Pantheon Report

Generated at 2018-01-10 16:29:08 (UTC).

Data path: AWS India 1 Ethernet (*local*) →India ppp0 (*remote*).

Repeated the test of 14 congestion control schemes 3 times.

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

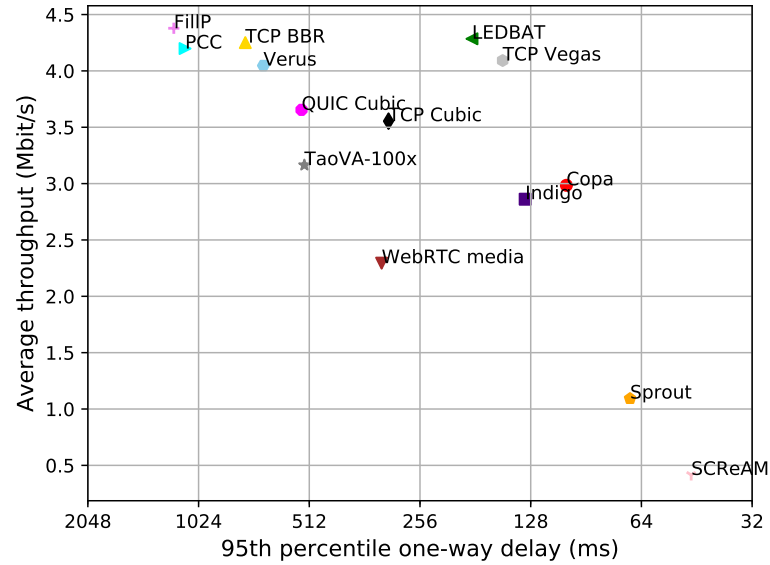Increased UDP receive buffer to 16 MB (default) and 32 MB (max).

Tested BBR with qdisc of Fair Queuing (`fq`), and other schemes with the default Linux qdisc (`pfifo_fast`).

NTP offsets were measured against `nets.org.sg` and have been applied to correct the timestamps in logs.
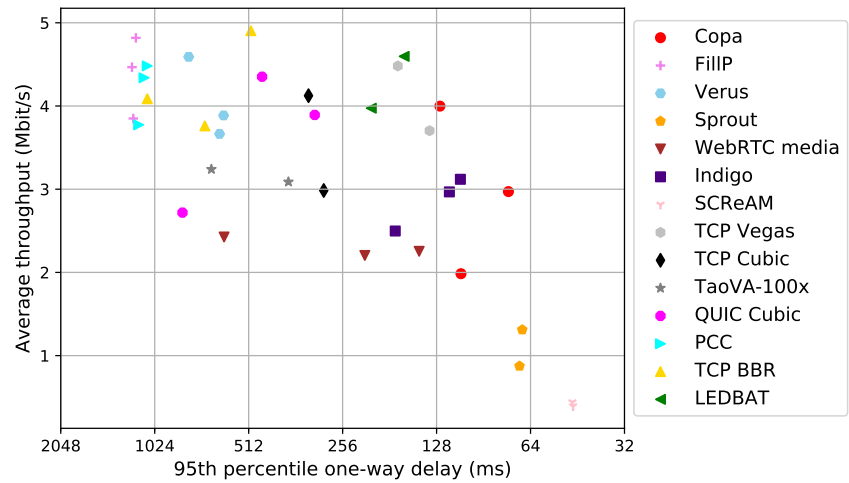
```
Git summary:
branch: master @ 56d1792c316a5efca3f2d21342905405fedffb48
third_party/calibrated_koho @ 3cb73c0d1c0322cdfae446ea37a522e53227db50
 M datagrump/sender.cc
third_party/fillp @ ec9585325218d5048c4d4152fa42240af54c6e67
third_party/genericCC @ 80b516c448f795fd6e9675f7177b69c622f07da8
third_party/indigo @ b19f3730105f9aa95452552af924e3719b03cc55
third_party/indigo-no-calib @ 7224f2202e8a044d8306fa0b983ad84360c53d89
third_party/koho_cc @ f0f2e693303aee82ea808e6928eac4f1083a6681
 M datagrump/sender.cc
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/pantheon-tunnel @ fb1053193c2861da659ba9013db26744ccfcf993
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/proto-quic @ 77961f1a82733a86b42f1bc8143ebc978f3cff42
third_party/scream @ c3370fd7bd17265a79aeb34e4016ad23f5965885
third_party/sourdough @ f1a14bffe749737437f61b1eaeeb30b267cde681
third_party/sprout @ 6f2efe6e088d91066a9f023df375eee2665089ce
 M src/examples/cellsim.cc
 M src/examples/sproutbt2.cc
 M src/network/sproutconn.cc
third_party/verus @ d4b447ea74c6c60a261149af2629562939f9a494
 M src/verus.hpp
 M tools/plot.py
third_party/webrtc @ a488197ddd041ace68a42849b2540ad834825f42
```

test from AWS India 1 Ethernet to India ppp0, 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 Ethernet to India ppp0, 3 runs of 30s each per scheme
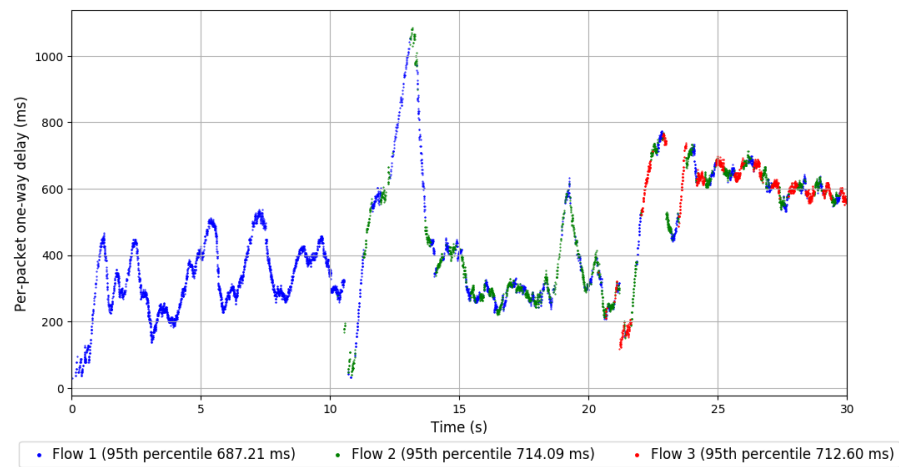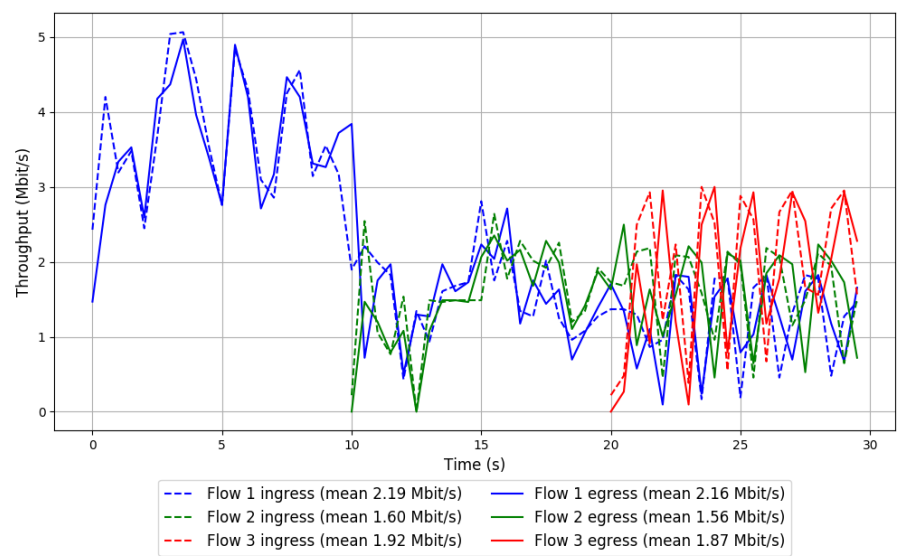3 flows with 10s interval between flows

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	3	2.51	1.73	1.93	755.24	765.53	764.16	7.45	8.08	15.21
TCP Cubic	2	1.42	2.44	1.60	311.27	342.44	262.98	6.02	0.96	1.71
LEDBAT	2	2.58	2.00	1.18	179.26	191.16	191.79	0.41	0.83	1.16
PCC	3	2.96	1.29	1.34	1074.03	1116.71	1220.14	32.97	61.00	96.83
QUIC Cubic	3	2.04	2.08	0.75	440.09	532.58	607.60	3.64	1.58	8.62
SCReAM	2	0.20	0.22	0.22	42.42	42.17	48.08	0.12	0.21	0.35
WebRTC media	3	1.53	0.49	0.30	196.47	312.13	473.33	0.26	0.22	0.78
Sprout	2	0.52	0.56	0.60	67.55	71.56	68.21	0.05	0.23	0.01
TaoVA-100x	2	1.79	1.52	1.45	413.05	574.85	671.07	1.46	2.08	4.84
TCP Vegas	2	2.54	1.43	1.84	131.82	209.03	172.54	0.10	6.69	0.53
Verus	3	2.28	2.23	0.94	645.20	747.07	684.49	7.36	3.97	6.72
Copa	3	1.94	1.43	1.02	90.37	104.97	112.47	0.26	0.36	0.57
FillP	3	2.58	1.80	2.22	1145.58	1220.99	1226.10	93.34	97.79	98.62
Indigo	3	1.07	1.53	2.39	104.38	132.67	153.09	0.07	0.05	0.29

```
Run 1: Statistics of TCP BBR

Start at: 2018-01-10 15:42:33
End at: 2018-01-10 15:43:03
Local clock offset: 0.797 ms
Remote clock offset: -15.638 ms


# Below is generated by plot.py at 2018-01-10 16:28:02
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.76 Mbit/s
95th percentile per-packet one-way delay: 707.400 ms
Loss rate: 3.24%
-- Flow 1:
Average throughput: 2.16 Mbit/s
95th percentile per-packet one-way delay: 687.207 ms
Loss rate: 1.87%
-- Flow 2:
Average throughput: 1.56 Mbit/s
95th percentile per-packet one-way delay: 714.085 ms
Loss rate: 4.20%
-- Flow 3:
Average throughput: 1.87 Mbit/s
95th percentile per-packet one-way delay: 712.600 ms
Loss rate: 6.34%
```
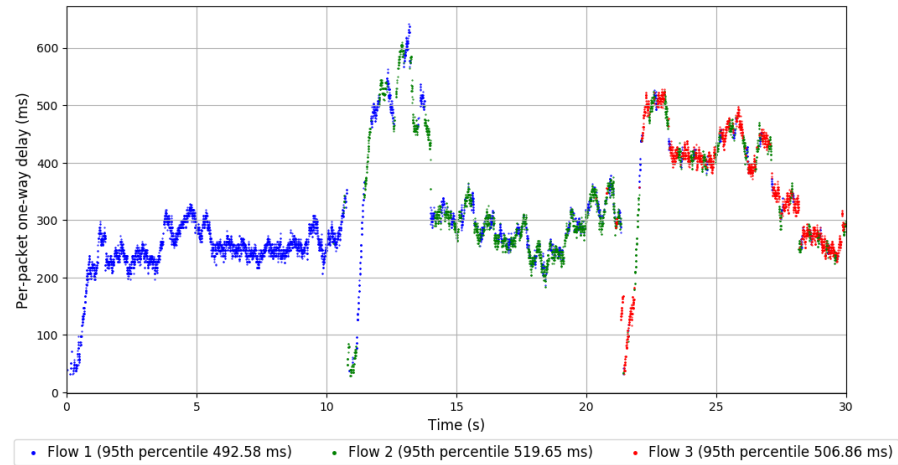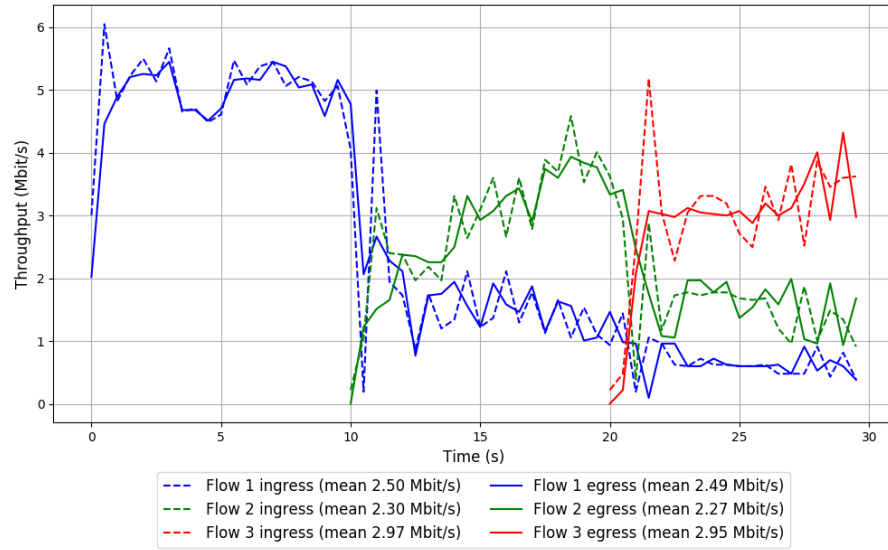
Run 1: Report of TCP BBR — Data Link

Flow 1 ingress (mean 2.19 Mbit/s) --- Flow 1 egress (mean 2.16 Mbit/s)
Flow 2 ingress (mean 1.60 Mbit/s) --- Flow 2 egress (mean 1.56 Mbit/s)
Flow 3 ingress (mean 1.92 Mbit/s) --- Flow 3 egress (mean 1.87 Mbit/s)

Flow 1 (95th percentile 687.21 ms) · Flow 2 (95th percentile 714.09 ms) · Flow 3 (95th percentile 712.60 ms)
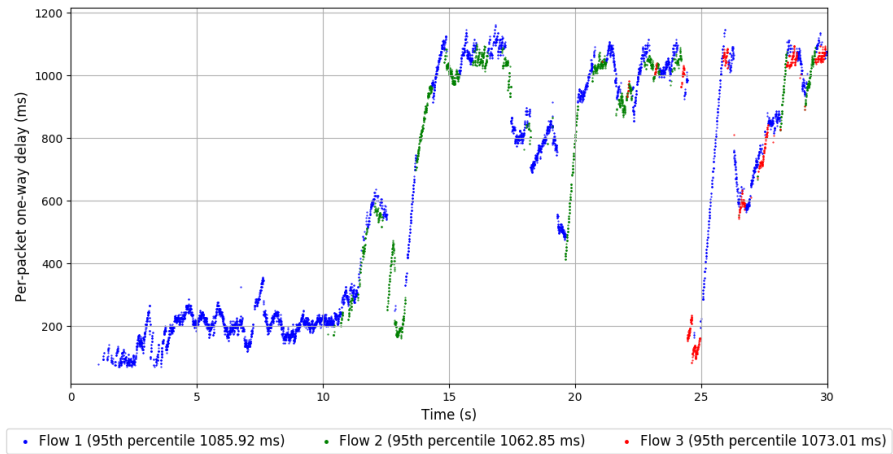
```
Run 2: Statistics of TCP BBR

Start at: 2018-01-10 15:59:11
End at: 2018-01-10 15:59:41
Local clock offset: 2.507 ms
Remote clock offset: -14.053 ms


# Below is generated by plot.py at 2018-01-10 16:28:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.91 Mbit/s
95th percentile per-packet one-way delay: 503.816 ms
Loss rate: 1.47%
-- Flow 1:
Average throughput: 2.49 Mbit/s
95th percentile per-packet one-way delay: 492.577 ms
Loss rate: 0.78%
-- Flow 2:
Average throughput: 2.27 Mbit/s
95th percentile per-packet one-way delay: 519.649 ms
Loss rate: 0.80%
-- Flow 3:
Average throughput: 2.95 Mbit/s
95th percentile per-packet one-way delay: 506.859 ms
Loss rate: 4.27%
```

Run 2: Report of TCP BBR — Data Link

```
Run 3: Statistics of TCP BBR

Start at: 2018-01-10 16:15:54
End at: 2018-01-10 16:16:24
Local clock offset: 2.696 ms
Remote clock offset: -17.049 ms


# Below is generated by plot.py at 2018-01-10 16:28:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.09 Mbit/s
95th percentile per-packet one-way delay: 1081.383 ms
Loss rate: 20.98%
-- Flow 1:
Average throughput: 2.88 Mbit/s
95th percentile per-packet one-way delay: 1085.925 ms
Loss rate: 19.70%
-- Flow 2:
Average throughput: 1.35 Mbit/s
95th percentile per-packet one-way delay: 1062.851 ms
Loss rate: 19.25%
-- Flow 3:
Average throughput: 0.98 Mbit/s
95th percentile per-packet one-way delay: 1073.008 ms
Loss rate: 35.03%
```
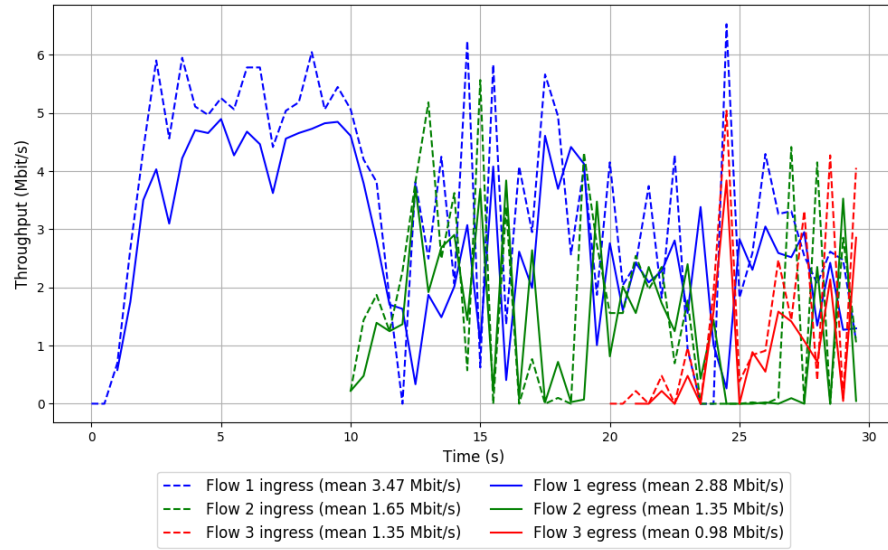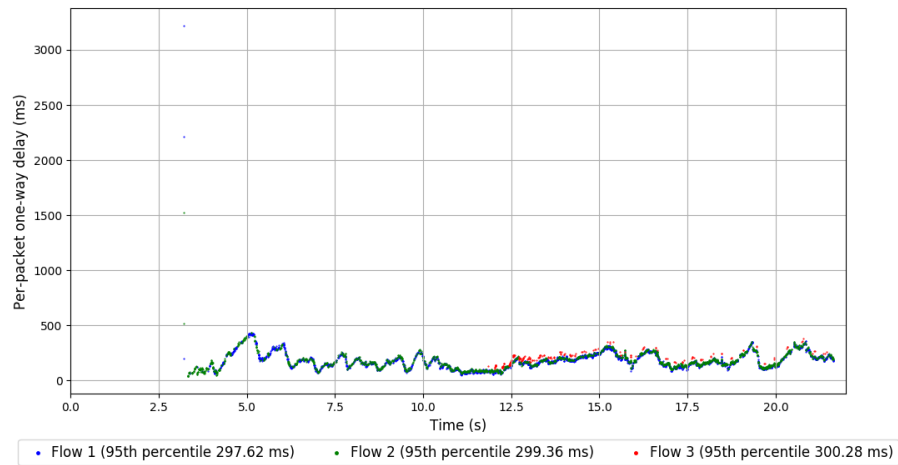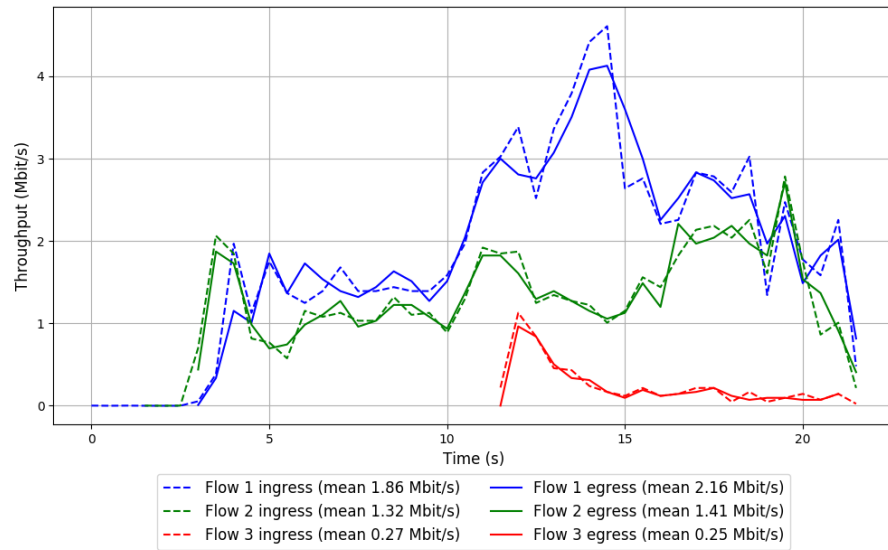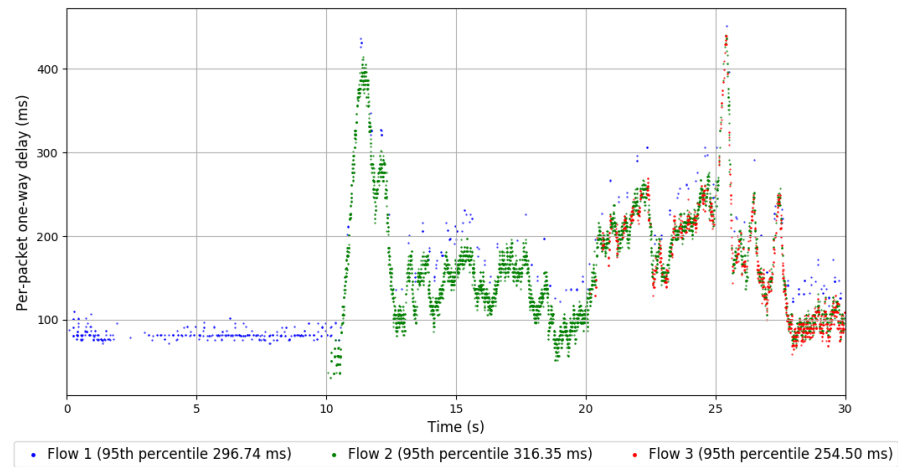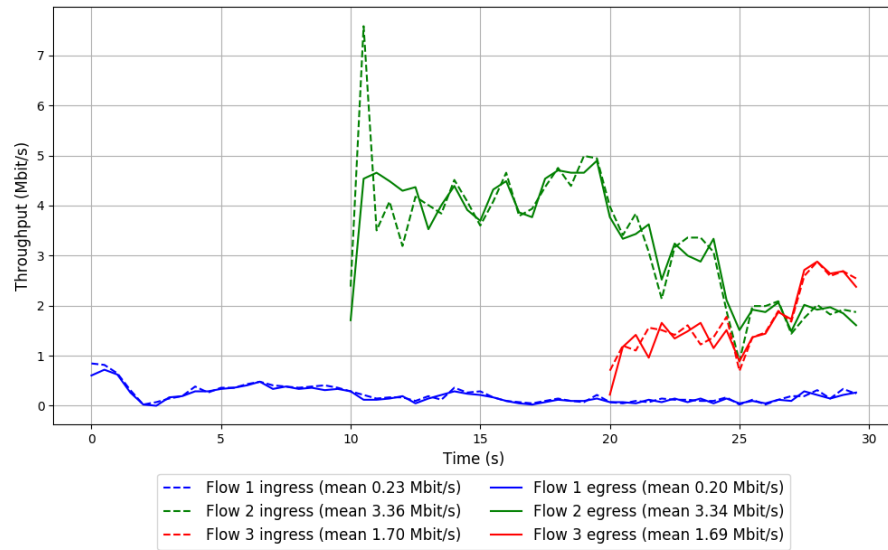
Run 3: Report of TCP BBR — Data Link

