Pantheon Report

Generated at 2018-08-28 09:19:52 (UTC).

Data path: AWS India 1 on `ens5` (*local*) →India on `em1` (*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.

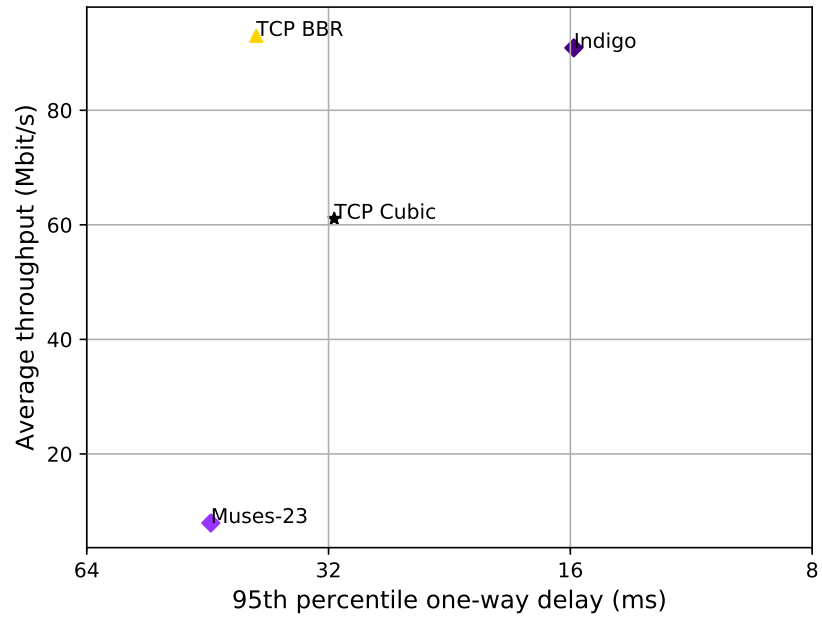NTP offsets were measured against `nets.org.sg` and have been applied to correct the timestamps in logs.

```
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

Git summary:
branch: muses-23 @ 88af05c5b0b7531637ca401951507a2fde628df6
third_party/fillp @ d47f4fa1b454a5e3c0537115c5a28436dbd4b834
third_party/fillp-sheep @ daed0c84f98531712514b2231f43ec6901114ffe
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/muses @ b261c9e99c63be452bc16f94ce0caa99a4c9d39a
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
```
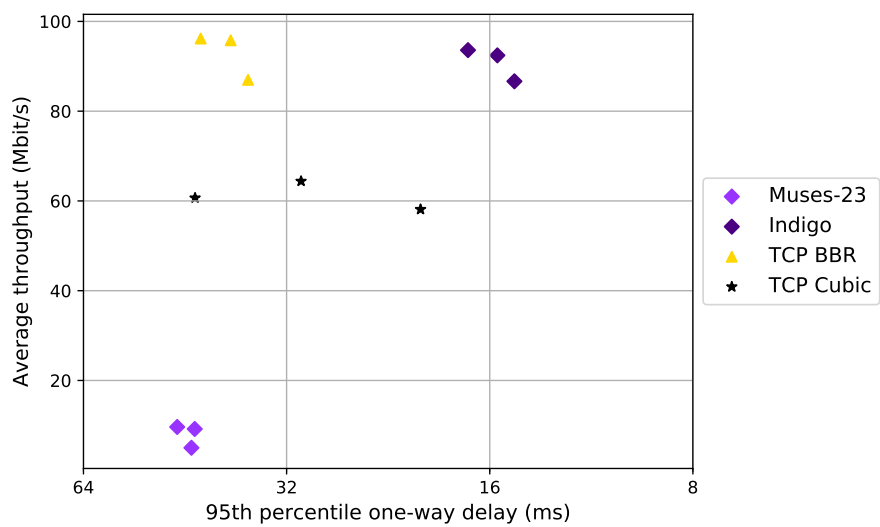
test from AWS India 1 to India, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)

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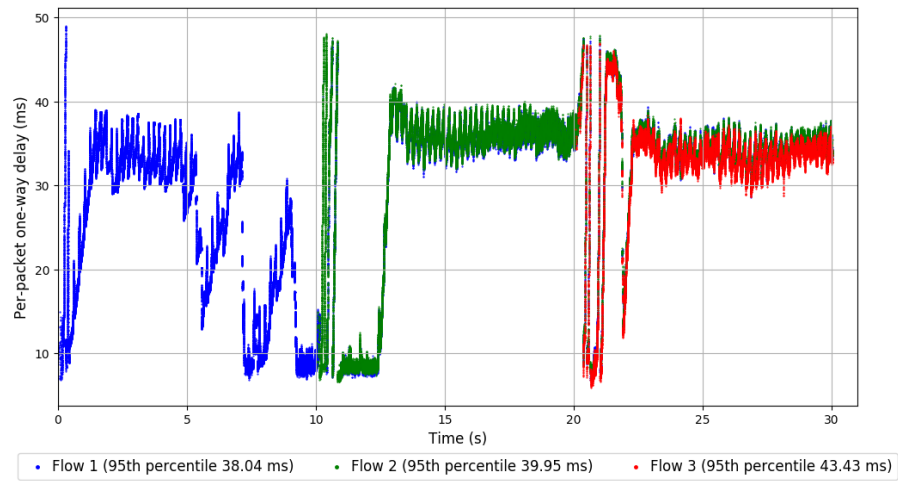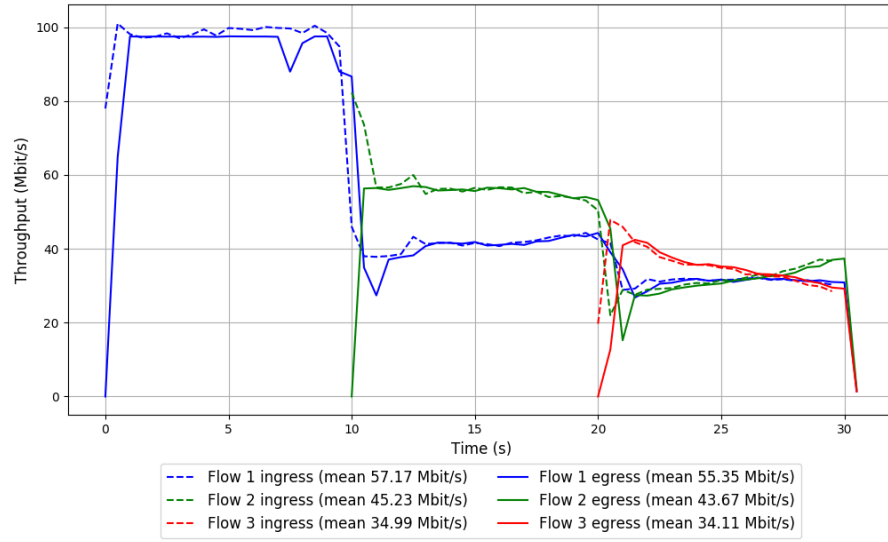3 flows with 10s interval between flows

