Pantheon Report

Generated at 2018-09-05 21:53:26 (UTC).

Data path: AWS California 1 on **ens5** (*local*) →Stanford on **eno1** (*remote*).

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.stanford.edu` and have been applied to correct the timestamps in logs.
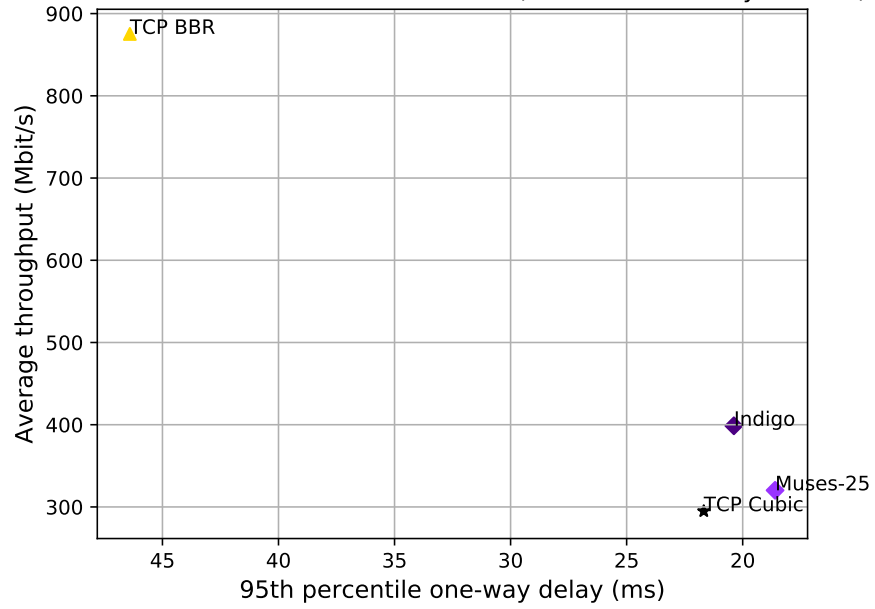
```
System info:
Linux 4.15.0-1020-aws
net.core.default_qdisc = fq
net.core.rmem_default = 16777216
net.core.rmem_max = 536870912
net.core.wmem_default = 16777216
net.core.wmem_max = 536870912
net.ipv4.tcp_rmem = 4096 16777216 536870912
net.ipv4.tcp_wmem = 4096 16777216 536870912
net.ipv4.tcp_mem = 536870912 536870912 536870912

Git summary:
branch: muses @ 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
```
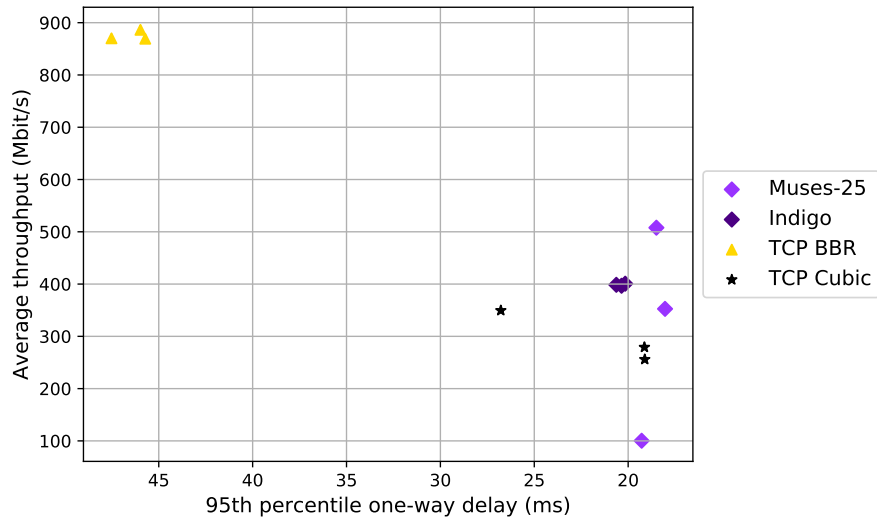
test from AWS California 1 to Stanford, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

test from AWS California 1 to Stanford, 3 runs of 30s each per scheme
3 flows with 10s interval between flows