Flow 1 ingress (mean 3.47 Mbit/s) ---- Flow 1 egress (mean 2.88 Mbit/s) ——
Flow 2 ingress (mean 1.65 Mbit/s) ---- Flow 2 egress (mean 1.35 Mbit/s) ——
Flow 3 ingress (mean 1.35 Mbit/s) ---- Flow 3 egress (mean 0.98 Mbit/s) ——

• Flow 1 (95th percentile 1085.92 ms)   • Flow 2 (95th percentile 1062.85 ms)   • Flow 3 (95th percentile 1073.01 ms)

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```
Run 1: Statistics of TCP Cubic

Start at: 2018-01-10 15:37:01
End at: 2018-01-10 15:37:31
Local clock offset: 1.03 ms
Remote clock offset: -15.927 ms
```

Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2018-01-10 15:53:40
End at: 2018-01-10 15:54:10
Local clock offset: 2.433 ms
Remote clock offset: -15.828 ms


# Below is generated by plot.py at 2018-01-10 16:28:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.98 Mbit/s
95th percentile per-packet one-way delay: 294.257 ms
Loss rate: 1.77%
-- Flow 1:
Average throughput: 0.20 Mbit/s
95th percentile per-packet one-way delay: 296.736 ms
Loss rate: 11.05%
-- Flow 2:
Average throughput: 3.34 Mbit/s
95th percentile per-packet one-way delay: 316.354 ms
Loss rate: 0.75%
-- Flow 3:
Average throughput: 1.69 Mbit/s
95th percentile per-packet one-way delay: 254.500 ms
Loss rate: 2.05%
```

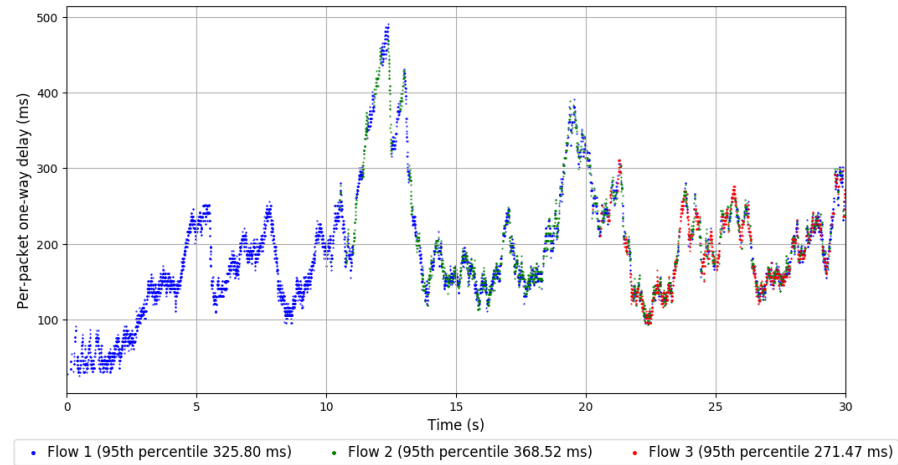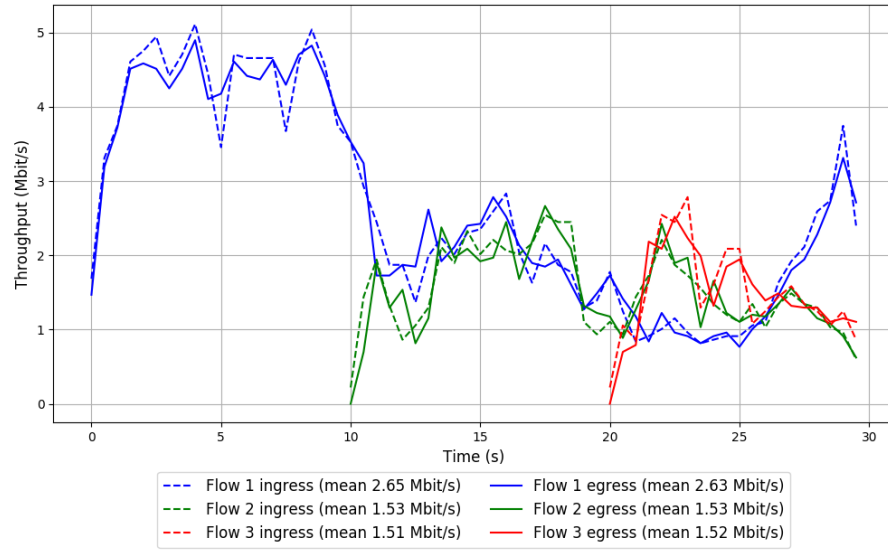Run 2: Report of TCP Cubic — Data Link

```
Run 3: Statistics of TCP Cubic

Start at: 2018-01-10 16:10:21
End at: 2018-01-10 16:10:51
Local clock offset: 2.154 ms
Remote clock offset: -17.659 ms


# Below is generated by plot.py at 2018-01-10 16:28:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.12 Mbit/s
95th percentile per-packet one-way delay: 329.296 ms
Loss rate: 1.08%
-- Flow 1:
Average throughput: 2.63 Mbit/s
95th percentile per-packet one-way delay: 325.804 ms
Loss rate: 0.98%
-- Flow 2:
Average throughput: 1.53 Mbit/s
95th percentile per-packet one-way delay: 368.523 ms
Loss rate: 1.18%
-- Flow 3:
Average throughput: 1.52 Mbit/s
95th percentile per-packet one-way delay: 271.468 ms
Loss rate: 1.37%
```

Run 3: Report of TCP Cubic — Data Link

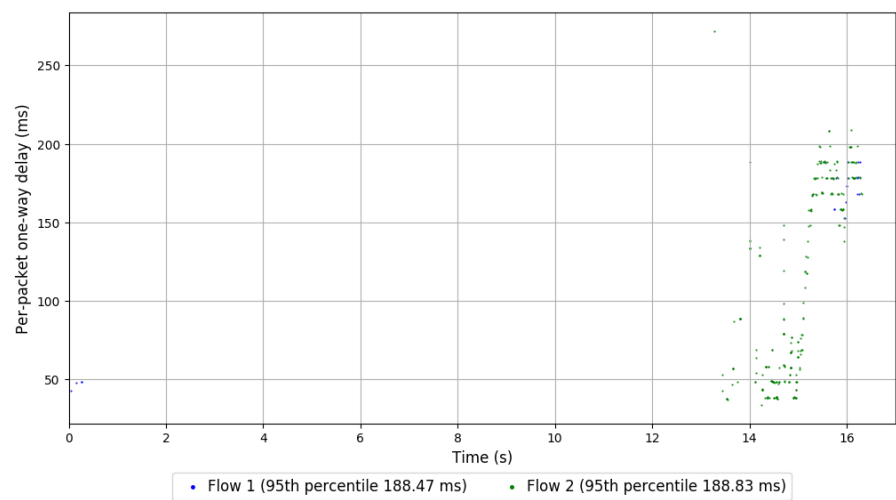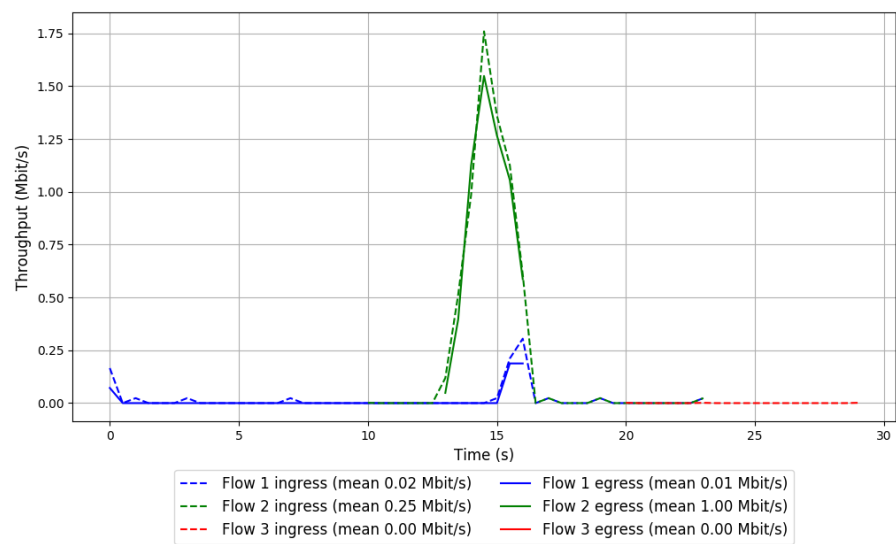```
Run 1: Statistics of LEDBAT

Start at: 2018-01-10 15:47:00
End at: 2018-01-10 15:47:30
Local clock offset: 1.333 ms
Remote clock offset: -15.222 ms
```
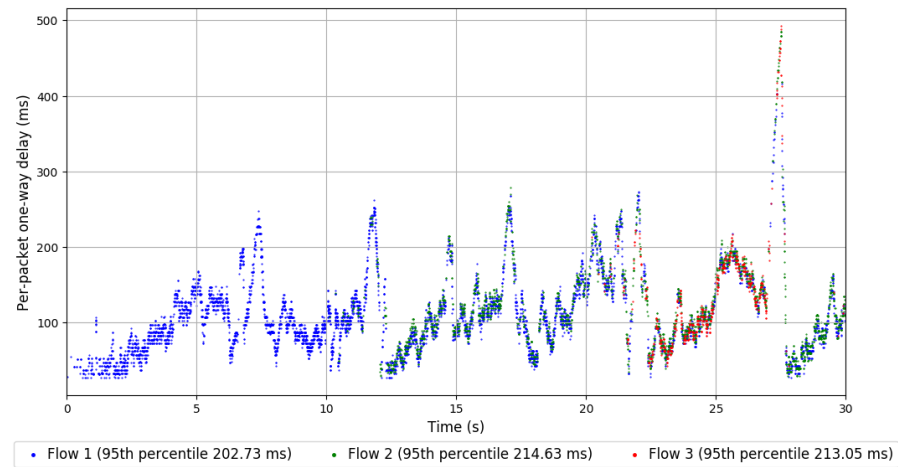
Run 1: Report of LEDBAT — Data Link

```
Run 2: Statistics of LEDBAT

Start at: 2018-01-10 16:03:38
End at: 2018-01-10 16:04:08
Local clock offset: 2.889 ms
Remote clock offset: -15.368 ms

Below is generated by plot.py at 2018-01-10 16:28:06
Datalink statistics
-- Total of 3 flows:
Average throughput: 3.97 Mbit/s
95th percentile per-packet one-way delay: 207.228 ms
Loss rate: 0.56%
-- Flow 1:
Average throughput: 2.58 Mbit/s
95th percentile per-packet one-way delay: 202.731 ms
Loss rate: 0.42%
-- Flow 2:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 214.627 ms
Loss rate: 0.88%
-- Flow 3:
Average throughput: 0.91 Mbit/s
95th percentile per-packet one-way delay: 213.052 ms
Loss rate: 0.53%
```
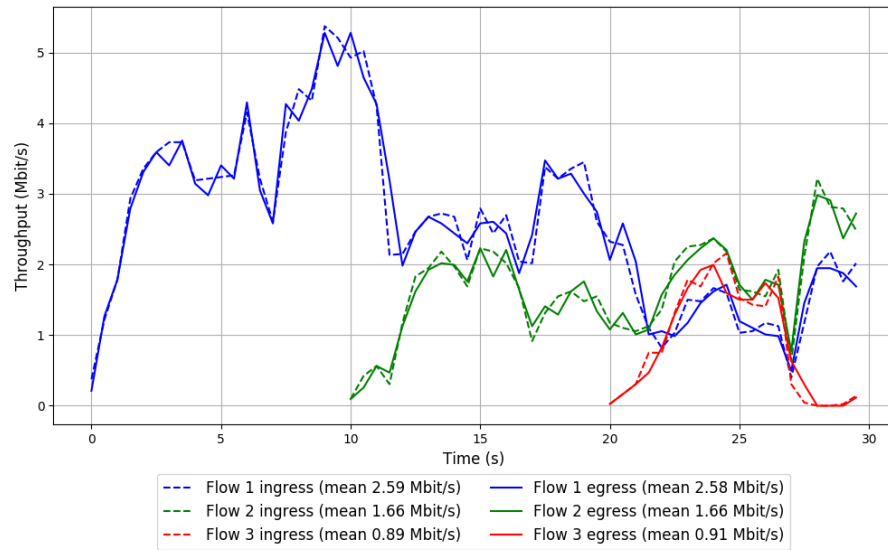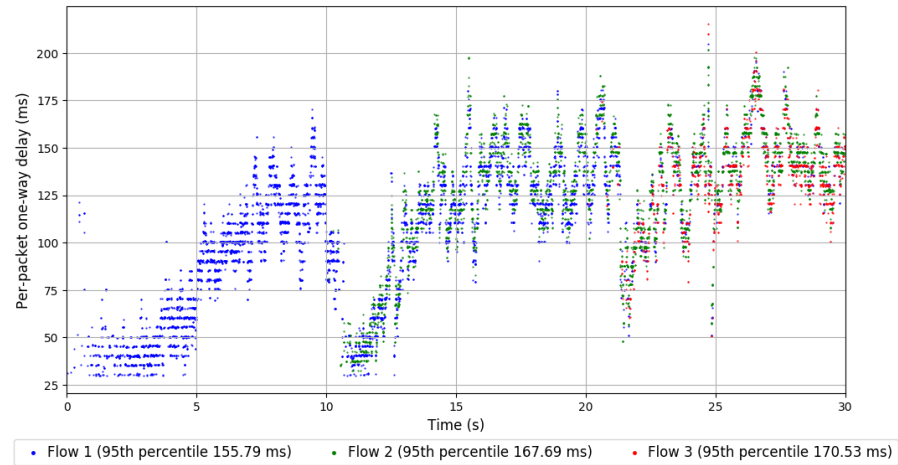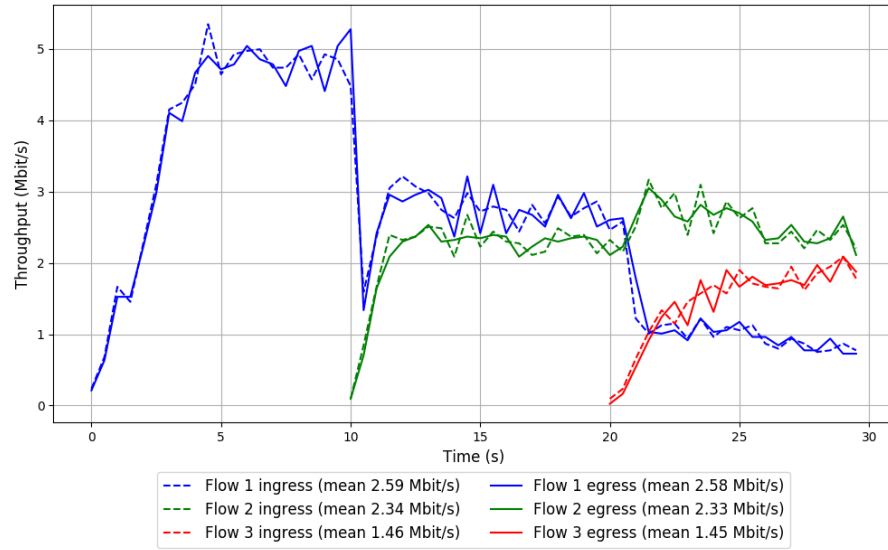
Run 2: Report of LEDBAT — Data Link

```
Run 3: Statistics of LEDBAT

Start at: 2018-01-10 16:20:28
End at: 2018-01-10 16:20:58
Local clock offset: -0.451 ms
Remote clock offset: -17.377 ms