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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	54.09	40.38	36.12	37.38	40.15	42.26	4.46	5.07	5.09
TCP Cubic	3	33.61	27.69	27.09	33.07	29.65	15.81	0.53	0.46	0.11
Indigo	3	54.04	37.13	39.20	15.33	16.44	18.07	3.41	3.79	4.25
Muses-23	3	3.66	4.64	3.98	31.68	43.27	50.15	68.24	66.96	81.13

```
Run 1: Statistics of TCP BBR

Start at: 2018-08-28 09:06:24
End at: 2018-08-28 09:06:54
Local clock offset: -0.395 ms
Remote clock offset: -5.848 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 95.79 Mbit/s
95th percentile per-packet one-way delay: 38.728 ms
Loss rate: 3.10%
-- Flow 1:
Average throughput: 55.35 Mbit/s
95th percentile per-packet one-way delay: 38.044 ms
Loss rate: 3.10%
-- Flow 2:
Average throughput: 43.67 Mbit/s
95th percentile per-packet one-way delay: 39.945 ms
Loss rate: 3.33%
-- Flow 3:
Average throughput: 34.11 Mbit/s
95th percentile per-packet one-way delay: 43.431 ms
Loss rate: 2.52%
```
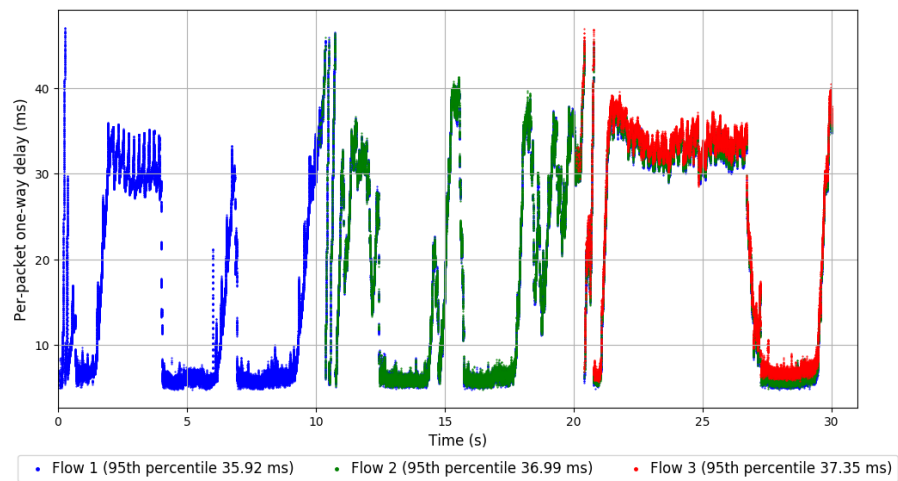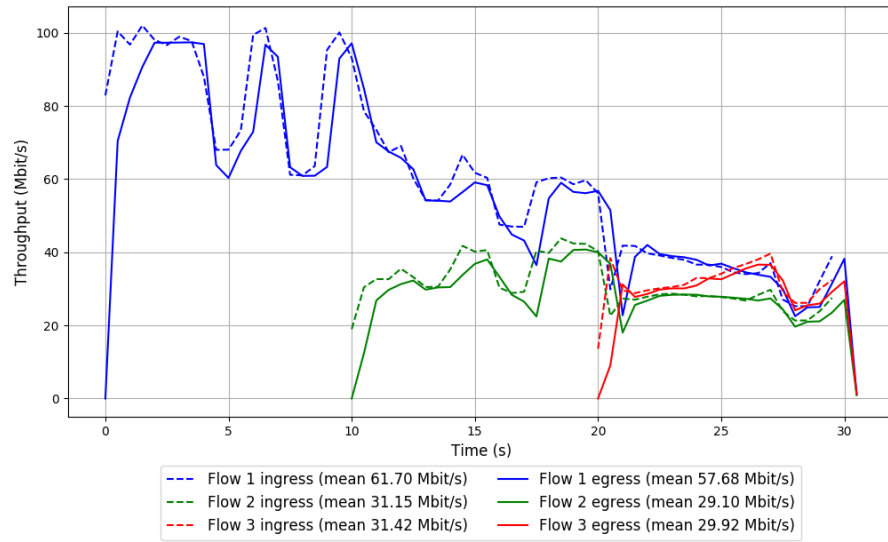
Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 57.17 Mbit/s)   Flow 1 egress (mean 55.35 Mbit/s)
Flow 2 ingress (mean 45.23 Mbit/s)   Flow 2 egress (mean 43.67 Mbit/s)
Flow 3 ingress (mean 34.99 Mbit/s)   Flow 3 egress (mean 34.11 Mbit/s)

Flow 1 (95th percentile 38.04 ms)   Flow 2 (95th percentile 39.95 ms)   Flow 3 (95th percentile 43.43 ms)

```
Run 2: Statistics of TCP BBR

Start at: 2018-08-28 09:11:00
End at: 2018-08-28 09:11:30
Local clock offset: 1.201 ms
Remote clock offset: -4.817 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 86.98 Mbit/s
95th percentile per-packet one-way delay: 36.500 ms
Loss rate: 6.27%
-- Flow 1:
Average throughput: 57.68 Mbit/s
95th percentile per-packet one-way delay: 35.922 ms
Loss rate: 6.43%
-- Flow 2:
Average throughput: 29.10 Mbit/s
95th percentile per-packet one-way delay: 36.994 ms
Loss rate: 6.56%
-- Flow 3:
Average throughput: 29.92 Mbit/s
95th percentile per-packet one-way delay: 37.354 ms
Loss rate: 4.71%
```