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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	493.28	430.67	285.87	47.93	36.41	20.52	6.26	10.35	13.60
TCP Cubic	3	132.77	137.96	210.86	24.10	19.84	20.46	0.03	0.03	0.05
Indigo	3	202.24	201.54	194.48	20.36	19.72	21.11	0.07	0.10	0.09
Muses-25	3	93.72	229.92	224.19	18.65	18.55	18.73	0.09	0.26	0.67

```
Run 1: Statistics of TCP BBR

Start at: 2018-09-05 21:25:00
End at: 2018-09-05 21:25:30
Local clock offset: -1.711 ms
Remote clock offset: 2.769 ms


# Below is generated by plot.py at 2018-09-05 21:53:17
# Datalink statistics
-- Total of 3 flows:
Average throughput: 870.12 Mbit/s
95th percentile per-packet one-way delay: 47.518 ms
Loss rate: 8.20%
-- Flow 1:
Average throughput: 469.73 Mbit/s
95th percentile per-packet one-way delay: 49.198 ms
Loss rate: 6.49%
-- Flow 2:
Average throughput: 464.45 Mbit/s
95th percentile per-packet one-way delay: 42.329 ms
Loss rate: 9.28%
-- Flow 3:
Average throughput: 273.61 Mbit/s
95th percentile per-packet one-way delay: 20.442 ms
Loss rate: 12.93%
```
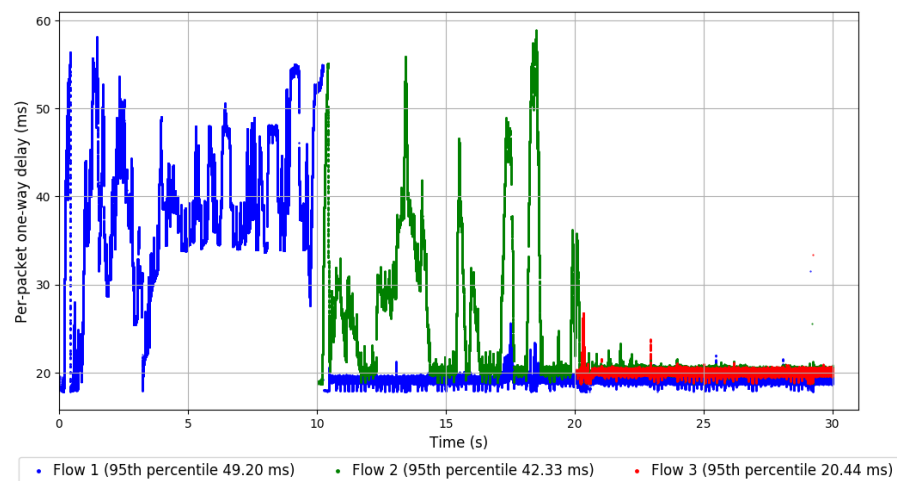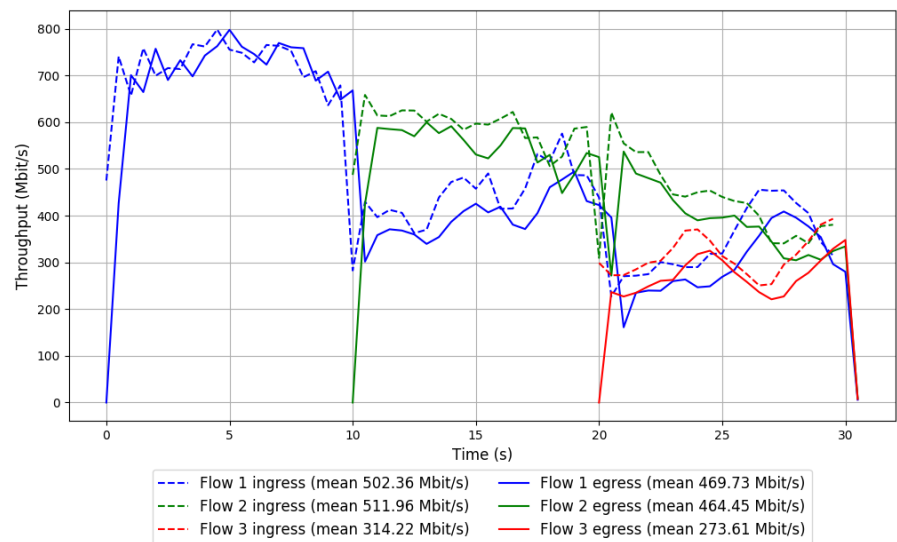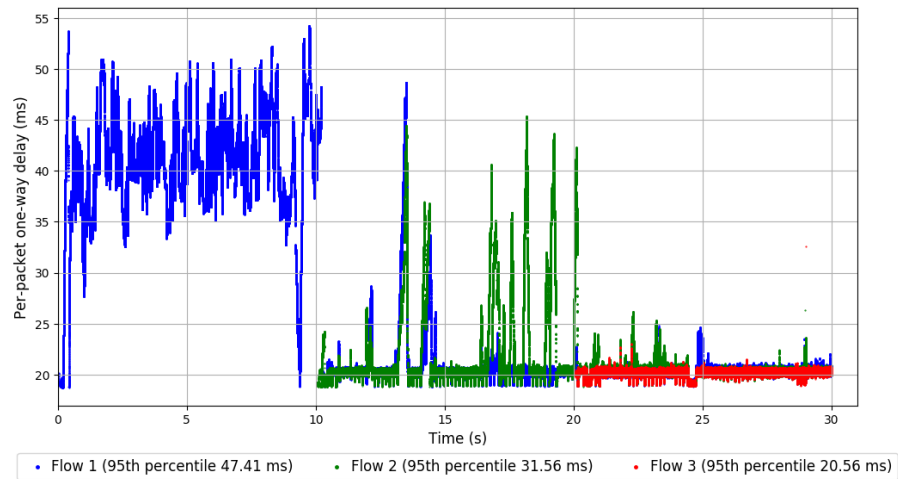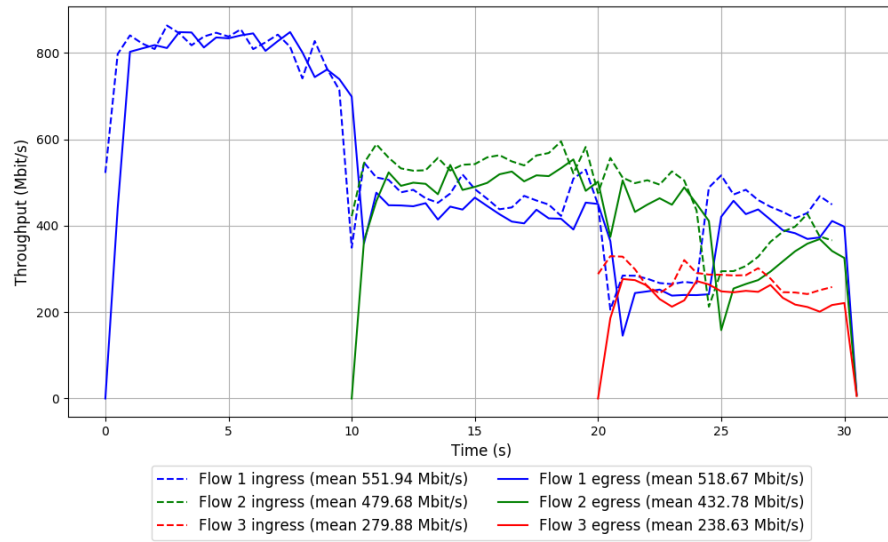
Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 502.36 Mbit/s) --- Flow 1 egress (mean 469.73 Mbit/s)
Flow 2 ingress (mean 511.96 Mbit/s) --- Flow 2 egress (mean 464.45 Mbit/s)
Flow 3 ingress (mean 314.22 Mbit/s) --- Flow 3 egress (mean 273.61 Mbit/s)

Flow 1 (95th percentile 49.20 ms)   Flow 2 (95th percentile 42.33 ms)   Flow 3 (95th percentile 20.44 ms)

