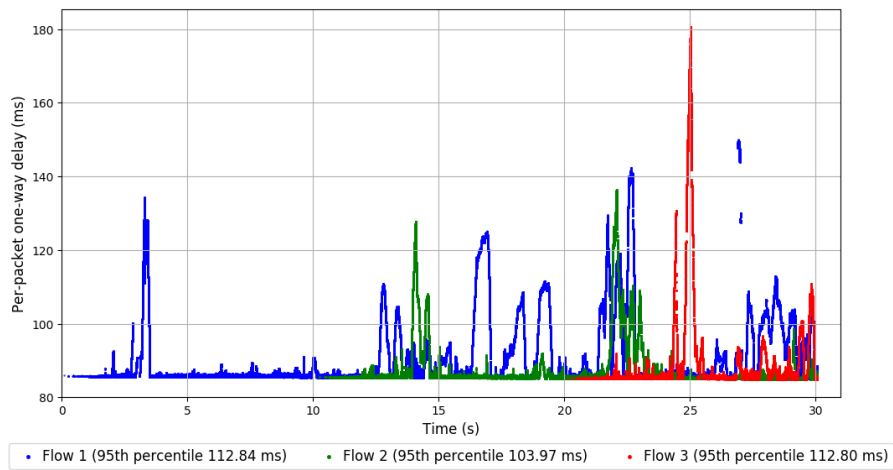
Run 1: Report of TCP Cubic — Data Link

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Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 21:35:28
End at: 2018-09-05 21:35:58
Local clock offset: 25.872 ms
Remote clock offset: 8.198 ms


# Below is generated by plot.py at 2018-09-05 21:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1010.44 Mbit/s
95th percentile per-packet one-way delay: 109.816 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 545.00 Mbit/s
95th percentile per-packet one-way delay: 112.841 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 487.76 Mbit/s
95th percentile per-packet one-way delay: 103.970 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 422.77 Mbit/s
95th percentile per-packet one-way delay: 112.803 ms
Loss rate: 0.00%
```
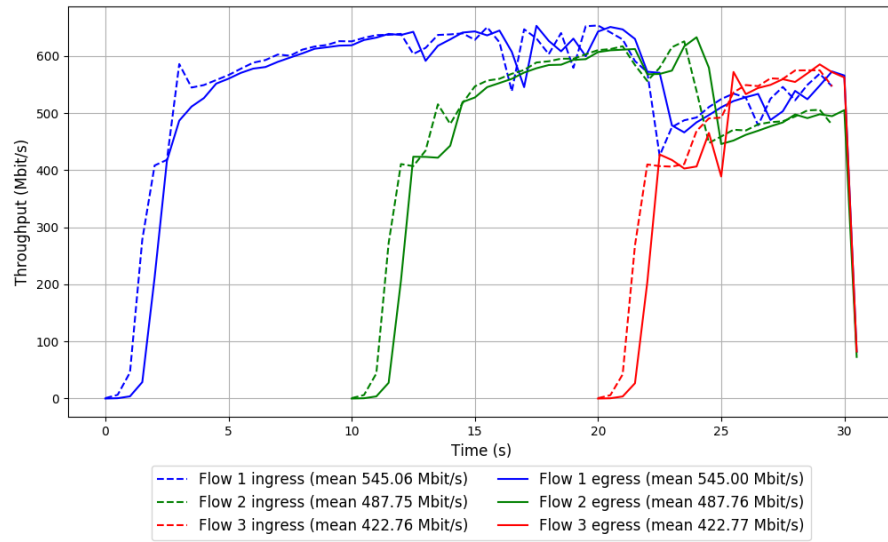
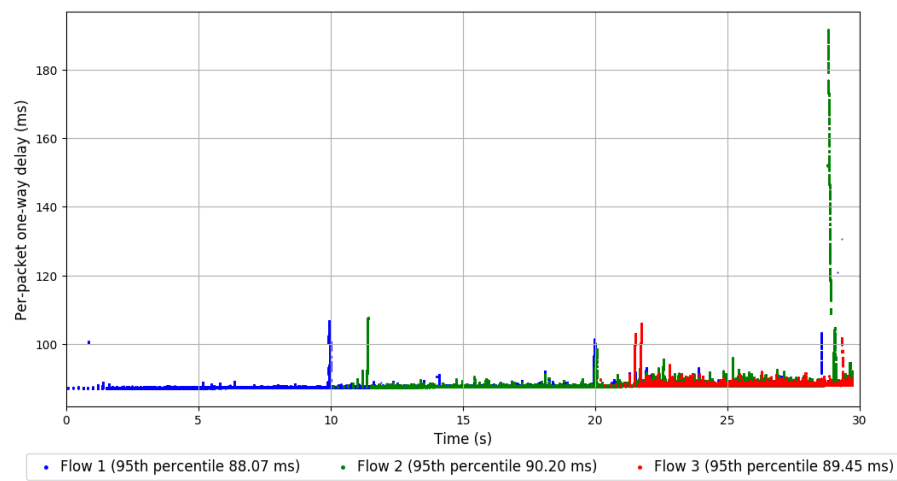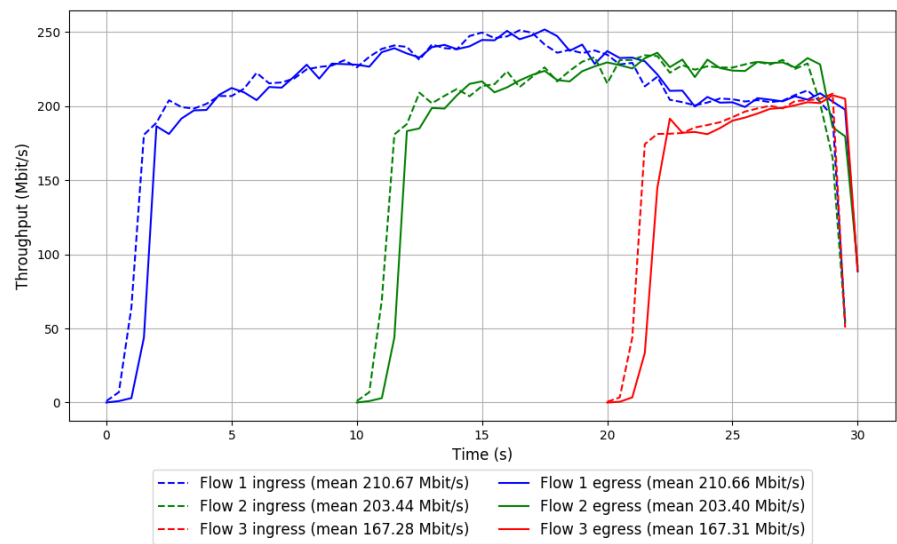Run 2: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-09-05 21:25:25
End at: 2018-09-05 21:25:55