# Below is generated by plot.py at 2018-01-10 16:28:07
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.60 Mbit/s
95th percentile per-packet one-way delay: 162.593 ms
Loss rate: 0.67%
-- Flow 1:
Average throughput: 2.58 Mbit/s
95th percentile per-packet one-way delay: 155.789 ms
Loss rate: 0.39%
-- Flow 2:
Average throughput: 2.33 Mbit/s
95th percentile per-packet one-way delay: 167.691 ms
Loss rate: 0.78%
-- Flow 3:
Average throughput: 1.45 Mbit/s
95th percentile per-packet one-way delay: 170.530 ms
Loss rate: 1.78%
```

Run 3: Report of LEDBAT — Data Link

- - - Flow 1 ingress (mean 2.59 Mbit/s) —— Flow 1 egress (mean 2.58 Mbit/s)
- - - Flow 2 ingress (mean 2.34 Mbit/s) —— Flow 2 egress (mean 2.33 Mbit/s)
- - - Flow 3 ingress (mean 1.46 Mbit/s) —— Flow 3 egress (mean 1.45 Mbit/s)

• Flow 1 (95th percentile 155.79 ms)   • Flow 2 (95th percentile 167.69 ms)   • Flow 3 (95th percentile 170.53 ms)
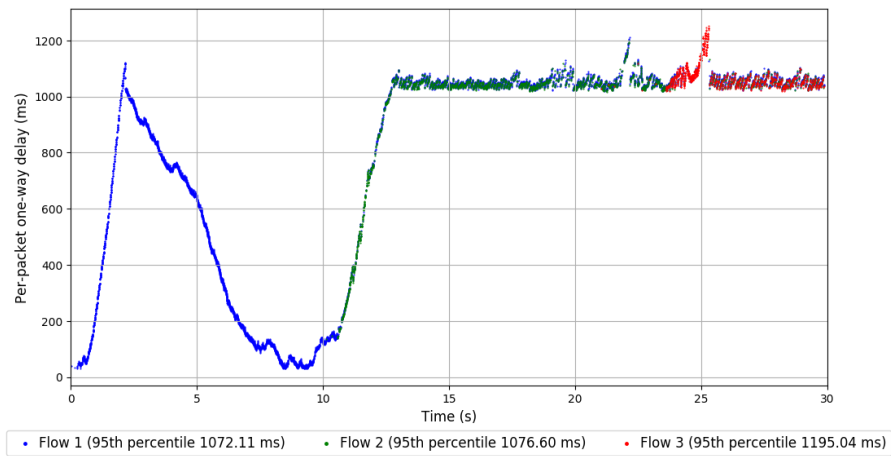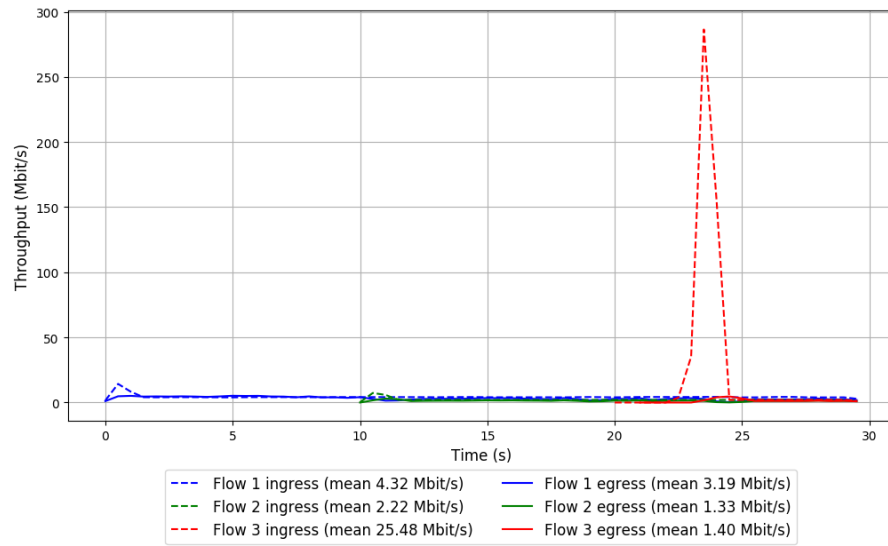
21

```
Run 1: Statistics of PCC

Start at: 2018-01-10 15:43:39
End at: 2018-01-10 15:44:09
Local clock offset: 1.411 ms
Remote clock offset: -15.328 ms

# Below is generated by plot.py at 2018-01-10 16:28:21
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.48 Mbit/s
95th percentile per-packet one-way delay: 1082.232 ms
Loss rate: 68.49%
-- Flow 1:
Average throughput: 3.19 Mbit/s
95th percentile per-packet one-way delay: 1072.111 ms
Loss rate: 26.28%
-- Flow 2:
Average throughput: 1.33 Mbit/s
95th percentile per-packet one-way delay: 1076.603 ms
Loss rate: 40.65%
-- Flow 3:
Average throughput: 1.40 Mbit/s
95th percentile per-packet one-way delay: 1195.041 ms
Loss rate: 95.08%
```
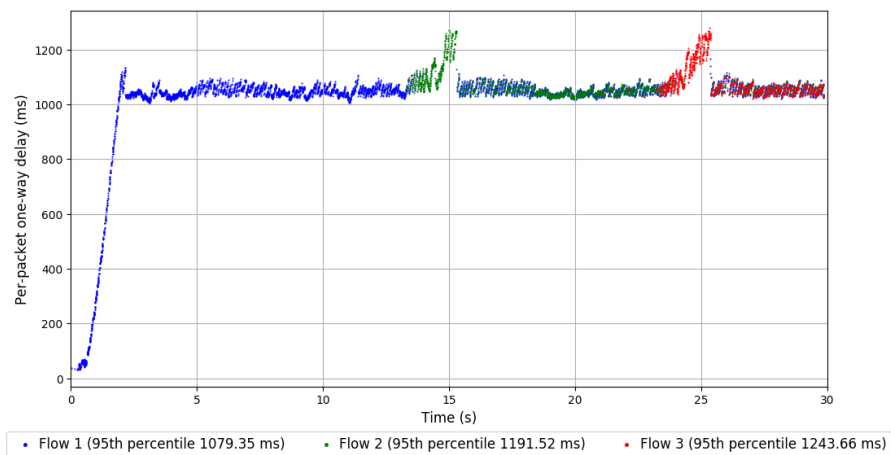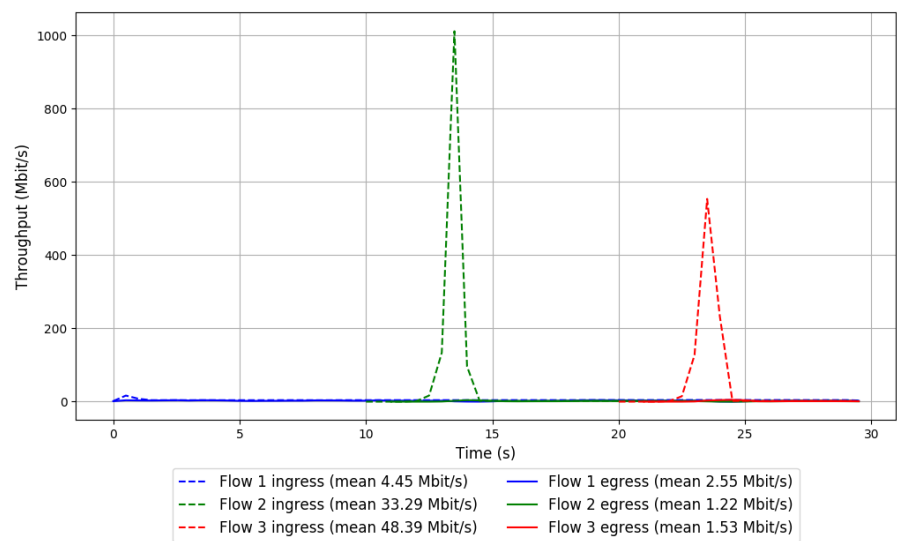
Run 1: Report of PCC — Data Link

Flow 1 ingress (mean 4.32 Mbit/s)   Flow 1 egress (mean 3.19 Mbit/s)
Flow 2 ingress (mean 2.22 Mbit/s)   Flow 2 egress (mean 1.33 Mbit/s)
Flow 3 ingress (mean 25.48 Mbit/s) Flow 3 egress (mean 1.40 Mbit/s)

Flow 1 (95th percentile 1072.11 ms)   Flow 2 (95th percentile 1076.60 ms)   Flow 3 (95th percentile 1195.04 ms)

```
Run 2: Statistics of PCC

Start at: 2018-01-10 16:00:17
End at: 2018-01-10 16:00:47
Local clock offset: 1.921 ms
Remote clock offset: -15.196 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.77 Mbit/s
95th percentile per-packet one-way delay: 1152.609 ms
Loss rate: 91.14%
-- Flow 1:
Average throughput: 2.55 Mbit/s
95th percentile per-packet one-way delay: 1079.352 ms
Loss rate: 42.72%
-- Flow 2:
Average throughput: 1.22 Mbit/s
95th percentile per-packet one-way delay: 1191.524 ms
Loss rate: 96.53%
-- Flow 3:
Average throughput: 1.53 Mbit/s
95th percentile per-packet one-way delay: 1243.662 ms
Loss rate: 97.17%
```
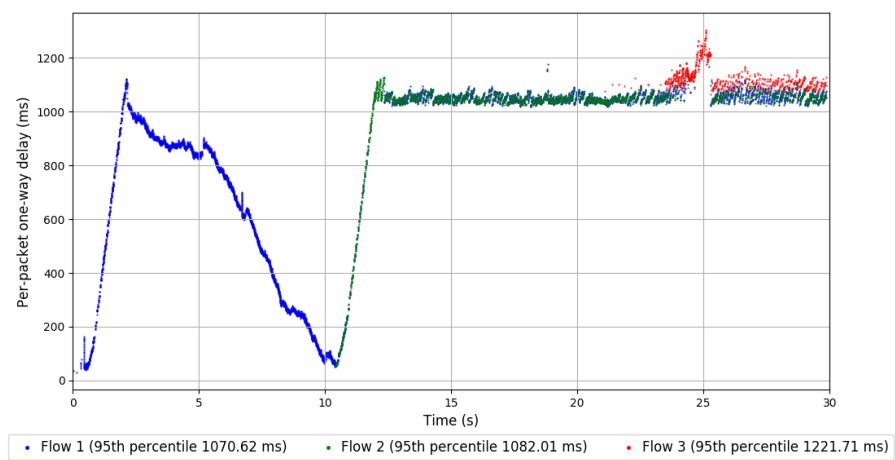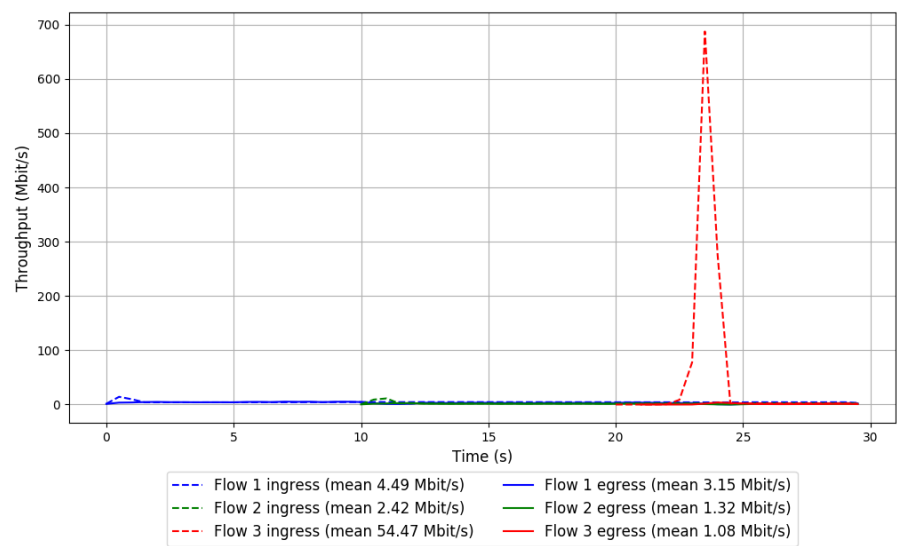
Run 2: Report of PCC — Data Link

- - - Flow 1 ingress (mean 4.45 Mbit/s)   —— Flow 1 egress (mean 2.55 Mbit/s)
- - - Flow 2 ingress (mean 33.29 Mbit/s)   —— Flow 2 egress (mean 1.22 Mbit/s)
- - - Flow 3 ingress (mean 48.39 Mbit/s)   —— Flow 3 egress (mean 1.53 Mbit/s)

- Flow 1 (95th percentile 1079.35 ms)   • Flow 2 (95th percentile 1191.52 ms)   • Flow 3 (95th percentile 1243.66 ms)

```
Run 3: Statistics of PCC

Start at: 2018-01-10 16:17:02
End at: 2018-01-10 16:17:32
Local clock offset: 1.156 ms
Remote clock offset: -16.755 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.34 Mbit/s
95th percentile per-packet one-way delay: 1107.839 ms
Loss rate: 81.98%
-- Flow 1:
Average throughput: 3.15 Mbit/s
95th percentile per-packet one-way delay: 1070.619 ms
Loss rate: 29.90%
-- Flow 2:
Average throughput: 1.32 Mbit/s
95th percentile per-packet one-way delay: 1082.007 ms
Loss rate: 45.81%
-- Flow 3:
Average throughput: 1.08 Mbit/s
95th percentile per-packet one-way delay: 1221.713 ms
Loss rate: 98.24%
```
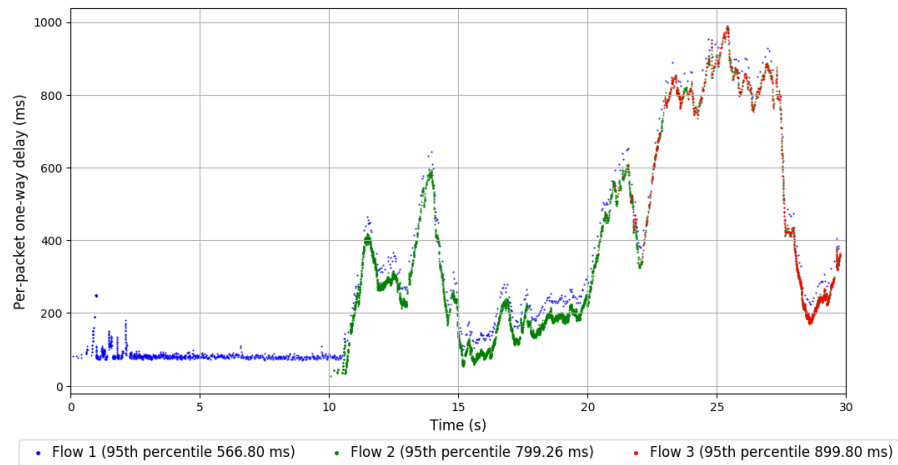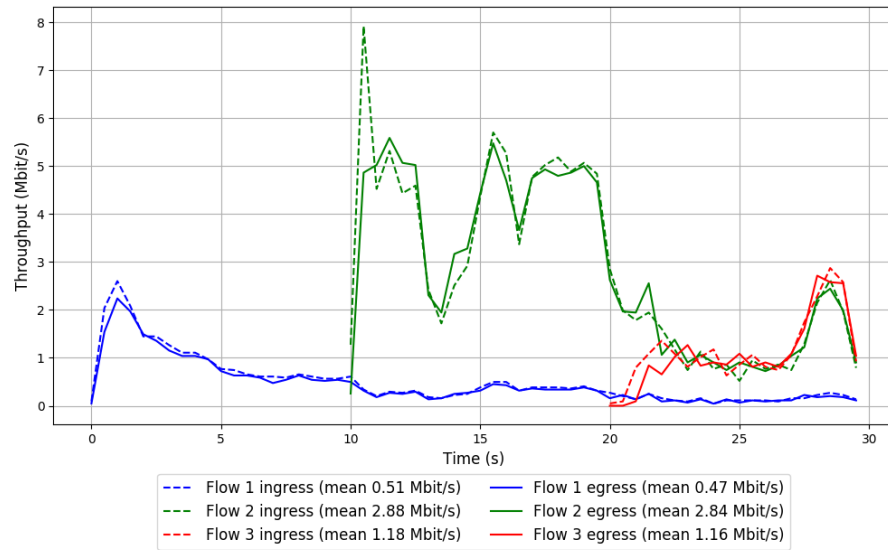
Run 3: Report of PCC — Data Link

Flow 1 ingress (mean 4.49 Mbit/s) —— Flow 1 egress (mean 3.15 Mbit/s)
Flow 2 ingress (mean 2.42 Mbit/s) —— Flow 2 egress (mean 1.32 Mbit/s)
Flow 3 ingress (mean 54.47 Mbit/s) —— Flow 3 egress (mean 1.08 Mbit/s)

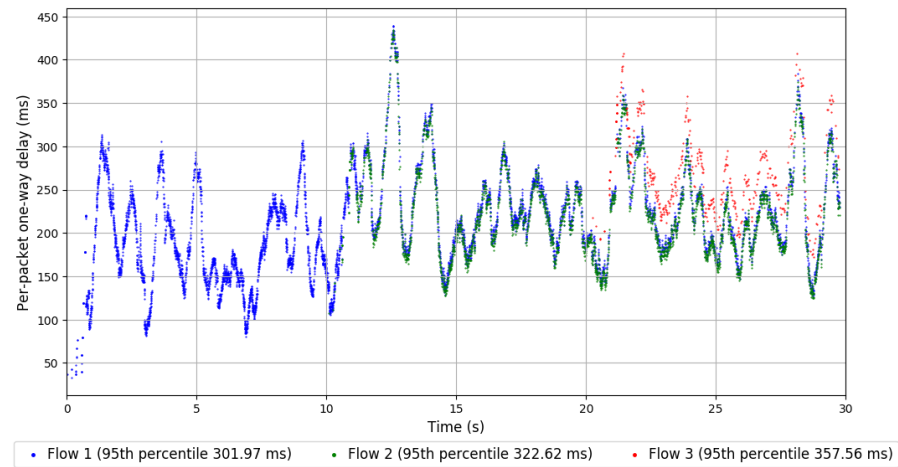Flow 1 (95th percentile 1070.62 ms)   Flow 2 (95th percentile 1082.01 ms)   Flow 3 (95th percentile 1221.71 ms)

```
Run 1: Statistics of QUIC Cubic

Start at: 2018-01-10 15:38:07
End at: 2018-01-10 15:38:37
Local clock offset: 2.716 ms
Remote clock offset: -15.305 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.72 Mbit/s
95th percentile per-packet one-way delay: 834.279 ms
Loss rate: 3.44%
-- Flow 1:
Average throughput: 0.47 Mbit/s
95th percentile per-packet one-way delay: 566.796 ms
Loss rate: 9.20%
-- Flow 2:
Average throughput: 2.84 Mbit/s
95th percentile per-packet one-way delay: 799.262 ms
Loss rate: 1.37%
-- Flow 3:
Average throughput: 1.16 Mbit/s
95th percentile per-packet one-way delay: 899.803 ms
Loss rate: 5.98%
```

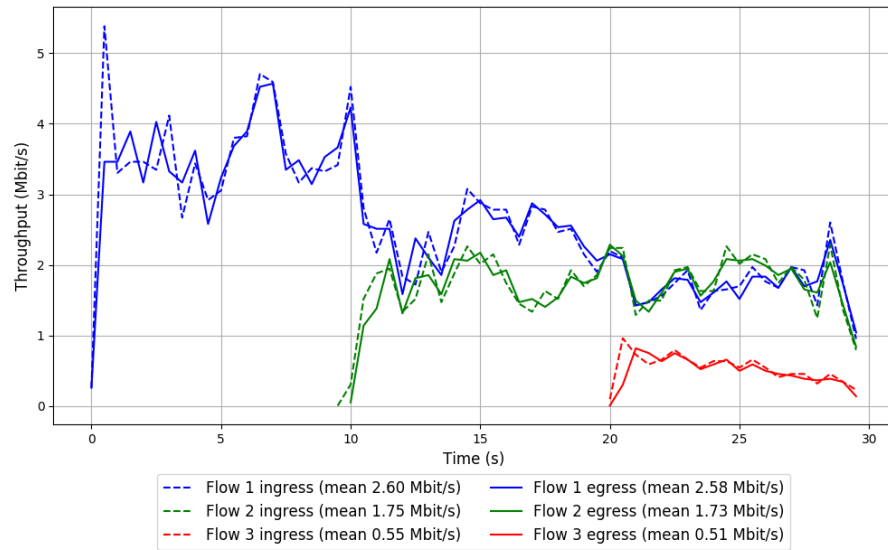Run 1: Report of QUIC Cubic — Data Link