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```
Run 2: Statistics of TCP BBR

Start at: 2018-09-05 21:31:35
End at: 2018-09-05 21:32:05
Local clock offset: -2.526 ms
Remote clock offset: 1.553 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 886.39 Mbit/s
95th percentile per-packet one-way delay: 45.976 ms
Loss rate: 8.11%
-- Flow 1:
Average throughput: 518.67 Mbit/s
95th percentile per-packet one-way delay: 47.412 ms
Loss rate: 6.02%
-- Flow 2:
Average throughput: 432.78 Mbit/s
95th percentile per-packet one-way delay: 31.560 ms
Loss rate: 9.77%
-- Flow 3:
Average throughput: 238.63 Mbit/s
95th percentile per-packet one-way delay: 20.559 ms
Loss rate: 14.74%
```
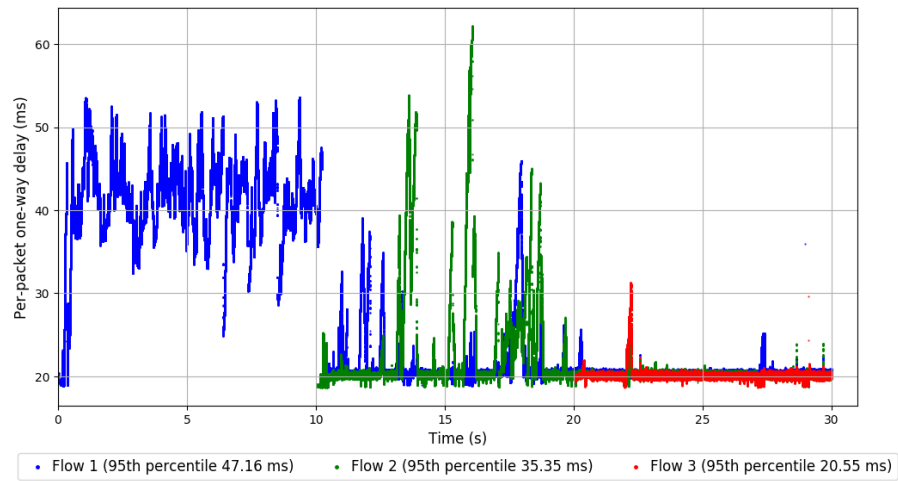
Run 2: Report of TCP BBR — Data Link

```
Run 3: Statistics of TCP BBR

Start at: 2018-09-05 21:38:05
End at: 2018-09-05 21:38:35
Local clock offset: -2.038 ms
Remote clock offset: 0.628 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 869.35 Mbit/s
95th percentile per-packet one-way delay: 45.719 ms
Loss rate: 9.01%
-- Flow 1:
Average throughput: 491.43 Mbit/s
95th percentile per-packet one-way delay: 47.165 ms
Loss rate: 6.26%
-- Flow 2:
Average throughput: 394.78 Mbit/s
95th percentile per-packet one-way delay: 35.351 ms
Loss rate: 12.01%
-- Flow 3:
Average throughput: 345.37 Mbit/s
95th percentile per-packet one-way delay: 20.555 ms
Loss rate: 13.13%
```
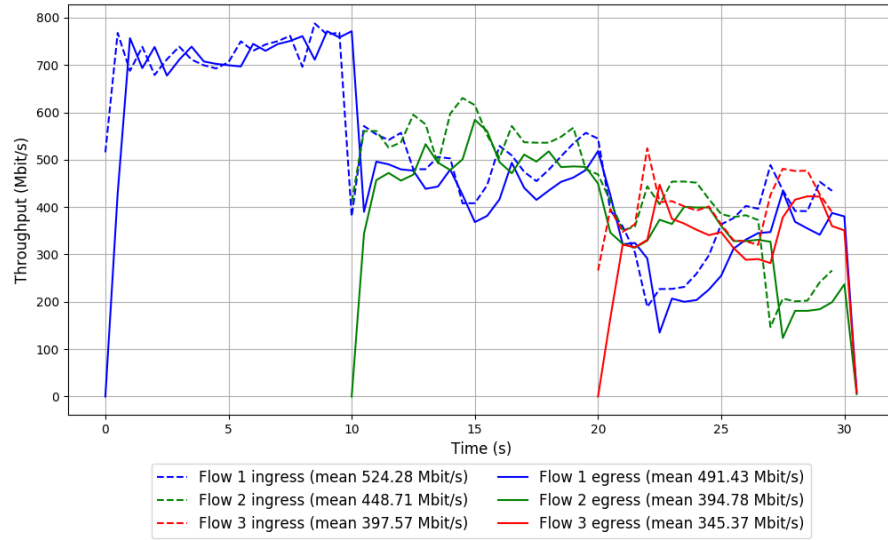
Run 3: Report of TCP BBR — Data Link