Run 2: Report of TCP BBR — Data Link

```
Run 3: Statistics of TCP BBR

Start at: 2018-08-28 09:15:38
End at: 2018-08-28 09:16:08
Local clock offset: 1.314 ms
Remote clock offset: -2.828 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 96.18 Mbit/s
95th percentile per-packet one-way delay: 42.900 ms
Loss rate: 5.01%
-- Flow 1:
Average throughput: 49.25 Mbit/s
95th percentile per-packet one-way delay: 38.175 ms
Loss rate: 3.84%
-- Flow 2:
Average throughput: 48.38 Mbit/s
95th percentile per-packet one-way delay: 43.508 ms
Loss rate: 5.32%
-- Flow 3:
Average throughput: 44.33 Mbit/s
95th percentile per-packet one-way delay: 46.010 ms
Loss rate: 8.05%
```
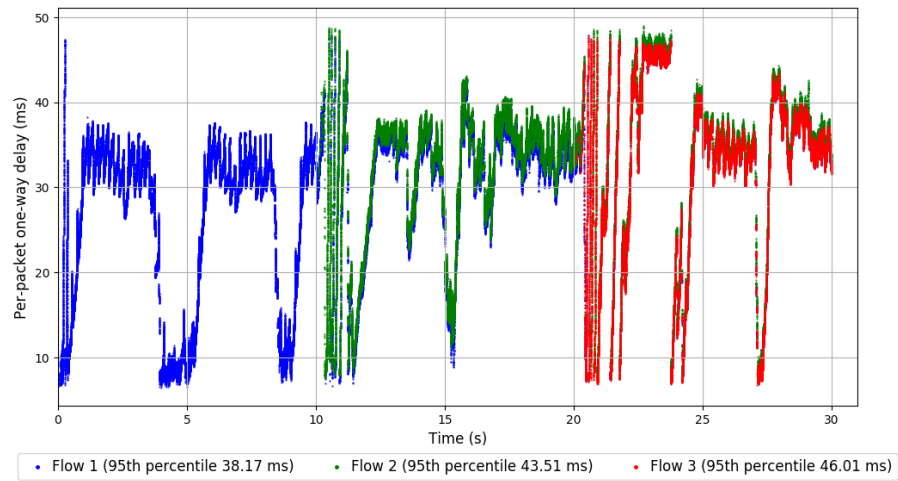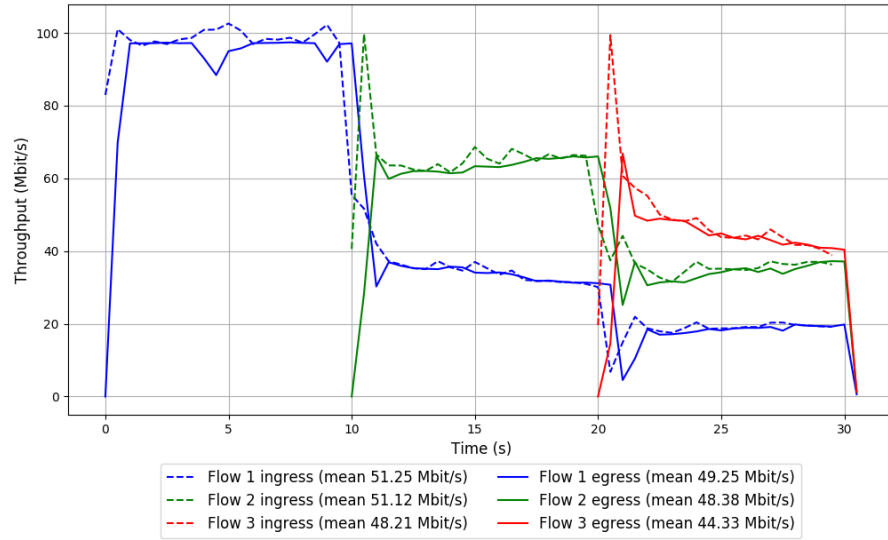
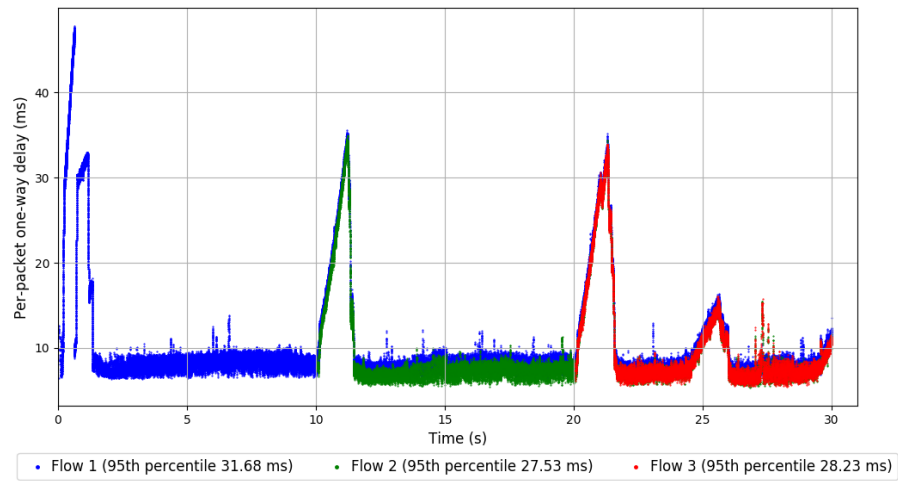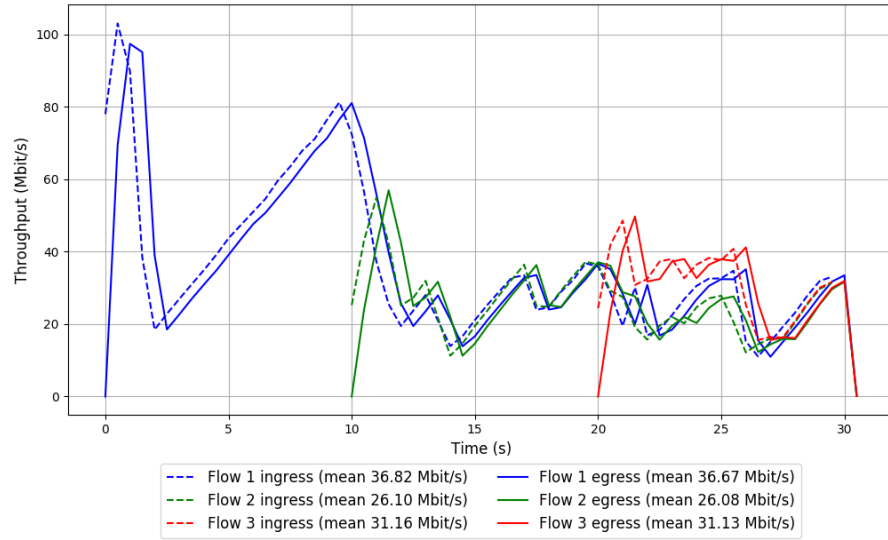Run 3: Report of TCP BBR — Data Link