Local clock offset: 15.546 ms
Remote clock offset: 12.992 ms


# Below is generated by plot.py at 2018-09-05 21:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 399.09 Mbit/s
95th percentile per-packet one-way delay: 89.034 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 210.66 Mbit/s
95th percentile per-packet one-way delay: 88.074 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 203.40 Mbit/s
95th percentile per-packet one-way delay: 90.203 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 167.31 Mbit/s
95th percentile per-packet one-way delay: 89.449 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

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Run 2: Statistics of Indigo

Start at: 2018-09-05 21:33:35
End at: 2018-09-05 21:34:05
Local clock offset: 26.039 ms
Remote clock offset: 8.492 ms


# Below is generated by plot.py at 2018-09-05 21:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 400.51 Mbit/s
95th percentile per-packet one-way delay: 89.003 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 208.17 Mbit/s
95th percentile per-packet one-way delay: 88.712 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 204.32 Mbit/s
95th percentile per-packet one-way delay: 89.175 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 177.90 Mbit/s
95th percentile per-packet one-way delay: 89.222 ms
Loss rate: 0.00%
```
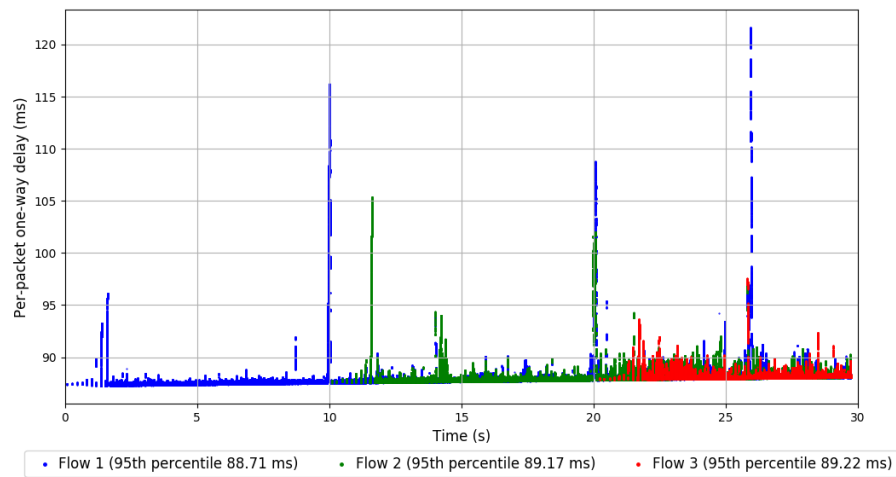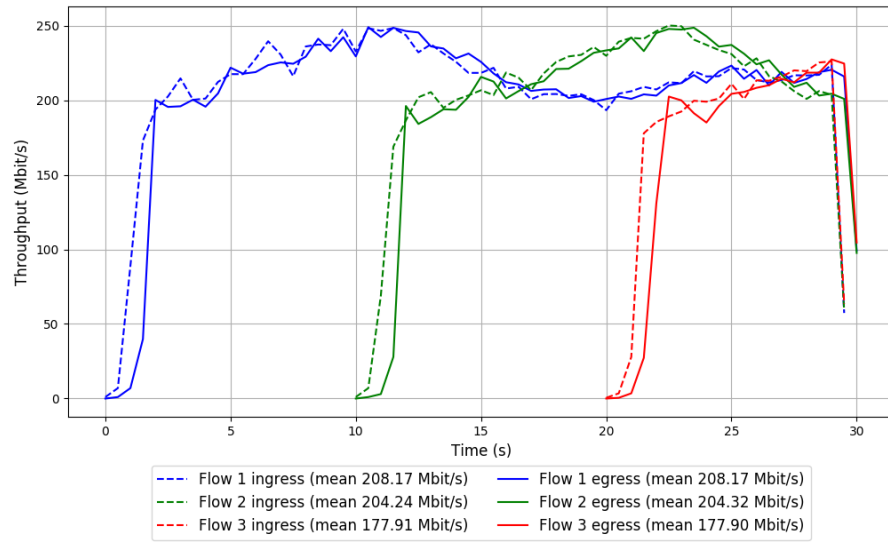
Run 2: Report of Indigo — Data Link

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Run 1: Statistics of Muses-25

Start at: 2018-09-05 21:31:37
End at: 2018-09-05 21:32:07
Local clock offset: 23.413 ms
Remote clock offset: 9.041 ms


# Below is generated by plot.py at 2018-09-05 21:58:43
# Datalink statistics
-- Total of 3 flows:
Average throughput: 841.03 Mbit/s
95th percentile per-packet one-way delay: 100.706 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 441.64 Mbit/s
95th percentile per-packet one-way delay: 104.356 ms
Loss rate: 0.01%
-- Flow 2:
Average throughput: 401.42 Mbit/s