```
Run 1: Statistics of TCP Cubic

Start at: 2018-09-05 21:28:28
End at: 2018-09-05 21:28:58
Local clock offset: -2.171 ms
Remote clock offset: 2.445 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 279.20 Mbit/s
95th percentile per-packet one-way delay: 19.133 ms
Loss rate: 0.03%
-- Flow 1:
Average throughput: 137.62 Mbit/s
95th percentile per-packet one-way delay: 19.235 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 118.06 Mbit/s
95th percentile per-packet one-way delay: 19.044 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 189.03 Mbit/s
95th percentile per-packet one-way delay: 18.579 ms
Loss rate: 0.04%
```
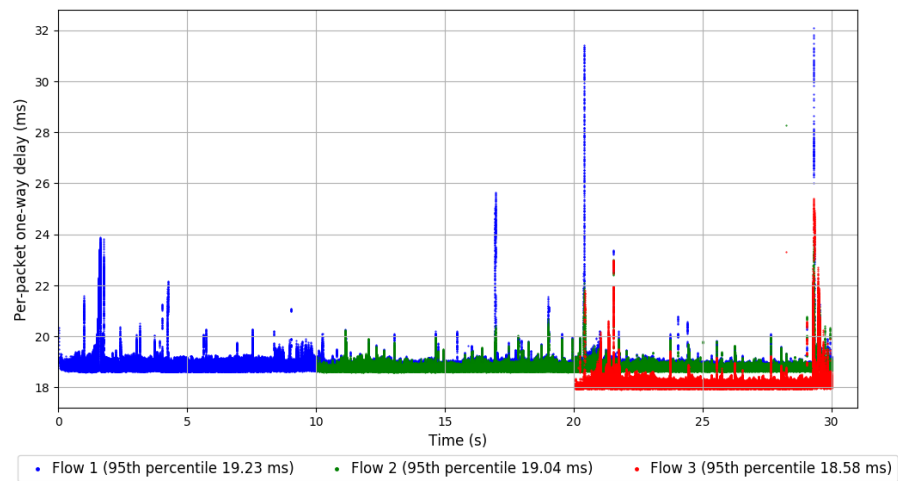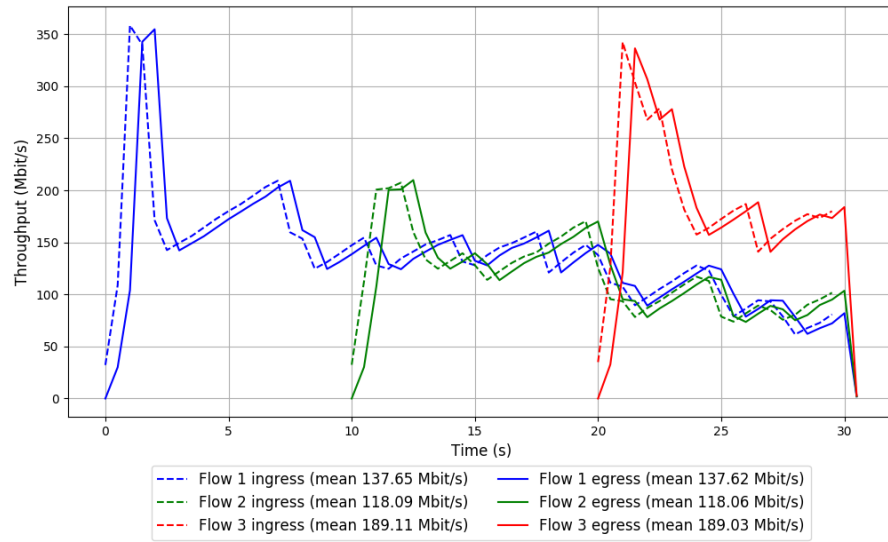
Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-09-05 21:34:56
End at: 2018-09-05 21:35:26
Local clock offset: -2.142 ms
Remote clock offset: 1.046 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 349.44 Mbit/s
95th percentile per-packet one-way delay: 26.782 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 135.69 Mbit/s
95th percentile per-packet one-way delay: 33.870 ms
Loss rate: 0.05%
-- Flow 2:
Average throughput: 178.53 Mbit/s
95th percentile per-packet one-way delay: 22.070 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 284.83 Mbit/s
95th percentile per-packet one-way delay: 24.322 ms
Loss rate: 0.09%
```
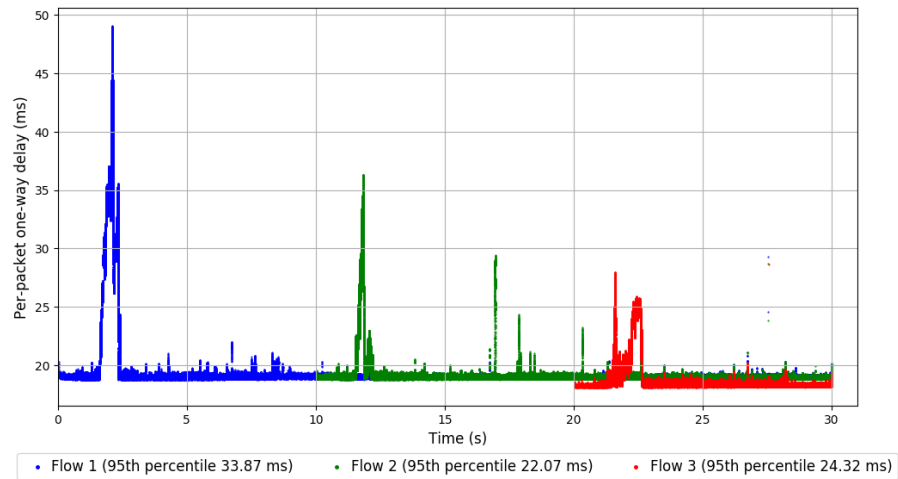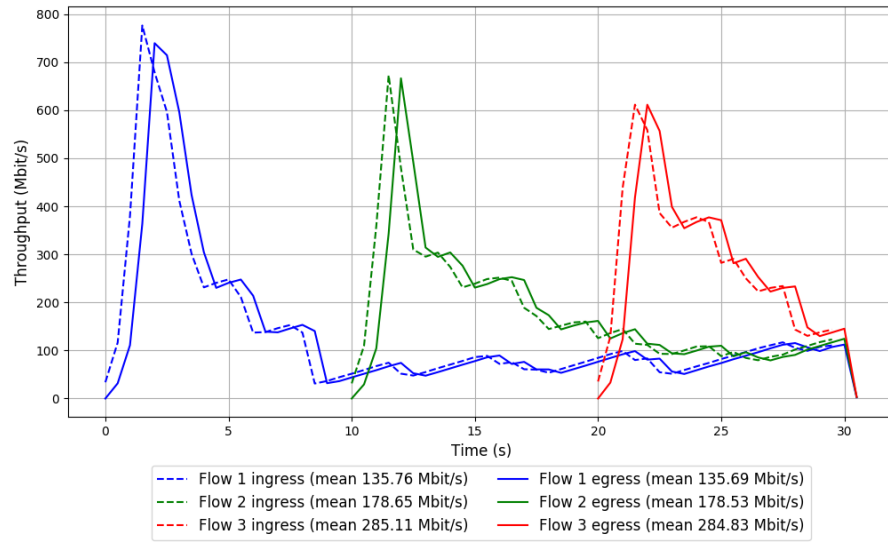
Run 2: Report of TCP Cubic — Data Link

```
Run 3: Statistics of TCP Cubic

Start at: 2018-09-05 21:41:38
End at: 2018-09-05 21:42:08