```
Run 2: Statistics of QUIC Cubic

Start at: 2018-01-10 15:54:46
End at: 2018-01-10 15:55:16
Local clock offset: 3.458 ms
Remote clock offset: -15.11 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.89 Mbit/s
95th percentile per-packet one-way delay: 314.480 ms
Loss rate: 1.35%
-- Flow 1:
Average throughput: 2.58 Mbit/s
95th percentile per-packet one-way delay: 301.969 ms
Loss rate: 0.83%
-- Flow 2:
Average throughput: 1.73 Mbit/s
95th percentile per-packet one-way delay: 322.622 ms
Loss rate: 1.37%
-- Flow 3:
Average throughput: 0.51 Mbit/s
95th percentile per-packet one-way delay: 357.556 ms
Loss rate: 8.74%
```

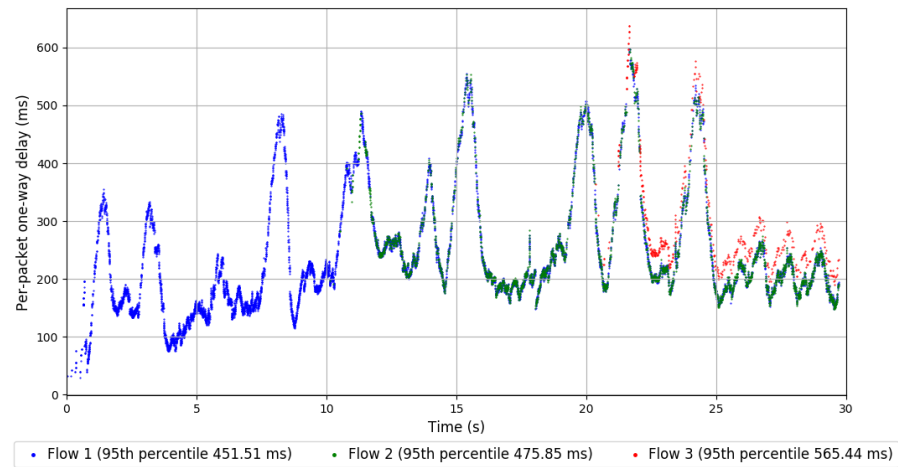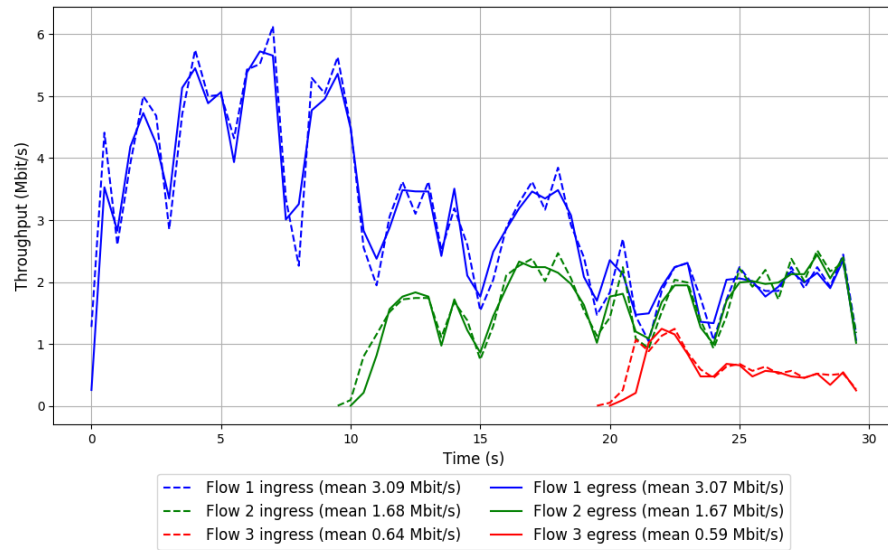Run 2: Report of QUIC Cubic — Data Link
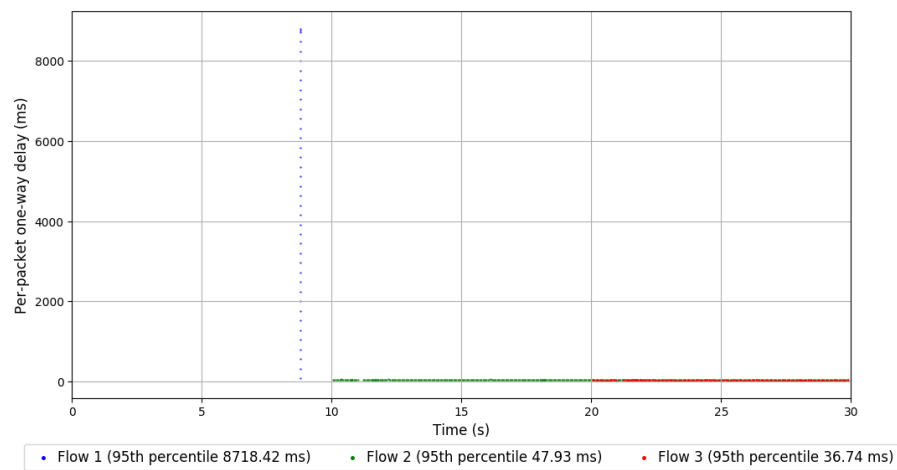
```
Run 3: Statistics of QUIC Cubic

Start at: 2018-01-10 16:11:28
End at: 2018-01-10 16:11:58
Local clock offset: 3.87 ms
Remote clock offset: -16.882 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.35 Mbit/s
95th percentile per-packet one-way delay: 463.720 ms
Loss rate: 1.66%
-- Flow 1:
Average throughput: 3.07 Mbit/s
95th percentile per-packet one-way delay: 451.508 ms
Loss rate: 0.90%
-- Flow 2:
Average throughput: 1.67 Mbit/s
95th percentile per-packet one-way delay: 475.850 ms
Loss rate: 2.01%
-- Flow 3:
Average throughput: 0.59 Mbit/s
95th percentile per-packet one-way delay: 565.437 ms
Loss rate: 11.14%
```
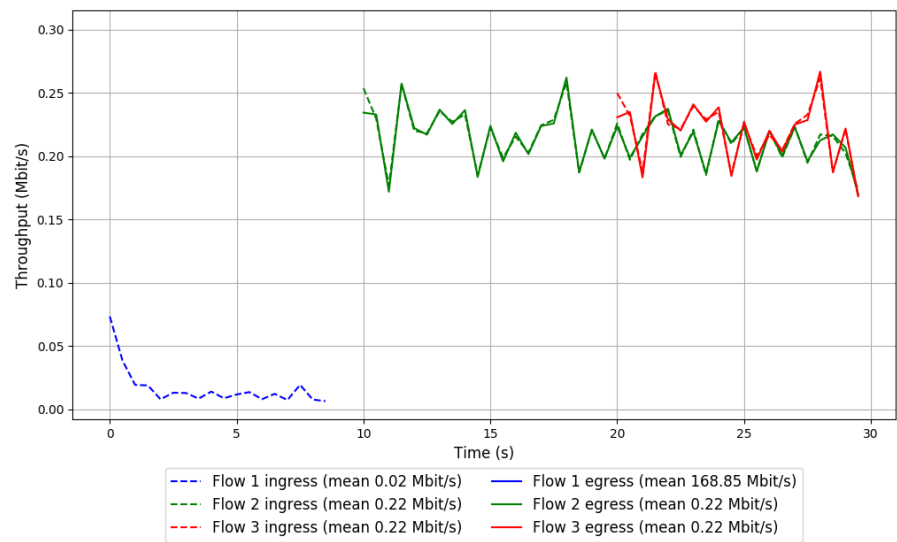
Run 3: Report of QUIC Cubic — Data Link

Flow 1 ingress (mean 3.09 Mbit/s)   Flow 1 egress (mean 3.07 Mbit/s)
Flow 2 ingress (mean 1.68 Mbit/s)   Flow 2 egress (mean 1.67 Mbit/s)
Flow 3 ingress (mean 0.64 Mbit/s)   Flow 3 egress (mean 0.59 Mbit/s)

Flow 1 (95th percentile 451.51 ms)   Flow 2 (95th percentile 475.85 ms)   Flow 3 (95th percentile 565.44 ms)

```
Run 1: Statistics of SCReAM

Start at: 2018-01-10 15:39:14
End at: 2018-01-10 15:39:44
Local clock offset: 1.519 ms
Remote clock offset: -16.546 ms
```

Run 1: Report of SCReAM — Data Link

```
Run 2: Statistics of SCReAM

Start at: 2018-01-10 15:55:52
End at: 2018-01-10 15:56:22
Local clock offset: 2.759 ms
Remote clock offset: -14.718 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.44 Mbit/s
95th percentile per-packet one-way delay: 46.982 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 38.127 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 47.511 ms
Loss rate: 0.20%
-- Flow 3:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 47.266 ms
Loss rate: 0.35%
```
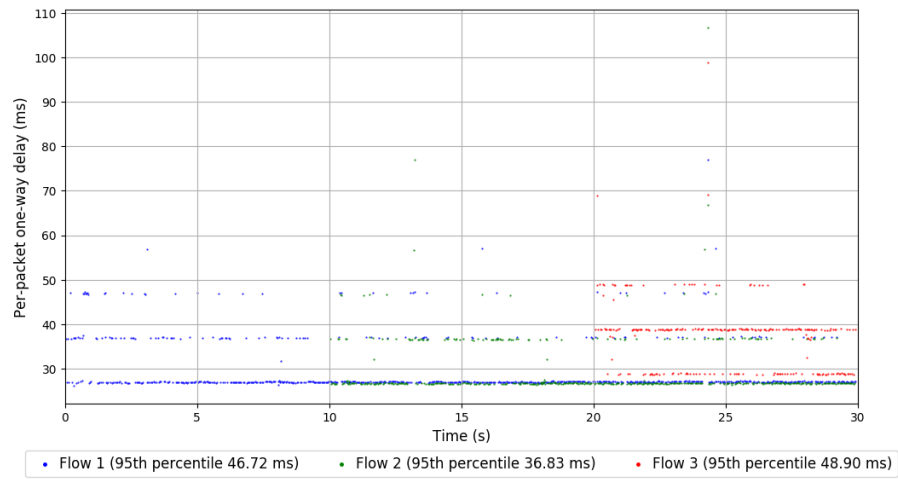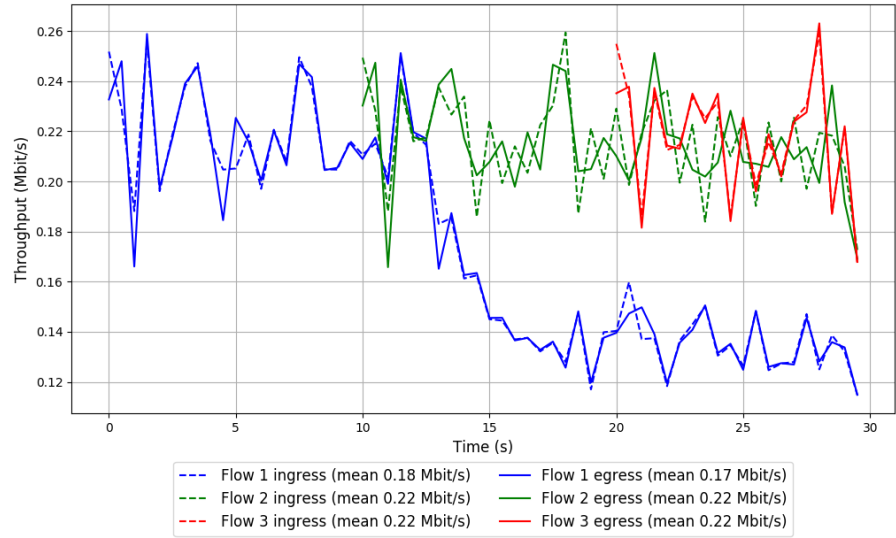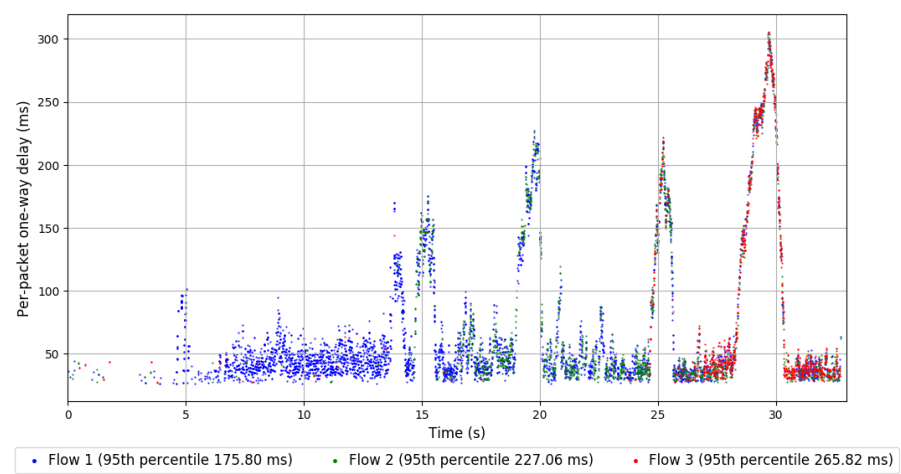
Run 2: Report of SCReAM — Data Link

Flow 1 ingress (mean 0.22 Mbit/s)   Flow 1 egress (mean 0.22 Mbit/s)
Flow 2 ingress (mean 0.22 Mbit/s)   Flow 2 egress (mean 0.22 Mbit/s)
Flow 3 ingress (mean 0.22 Mbit/s)   Flow 3 egress (mean 0.22 Mbit/s)

Flow 1 (95th percentile 38.13 ms)   Flow 2 (95th percentile 47.51 ms)   Flow 3 (95th percentile 47.27 ms)

```
Run 3: Statistics of SCReAM

Start at: 2018-01-10 16:12:34
End at: 2018-01-10 16:13:04
Local clock offset: 3.245 ms
Remote clock offset: -15.83 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.39 Mbit/s
95th percentile per-packet one-way delay: 46.762 ms
Loss rate: 0.26%
-- Flow 1:
Average throughput: 0.17 Mbit/s
95th percentile per-packet one-way delay: 46.721 ms
Loss rate: 0.25%
-- Flow 2:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 36.832 ms
Loss rate: 0.21%
-- Flow 3:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 48.898 ms
Loss rate: 0.35%
```
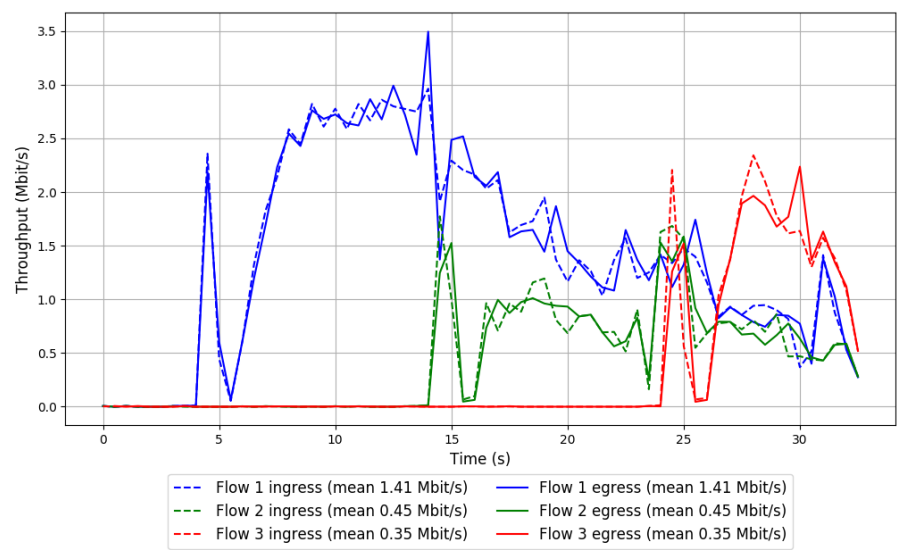
Run 3: Report of SCReAM — Data Link

```
Run 1: Statistics of WebRTC media

Start at: 2018-01-10 15:49:12
End at: 2018-01-10 15:49:42
Local clock offset: 1.331 ms
Remote clock offset: -14.859 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.20 Mbit/s
95th percentile per-packet one-way delay: 217.321 ms
Loss rate: 0.10%
-- Flow 1:
Average throughput: 1.41 Mbit/s
95th percentile per-packet one-way delay: 175.798 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 0.45 Mbit/s
95th percentile per-packet one-way delay: 227.064 ms
Loss rate: 0.16%
-- Flow 3:
Average throughput: 0.35 Mbit/s
95th percentile per-packet one-way delay: 265.816 ms
Loss rate: 0.08%
```

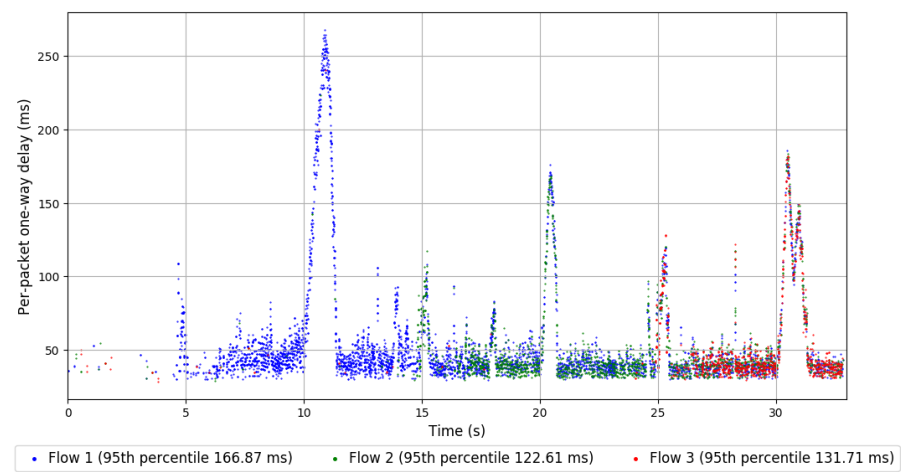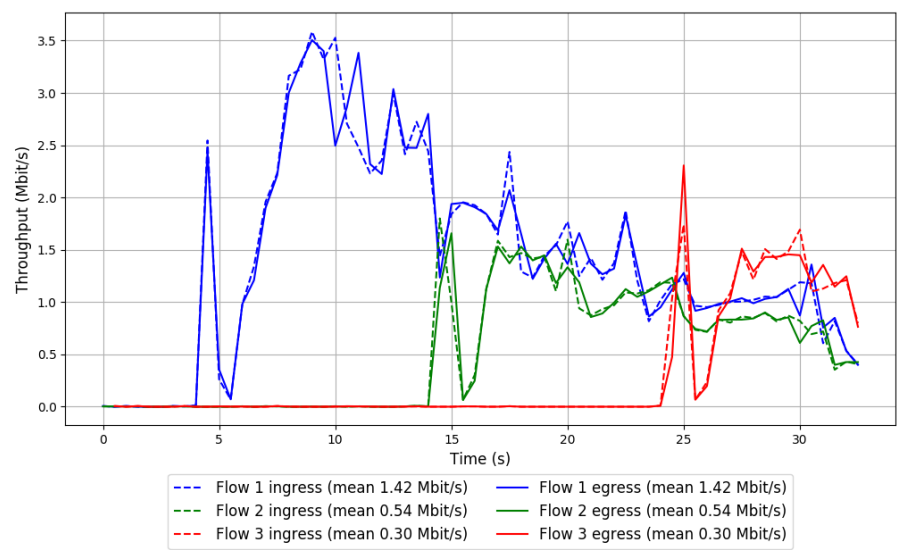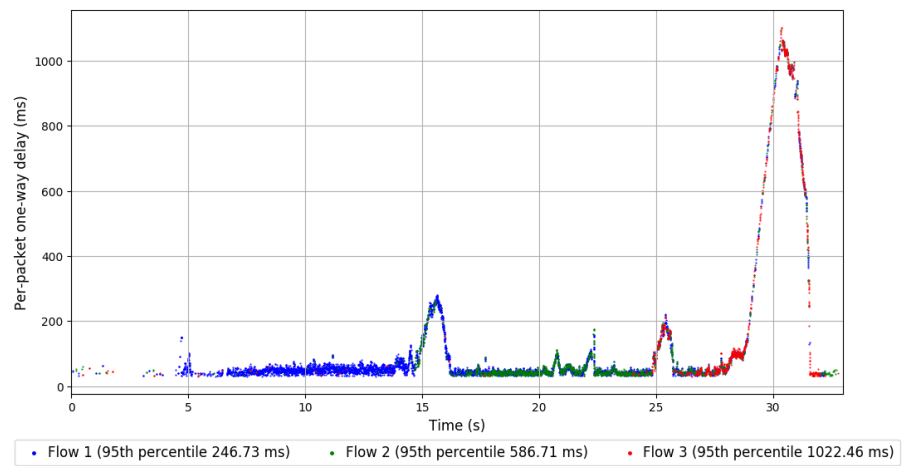Run 1: Report of WebRTC media — Data Link

Flow 1 ingress (mean 1.41 Mbit/s)   Flow 1 egress (mean 1.41 Mbit/s)
Flow 2 ingress (mean 0.45 Mbit/s)   Flow 2 egress (mean 0.45 Mbit/s)
Flow 3 ingress (mean 0.35 Mbit/s)   Flow 3 egress (mean 0.35 Mbit/s)

Flow 1 (95th percentile 175.80 ms)   Flow 2 (95th percentile 227.06 ms)   Flow 3 (95th percentile 265.82 ms)

