

Pantheon Report

Generated at 2018-01-26 05:03:18 (UTC).

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

Repeated the test of 15 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).

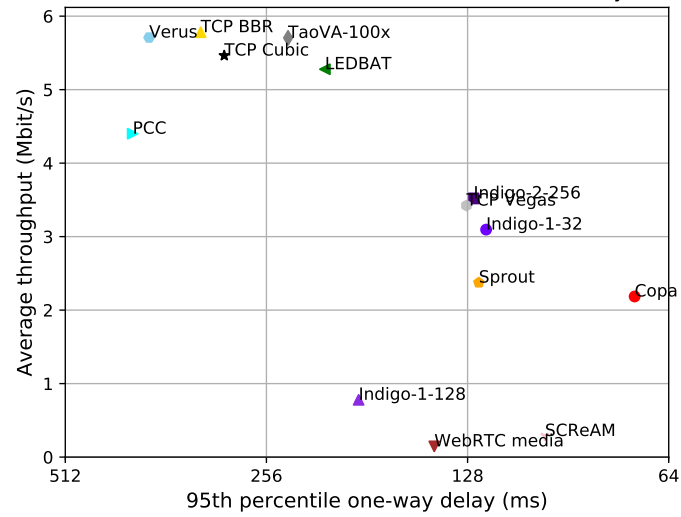
Tested BBR with qdisc of Fair Queuing (**fq**), and other schemes with the default Linux qdisc (**pfifo_fast**).

NTP offsets were measured against `time.stanford.edu` and have been applied to correct the timestamps in logs.

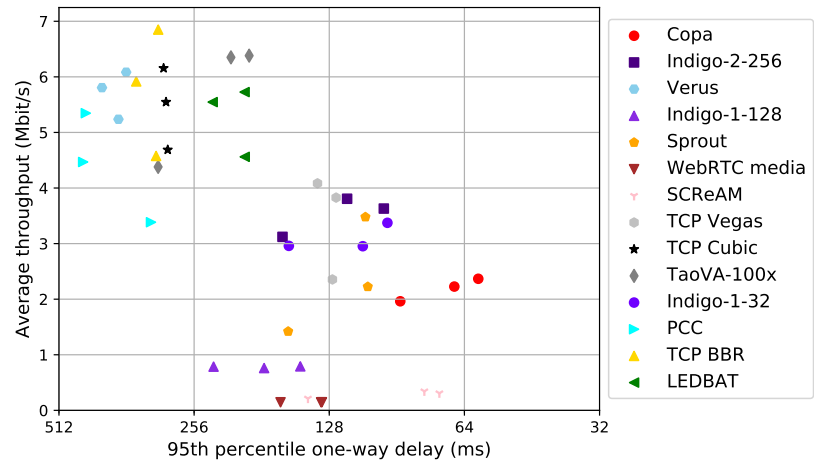
Git summary:

```
branch: master @ f23294ec38436c9f802847d477a41b7343ec76e6
third_party/calibrated_koho @ 3cb73c0d1c0322cdfae446ea37a522e53227db50
  M datagrump/sender.cc
third_party/fillp @ ec9585325218d5048c4d4152fa42240af54c6e67
third_party/genericCC @ 80b516c448f795fd6e9675f7177b69c622f07da8
third_party/indigo @ a9b2060d39e4da2e8987e893e3eca2a6c7cd0ab9
third_party/indigo-1-layer-128-unit @ 3ae9e4ef4230db7484501f82ce8b377695f2f66d
third_party/indigo-1-layer-32-unit @ 2601c92e4aa9d58d38dc4dfe0ecd9c077e64d
third_party/indigo-1-layer-32-unit-no-calib @ 1f3a7f75b41135ed5b540c0fd3505939528e2a5f
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/vivace @ 423cbca3e8ea1d599e7b5cf725835e8a2b6bfac6
third_party/webrtc @ a488197ddd041ace68a42849b2540ad834825f42
```

test from Stanford ppp0 to AWS California 1 Ethernet, 3 runs of 30s each per scheme
3 flows with 10s interval between flows (mean of all runs by scheme)



test from Stanford ppp0 to AWS California 1 Ethernet, 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	3.40	2.56	2.02	307.90	320.89	382.57	3.14	5.52	15.33
TCP Cubic	3	3.85	1.77	1.40	294.42	298.16	298.36	1.44	3.12	4.96
LEDBAT	3	3.01	2.56	1.94	197.17	218.68	218.65	0.14	0.78	2.69
PCC	3	2.97	1.56	1.22	397.43	406.18	474.34	18.27	26.99	50.18
QUIC Cubic	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SCReAM	3	0.11	0.17	0.19	108.70	85.80	82.68	0.56	0.82	0.29
WebRTC media	3	0.05	0.05	0.05	128.58	148.03	147.60	0.02	0.10	0.20
Sprout	3	1.24	1.10	1.24	125.86	123.79	113.85	0.66	1.04	1.02
TaoVA-100x	3	3.36	2.53	2.00	228.76	243.91	252.59	1.18	2.79	6.05
TCP Vegas	3	1.61	1.69	2.08	140.66	113.83	99.52	1.07	0.23	0.56
Verus	3	3.74	2.38	1.28	372.32	393.53	406.08	9.53	14.16	25.42
Copa	3	1.07	1.08	1.22	73.47	68.31	69.08	0.44	0.42	2.02
Indigo-2-256	3	1.62	1.25	3.22	122.59	103.35	142.19	0.43	0.35	0.78
Indigo-1-32	3	1.49	1.60	1.71	116.13	106.88	147.36	1.15	0.93	1.52
Indigo-1-128	3	0.34	0.43	0.47	159.99	187.10	202.17	2.80	5.83	3.10

Run 1: Statistics of TCP BBR

Start at: 2018-01-26 00:55:22

End at: 2018-01-26 00:55:52

Local clock offset: 0.486 ms

Below is generated by plot.py at 2018-01-26 05:02:37

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.92 Mbit/s

95th percentile per-packet one-way delay: 344.453 ms

Loss rate: 4.64%

-- Flow 1:

Average throughput: 3.54 Mbit/s

95th percentile per-packet one-way delay: 329.481 ms

Loss rate: 3.59%

-- Flow 2:

Average throughput: 2.72 Mbit/s

95th percentile per-packet one-way delay: 345.127 ms

Loss rate: 4.62%

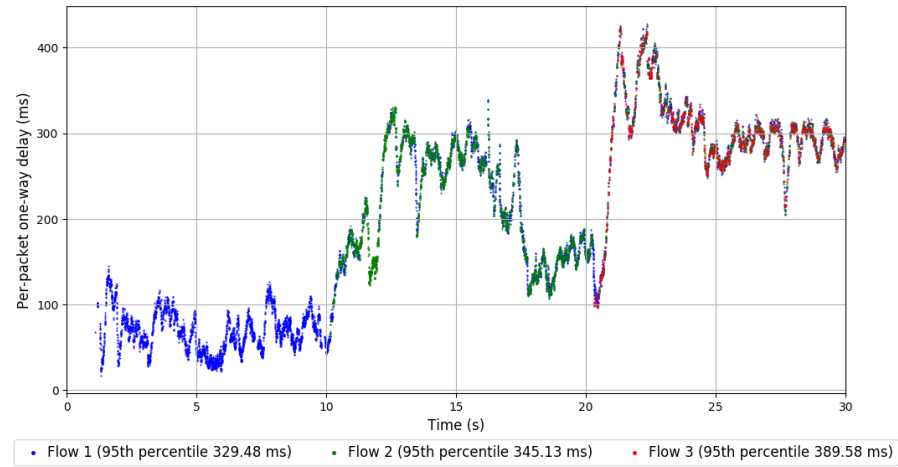
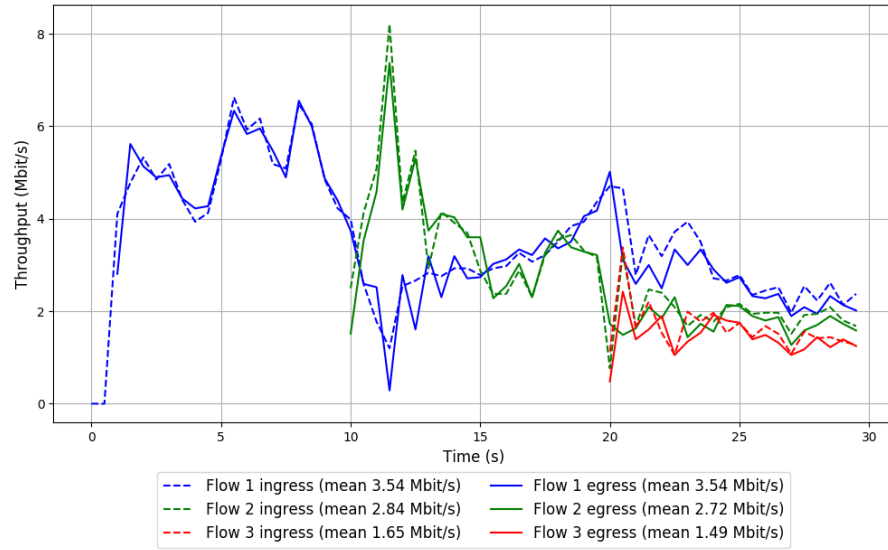
-- Flow 3:

Average throughput: 1.49 Mbit/s

95th percentile per-packet one-way delay: 389.580 ms

Loss rate: 11.52%

Run 1: Report of TCP BBR — Data Link



Run 2: Statistics of TCP BBR

Start at: 2018-01-26 01:42:15

End at: 2018-01-26 01:42:45

Local clock offset: -2.131 ms

Below is generated by plot.py at 2018-01-26 05:02:39

Datalink statistics

-- Total of 3 flows:

Average throughput: 6.85 Mbit/s

95th percentile per-packet one-way delay: 307.759 ms

Loss rate: 2.32%

-- Flow 1:

Average throughput: 3.99 Mbit/s

95th percentile per-packet one-way delay: 290.263 ms

Loss rate: 1.08%

-- Flow 2:

Average throughput: 2.92 Mbit/s

95th percentile per-packet one-way delay: 307.457 ms

Loss rate: 2.44%

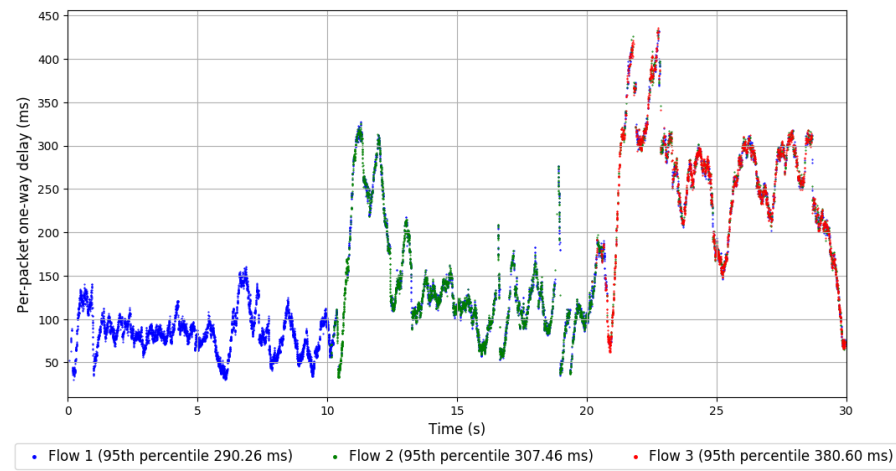
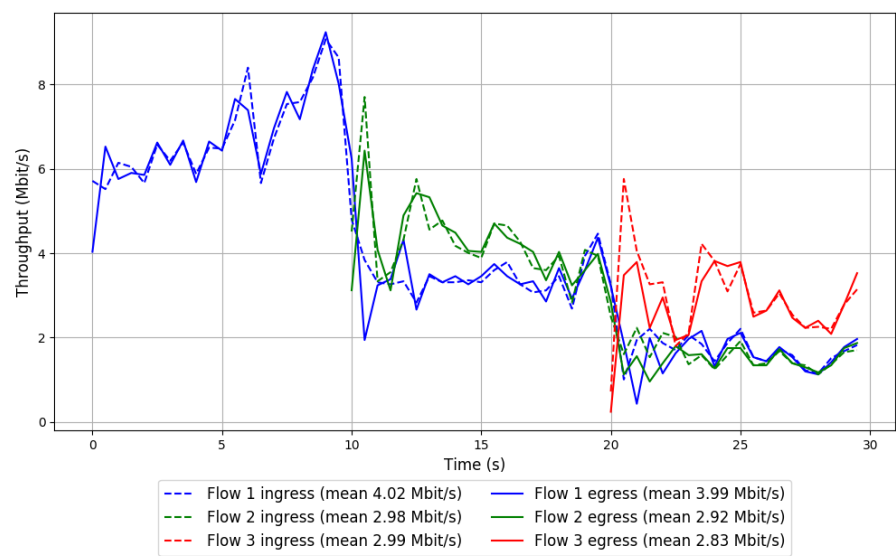
-- Flow 3:

Average throughput: 2.83 Mbit/s

95th percentile per-packet one-way delay: 380.599 ms

Loss rate: 7.16%

Run 2: Report of TCP BBR — Data Link



Run 3: Statistics of TCP BBR

Start at: 2018-01-26 02:29:13

End at: 2018-01-26 02:29:43

Local clock offset: 4.186 ms

Below is generated by plot.py at 2018-01-26 05:02:39

Datalink statistics

-- Total of 3 flows:

Average throughput: 4.58 Mbit/s

95th percentile per-packet one-way delay: 311.128 ms

Loss rate: 9.62%

-- Flow 1:

Average throughput: 2.67 Mbit/s

95th percentile per-packet one-way delay: 303.945 ms

Loss rate: 4.74%

-- Flow 2:

Average throughput: 2.03 Mbit/s

95th percentile per-packet one-way delay: 310.075 ms

Loss rate: 9.50%

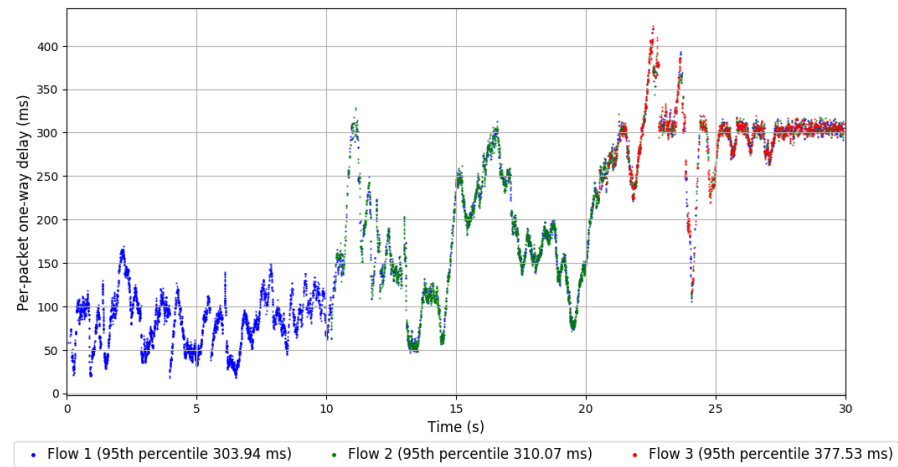
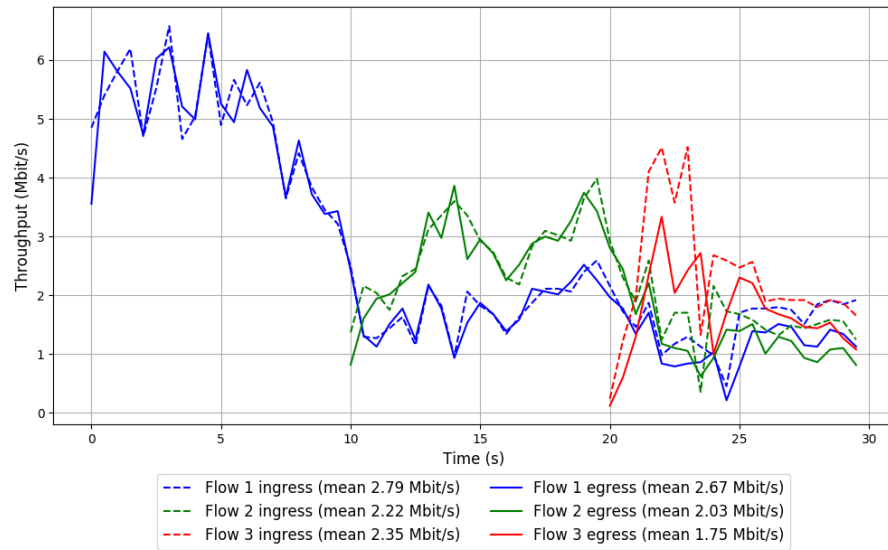
-- Flow 3:

Average throughput: 1.75 Mbit/s

95th percentile per-packet one-way delay: 377.533 ms

Loss rate: 27.30%

Run 3: Report of TCP BBR — Data Link



Run 1: Statistics of TCP Cubic

Start at: 2018-01-26 00:58:17

End at: 2018-01-26 00:58:47

Local clock offset: 1.333 ms

Below is generated by plot.py at 2018-01-26 05:02:39

Datalink statistics

-- Total of 3 flows:

Average throughput: 4.69 Mbit/s

95th percentile per-packet one-way delay: 293.123 ms

Loss rate: 2.14%

-- Flow 1:

Average throughput: 3.49 Mbit/s

95th percentile per-packet one-way delay: 292.476 ms

Loss rate: 1.74%

-- Flow 2:

Average throughput: 0.95 Mbit/s

95th percentile per-packet one-way delay: 293.574 ms

Loss rate: 3.58%

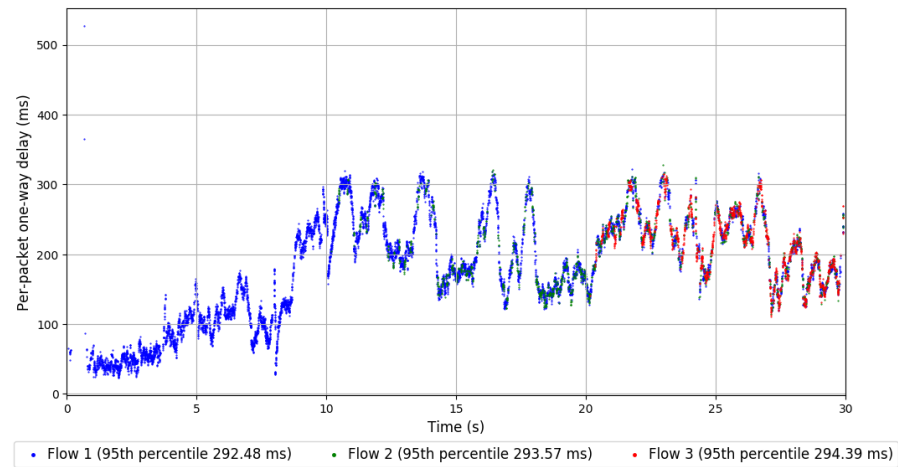
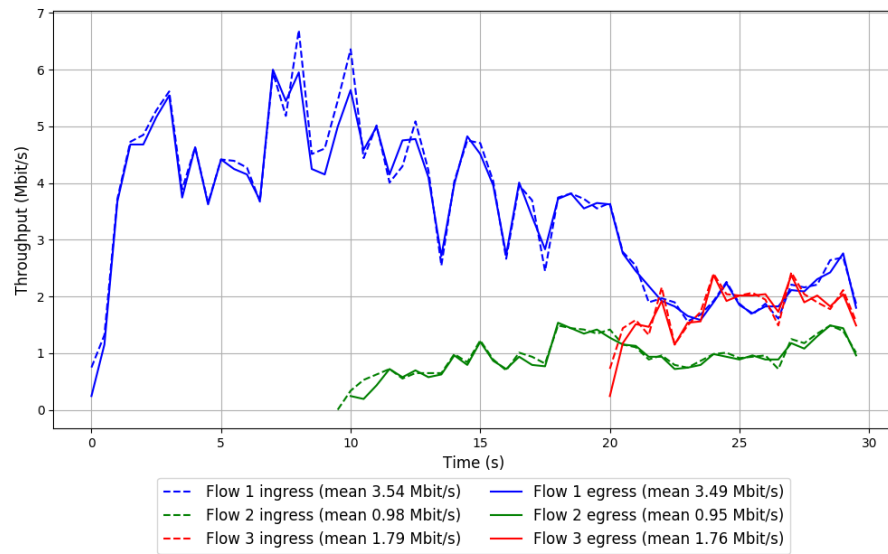
-- Flow 3:

Average throughput: 1.76 Mbit/s

95th percentile per-packet one-way delay: 294.394 ms

Loss rate: 2.99%

Run 1: Report of TCP Cubic — Data Link



Run 2: Statistics of TCP Cubic

Start at: 2018-01-26 01:45:11

End at: 2018-01-26 01:45:41

Local clock offset: -2.262 ms

Below is generated by plot.py at 2018-01-26 05:02:39

Datalink statistics

-- Total of 3 flows:

Average throughput: 6.16 Mbit/s

95th percentile per-packet one-way delay: 299.394 ms

Loss rate: 1.81%

-- Flow 1:

Average throughput: 4.45 Mbit/s

95th percentile per-packet one-way delay: 297.839 ms

Loss rate: 1.30%

-- Flow 2:

Average throughput: 2.14 Mbit/s

95th percentile per-packet one-way delay: 300.320 ms

Loss rate: 2.34%

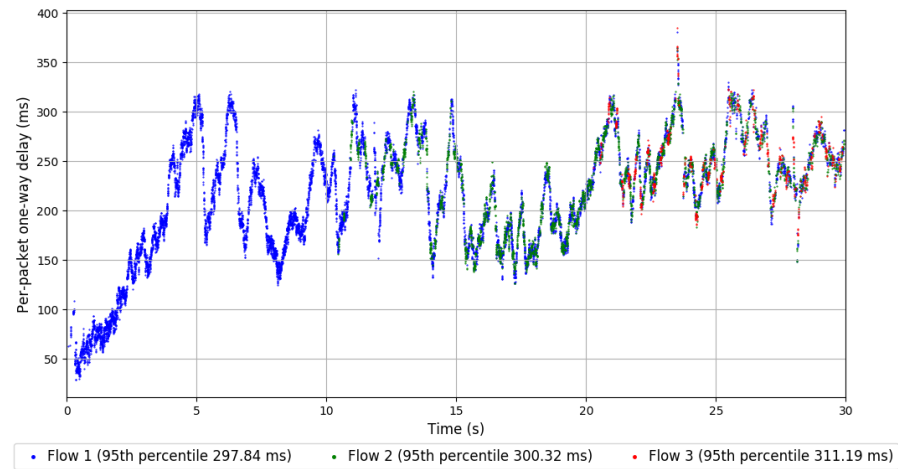
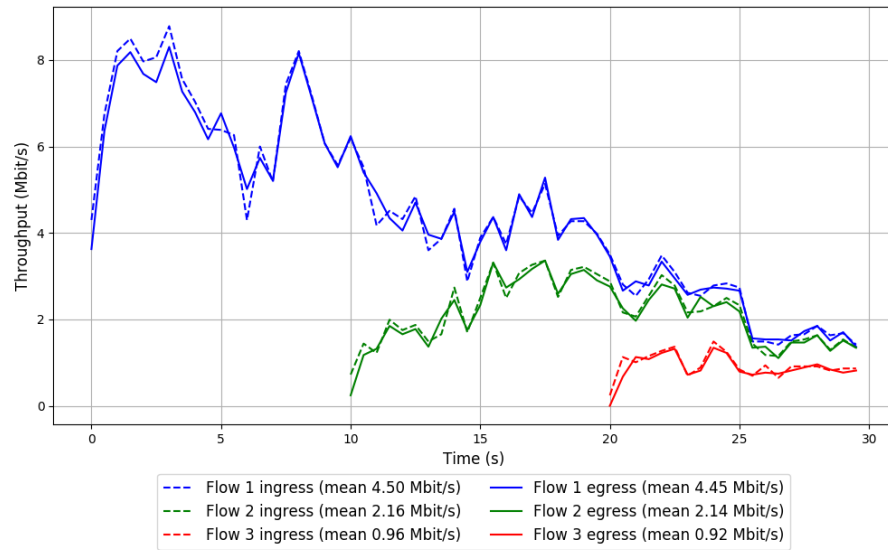
-- Flow 3:

Average throughput: 0.92 Mbit/s

95th percentile per-packet one-way delay: 311.193 ms

Loss rate: 6.61%

Run 2: Report of TCP Cubic — Data Link



Run 3: Statistics of TCP Cubic

Start at: 2018-01-26 02:32:08

End at: 2018-01-26 02:32:38

Local clock offset: 3.731 ms

Below is generated by plot.py at 2018-01-26 05:02:39

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.55 Mbit/s

95th percentile per-packet one-way delay: 295.652 ms

Loss rate: 2.22%

-- Flow 1:

Average throughput: 3.60 Mbit/s

95th percentile per-packet one-way delay: 292.930 ms

Loss rate: 1.28%

-- Flow 2:

Average throughput: 2.23 Mbit/s

95th percentile per-packet one-way delay: 300.598 ms

Loss rate: 3.43%

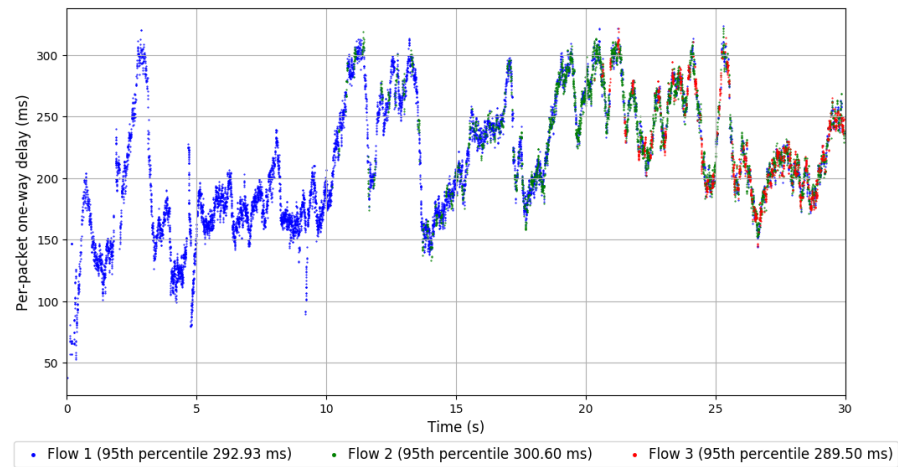
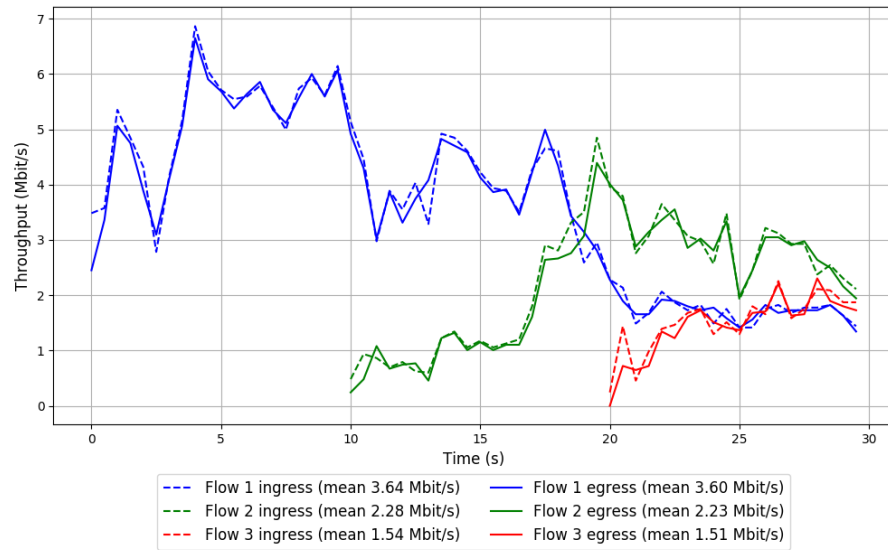
-- Flow 3:

Average throughput: 1.51 Mbit/s

95th percentile per-packet one-way delay: 289.497 ms

Loss rate: 5.27%

Run 3: Report of TCP Cubic — Data Link

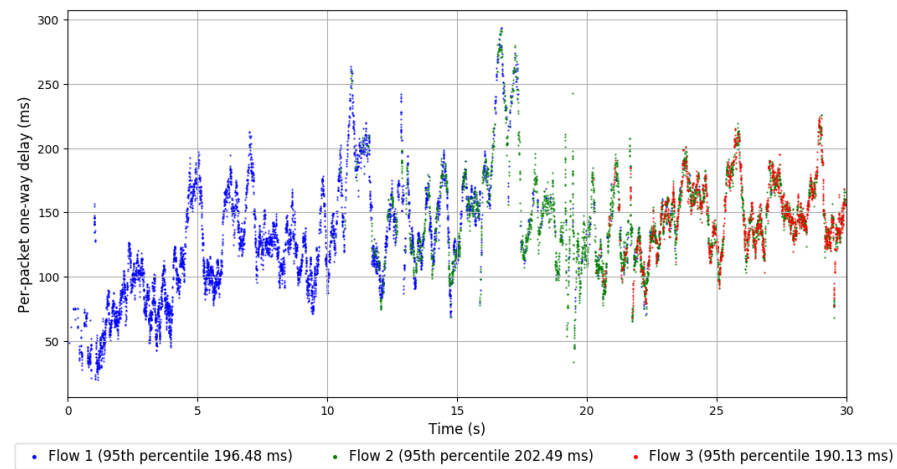
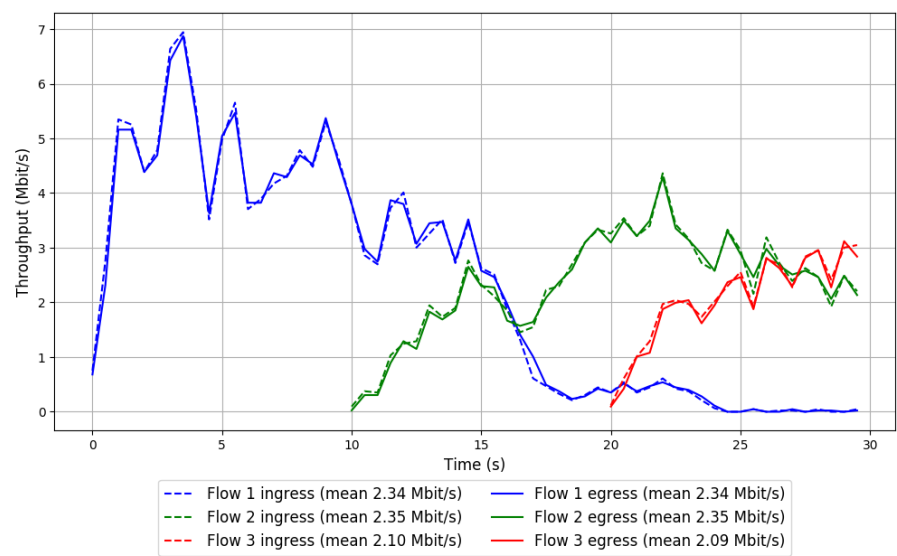


```
Run 1: Statistics of LEDBAT

Start at: 2018-01-26 01:04:09
End at: 2018-01-26 01:04:39
Local clock offset: 2.348 ms

# Below is generated by plot.py at 2018-01-26 05:02:39
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.56 Mbit/s
95th percentile per-packet one-way delay: 197.493 ms
Loss rate: 0.68%
-- Flow 1:
Average throughput: 2.34 Mbit/s
95th percentile per-packet one-way delay: 196.476 ms
Loss rate: 0.07%
-- Flow 2:
Average throughput: 2.35 Mbit/s
95th percentile per-packet one-way delay: 202.486 ms
Loss rate: 0.80%
-- Flow 3:
Average throughput: 2.09 Mbit/s
95th percentile per-packet one-way delay: 190.130 ms
Loss rate: 2.48%
```


Run 1: Report of LEDBAT — Data Link



Run 2: Statistics of LEDBAT

Start at: 2018-01-26 01:51:03

End at: 2018-01-26 01:51:33

Local clock offset: -2.592 ms

Below is generated by plot.py at 2018-01-26 05:02:39

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.73 Mbit/s

95th percentile per-packet one-way delay: 197.633 ms

Loss rate: 0.68%

-- Flow 1:

Average throughput: 3.24 Mbit/s

95th percentile per-packet one-way delay: 187.868 ms

Loss rate: 0.30%

-- Flow 2:

Average throughput: 2.76 Mbit/s

95th percentile per-packet one-way delay: 199.549 ms

Loss rate: 0.47%

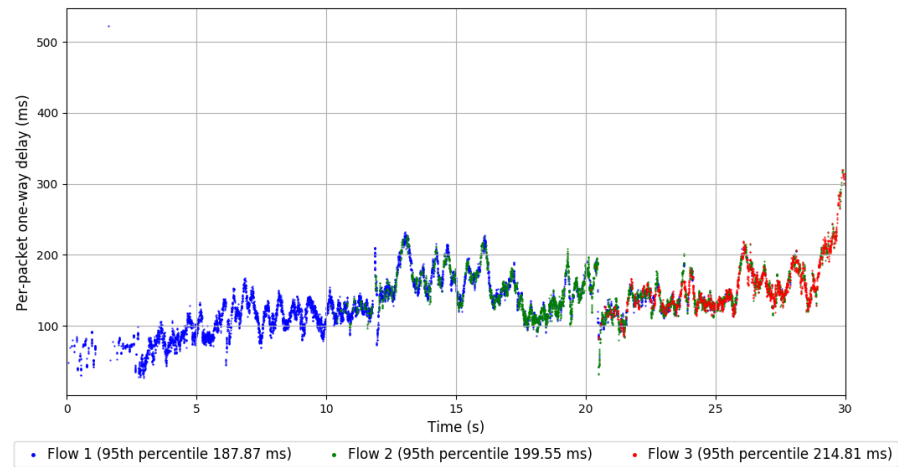
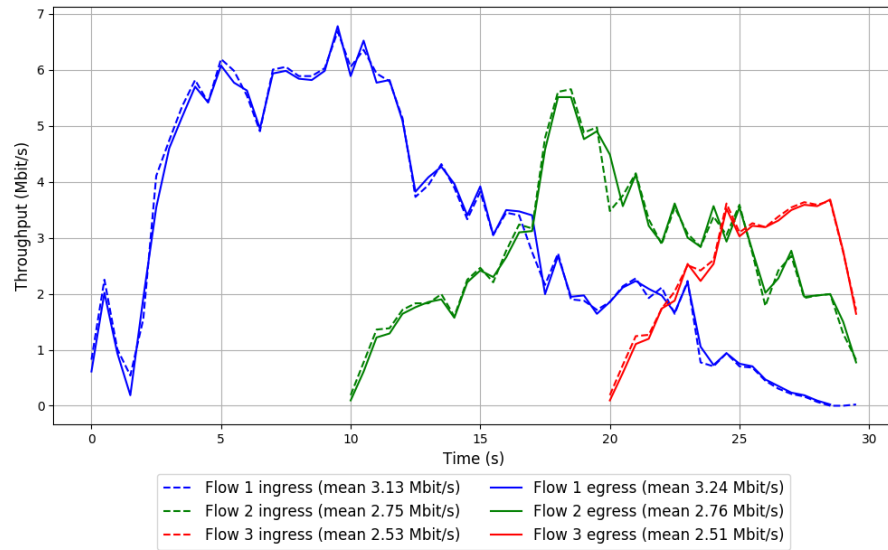
-- Flow 3:

Average throughput: 2.51 Mbit/s

95th percentile per-packet one-way delay: 214.813 ms

Loss rate: 2.53%

Run 2: Report of LEDBAT — Data Link



Run 3: Statistics of LEDBAT

Start at: 2018-01-26 02:38:00

End at: 2018-01-26 02:38:30

Local clock offset: 3.097 ms

Below is generated by plot.py at 2018-01-26 05:02:49

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.55 Mbit/s

95th percentile per-packet one-way delay: 232.772 ms

Loss rate: 0.58%

-- Flow 1:

Average throughput: 3.46 Mbit/s

95th percentile per-packet one-way delay: 207.172 ms

Loss rate: 0.05%

-- Flow 2:

Average throughput: 2.56 Mbit/s

95th percentile per-packet one-way delay: 254.019 ms

Loss rate: 1.08%

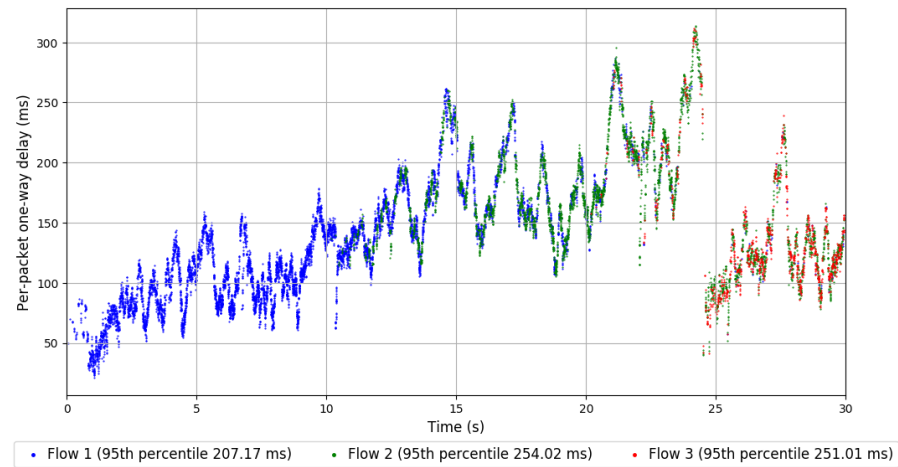
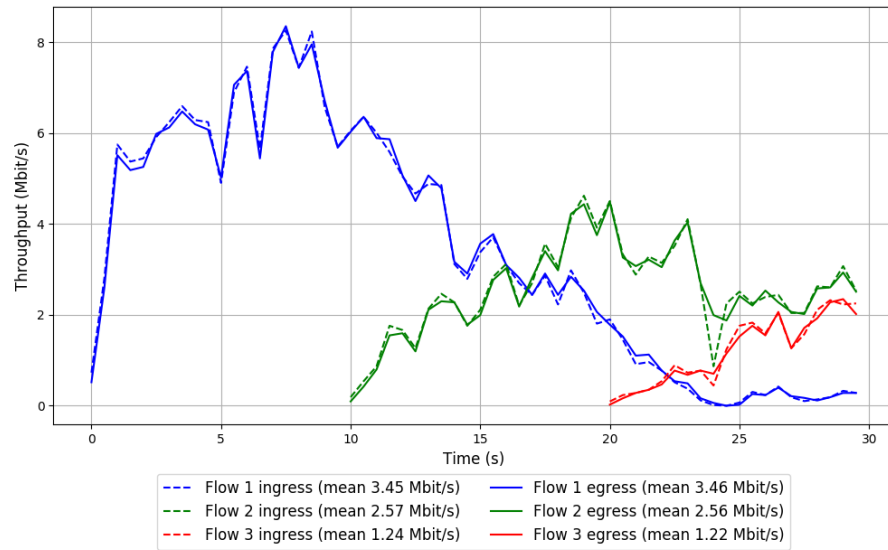
-- Flow 3:

Average throughput: 1.22 Mbit/s

95th percentile per-packet one-way delay: 251.015 ms

Loss rate: 3.06%

Run 3: Report of LEDBAT — Data Link

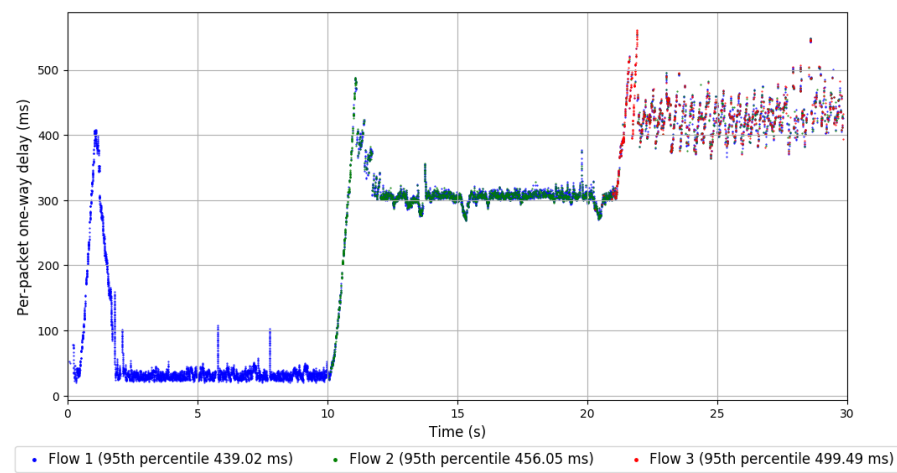
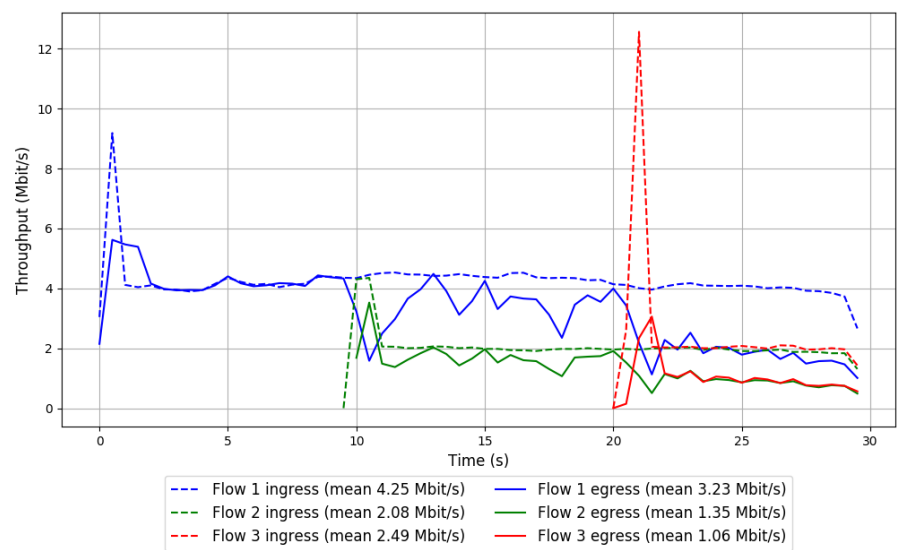


```
Run 1: Statistics of PCC

Start at: 2018-01-26 00:52:26
End at: 2018-01-26 00:52:56
Local clock offset: -0.509 ms

# Below is generated by plot.py at 2018-01-26 05:02:49
# Datalink statistics
-- Total of 3 flows:
Average throughput: 4.47 Mbit/s
95th percentile per-packet one-way delay: 452.279 ms
Loss rate: 31.01%
-- Flow 1:
Average throughput: 3.23 Mbit/s
95th percentile per-packet one-way delay: 439.017 ms
Loss rate: 24.25%
-- Flow 2:
Average throughput: 1.35 Mbit/s
95th percentile per-packet one-way delay: 456.050 ms
Loss rate: 35.28%
-- Flow 3:
Average throughput: 1.06 Mbit/s
95th percentile per-packet one-way delay: 499.491 ms
Loss rate: 58.83%
```

Run 1: Report of PCC — Data Link



Run 2: Statistics of PCC

Start at: 2018-01-26 01:39:19

End at: 2018-01-26 01:39:49

Local clock offset: -1.769 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.35 Mbit/s

95th percentile per-packet one-way delay: 446.088 ms

Loss rate: 18.06%

-- Flow 1:

Average throughput: 3.78 Mbit/s

95th percentile per-packet one-way delay: 442.197 ms

Loss rate: 14.03%

-- Flow 2:

Average throughput: 1.67 Mbit/s

95th percentile per-packet one-way delay: 446.852 ms

Loss rate: 20.01%

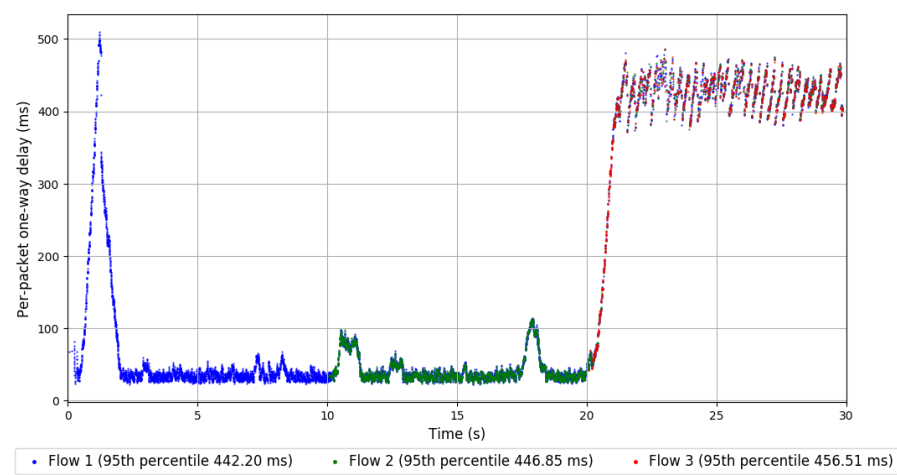
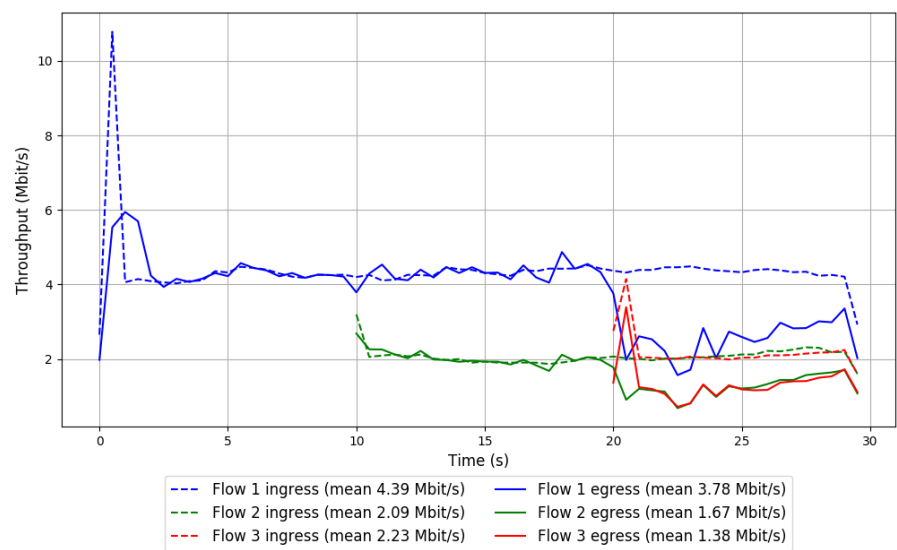
-- Flow 3:

Average throughput: 1.38 Mbit/s

95th percentile per-packet one-way delay: 456.515 ms

Loss rate: 38.42%

Run 2: Report of PCC — Data Link



Run 3: Statistics of PCC

Start at: 2018-01-26 02:26:17

End at: 2018-01-26 02:26:47

Local clock offset: 3.975 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 3.38 Mbit/s

95th percentile per-packet one-way delay: 319.347 ms

Loss rate: 26.15%

-- Flow 1:

Average throughput: 1.89 Mbit/s

95th percentile per-packet one-way delay: 311.074 ms

Loss rate: 16.52%

-- Flow 2:

Average throughput: 1.66 Mbit/s

95th percentile per-packet one-way delay: 315.641 ms

Loss rate: 25.68%

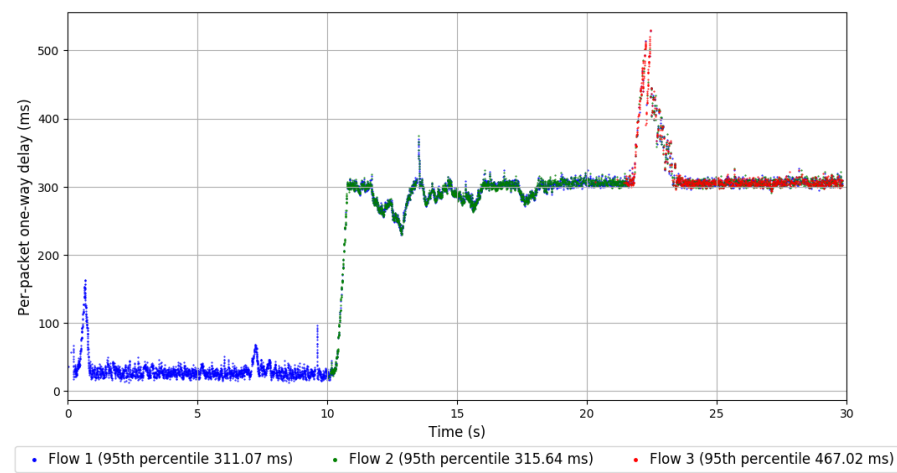
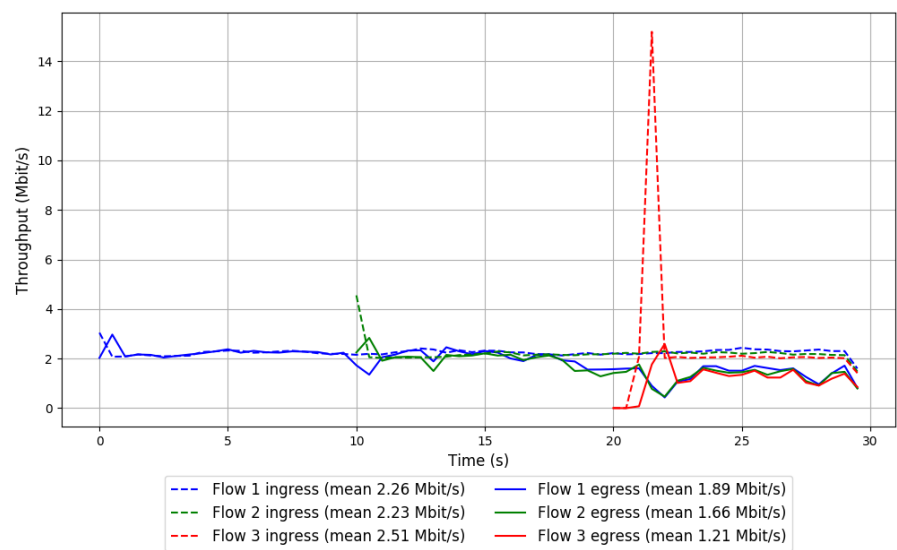
-- Flow 3:

Average throughput: 1.21 Mbit/s

95th percentile per-packet one-way delay: 467.016 ms

Loss rate: 53.30%

Run 3: Report of PCC — Data Link



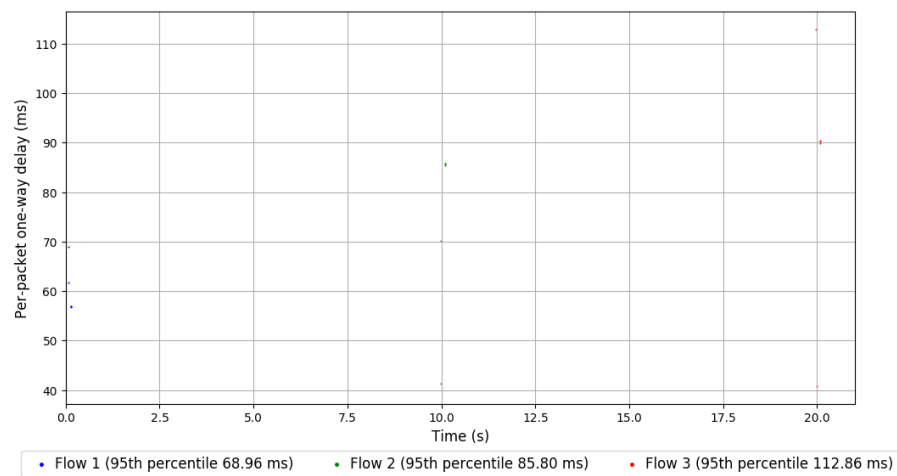
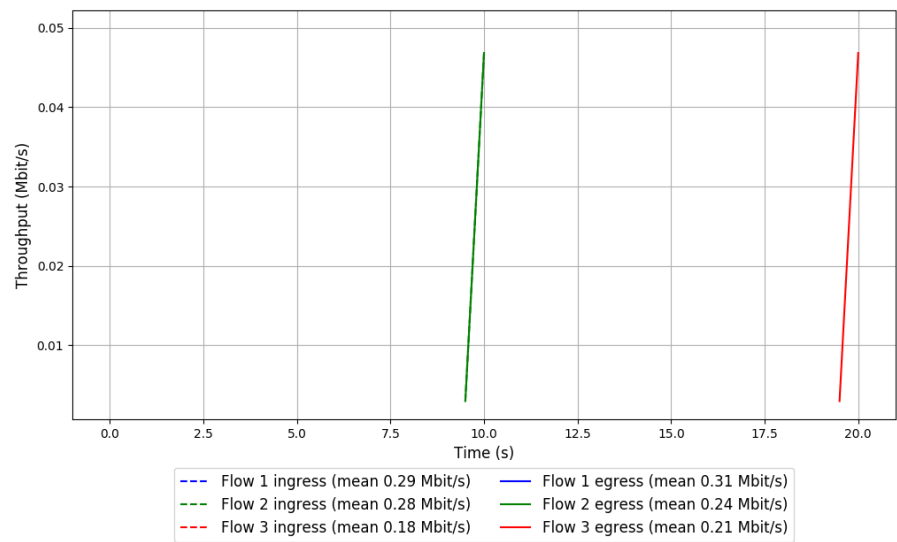
Run 1: Statistics of QUIC Cubic