Local clock offset: -2.287 ms
Remote clock offset: 0.25 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 255.89 Mbit/s
95th percentile per-packet one-way delay: 19.116 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 125.01 Mbit/s
95th percentile per-packet one-way delay: 19.186 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 117.29 Mbit/s
95th percentile per-packet one-way delay: 18.411 ms
Loss rate: 0.01%
-- Flow 3:
Average throughput: 158.73 Mbit/s
95th percentile per-packet one-way delay: 18.488 ms
Loss rate: 0.01%
```
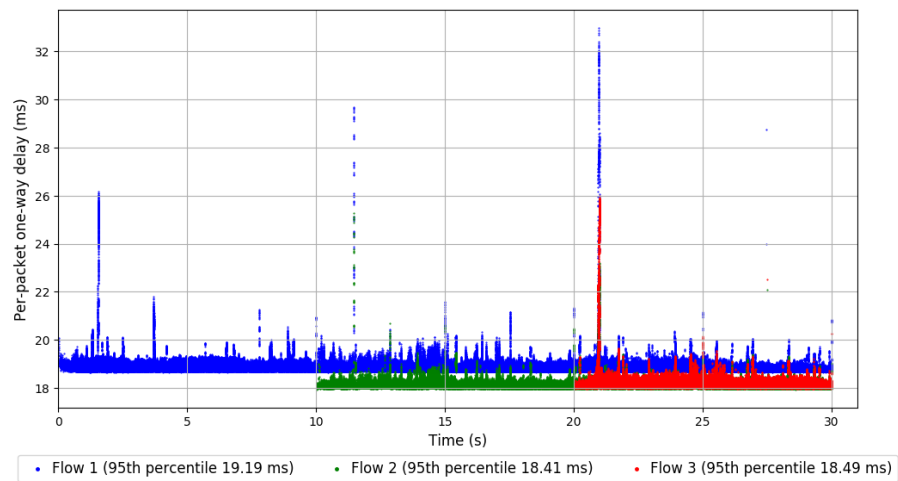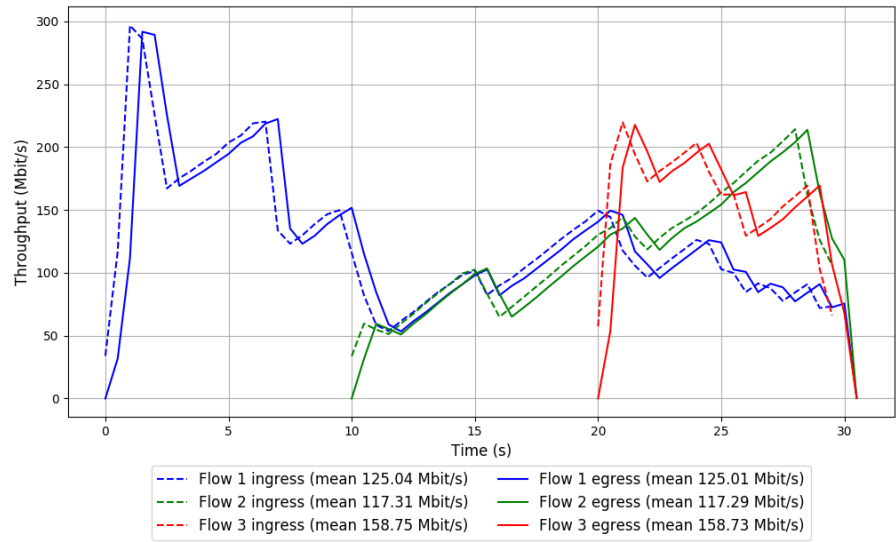
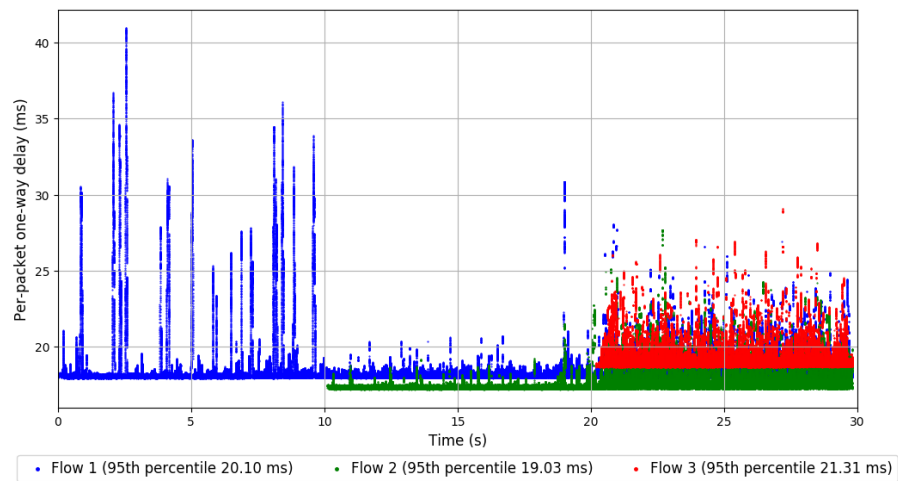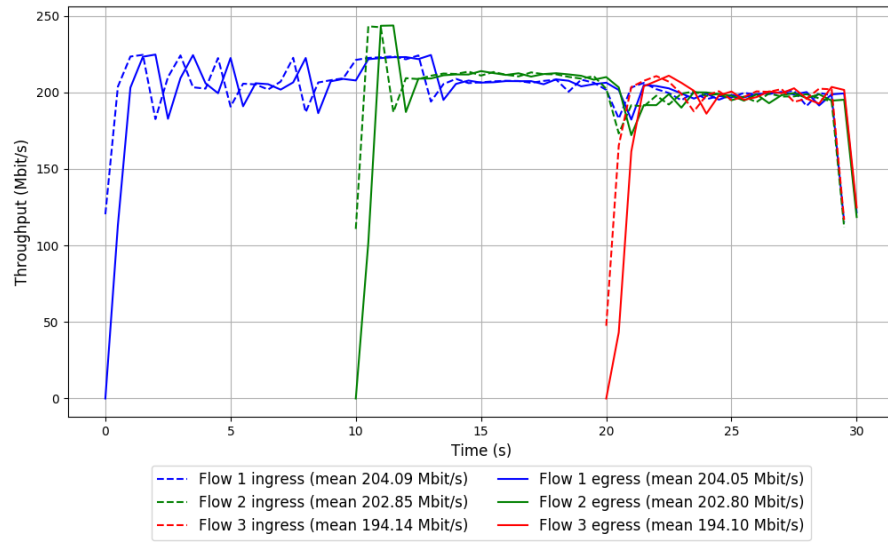Run 3: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-09-05 21:29:57
End at: 2018-09-05 21:30:27
Local clock offset: -2.531 ms
Remote clock offset: 1.993 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 400.72 Mbit/s
95th percentile per-packet one-way delay: 20.156 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 204.05 Mbit/s
95th percentile per-packet one-way delay: 20.097 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 202.80 Mbit/s
95th percentile per-packet one-way delay: 19.030 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 194.10 Mbit/s
95th percentile per-packet one-way delay: 21.312 ms
Loss rate: 0.02%
```

Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2018-09-05 21:36:28
End at: 2018-09-05 21:36:58
Local clock offset: -2.145 ms
Remote clock offset: 0.774 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 398.60 Mbit/s