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```
Run 1: Statistics of TCP Cubic

Start at: 2018-08-28 09:05:17
End at: 2018-08-28 09:05:47
Local clock offset: 0.565 ms
Remote clock offset: -5.157 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 64.40 Mbit/s
95th percentile per-packet one-way delay: 30.458 ms
Loss rate: 0.24%
-- Flow 1:
Average throughput: 36.67 Mbit/s
95th percentile per-packet one-way delay: 31.676 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 26.08 Mbit/s
95th percentile per-packet one-way delay: 27.526 ms
Loss rate: 0.06%
-- Flow 3:
Average throughput: 31.13 Mbit/s
95th percentile per-packet one-way delay: 28.231 ms
Loss rate: 0.05%
```

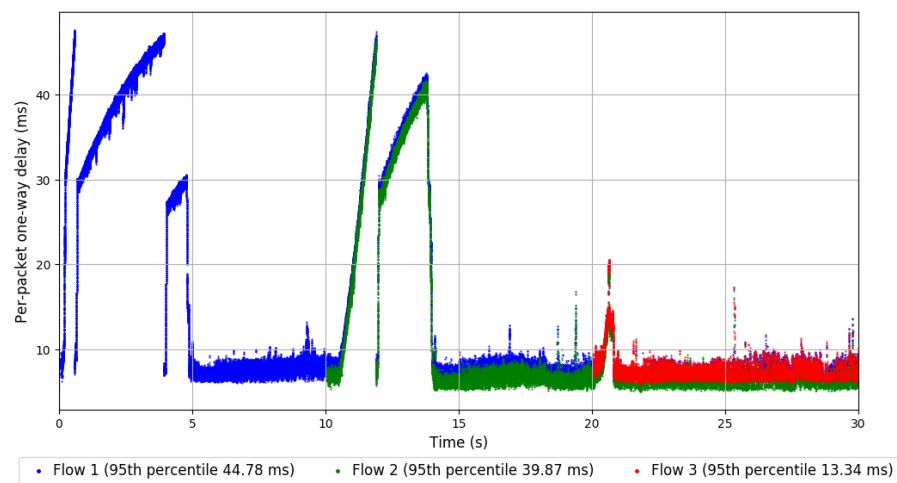Run 1: Report of TCP Cubic — Data Link
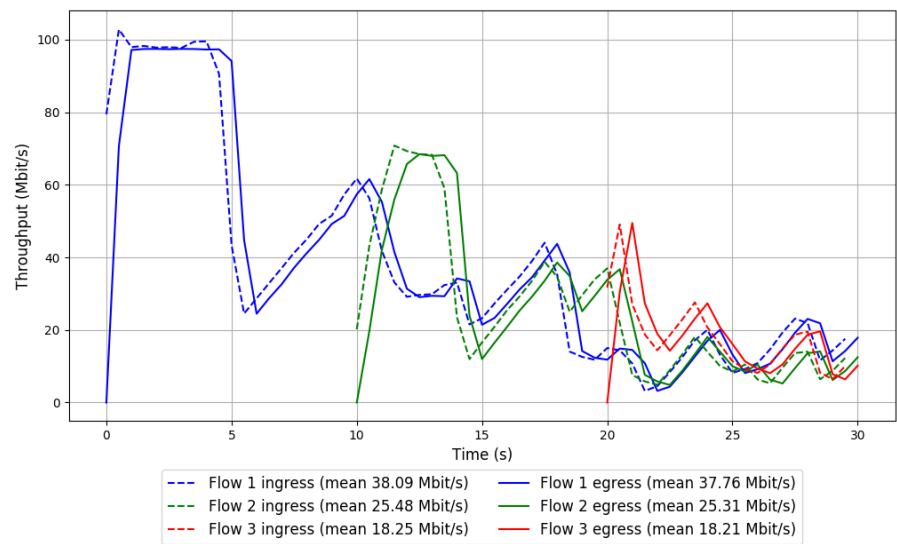

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```
Run 2: Statistics of TCP Cubic

Start at: 2018-08-28 09:09:50
End at: 2018-08-28 09:10:20
Local clock offset: 0.158 ms
Remote clock offset: -5.484 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 60.68 Mbit/s
95th percentile per-packet one-way delay: 43.730 ms
Loss rate: 0.75%
-- Flow 1:
Average throughput: 37.76 Mbit/s
95th percentile per-packet one-way delay: 44.778 ms
Loss rate: 0.86%
-- Flow 2:
Average throughput: 25.31 Mbit/s
95th percentile per-packet one-way delay: 39.869 ms
Loss rate: 0.68%
-- Flow 3:
Average throughput: 18.21 Mbit/s
95th percentile per-packet one-way delay: 13.340 ms
Loss rate: 0.23%
```

Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 38.09 Mbit/s) — Flow 1 egress (mean 37.76 Mbit/s)
Flow 2 ingress (mean 25.48 Mbit/s) — Flow 2 egress (mean 25.31 Mbit/s)
Flow 3 ingress (mean 18.25 Mbit/s) — Flow 3 egress (mean 18.21 Mbit/s)