```
Run 2: Statistics of WebRTC media

Start at: 2018-01-10 16:05:53
End at: 2018-01-10 16:06:23
Local clock offset: 1.899 ms
Remote clock offset: -16.545 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.25 Mbit/s
95th percentile per-packet one-way delay: 145.551 ms
Loss rate: 0.24%
-- Flow 1:
Average throughput: 1.42 Mbit/s
95th percentile per-packet one-way delay: 166.873 ms
Loss rate: 0.24%
-- Flow 2:
Average throughput: 0.54 Mbit/s
95th percentile per-packet one-way delay: 122.609 ms
Loss rate: 0.10%
-- Flow 3:
Average throughput: 0.30 Mbit/s
95th percentile per-packet one-way delay: 131.714 ms
Loss rate: 0.46%
```

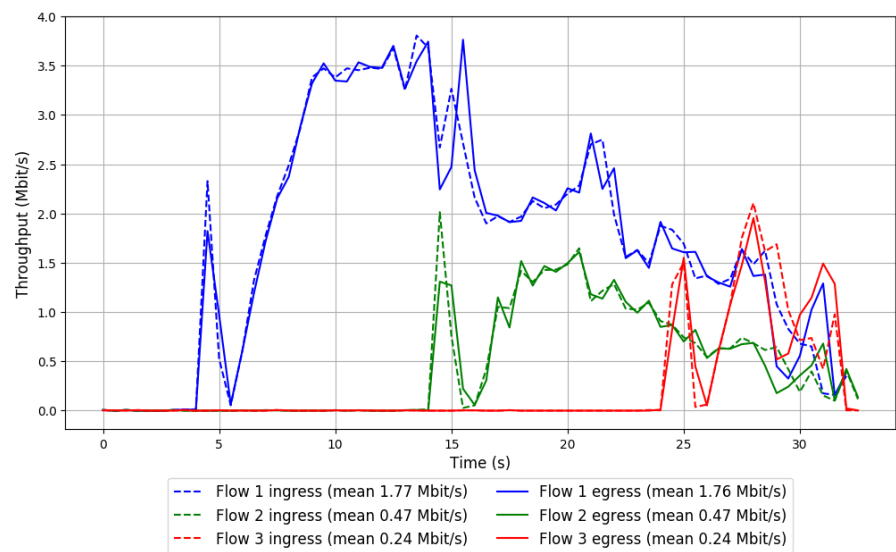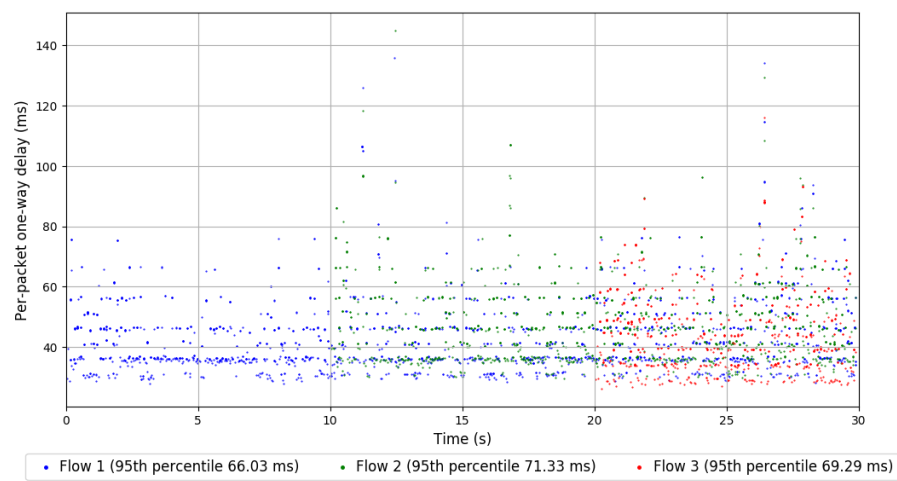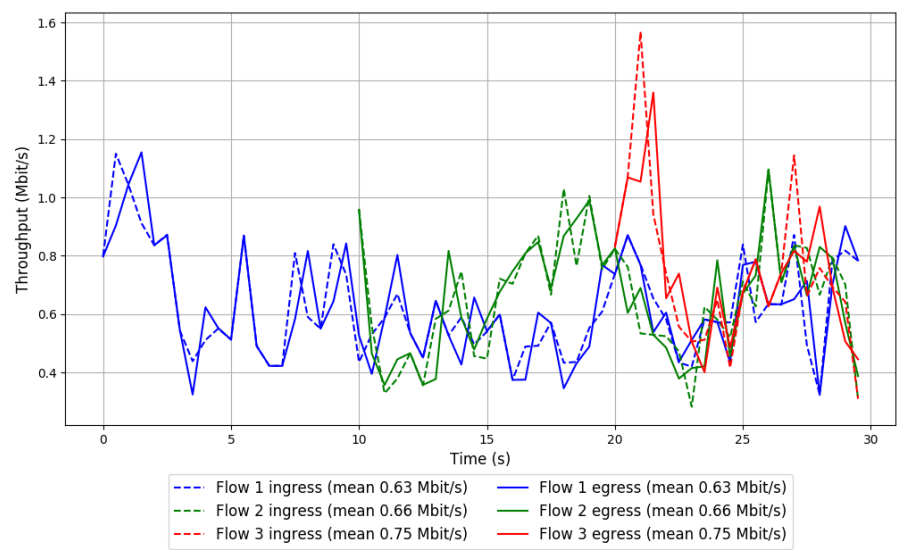Run 2: Report of WebRTC media — Data Link

Flow 1 ingress (mean 1.42 Mbit/s) Flow 1 egress (mean 1.42 Mbit/s)
Flow 2 ingress (mean 0.54 Mbit/s) Flow 2 egress (mean 0.54 Mbit/s)
Flow 3 ingress (mean 0.30 Mbit/s) Flow 3 egress (mean 0.30 Mbit/s)

Flow 1 (95th percentile 166.87 ms) Flow 2 (95th percentile 122.61 ms) Flow 3 (95th percentile 131.71 ms)

```
Run 3: Statistics of WebRTC media

Start at: 2018-01-10 16:22:40
End at: 2018-01-10 16:23:10
Local clock offset: 1.542 ms
Remote clock offset: -17.077 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.43 Mbit/s
95th percentile per-packet one-way delay: 613.811 ms
Loss rate: 0.58%
-- Flow 1:
Average throughput: 1.76 Mbit/s
95th percentile per-packet one-way delay: 246.728 ms
Loss rate: 0.46%
-- Flow 2:
Average throughput: 0.47 Mbit/s
95th percentile per-packet one-way delay: 586.712 ms
Loss rate: 0.41%
-- Flow 3:
Average throughput: 0.24 Mbit/s
95th percentile per-packet one-way delay: 1022.463 ms
Loss rate: 1.79%
```
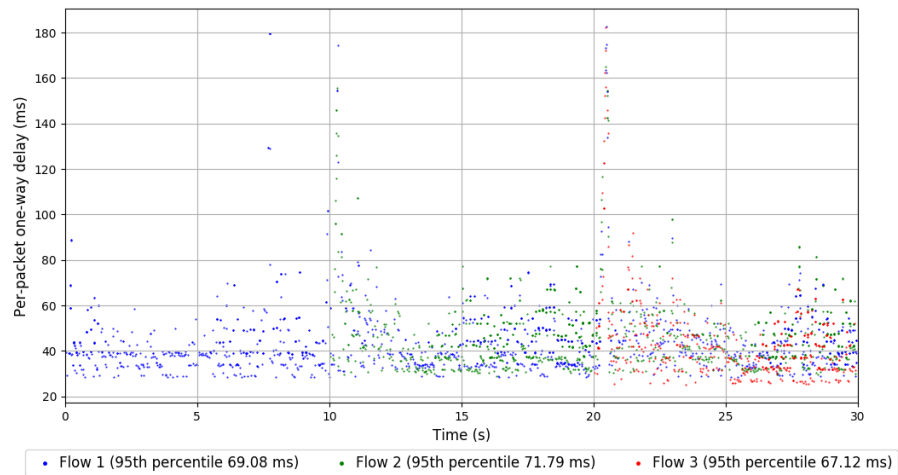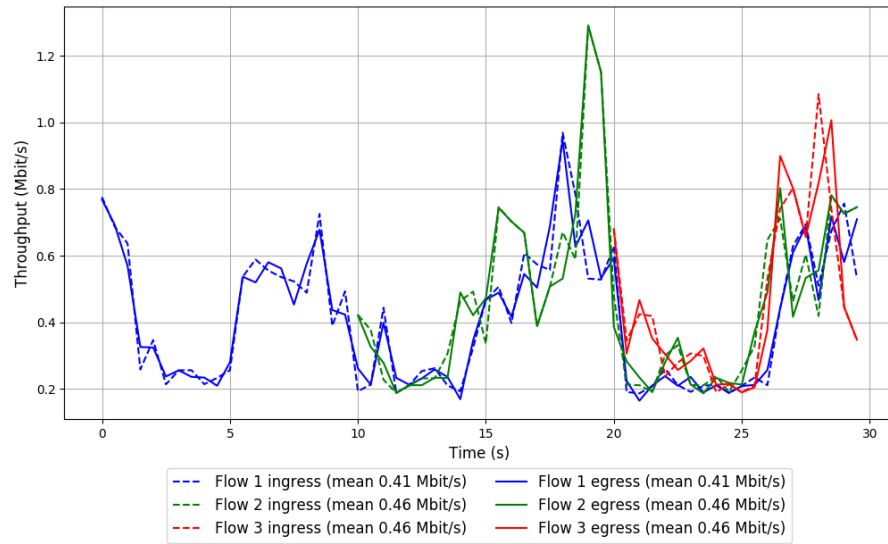
Run 3: Report of WebRTC media — Data Link

```
Run 1: Statistics of Sprout

Start at: 2018-01-10 15:48:06
End at: 2018-01-10 15:48:36
Local clock offset: 1.448 ms
Remote clock offset: -14.294 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1.31 Mbit/s
95th percentile per-packet one-way delay: 68.038 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 0.63 Mbit/s
95th percentile per-packet one-way delay: 66.026 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.66 Mbit/s
95th percentile per-packet one-way delay: 71.327 ms
Loss rate: 0.21%
-- Flow 3:
Average throughput: 0.75 Mbit/s
95th percentile per-packet one-way delay: 69.287 ms
Loss rate: 0.01%
```

Run 1: Report of Sprout — Data Link

```
Run 2: Statistics of Sprout

Start at: 2018-01-10 16:04:45
End at: 2018-01-10 16:05:15
Local clock offset: 1.963 ms
Remote clock offset: -16.557 ms


# Below is generated by plot.py at 2018-01-10 16:28:33
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.87 Mbit/s
95th percentile per-packet one-way delay: 69.423 ms
Loss rate: 0.14%
-- Flow 1:
Average throughput: 0.41 Mbit/s
95th percentile per-packet one-way delay: 69.076 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 0.46 Mbit/s
95th percentile per-packet one-way delay: 71.792 ms
Loss rate: 0.26%
-- Flow 3:
Average throughput: 0.46 Mbit/s
95th percentile per-packet one-way delay: 67.125 ms
Loss rate: 0.00%
```

Run 2: Report of Sprout — Data Link

```
Run 3: Statistics of Sprout

Start at: 2018-01-10 16:21:34
End at: 2018-01-10 16:22:04
Local clock offset: 3.729 ms
Remote clock offset: -18.831 ms
```

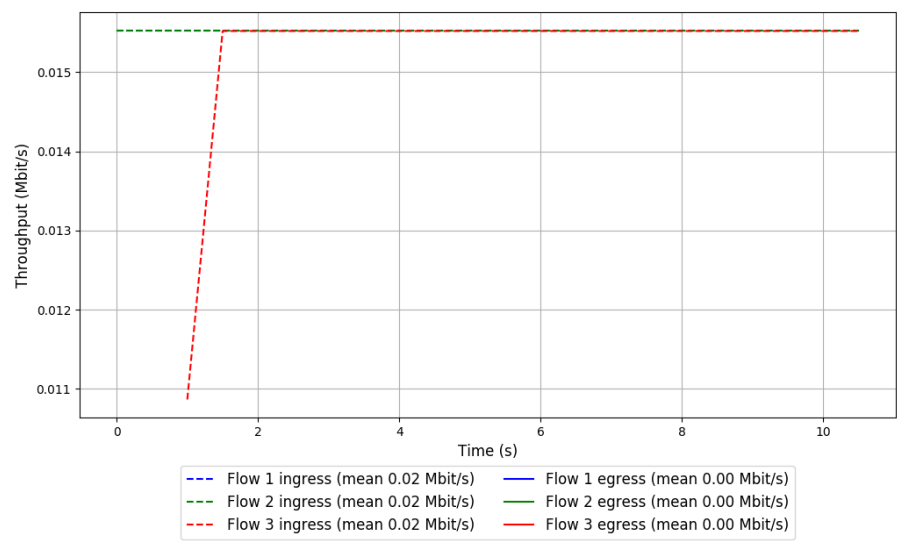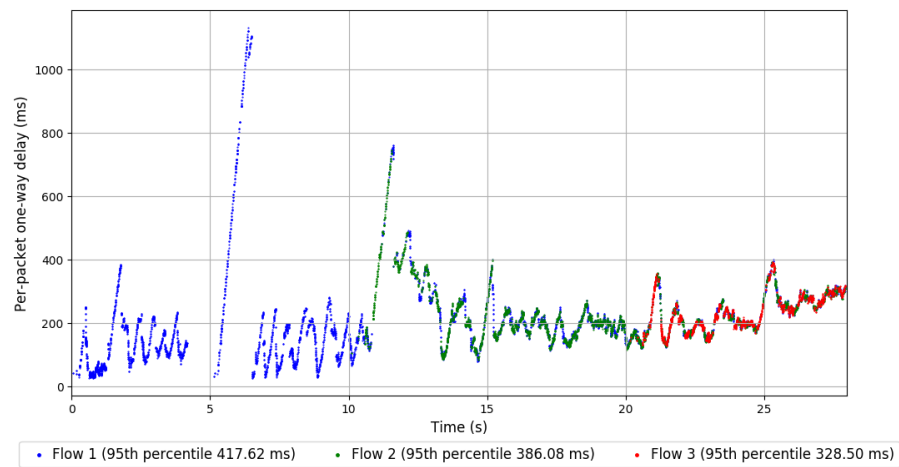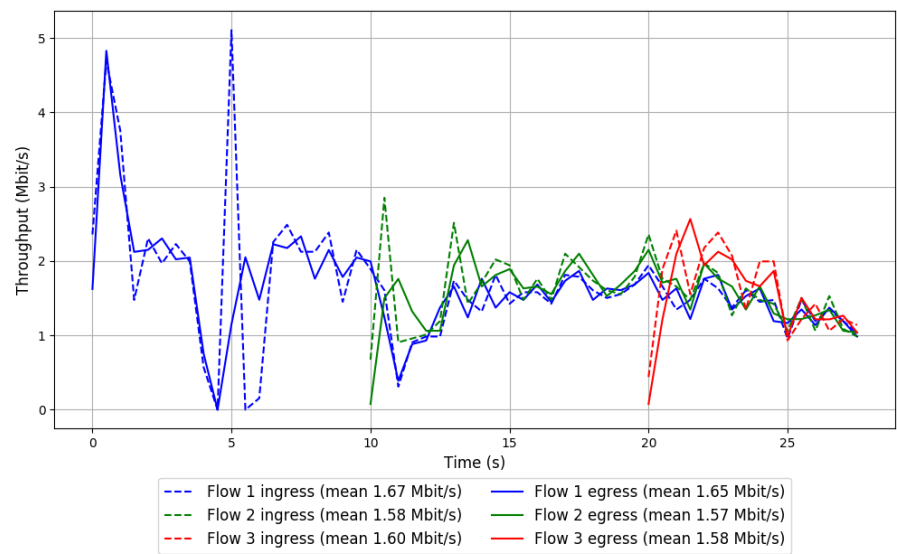Run 3: Report of Sprout — Data Link

Figure is missing

```
Run 1: Statistics of TaoVA-100x

Start at: 2018-01-10 15:40:20
End at: 2018-01-10 15:40:50
Local clock offset: 3.425 ms
Remote clock offset: -16.511 ms

# Below is generated by plot.py at 2018-01-10 16:28:37
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.09 Mbit/s
95th percentile per-packet one-way delay: 381.817 ms
Loss rate: 1.84%
-- Flow 1:
Average throughput: 1.65 Mbit/s
95th percentile per-packet one-way delay: 417.615 ms
Loss rate: 1.77%
-- Flow 2:
Average throughput: 1.57 Mbit/s
95th percentile per-packet one-way delay: 386.082 ms
Loss rate: 1.48%
-- Flow 3:
Average throughput: 1.58 Mbit/s
95th percentile per-packet one-way delay: 328.495 ms
Loss rate: 2.90%
```

Run 1: Report of TaoVA-100x — Data Link

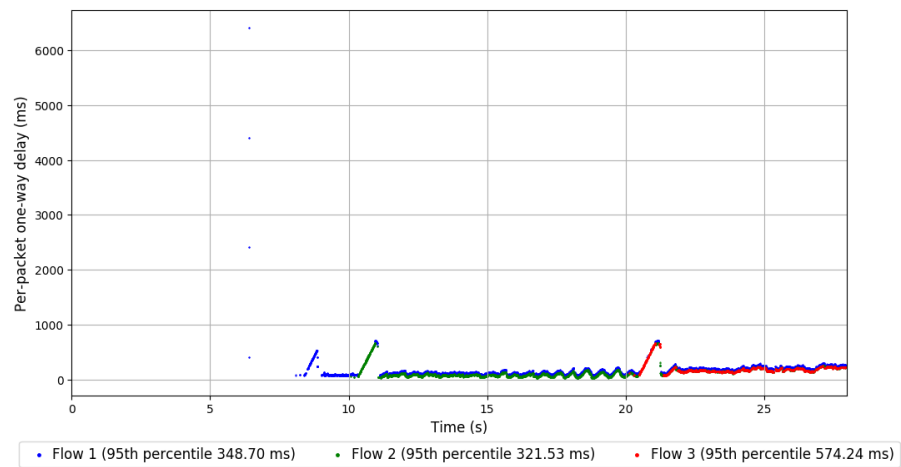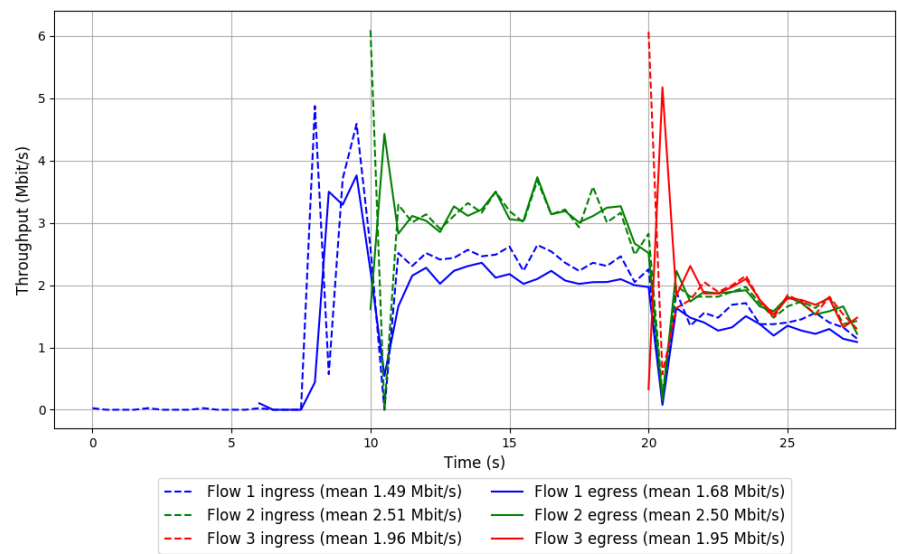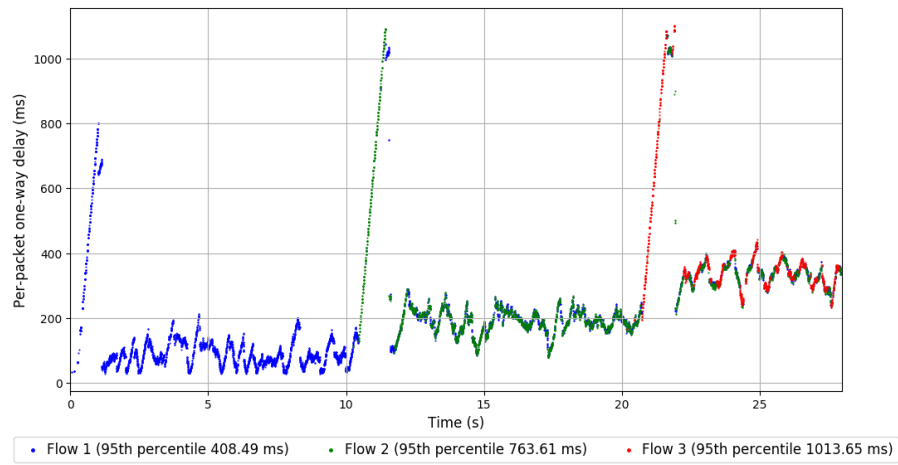Flow 1 ingress (mean 1.67 Mbit/s)   Flow 1 egress (mean 1.65 Mbit/s)
Flow 2 ingress (mean 1.58 Mbit/s)   Flow 2 egress (mean 1.57 Mbit/s)
Flow 3 ingress (mean 1.60 Mbit/s)   Flow 3 egress (mean 1.58 Mbit/s)

Flow 1 (95th percentile 417.62 ms)   Flow 2 (95th percentile 386.08 ms)   Flow 3 (95th percentile 328.50 ms)