95th percentile per-packet one-way delay: 20.630 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 201.72 Mbit/s
95th percentile per-packet one-way delay: 20.761 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 202.90 Mbit/s
95th percentile per-packet one-way delay: 19.768 ms
Loss rate: 0.02%
-- Flow 3:
Average throughput: 192.88 Mbit/s
95th percentile per-packet one-way delay: 21.352 ms
Loss rate: 0.05%
```
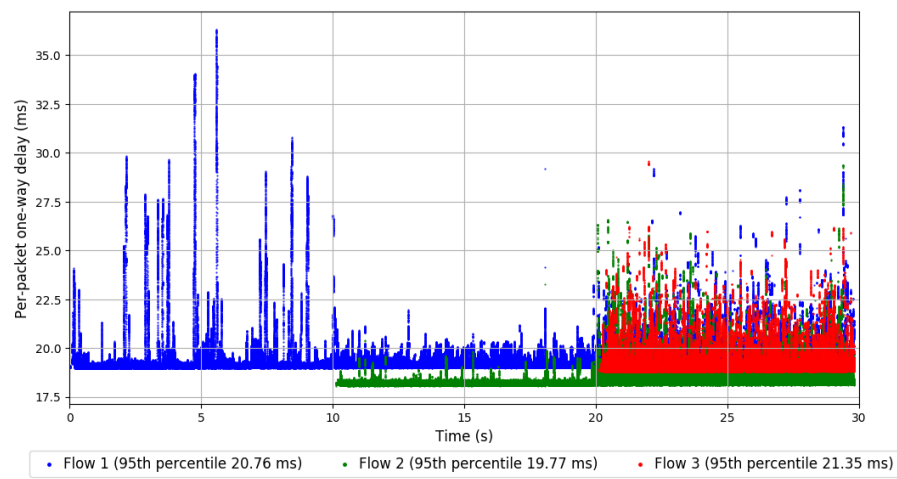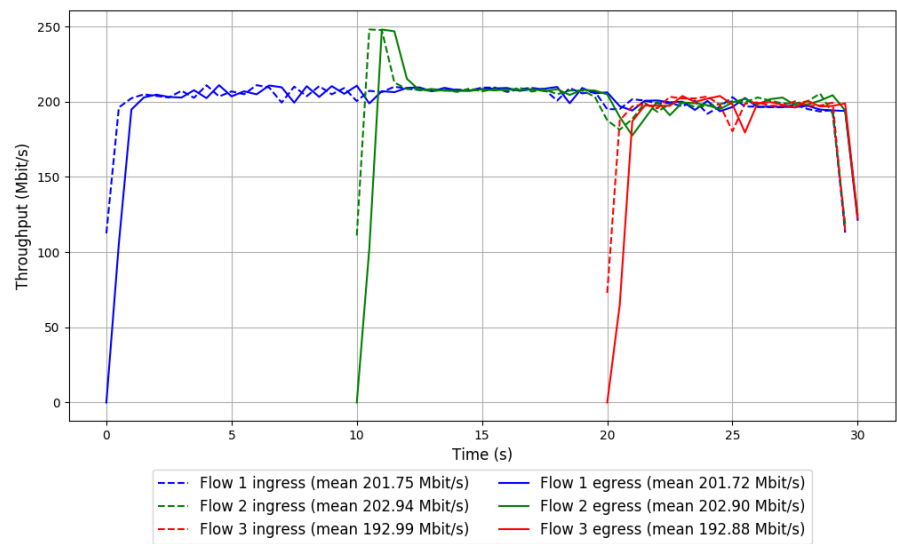
Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-09-05 21:43:07
End at: 2018-09-05 21:43:37
Local clock offset: -2.287 ms
Remote clock offset: 0.182 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 396.74 Mbit/s
95th percentile per-packet one-way delay: 20.353 ms
Loss rate: 0.20%
-- Flow 1:
Average throughput: 200.96 Mbit/s
95th percentile per-packet one-way delay: 20.217 ms
Loss rate: 0.17%
-- Flow 2:
Average throughput: 198.92 Mbit/s
95th percentile per-packet one-way delay: 20.359 ms
Loss rate: 0.25%
-- Flow 3:
Average throughput: 196.46 Mbit/s
95th percentile per-packet one-way delay: 20.670 ms
Loss rate: 0.20%
```
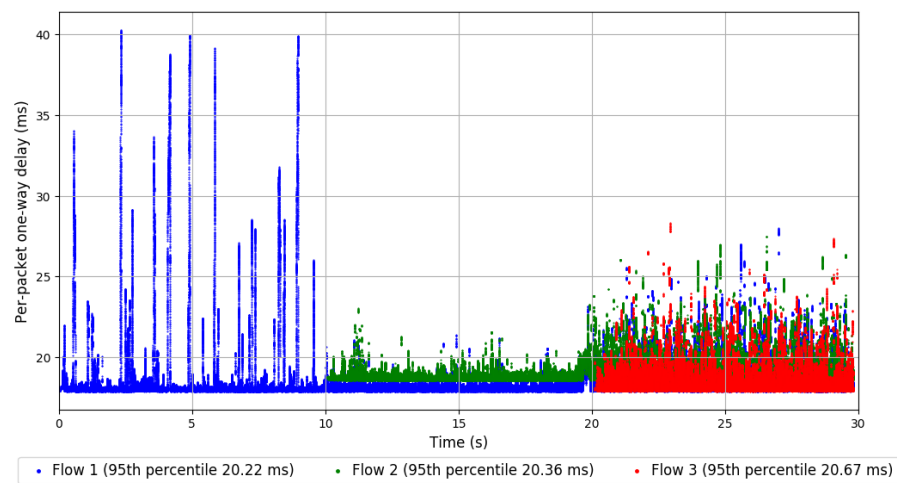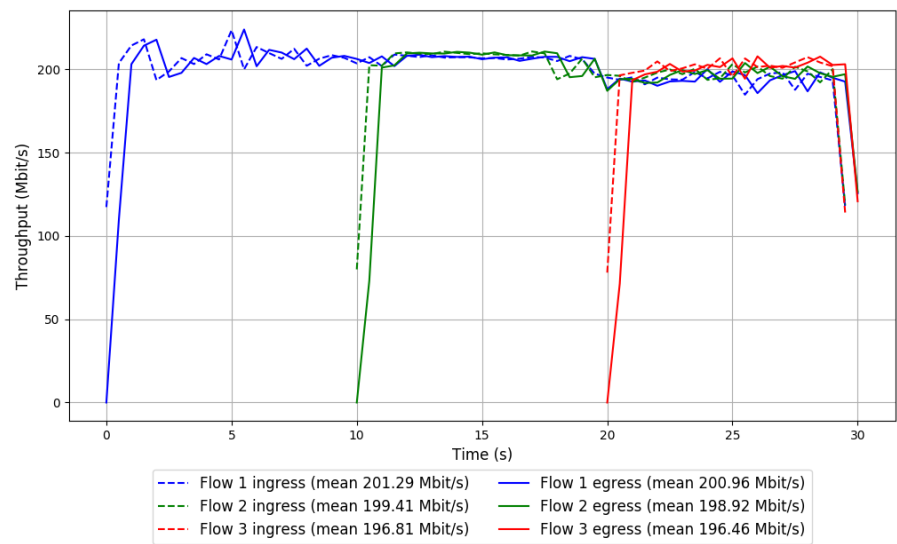
Run 3: Report of Indigo — Data Link

- - - Flow 1 ingress (mean 201.29 Mbit/s) —— Flow 1 egress (mean 200.96 Mbit/s)
- - - Flow 2 ingress (mean 199.41 Mbit/s) —— Flow 2 egress (mean 198.92 Mbit/s)
- - - Flow 3 ingress (mean 196.81 Mbit/s) —— Flow 3 egress (mean 196.46 Mbit/s)

- Flow 1 (95th percentile 20.22 ms)   • Flow 2 (95th percentile 20.36 ms)   • Flow 3 (95th percentile 20.67 ms)