Flow 1 (95th percentile 44.78 ms)　Flow 2 (95th percentile 39.87 ms)　Flow 3 (95th percentile 13.34 ms)
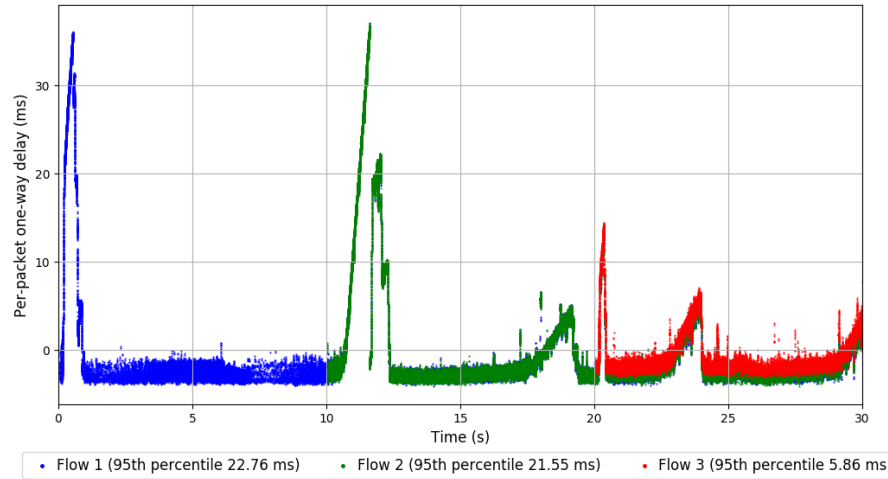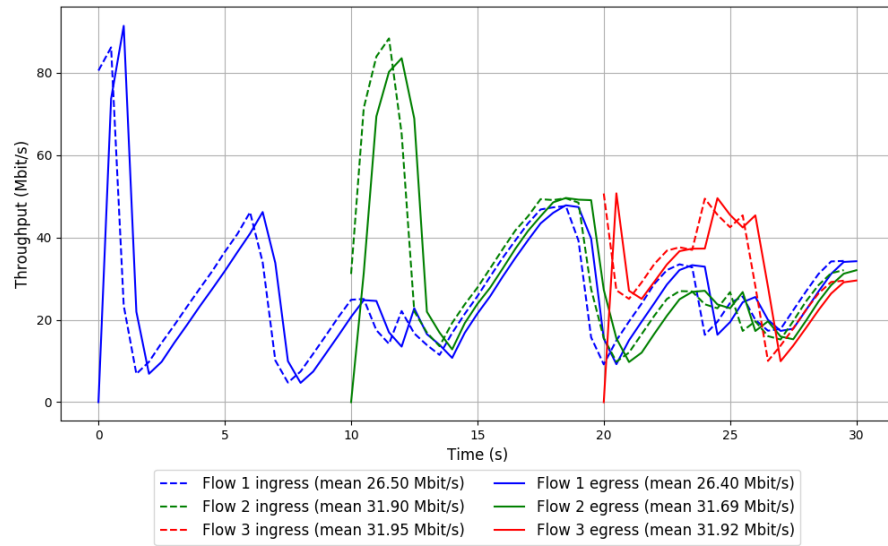
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```
Run 3: Statistics of TCP Cubic

Start at: 2018-08-28 09:14:26
End at: 2018-08-28 09:14:56
Local clock offset: 11.116 ms
Remote clock offset: -3.444 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 58.12 Mbit/s
95th percentile per-packet one-way delay: 20.262 ms
Loss rate: 0.40%
-- Flow 1:
Average throughput: 26.40 Mbit/s
95th percentile per-packet one-way delay: 22.761 ms
Loss rate: 0.35%
-- Flow 2:
Average throughput: 31.69 Mbit/s
95th percentile per-packet one-way delay: 21.555 ms
Loss rate: 0.63%
-- Flow 3:
Average throughput: 31.92 Mbit/s
95th percentile per-packet one-way delay: 5.860 ms
Loss rate: 0.05%
```

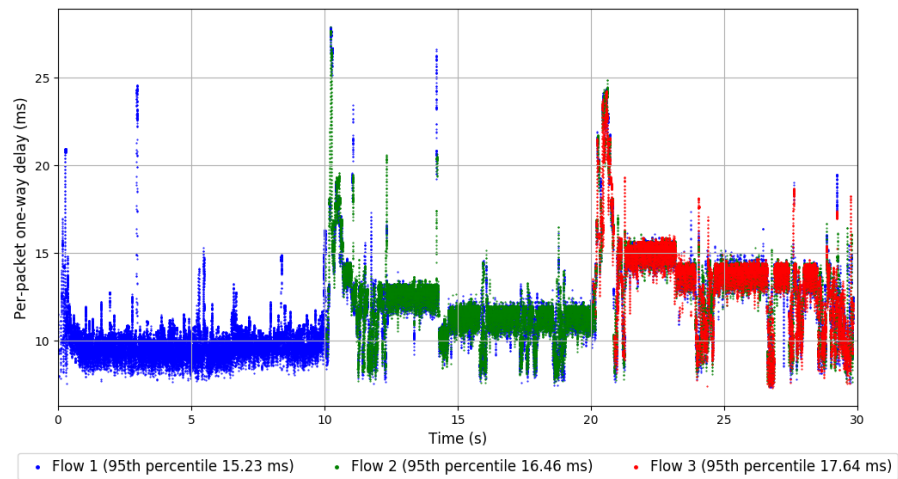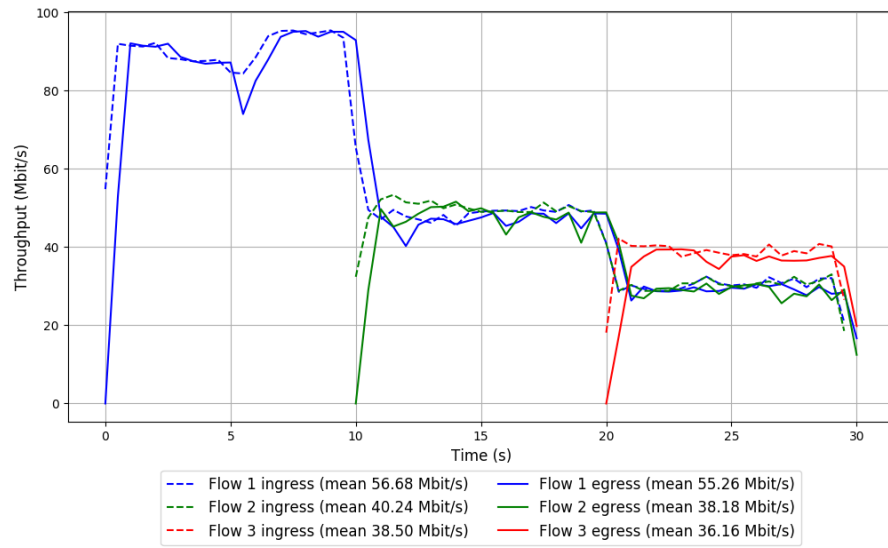Run 3: Report of TCP Cubic — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-08-28 09:07:34
End at: 2018-08-28 09:08:04
Local clock offset: -0.662 ms
Remote clock offset: -5.069 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 92.44 Mbit/s
95th percentile per-packet one-way delay: 15.589 ms
Loss rate: 3.71%
-- Flow 1:
Average throughput: 55.26 Mbit/s
95th percentile per-packet one-way delay: 15.233 ms
Loss rate: 2.51%
-- Flow 2:
Average throughput: 38.18 Mbit/s
95th percentile per-packet one-way delay: 16.461 ms
Loss rate: 5.14%
-- Flow 3:
Average throughput: 36.16 Mbit/s
95th percentile per-packet one-way delay: 17.645 ms
Loss rate: 6.07%
```
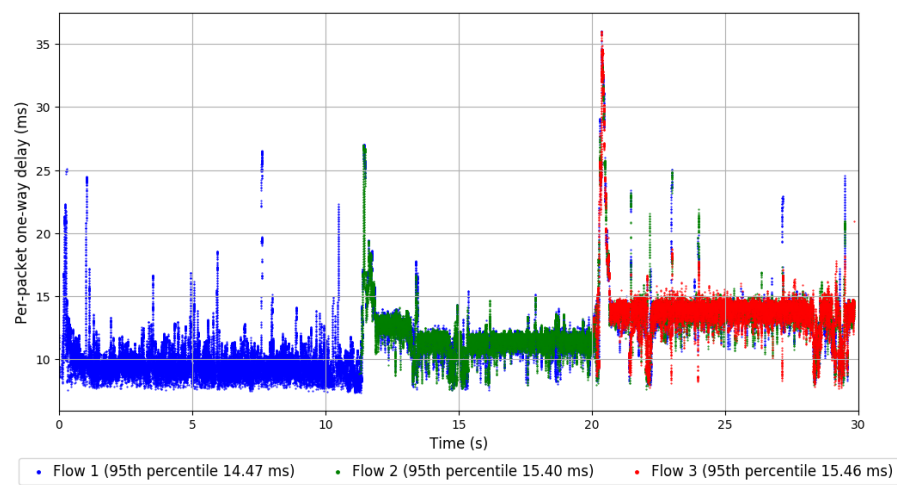
Run 1: Report of Indigo — Data Link