Start at: 2018-01-26 00:29:00

End at: 2018-01-26 00:29:30

Local clock offset: -3.149 ms

Run 1: Report of QUIC Cubic — Data Link



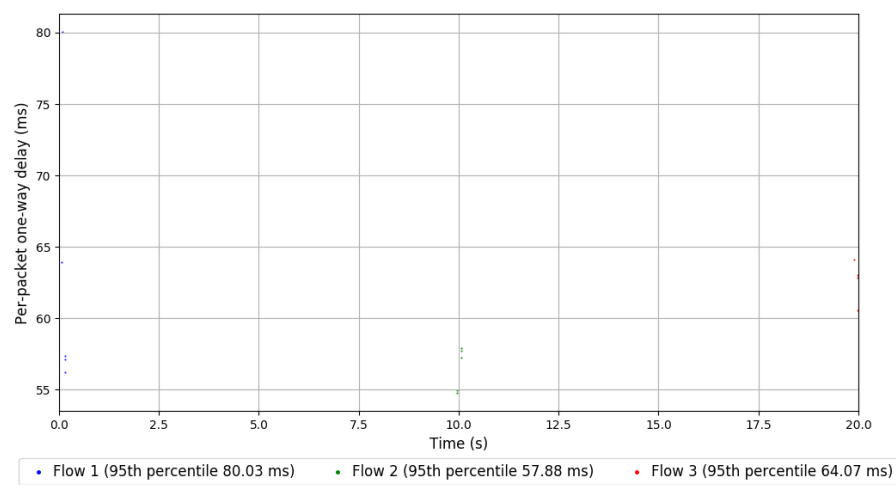
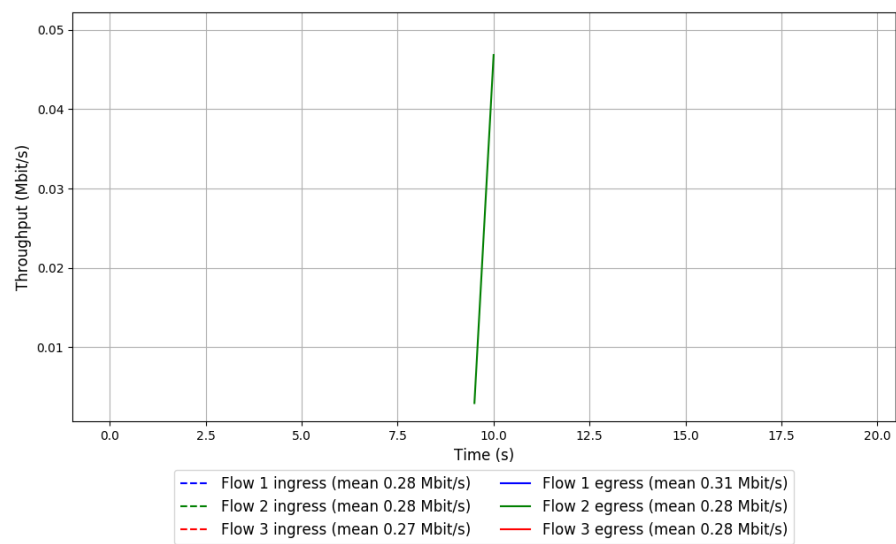
Run 2: Statistics of QUIC Cubic

Start at: 2018-01-26 01:15:53

End at: 2018-01-26 01:16:23

Local clock offset: 3.739 ms

Run 2: Report of QUIC Cubic — Data Link



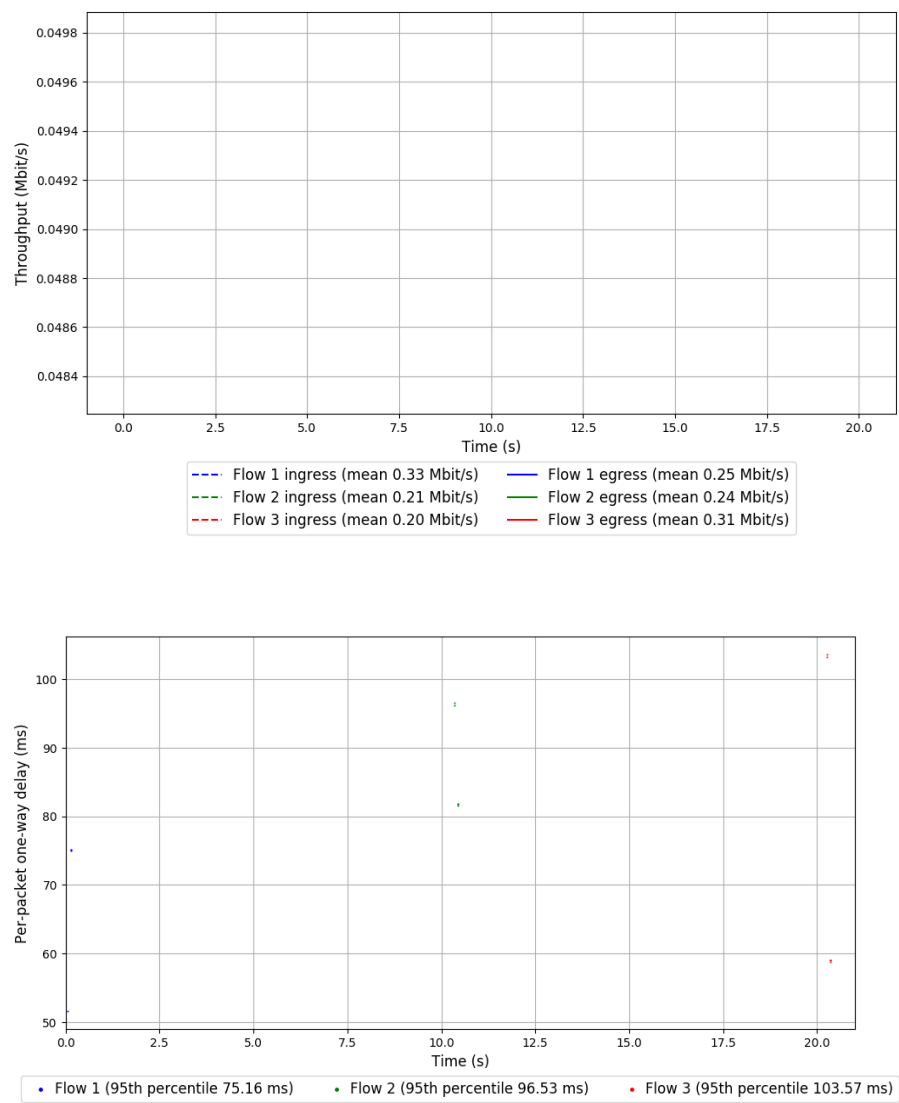
Run 3: Statistics of QUIC Cubic

Start at: 2018-01-26 02:02:52

End at: 2018-01-26 02:03:22

Local clock offset: 0.64 ms

Run 3: Report of QUIC Cubic — Data Link

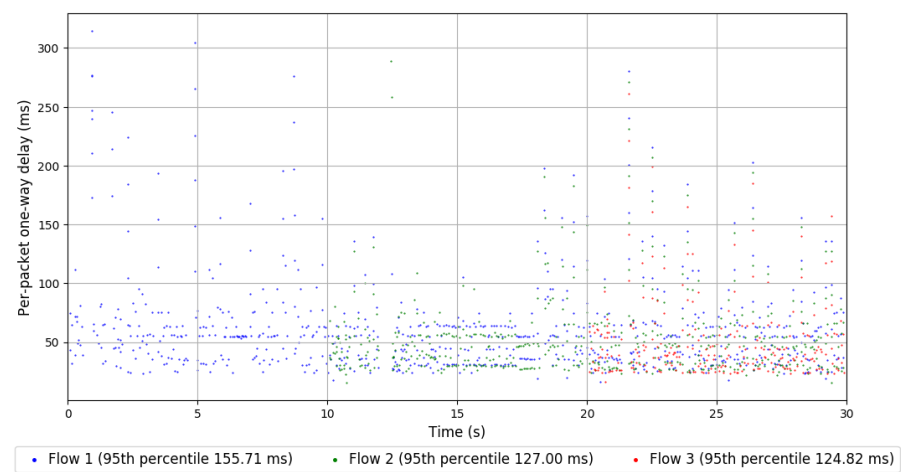
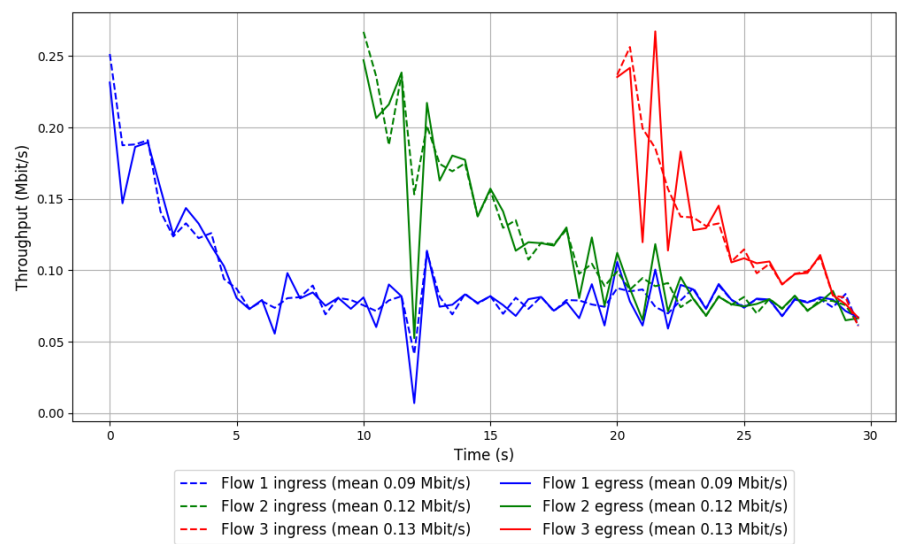


```
Run 1: Statistics of SReAM

Start at: 2018-01-26 00:46:34
End at: 2018-01-26 00:47:04
Local clock offset: -3.122 ms

# Below is generated by plot.py at 2018-01-26 05:02:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.21 Mbit/s
95th percentile per-packet one-way delay: 142.776 ms
Loss rate: 1.32%
-- Flow 1:
Average throughput: 0.09 Mbit/s
95th percentile per-packet one-way delay: 155.713 ms
Loss rate: 1.21%
-- Flow 2:
Average throughput: 0.12 Mbit/s
95th percentile per-packet one-way delay: 127.005 ms
Loss rate: 2.04%
-- Flow 3:
Average throughput: 0.13 Mbit/s
95th percentile per-packet one-way delay: 124.817 ms
Loss rate: 0.22%
```