```
Run 1: Statistics of Muses-25

Start at: 2018-09-05 21:26:56
End at: 2018-09-05 21:27:26
Local clock offset: -1.945 ms
Remote clock offset: 2.772 ms


# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 352.58 Mbit/s
95th percentile per-packet one-way delay: 18.036 ms
Loss rate: 0.29%
-- Flow 1:
Average throughput: 18.32 Mbit/s
95th percentile per-packet one-way delay: 18.282 ms
Loss rate: 0.03%
-- Flow 2:
Average throughput: 329.71 Mbit/s
95th percentile per-packet one-way delay: 17.832 ms
Loss rate: 0.14%
-- Flow 3:
Average throughput: 348.69 Mbit/s
95th percentile per-packet one-way delay: 18.105 ms
Loss rate: 0.63%
```
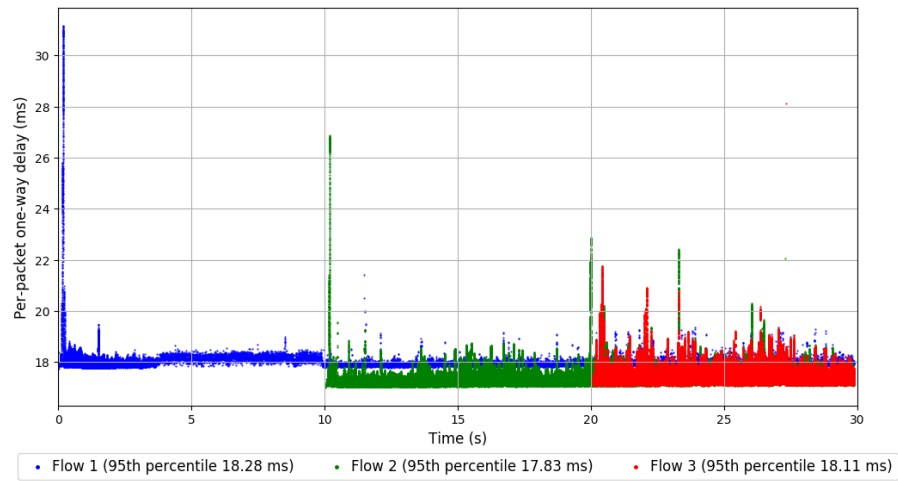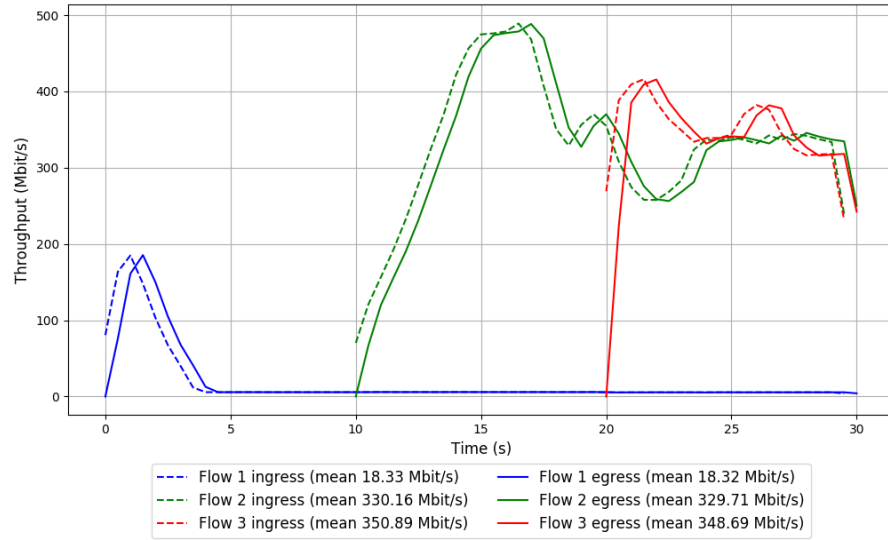
Run 1: Report of Muses-25 — Data Link