Flow 1 ingress (mean 56.68 Mbit/s) — — —   Flow 1 egress (mean 55.26 Mbit/s) ———
Flow 2 ingress (mean 40.24 Mbit/s) — — —   Flow 2 egress (mean 38.18 Mbit/s) ———
Flow 3 ingress (mean 38.50 Mbit/s) — — —   Flow 3 egress (mean 36.16 Mbit/s) ———

· Flow 1 (95th percentile 15.23 ms)   · Flow 2 (95th percentile 16.46 ms)   · Flow 3 (95th percentile 17.64 ms)
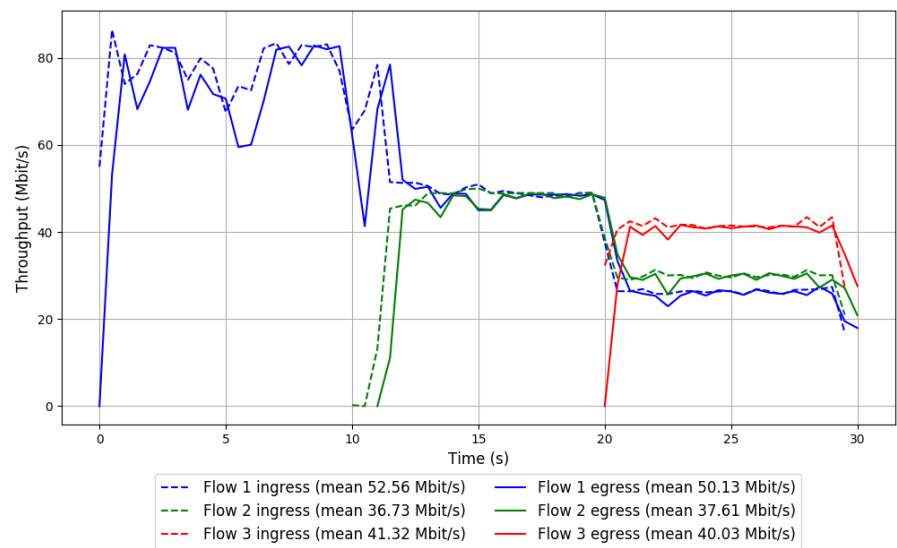
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```
Run 2: Statistics of Indigo

Start at: 2018-08-28 09:12:10
End at: 2018-08-28 09:12:40
Local clock offset: 2.025 ms
Remote clock offset: -2.085 ms