```
Run 2: Statistics of TaoVA-100x

Start at: 2018-01-10 15:56:58
End at: 2018-01-10 15:57:28
Local clock offset: 3.109 ms
Remote clock offset: -15.658 ms
```

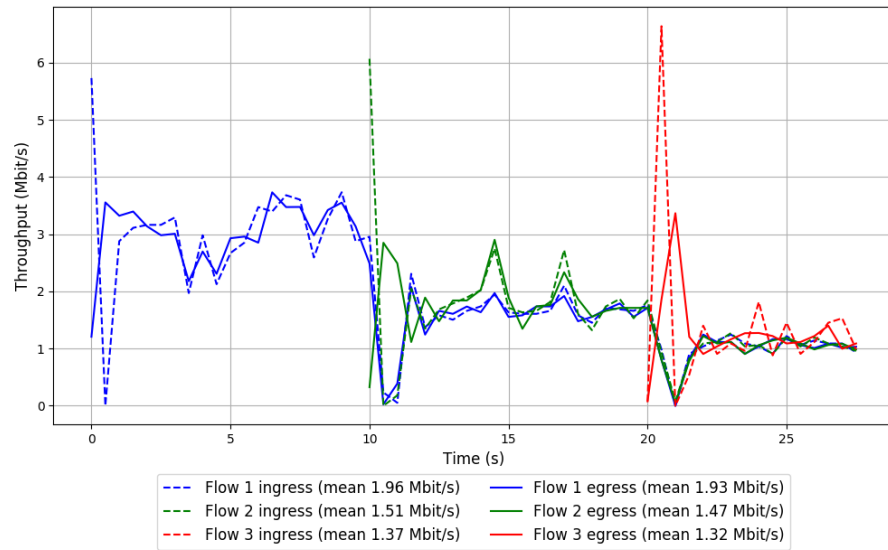# Run 2: Report of TaoVA-100x — Data Link

Flow 1 ingress (mean 1.49 Mbit/s) --- Flow 1 egress (mean 1.68 Mbit/s)
Flow 2 ingress (mean 2.51 Mbit/s) --- Flow 2 egress (mean 2.50 Mbit/s)
Flow 3 ingress (mean 1.96 Mbit/s) --- Flow 3 egress (mean 1.95 Mbit/s)

Flow 1 (95th percentile 348.70 ms) Flow 2 (95th percentile 321.53 ms) Flow 3 (95th percentile 574.24 ms)
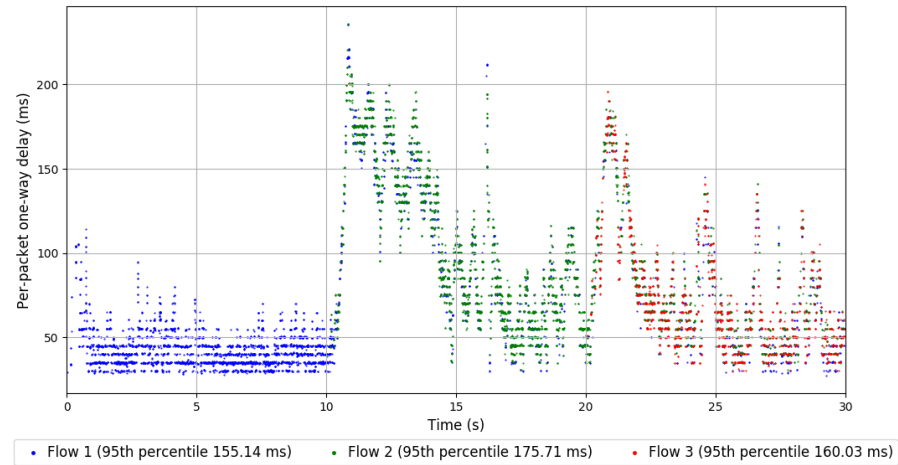
55

```
Run 3: Statistics of TaoVA-100x

Start at: 2018-01-10 16:13:41
End at: 2018-01-10 16:14:11
Local clock offset: 2.965 ms
Remote clock offset: -15.35 ms

# Below is generated by plot.py at 2018-01-10 16:28:42
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.24 Mbit/s
95th percentile per-packet one-way delay: 674.107 ms
Loss rate: 2.25%
-- Flow 1:
Average throughput: 1.93 Mbit/s
95th percentile per-packet one-way delay: 408.488 ms
Loss rate: 1.14%
-- Flow 2:
Average throughput: 1.47 Mbit/s
95th percentile per-packet one-way delay: 763.611 ms
Loss rate: 2.68%
-- Flow 3:
Average throughput: 1.32 Mbit/s
95th percentile per-packet one-way delay: 1013.652 ms
Loss rate: 6.78%
```

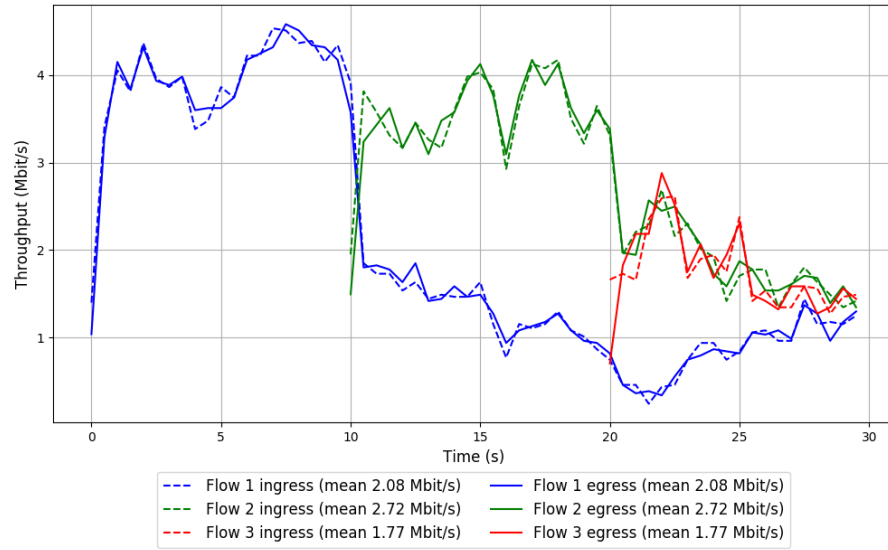# Run 3: Report of TaoVA-100x — Data Link

```
Run 1: Statistics of TCP Vegas

Start at: 2018-01-10 15:44:46
End at: 2018-01-10 15:45:16
Local clock offset: 1.295 ms
Remote clock offset: -14.882 ms


# Below is generated by plot.py at 2018-01-10 16:28:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.48 Mbit/s
95th percentile per-packet one-way delay: 170.378 ms
Loss rate: 0.18%
-- Flow 1:
Average throughput: 2.08 Mbit/s
95th percentile per-packet one-way delay: 155.137 ms
Loss rate: 0.12%
-- Flow 2:
Average throughput: 2.72 Mbit/s
95th percentile per-packet one-way delay: 175.708 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 1.77 Mbit/s
95th percentile per-packet one-way delay: 160.028 ms
Loss rate: 0.61%
```

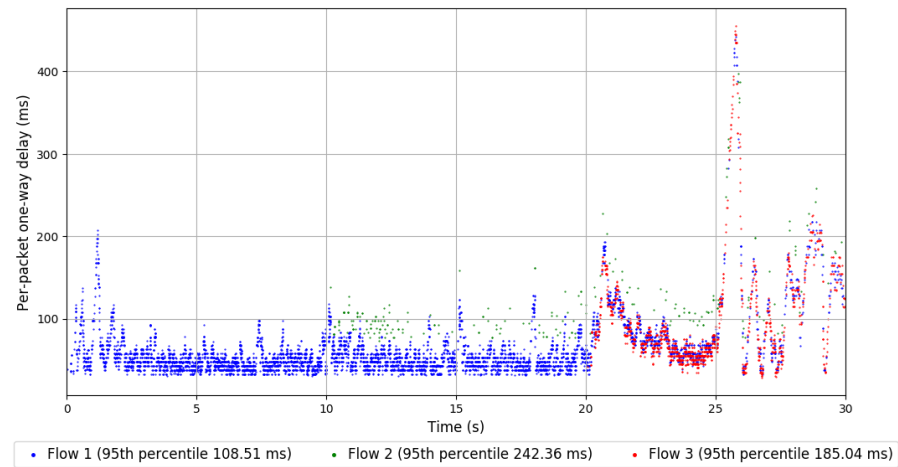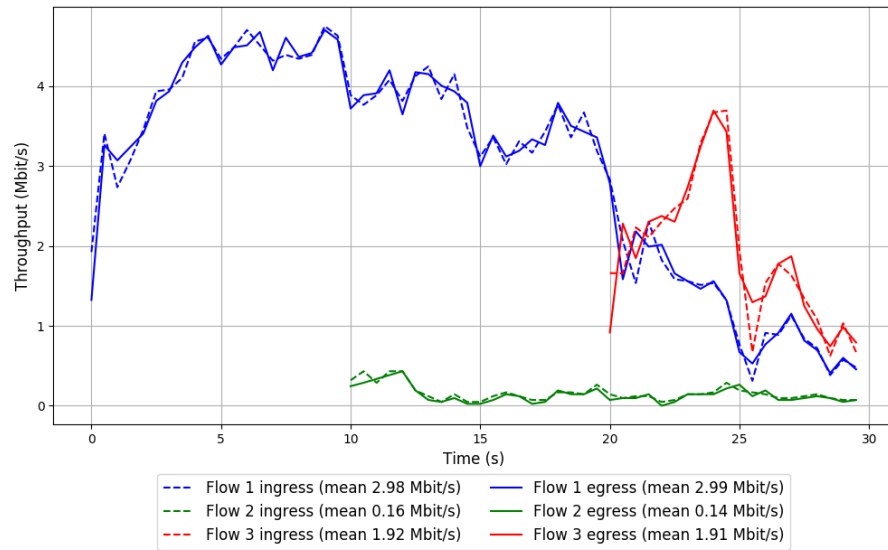Run 1: Report of TCP Vegas — Data Link

```
Run 2: Statistics of TCP Vegas

Start at: 2018-01-10 16:01:24
End at: 2018-01-10 16:01:54
Local clock offset: 2.011 ms
Remote clock offset: -15.329 ms


# Below is generated by plot.py at 2018-01-10 16:28:44
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.70 Mbit/s
95th percentile per-packet one-way delay: 134.788 ms
Loss rate: 0.53%
-- Flow 1:
Average throughput: 2.99 Mbit/s
95th percentile per-packet one-way delay: 108.508 ms
Loss rate: 0.09%
-- Flow 2:
Average throughput: 0.14 Mbit/s
95th percentile per-packet one-way delay: 242.359 ms
Loss rate: 13.27%
-- Flow 3:
Average throughput: 1.91 Mbit/s
95th percentile per-packet one-way delay: 185.045 ms
Loss rate: 0.44%
```
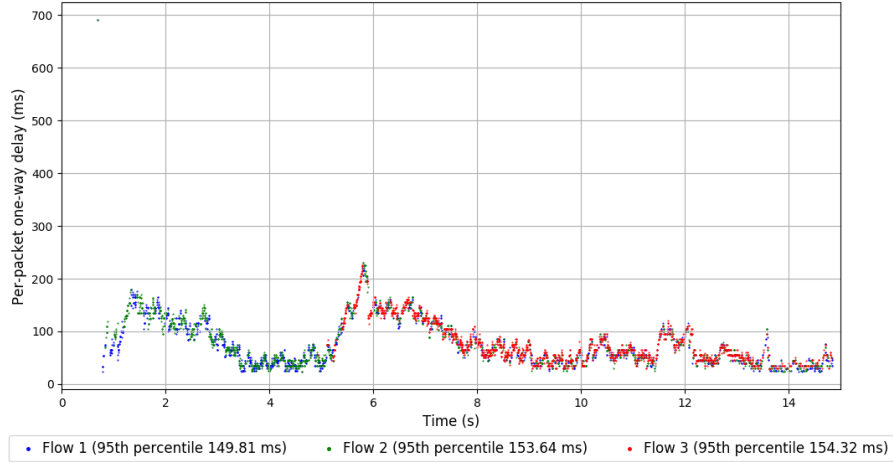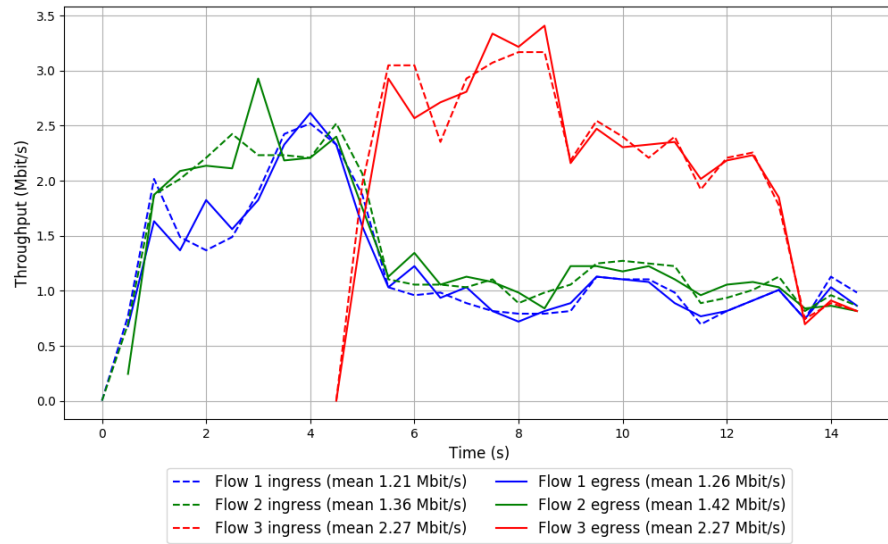
Run 2: Report of TCP Vegas — Data Link

```
Run 3: Statistics of TCP Vegas

Start at: 2018-01-10 16:18:11
End at: 2018-01-10 16:18:41
Local clock offset: 4.11 ms
Remote clock offset: -17.88 ms
```
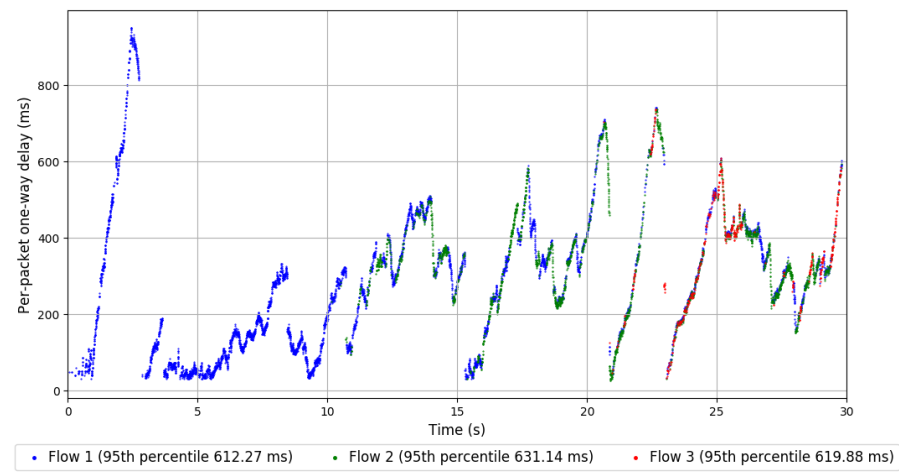
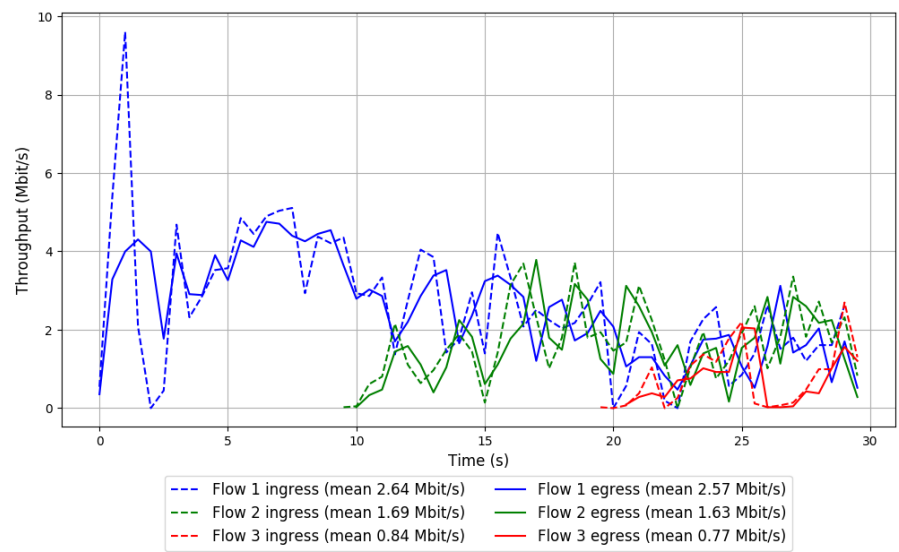Run 3: Report of TCP Vegas — Data Link

```
Run 1: Statistics of Verus

Start at: 2018-01-10 15:50:18
End at: 2018-01-10 15:50:48
Local clock offset: 1.604 ms
Remote clock offset: -16.697 ms