```
Run 2: Statistics of Muses-25

Start at: 2018-09-05 21:33:32
End at: 2018-09-05 21:34:02
Local clock offset: -2.256 ms
Remote clock offset: 1.195 ms

# Below is generated by plot.py at 2018-09-05 21:53:24
# Datalink statistics
-- Total of 3 flows:
Average throughput: 100.30 Mbit/s
95th percentile per-packet one-way delay: 19.281 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 14.55 Mbit/s
95th percentile per-packet one-way delay: 19.435 ms
Loss rate: 0.02%
-- Flow 2:
Average throughput: 88.21 Mbit/s
95th percentile per-packet one-way delay: 19.216 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 82.39 Mbit/s
95th percentile per-packet one-way delay: 19.212 ms
Loss rate: 0.00%
```
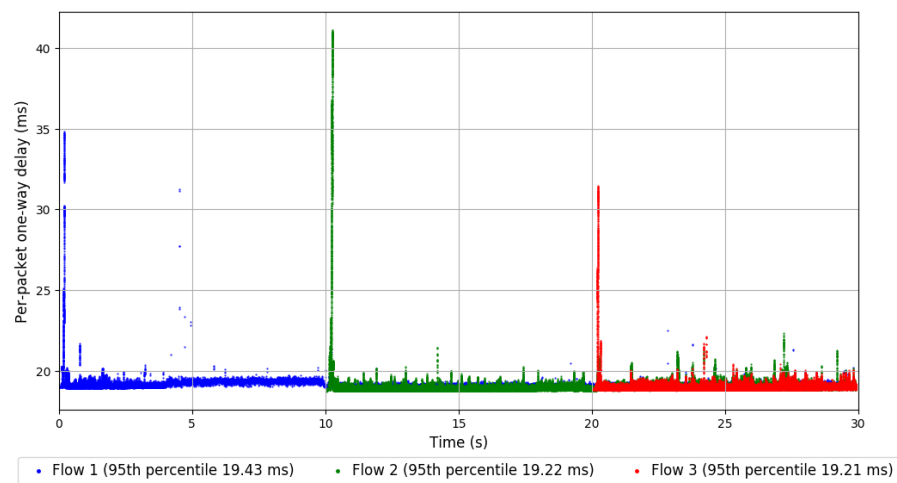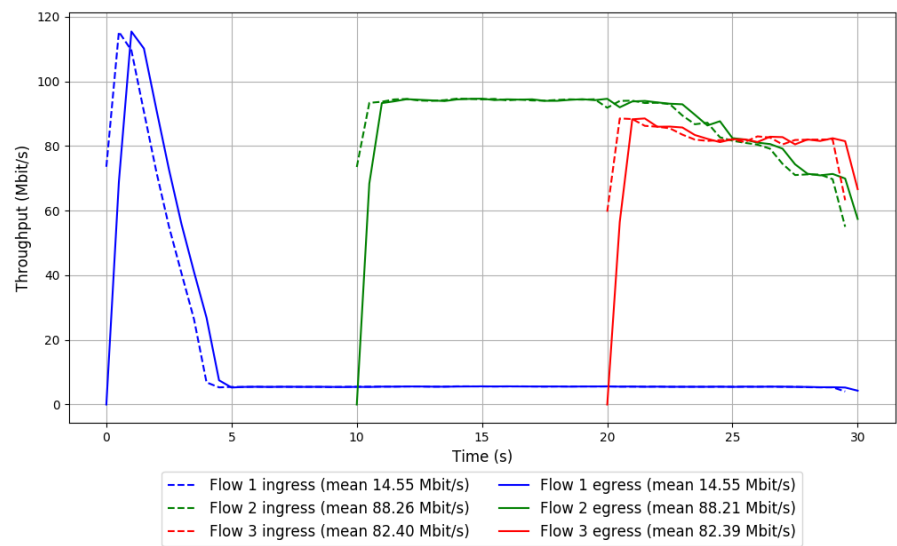
Run 2: Report of Muses-25 — Data Link

```
Run 3: Statistics of Muses-25

Start at: 2018-09-05 21:40:01
End at: 2018-09-05 21:40:31
Local clock offset: -2.203 ms
Remote clock offset: 0.461 ms


# Below is generated by plot.py at 2018-09-05 21:53:25
# Datalink statistics
-- Total of 3 flows:
Average throughput: 507.85 Mbit/s
95th percentile per-packet one-way delay: 18.496 ms
Loss rate: 0.53%
-- Flow 1:
Average throughput: 248.29 Mbit/s
95th percentile per-packet one-way delay: 18.242 ms
Loss rate: 0.22%
-- Flow 2:
Average throughput: 271.83 Mbit/s
95th percentile per-packet one-way delay: 18.605 ms
Loss rate: 0.58%
-- Flow 3:
Average throughput: 241.48 Mbit/s
95th percentile per-packet one-way delay: 18.872 ms
Loss rate: 1.38%
```

Run 3: Report of Muses-25 — Data Link