# Below is generated by plot.py at 2018-08-28 09:19:48
# Datalink statistics
-- Total of 3 flows:
Average throughput: 86.65 Mbit/s
95th percentile per-packet one-way delay: 14.708 ms
Loss rate: 3.90%
-- Flow 1:
Average throughput: 50.13 Mbit/s
95th percentile per-packet one-way delay: 14.467 ms
Loss rate: 4.62%
-- Flow 2:
Average throughput: 37.61 Mbit/s
95th percentile per-packet one-way delay: 15.403 ms
Loss rate: 2.82%
-- Flow 3:
Average throughput: 40.03 Mbit/s
95th percentile per-packet one-way delay: 15.457 ms
Loss rate: 3.04%
```

Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-08-28 09:16:49
End at: 2018-08-28 09:17:19
Local clock offset: -0.394 ms
Remote clock offset: -1.685 ms


# Below is generated by plot.py at 2018-08-28 09:19:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 93.60 Mbit/s
95th percentile per-packet one-way delay: 17.233 ms
Loss rate: 3.25%
-- Flow 1:
Average throughput: 56.72 Mbit/s
95th percentile per-packet one-way delay: 16.297 ms
Loss rate: 3.09%
-- Flow 2:
Average throughput: 35.61 Mbit/s
95th percentile per-packet one-way delay: 17.465 ms
Loss rate: 3.41%
-- Flow 3:
Average throughput: 41.41 Mbit/s
95th percentile per-packet one-way delay: 21.110 ms
Loss rate: 3.65%
```
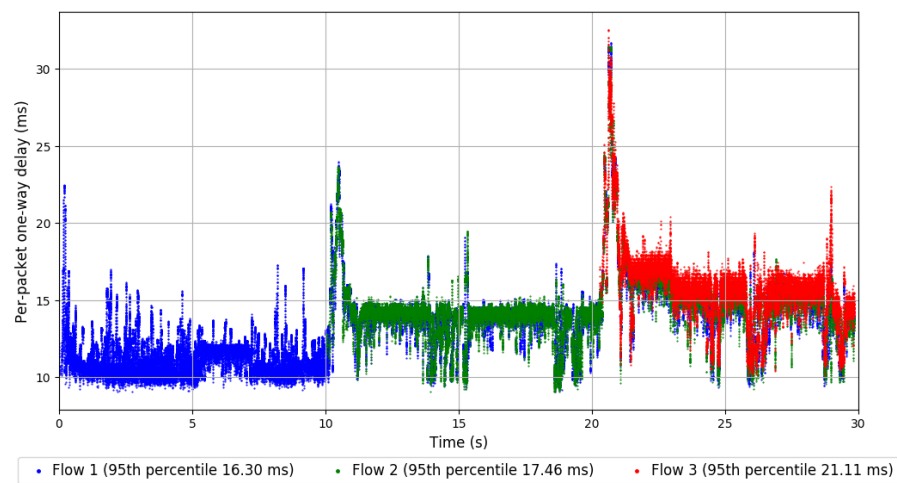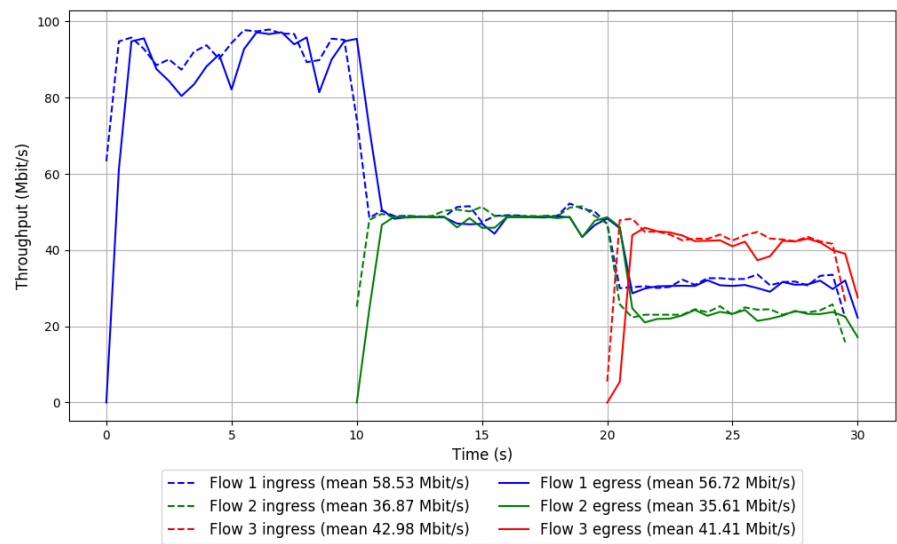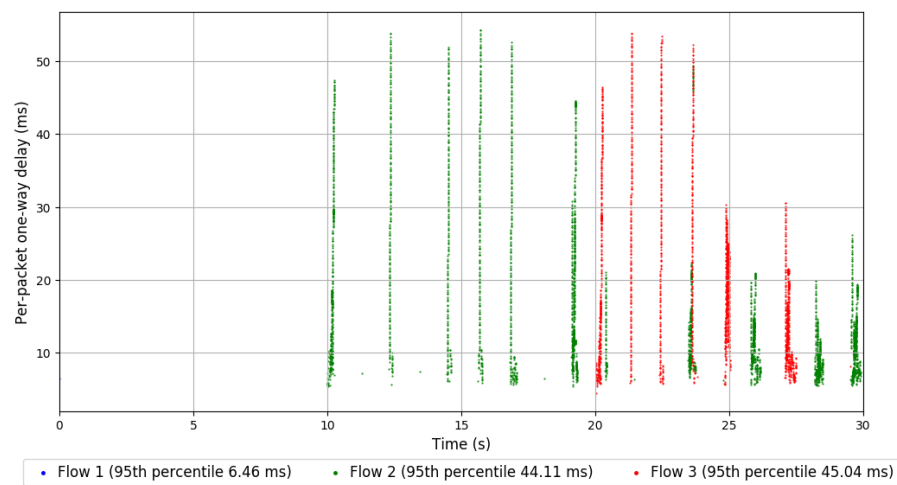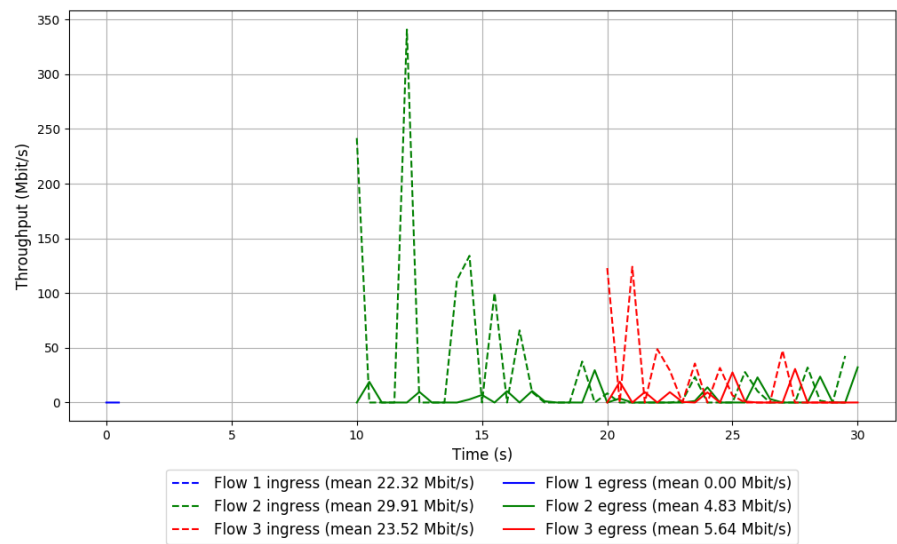
Run 3: Report of Indigo — Data Link

```
Run 1: Statistics of Muses-23

Start at: 2018-08-28 09:08:44
End at: 2018-08-28 09:09:14
Local clock offset: 2.359 ms
Remote clock offset: -4.508 ms

# Below is generated by plot.py at 2018-08-28 09:19:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 5.00 Mbit/s
95th percentile per-packet one-way delay: 44.276 ms
Loss rate: 81.73%
-- Flow 1:
Average throughput: 0.00 Mbit/s
95th percentile per-packet one-way delay: 6.462 ms
Loss rate: 97.39%
-- Flow 2:
Average throughput: 4.83 Mbit/s
95th percentile per-packet one-way delay: 44.112 ms
Loss rate: 83.87%
-- Flow 3:
Average throughput: 5.64 Mbit/s
95th percentile per-packet one-way delay: 45.044 ms
Loss rate: 76.02%
```