# Below is generated by plot.py at 2018-01-10 16:28:45
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.89 Mbit/s
95th percentile per-packet one-way delay: 616.006 ms
Loss rate: 2.98%
-- Flow 1:
Average throughput: 2.57 Mbit/s
95th percentile per-packet one-way delay: 612.275 ms
Loss rate: 1.37%
-- Flow 2:
Average throughput: 1.63 Mbit/s
95th percentile per-packet one-way delay: 631.137 ms
Loss rate: 4.35%
-- Flow 3:
Average throughput: 0.77 Mbit/s
95th percentile per-packet one-way delay: 619.884 ms
Loss rate: 12.70%
```

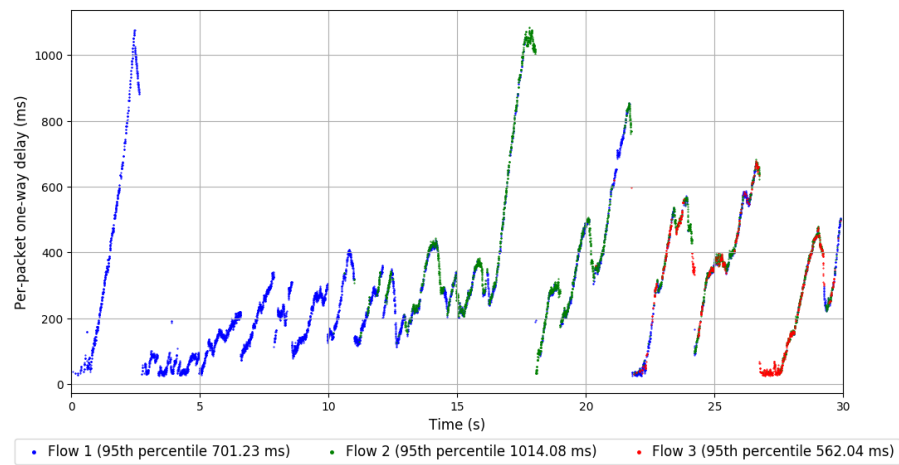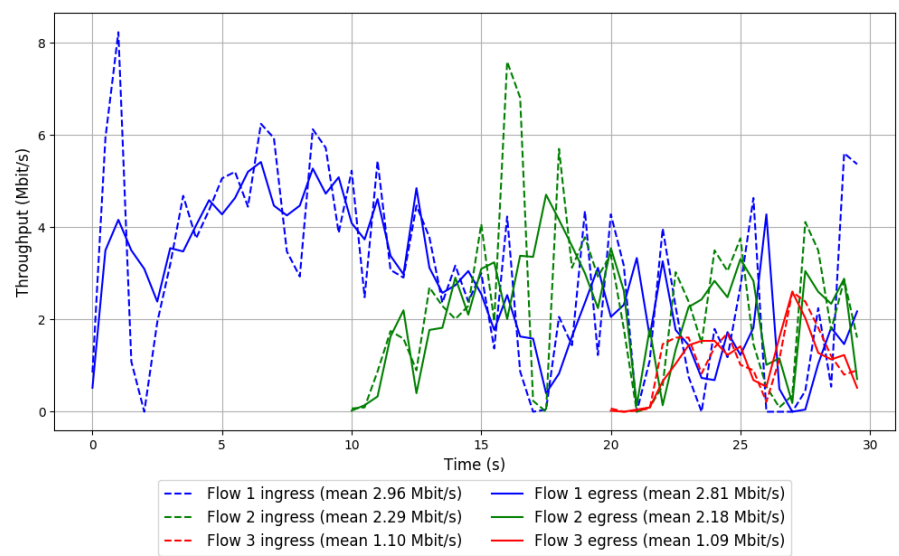Run 1: Report of Verus — Data Link

```
Run 2: Statistics of Verus

Start at: 2018-01-10 16:07:00
End at: 2018-01-10 16:07:30
Local clock offset: 2.396 ms
Remote clock offset: -17.428 ms


# Below is generated by plot.py at 2018-01-10 16:28:46
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.59 Mbit/s
95th percentile per-packet one-way delay: 796.955 ms
Loss rate: 5.17%
-- Flow 1:
Average throughput: 2.81 Mbit/s
95th percentile per-packet one-way delay: 701.234 ms
Loss rate: 5.39%
-- Flow 2:
Average throughput: 2.18 Mbit/s
95th percentile per-packet one-way delay: 1014.081 ms
Loss rate: 4.77%
-- Flow 3:
Average throughput: 1.09 Mbit/s
95th percentile per-packet one-way delay: 562.045 ms
Loss rate: 5.00%
```

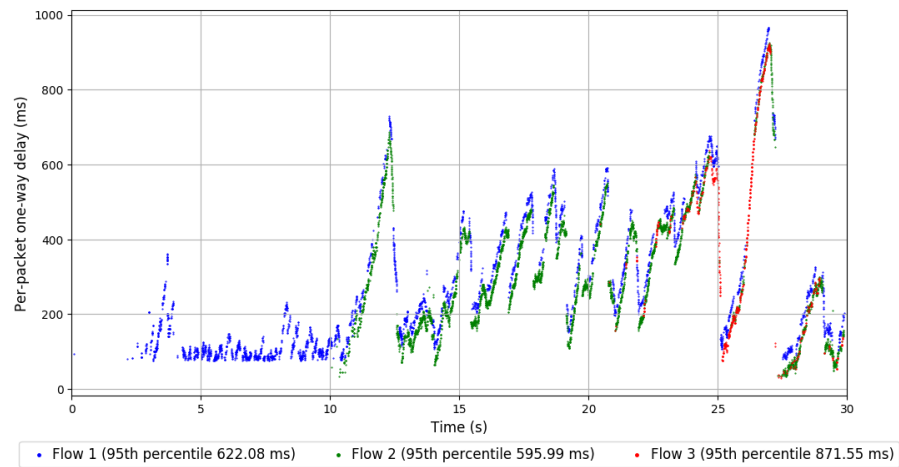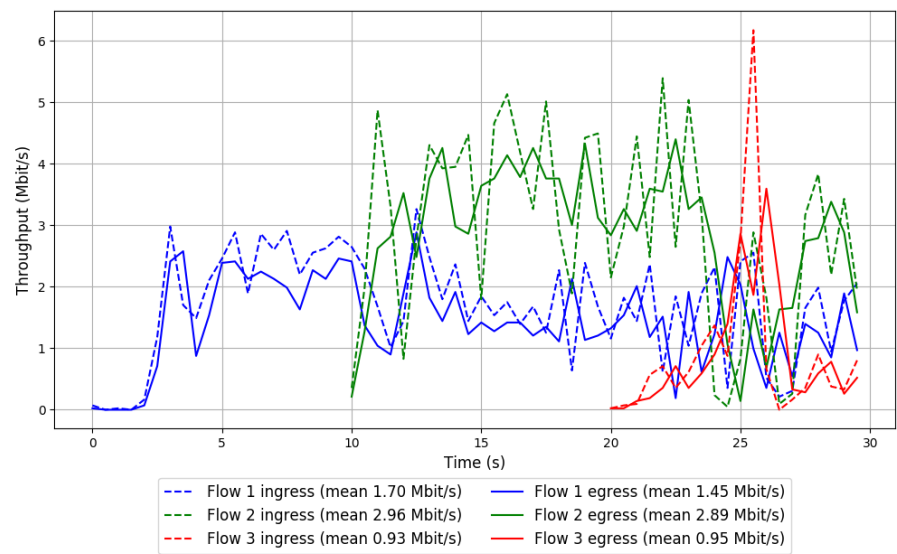Run 2: Report of Verus — Data Link

```
Run 3: Statistics of Verus

Start at: 2018-01-10 16:23:47
End at: 2018-01-10 16:24:17
Local clock offset: 2.514 ms
Remote clock offset: -15.844 ms


# Below is generated by plot.py at 2018-01-10 16:28:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.66 Mbit/s
95th percentile per-packet one-way delay: 634.509 ms
Loss rate: 8.12%
-- Flow 1:
Average throughput: 1.45 Mbit/s
95th percentile per-packet one-way delay: 622.078 ms
Loss rate: 15.31%
-- Flow 2:
Average throughput: 2.89 Mbit/s
95th percentile per-packet one-way delay: 595.994 ms
Loss rate: 2.79%
-- Flow 3:
Average throughput: 0.95 Mbit/s
95th percentile per-packet one-way delay: 871.555 ms
Loss rate: 2.46%
```
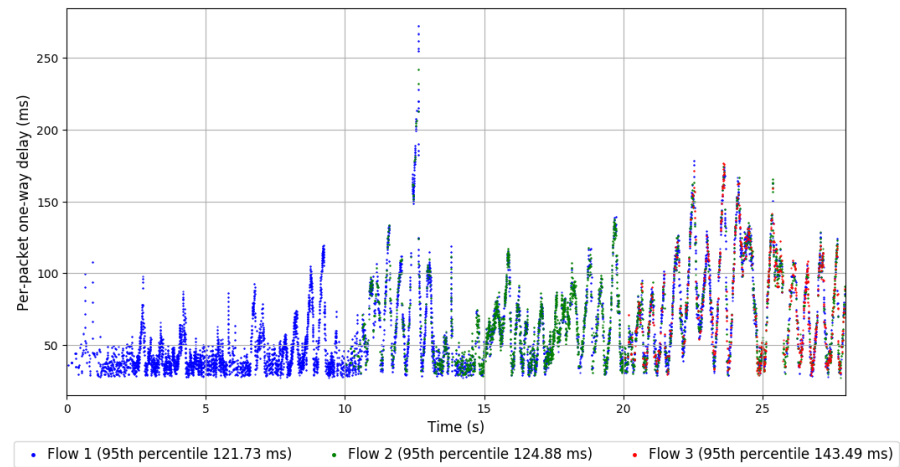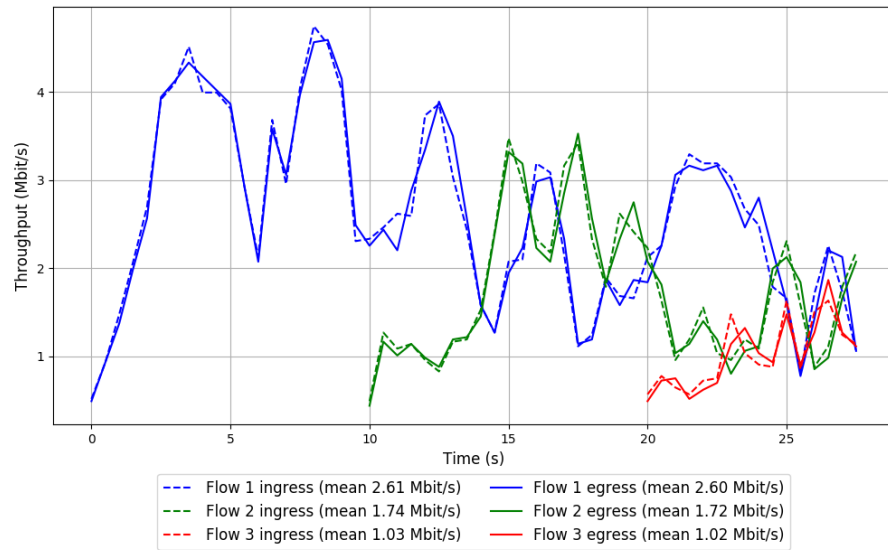
Run 3: Report of Verus — Data Link

```
Run 1: Statistics of Copa

Start at: 2018-01-10 15:45:53
End at: 2018-01-10 15:46:23
Local clock offset: -0.116 ms
Remote clock offset: -14.807 ms

# Below is generated by plot.py at 2018-01-10 16:28:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.00 Mbit/s
95th percentile per-packet one-way delay: 124.873 ms
Loss rate: 0.46%
-- Flow 1:
Average throughput: 2.60 Mbit/s
95th percentile per-packet one-way delay: 121.735 ms
Loss rate: 0.16%
-- Flow 2:
Average throughput: 1.72 Mbit/s
95th percentile per-packet one-way delay: 124.878 ms
Loss rate: 0.96%
-- Flow 3:
Average throughput: 1.02 Mbit/s
95th percentile per-packet one-way delay: 143.487 ms
Loss rate: 1.27%
```

Run 1: Report of Copa — Data Link

Flow 1 ingress (mean 2.61 Mbit/s)   Flow 1 egress (mean 2.60 Mbit/s)
Flow 2 ingress (mean 1.74 Mbit/s)   Flow 2 egress (mean 1.72 Mbit/s)
Flow 3 ingress (mean 1.03 Mbit/s)   Flow 3 egress (mean 1.02 Mbit/s)

Flow 1 (95th percentile 121.73 ms)   Flow 2 (95th percentile 124.88 ms)   Flow 3 (95th percentile 143.49 ms)
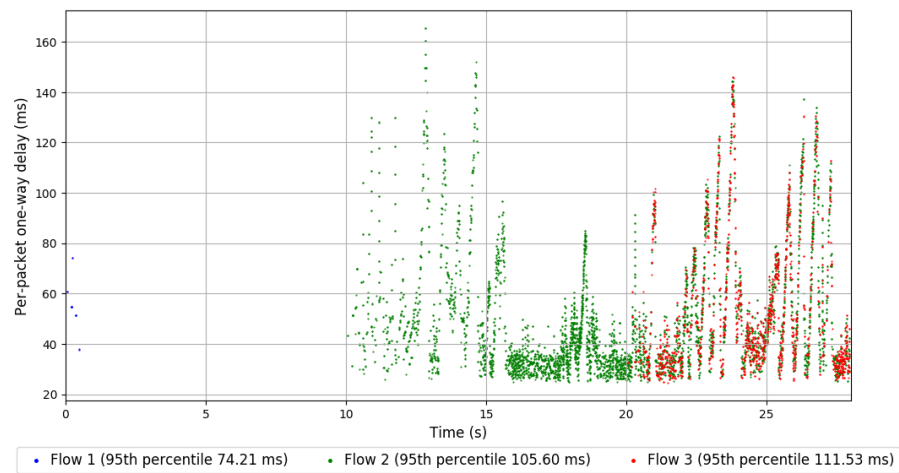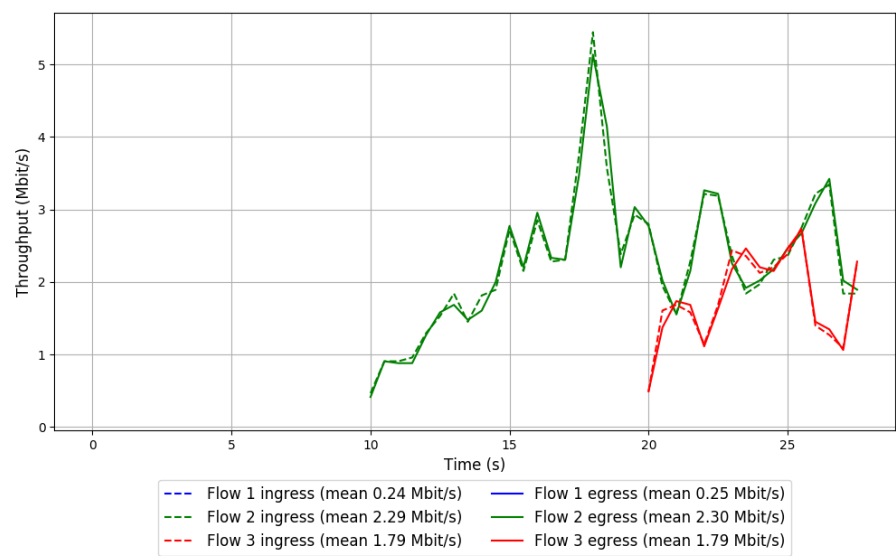
```
Run 2: Statistics of Copa

Start at: 2018-01-10 16:02:30
End at: 2018-01-10 16:03:00
Local clock offset: 2.267 ms
Remote clock offset: -15.413 ms

# Below is generated by plot.py at 2018-01-10 16:28:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 1.98 Mbit/s
95th percentile per-packet one-way delay: 106.916 ms
Loss rate: 0.21%
-- Flow 1:
Average throughput: 0.25 Mbit/s
95th percentile per-packet one-way delay: 74.213 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 2.30 Mbit/s
95th percentile per-packet one-way delay: 105.599 ms
Loss rate: 0.13%
-- Flow 3:
Average throughput: 1.79 Mbit/s
95th percentile per-packet one-way delay: 111.527 ms
Loss rate: 0.45%
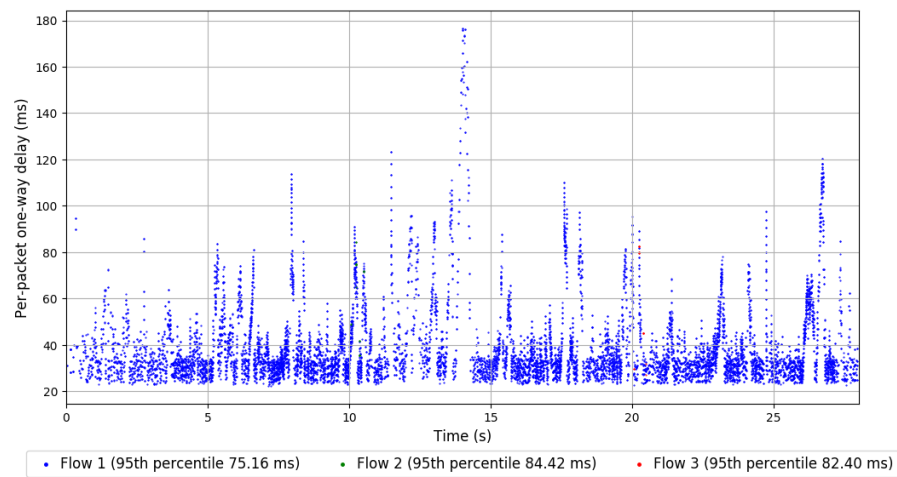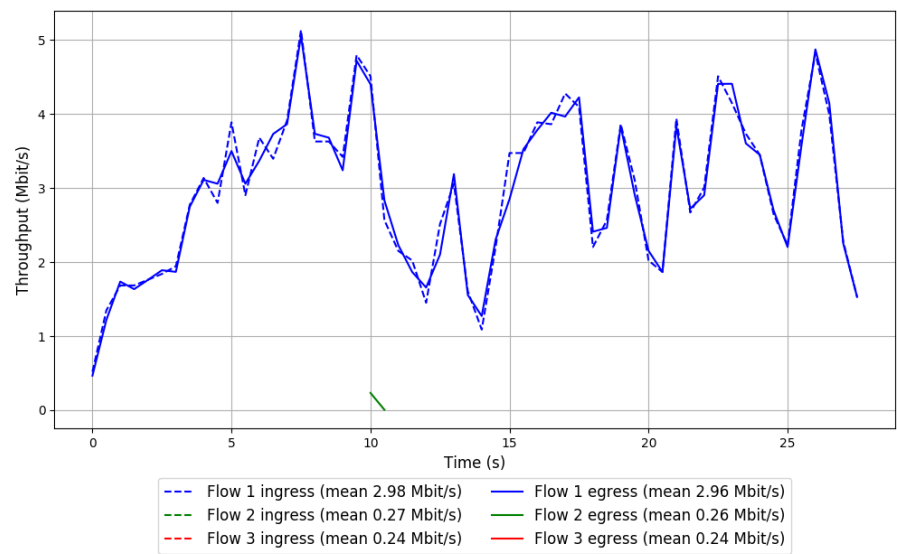```

Run 2: Report of Copa — Data Link

```
Run 3: Statistics of Copa

Start at: 2018-01-10 16:19:19
End at: 2018-01-10 16:19:49
Local clock offset: 3.607 ms
Remote clock offset: -18.772 ms


# Below is generated by plot.py at 2018-01-10 16:28:57
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.97 Mbit/s
95th percentile per-packet one-way delay: 75.347 ms
Loss rate: 0.61%
-- Flow 1:
Average throughput: 2.96 Mbit/s
95th percentile per-packet one-way delay: 75.163 ms
Loss rate: 0.61%
-- Flow 2:
Average throughput: 0.26 Mbit/s
95th percentile per-packet one-way delay: 84.422 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 0.24 Mbit/s
95th percentile per-packet one-way delay: 82.403 ms
Loss rate: 0.00%
```

Run 3: Report of Copa — Data Link

Flow 1 ingress (mean 2.98 Mbit/s) — Flow 1 egress (mean 2.96 Mbit/s)
Flow 2 ingress (mean 0.27 Mbit/s) — Flow 2 egress (mean 0.26 Mbit/s)
Flow 3 ingress (mean 0.24 Mbit/s) — Flow 3 egress (mean 0.24 Mbit/s)