95th percentile per-packet one-way delay: 97.863 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 409.79 Mbit/s
95th percentile per-packet one-way delay: 93.350 ms
Loss rate: 0.00%
```
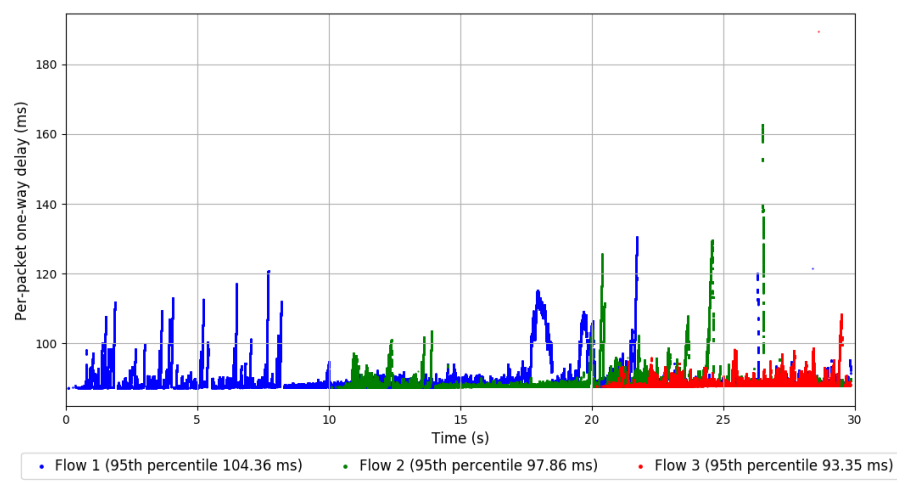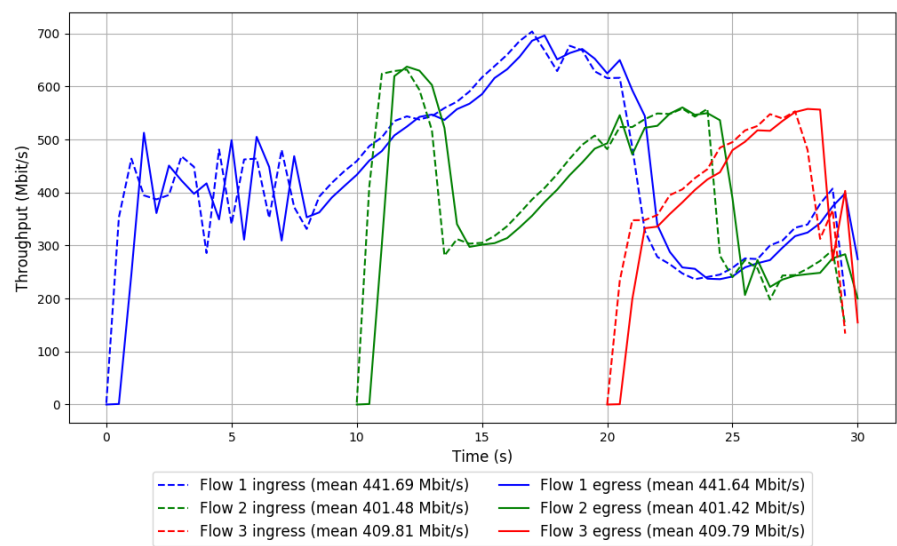
Run 1: Report of Muses-25 — Data Link





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```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 21:39:50
End at: 2018-09-05 21:40:20
Local clock offset: 21.142 ms
Remote clock offset: 8.113 ms


# Below is generated by plot.py at 2018-09-05 21:58:46
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1033.46 Mbit/s
95th percentile per-packet one-way delay: 93.125 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 559.78 Mbit/s
95th percentile per-packet one-way delay: 96.963 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 525.38 Mbit/s
95th percentile per-packet one-way delay: 89.486 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 388.27 Mbit/s
95th percentile per-packet one-way delay: 92.204 ms
Loss rate: 0.00%
```

Run 2: Report of Muses-25 — Data Link