Run 1: Report of Muses-23 — Data Link

```
Run 2: Statistics of Muses-23

Start at: 2018-08-28 09:13:21
End at: 2018-08-28 09:13:51
Local clock offset: -0.054 ms
Remote clock offset: -1.72 ms

# Below is generated by plot.py at 2018-08-28 09:19:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 9.19 Mbit/s
95th percentile per-packet one-way delay: 43.781 ms
Loss rate: 63.85%
-- Flow 1:
Average throughput: 4.87 Mbit/s
95th percentile per-packet one-way delay: 44.123 ms
Loss rate: 51.04%
-- Flow 2:
Average throughput: 4.87 Mbit/s
95th percentile per-packet one-way delay: 39.107 ms
Loss rate: 66.29%
-- Flow 3:
Average throughput: 3.96 Mbit/s
95th percentile per-packet one-way delay: 50.310 ms
Loss rate: 80.51%
```
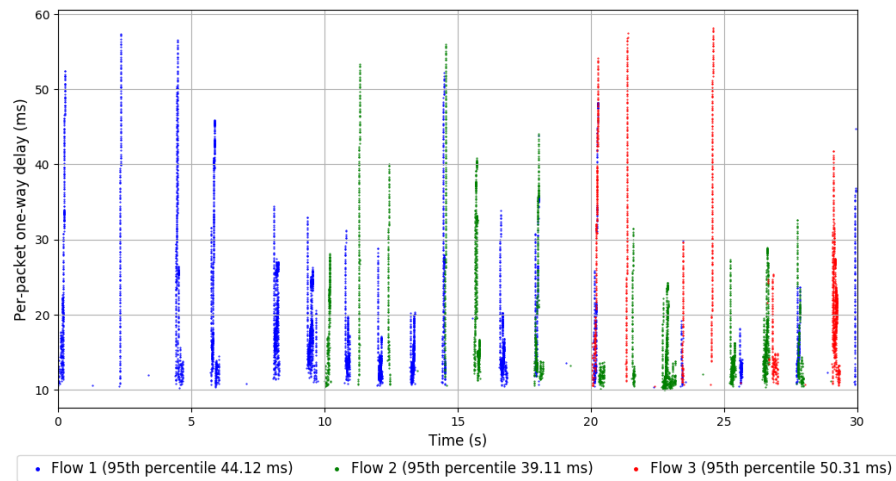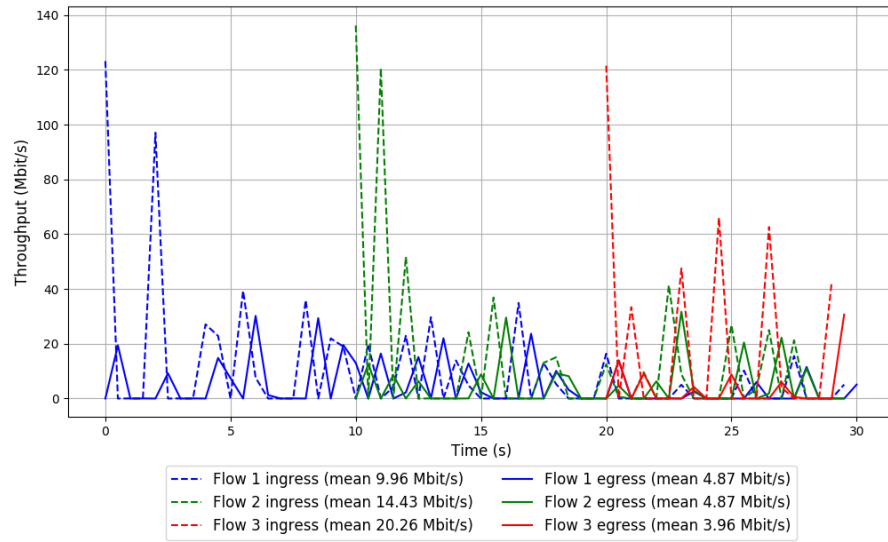
Run 2: Report of Muses-23 — Data Link

```
Run 3: Statistics of Muses-23

Start at: 2018-08-28 09:18:00
End at: 2018-08-28 09:18:30
Local clock offset: -0.211 ms
Remote clock offset: -1.809 ms


# Below is generated by plot.py at 2018-08-28 09:19:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 9.64 Mbit/s
95th percentile per-packet one-way delay: 46.482 ms
Loss rate: 62.10%
-- Flow 1:
Average throughput: 6.11 Mbit/s
95th percentile per-packet one-way delay: 44.456 ms
Loss rate: 56.29%
-- Flow 2:
Average throughput: 4.23 Mbit/s
95th percentile per-packet one-way delay: 46.605 ms
Loss rate: 50.71%
-- Flow 3:
Average throughput: 2.33 Mbit/s
95th percentile per-packet one-way delay: 55.106 ms
Loss rate: 86.85%
```

Run 3: Report of Muses-23 — Data Link