Flow 1 (95th percentile 75.16 ms) • Flow 2 (95th percentile 84.42 ms) • Flow 3 (95th percentile 82.40 ms)
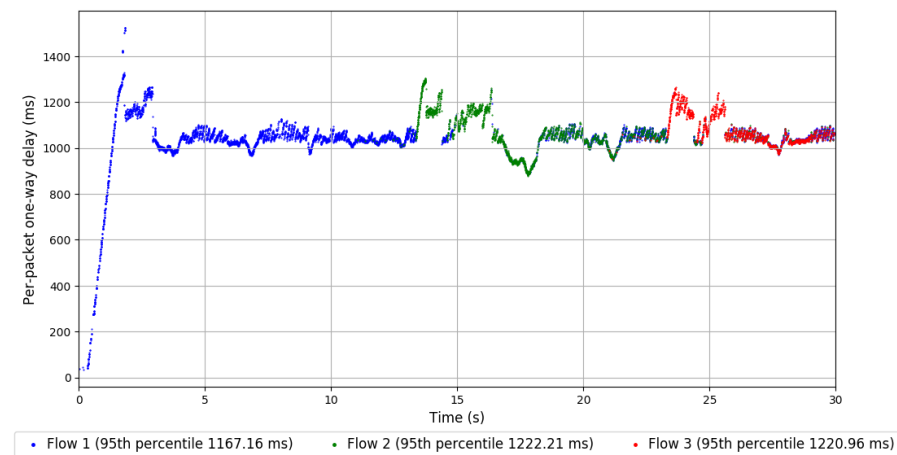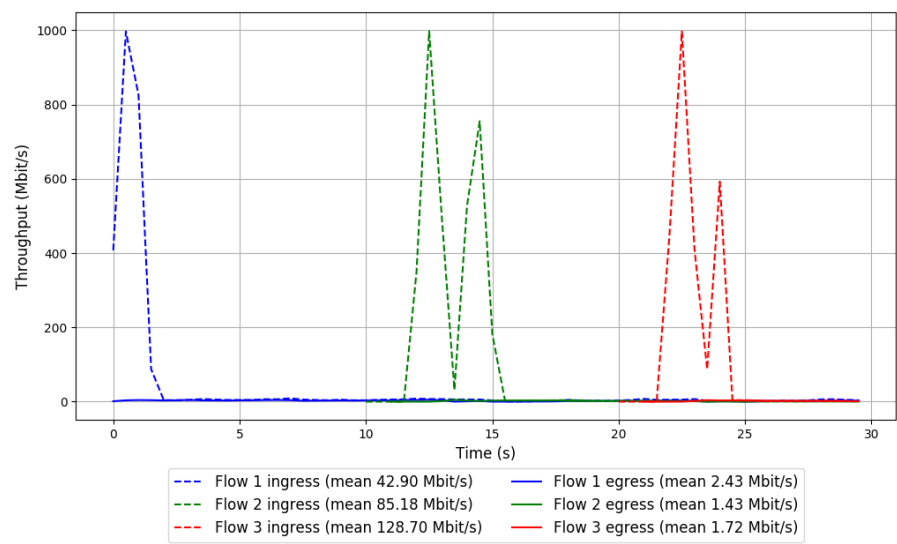
```
Run 1: Statistics of FillP

Start at: 2018-01-10 15:51:25
End at: 2018-01-10 15:51:55
Local clock offset: 2.057 ms
Remote clock offset: -16.218 ms


# Below is generated by plot.py at 2018-01-10 16:29:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.85 Mbit/s
95th percentile per-packet one-way delay: 1199.563 ms
Loss rate: 97.30%
-- Flow 1:
Average throughput: 2.43 Mbit/s
95th percentile per-packet one-way delay: 1167.165 ms
Loss rate: 94.33%
-- Flow 2:
Average throughput: 1.43 Mbit/s
95th percentile per-packet one-way delay: 1222.214 ms
Loss rate: 98.41%
-- Flow 3:
Average throughput: 1.72 Mbit/s
95th percentile per-packet one-way delay: 1220.958 ms
Loss rate: 98.80%
```
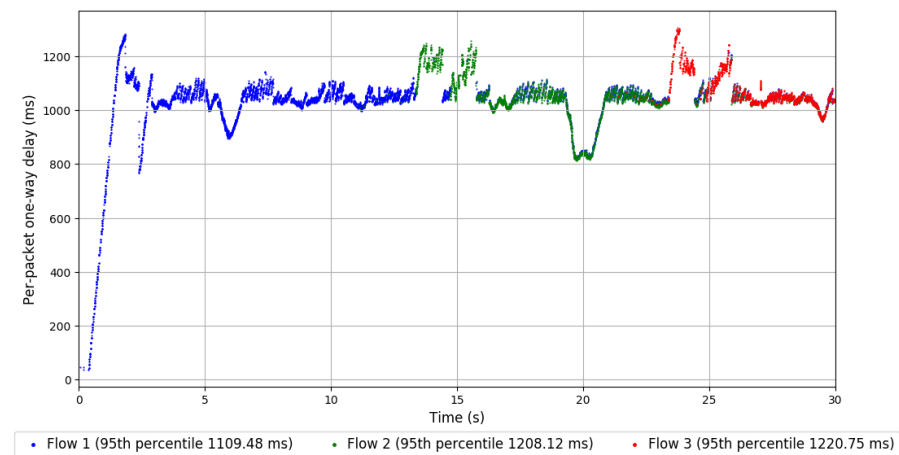
Run 1: Report of FillP — Data Link

Flow 1 ingress (mean 42.90 Mbit/s) —— Flow 1 egress (mean 2.43 Mbit/s)
Flow 2 ingress (mean 85.18 Mbit/s) —— Flow 2 egress (mean 1.43 Mbit/s)
Flow 3 ingress (mean 128.70 Mbit/s) —— Flow 3 egress (mean 1.72 Mbit/s)

Flow 1 (95th percentile 1167.16 ms) • Flow 2 (95th percentile 1222.21 ms) • Flow 3 (95th percentile 1220.96 ms)
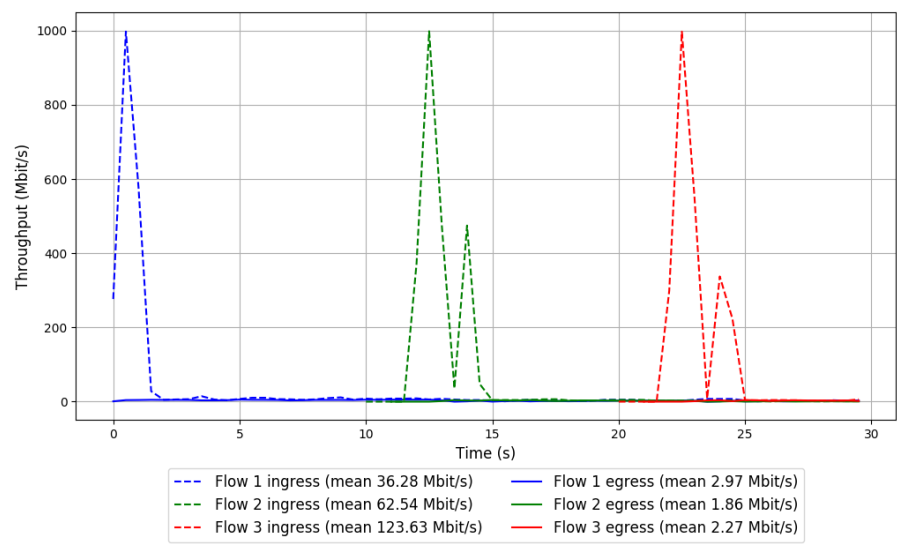
```
Run 2: Statistics of FillP

Start at: 2018-01-10 16:08:07
End at: 2018-01-10 16:08:37
Local clock offset: 1.348 ms
Remote clock offset: -17.274 ms

# Below is generated by plot.py at 2018-01-10 16:29:05
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.82 Mbit/s
95th percentile per-packet one-way delay: 1176.895 ms
Loss rate: 95.95%
-- Flow 1:
Average throughput: 2.97 Mbit/s
95th percentile per-packet one-way delay: 1109.485 ms
Loss rate: 91.83%
-- Flow 2:
Average throughput: 1.86 Mbit/s
95th percentile per-packet one-way delay: 1208.115 ms
Loss rate: 97.19%
-- Flow 3:
Average throughput: 2.27 Mbit/s
95th percentile per-packet one-way delay: 1220.754 ms
Loss rate: 98.36%
```

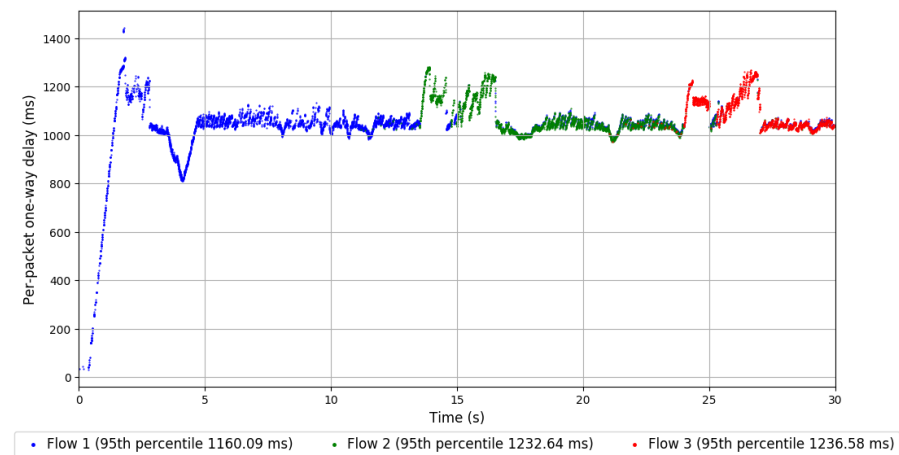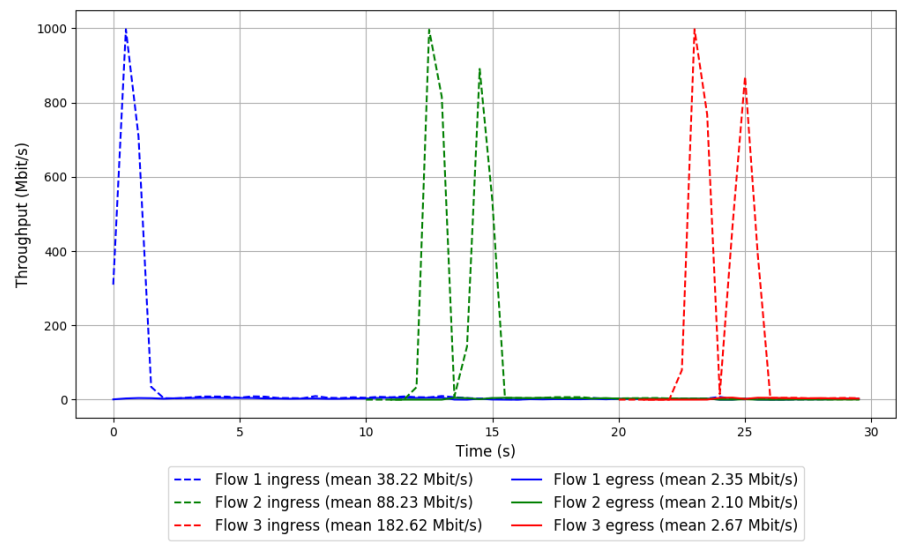Run 2: Report of FillP — Data Link

```
Run 3: Statistics of FillP

Start at: 2018-01-10 16:24:54
End at: 2018-01-10 16:25:24
Local clock offset: 1.705 ms
Remote clock offset: -17.251 ms


# Below is generated by plot.py at 2018-01-10 16:29:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.47 Mbit/s
95th percentile per-packet one-way delay: 1210.766 ms
Loss rate: 97.17%
-- Flow 1:
Average throughput: 2.35 Mbit/s
95th percentile per-packet one-way delay: 1160.092 ms
Loss rate: 93.85%
-- Flow 2:
Average throughput: 2.10 Mbit/s
95th percentile per-packet one-way delay: 1232.638 ms
Loss rate: 97.76%
-- Flow 3:
Average throughput: 2.67 Mbit/s
95th percentile per-packet one-way delay: 1236.580 ms
Loss rate: 98.69%
```

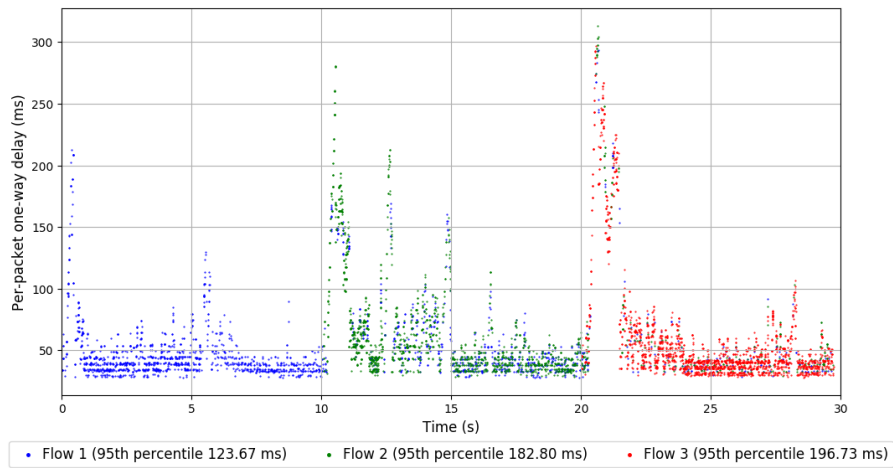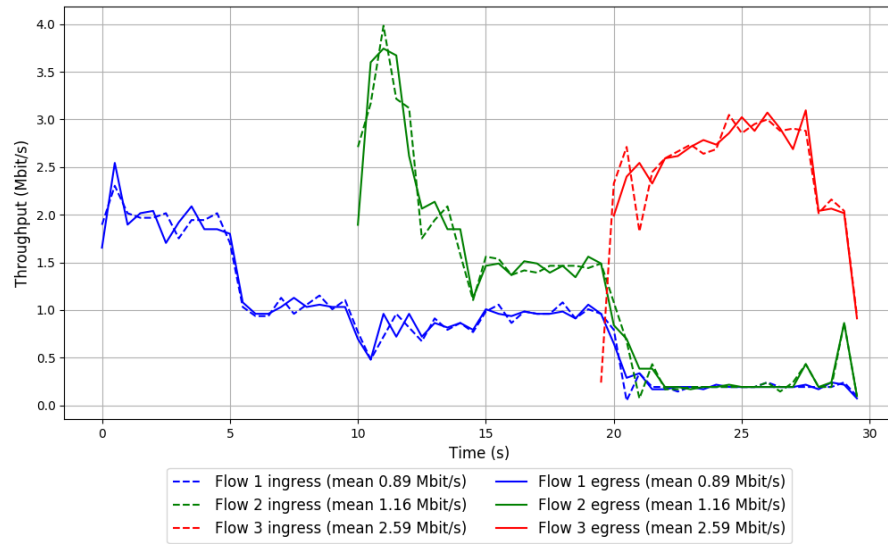Run 3: Report of FillP — Data Link

```
Run 1: Statistics of Indigo

Start at: 2018-01-10 15:41:27
End at: 2018-01-10 15:41:57
Local clock offset: 1.628 ms
Remote clock offset: -16.83 ms


# Below is generated by plot.py at 2018-01-10 16:29:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.50 Mbit/s
95th percentile per-packet one-way delay: 173.650 ms
Loss rate: 0.26%
-- Flow 1:
Average throughput: 0.89 Mbit/s
95th percentile per-packet one-way delay: 123.674 ms
Loss rate: 0.09%
-- Flow 2:
Average throughput: 1.16 Mbit/s
95th percentile per-packet one-way delay: 182.797 ms
Loss rate: 0.11%
-- Flow 3:
Average throughput: 2.59 Mbit/s
95th percentile per-packet one-way delay: 196.734 ms
Loss rate: 0.57%
```
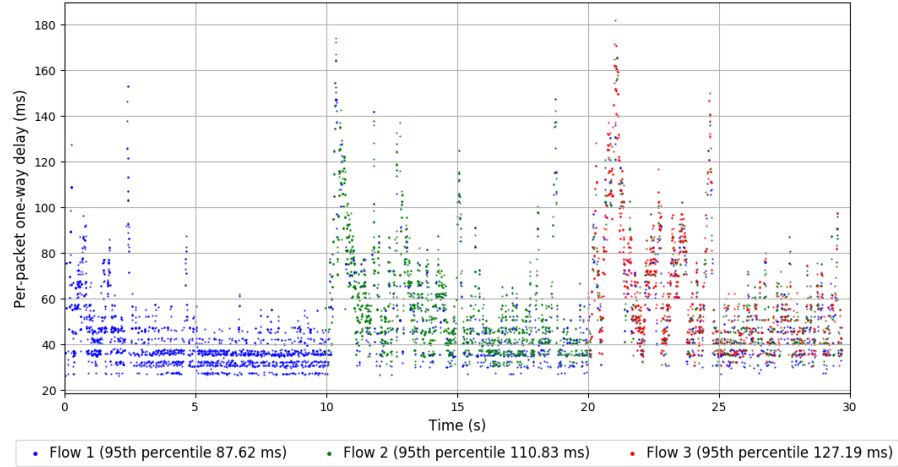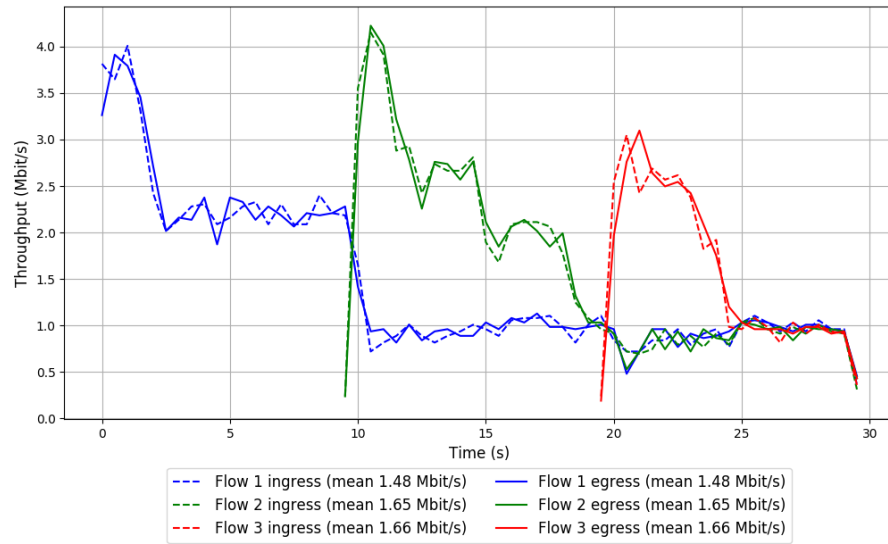
Run 1: Report of Indigo — Data Link

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```
Run 2: Statistics of Indigo

Start at: 2018-01-10 15:58:04
End at: 2018-01-10 15:58:34
Local clock offset: 0.445 ms
Remote clock offset: -15.797 ms


# Below is generated by plot.py at 2018-01-10 16:29:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.12 Mbit/s
95th percentile per-packet one-way delay: 107.378 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 1.48 Mbit/s
95th percentile per-packet one-way delay: 87.625 ms
Loss rate: 0.03%
-- Flow 2:
Average throughput: 1.65 Mbit/s
95th percentile per-packet one-way delay: 110.832 ms
Loss rate: 0.00%
-- Flow 3:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 127.185 ms
Loss rate: 0.00%
```

Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2018-01-10 16:14:48
End at: 2018-01-10 16:15:18
Local clock offset: 2.077 ms
Remote clock offset: -16.774 ms


# Below is generated by plot.py at 2018-01-10 16:29:06
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.97 Mbit/s
95th percentile per-packet one-way delay: 116.477 ms
Loss rate: 0.14%
-- Flow 1:
Average throughput: 0.85 Mbit/s
95th percentile per-packet one-way delay: 101.827 ms
Loss rate: 0.10%
-- Flow 2:
Average throughput: 1.77 Mbit/s
95th percentile per-packet one-way delay: 104.378 ms
Loss rate: 0.03%
-- Flow 3:
Average throughput: 2.92 Mbit/s
95th percentile per-packet one-way delay: 135.356 ms
Loss rate: 0.30%
```

Run 3: Report of Indigo — Data Link