Run 1: Report of SReAM — Data Link

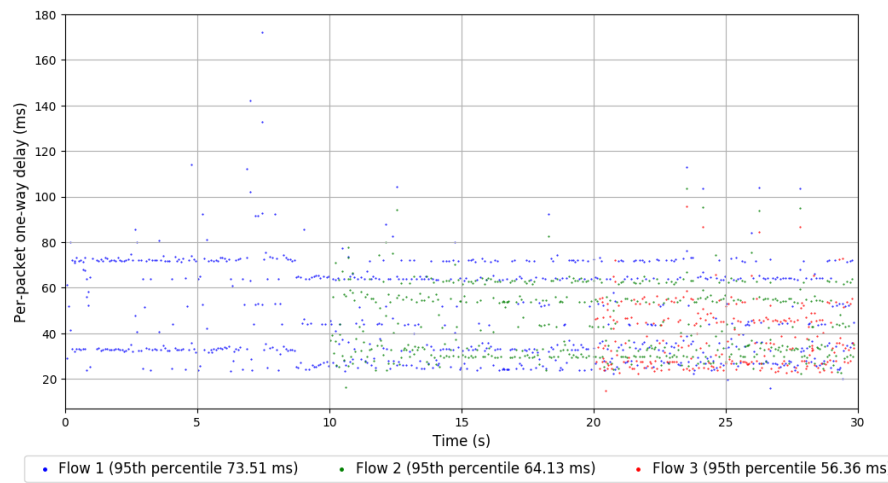
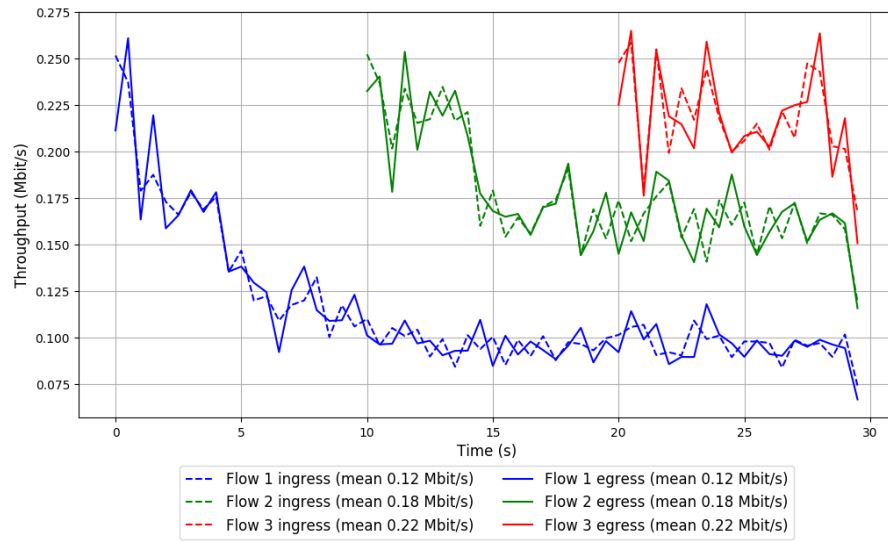


```
Run 2: Statistics of SReAM

Start at: 2018-01-26 01:33:28
End at: 2018-01-26 01:33:58
Local clock offset: -0.951 ms

# Below is generated by plot.py at 2018-01-26 05:02:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.31 Mbit/s
95th percentile per-packet one-way delay: 72.768 ms
Loss rate: 0.25%
-- Flow 1:
Average throughput: 0.12 Mbit/s
95th percentile per-packet one-way delay: 73.508 ms
Loss rate: 0.21%
-- Flow 2:
Average throughput: 0.18 Mbit/s
95th percentile per-packet one-way delay: 64.133 ms
Loss rate: 0.21%
-- Flow 3:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 56.359 ms
Loss rate: 0.38%
```

Run 2: Report of SCRaM — Data Link



Run 3: Statistics of SReAM

Start at: 2018-01-26 02:20:26

End at: 2018-01-26 02:20:56

Local clock offset: 3.443 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 0.34 Mbit/s

95th percentile per-packet one-way delay: 78.600 ms

Loss rate: 0.24%

-- Flow 1:

Average throughput: 0.13 Mbit/s

95th percentile per-packet one-way delay: 96.879 ms

Loss rate: 0.26%

-- Flow 2:

Average throughput: 0.22 Mbit/s

95th percentile per-packet one-way delay: 66.265 ms

Loss rate: 0.20%

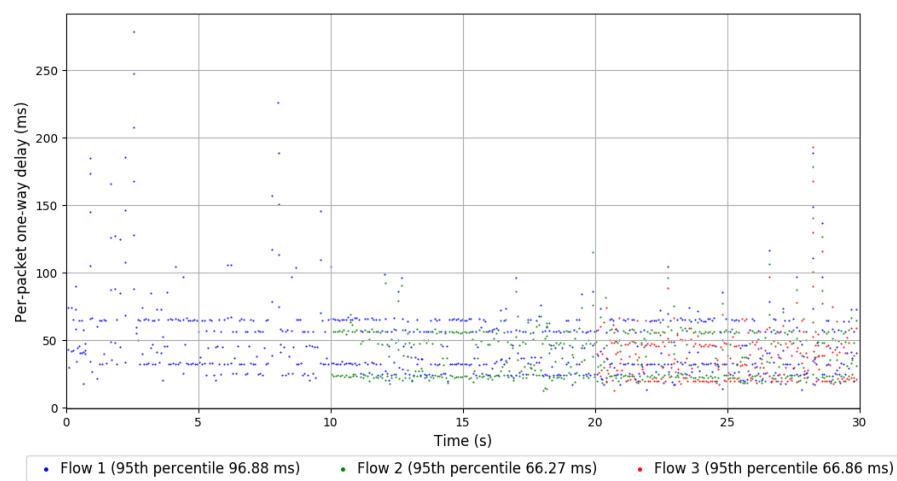
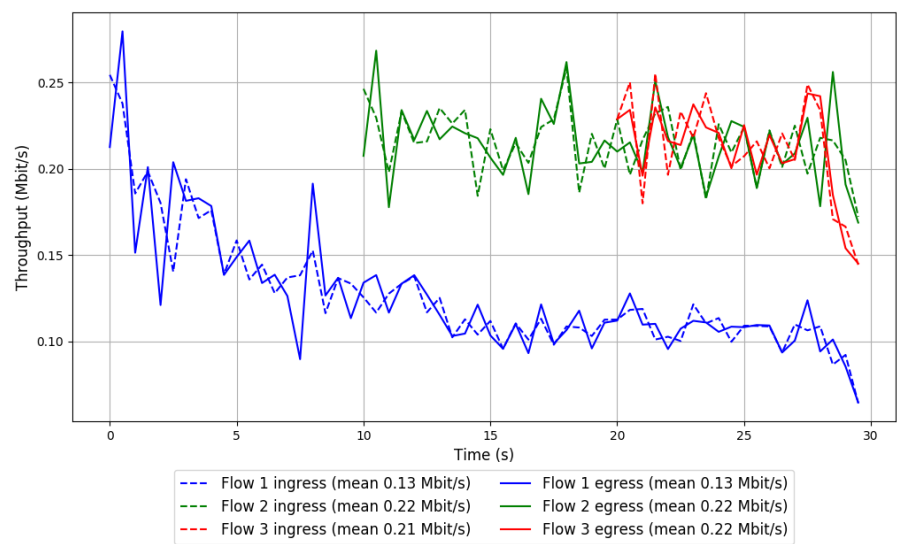
-- Flow 3:

Average throughput: 0.22 Mbit/s

95th percentile per-packet one-way delay: 66.857 ms

Loss rate: 0.28%

Run 3: Report of SReAM — Data Link

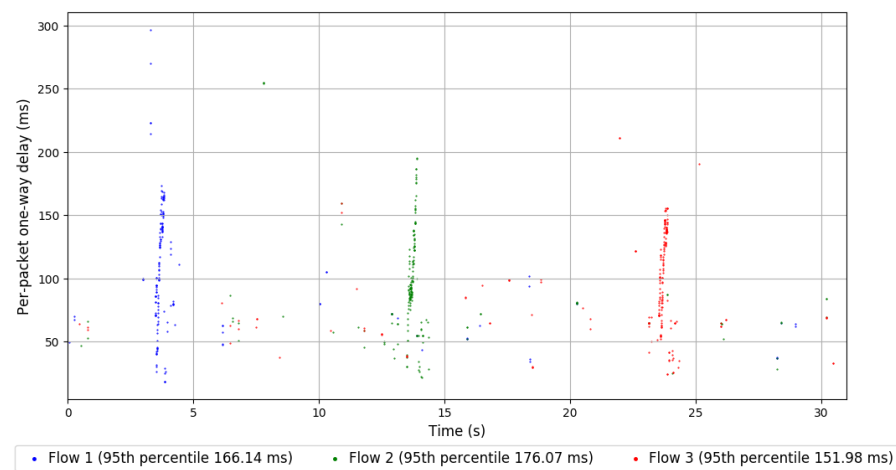
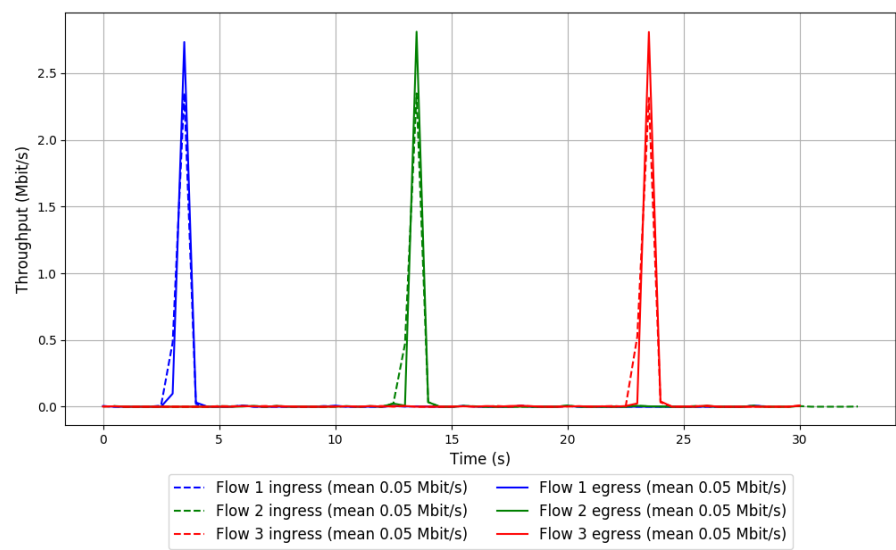


```
Run 1: Statistics of WebRTC media

Start at: 2018-01-26 00:40:43
End at: 2018-01-26 00:41:13
Local clock offset: -3.121 ms

# Below is generated by plot.py at 2018-01-26 05:02:51
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.15 Mbit/s
95th percentile per-packet one-way delay: 164.333 ms
Loss rate: 0.22%
-- Flow 1:
Average throughput: 0.05 Mbit/s
95th percentile per-packet one-way delay: 166.136 ms
Loss rate: 0.00%
-- Flow 2:
Average throughput: 0.05 Mbit/s
95th percentile per-packet one-way delay: 176.070 ms
Loss rate: 0.30%
-- Flow 3:
Average throughput: 0.05 Mbit/s
95th percentile per-packet one-way delay: 151.984 ms
Loss rate: 0.36%
```


Run 1: Report of WebRTC media — Data Link



Run 2: Statistics of WebRTC media

Start at: 2018-01-26 01:27:36

End at: 2018-01-26 01:28:06

Local clock offset: 0.765 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 0.15 Mbit/s

95th percentile per-packet one-way delay: 132.925 ms

Loss rate: 0.02%

-- Flow 1:

Average throughput: 0.05 Mbit/s

95th percentile per-packet one-way delay: 94.441 ms

Loss rate: 0.00%

-- Flow 2:

Average throughput: 0.05 Mbit/s

95th percentile per-packet one-way delay: 136.009 ms

Loss rate: 0.00%

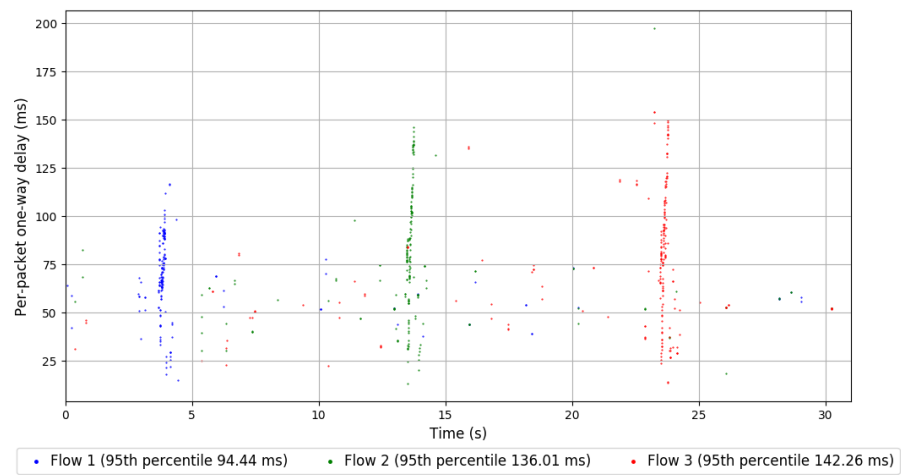
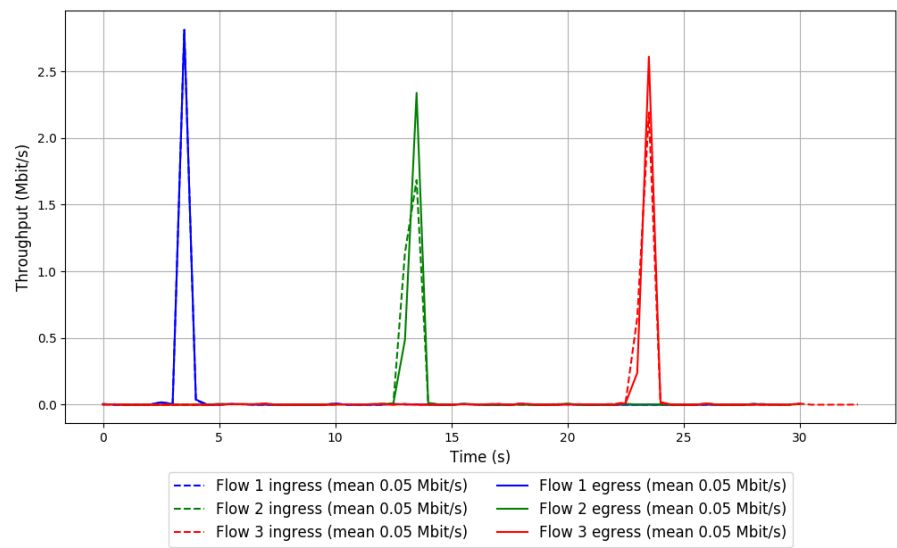
-- Flow 3:

Average throughput: 0.05 Mbit/s

95th percentile per-packet one-way delay: 142.260 ms

Loss rate: 0.05%

Run 2: Report of WebRTC media — Data Link



Run 3: Statistics of WebRTC media

Start at: 2018-01-26 02:14:34

End at: 2018-01-26 02:15:04

Local clock offset: 2.936 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 0.15 Mbit/s

95th percentile per-packet one-way delay: 133.466 ms

Loss rate: 0.08%

-- Flow 1:

Average throughput: 0.05 Mbit/s

95th percentile per-packet one-way delay: 125.173 ms

Loss rate: 0.05%

-- Flow 2:

Average throughput: 0.05 Mbit/s

95th percentile per-packet one-way delay: 132.025 ms

Loss rate: 0.00%

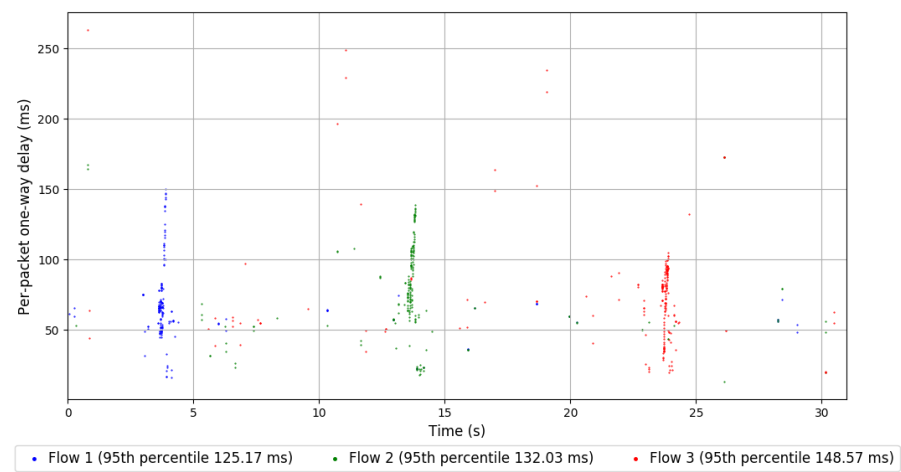
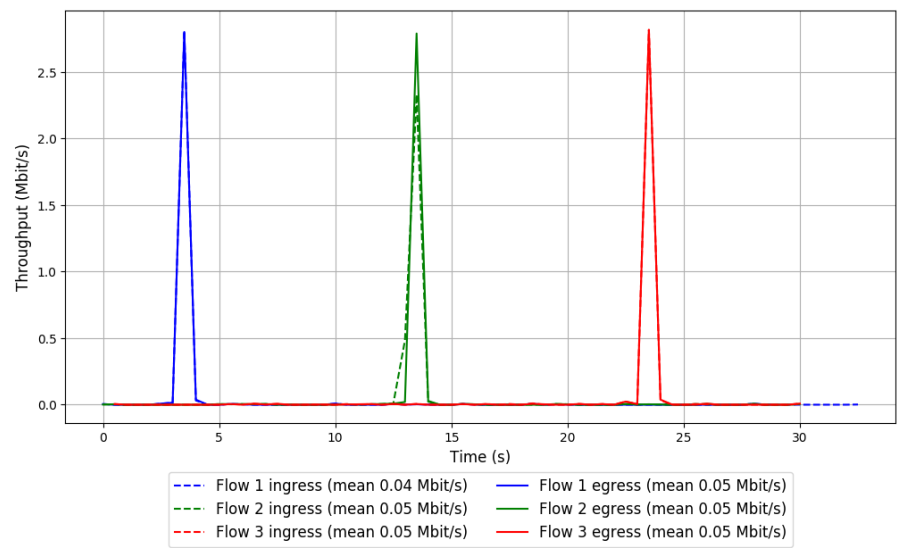
-- Flow 3:

Average throughput: 0.05 Mbit/s

95th percentile per-packet one-way delay: 148.567 ms

Loss rate: 0.18%

Run 3: Report of WebRTC media — Data Link



Run 1: Statistics of Sprout

Start at: 2018-01-26 00:34:51

End at: 2018-01-26 00:35:21

Local clock offset: -3.162 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 1.42 Mbit/s

95th percentile per-packet one-way delay: 158.031 ms

Loss rate: 1.29%

-- Flow 1:

Average throughput: 0.71 Mbit/s

95th percentile per-packet one-way delay: 165.974 ms

Loss rate: 0.81%

-- Flow 2:

Average throughput: 0.67 Mbit/s

95th percentile per-packet one-way delay: 163.126 ms

Loss rate: 2.31%

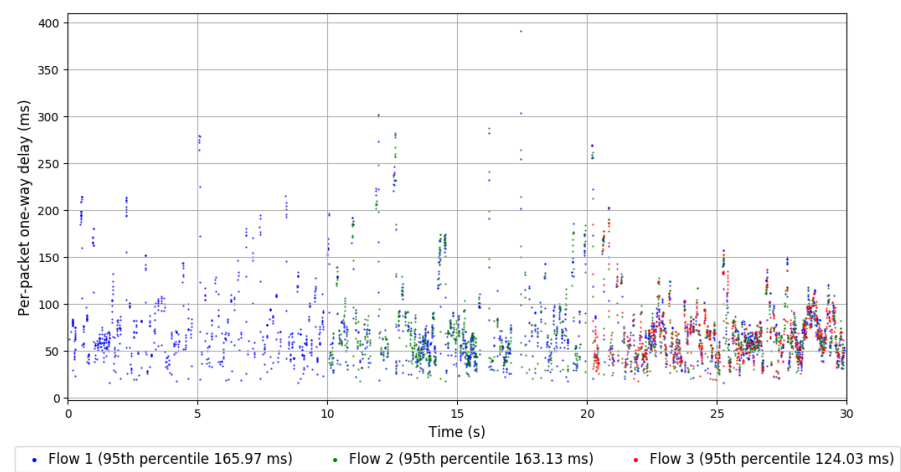
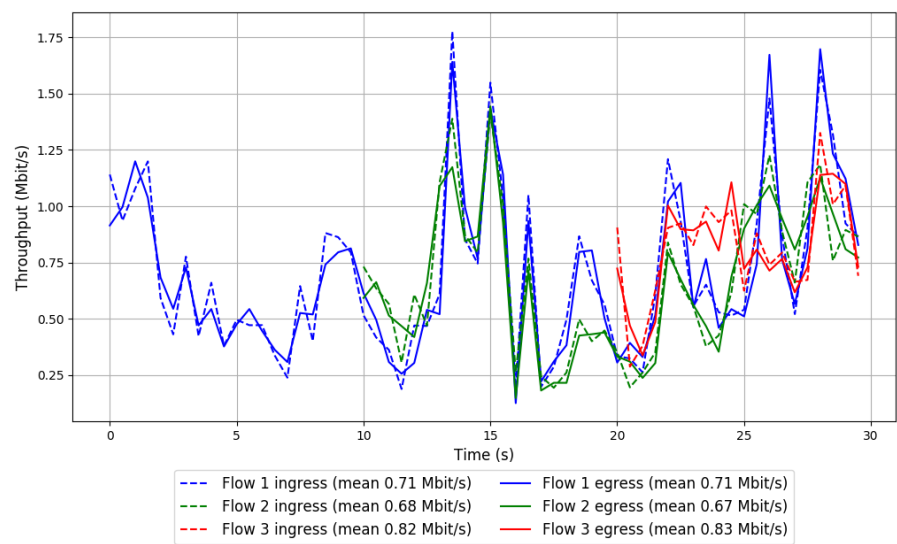
-- Flow 3:

Average throughput: 0.83 Mbit/s

95th percentile per-packet one-way delay: 124.027 ms

Loss rate: 0.84%

Run 1: Report of Sprout — Data Link



Run 2: Statistics of Sprout

Start at: 2018-01-26 01:21:45

End at: 2018-01-26 01:22:15

Local clock offset: 3.856 ms

Below is generated by plot.py at 2018-01-26 05:02:51

Datalink statistics

-- Total of 3 flows:

Average throughput: 2.22 Mbit/s

95th percentile per-packet one-way delay: 105.053 ms

Loss rate: 0.60%

-- Flow 1:

Average throughput: 1.09 Mbit/s

95th percentile per-packet one-way delay: 105.722 ms

Loss rate: 0.42%

-- Flow 2:

Average throughput: 1.09 Mbit/s

95th percentile per-packet one-way delay: 103.848 ms

Loss rate: 0.47%

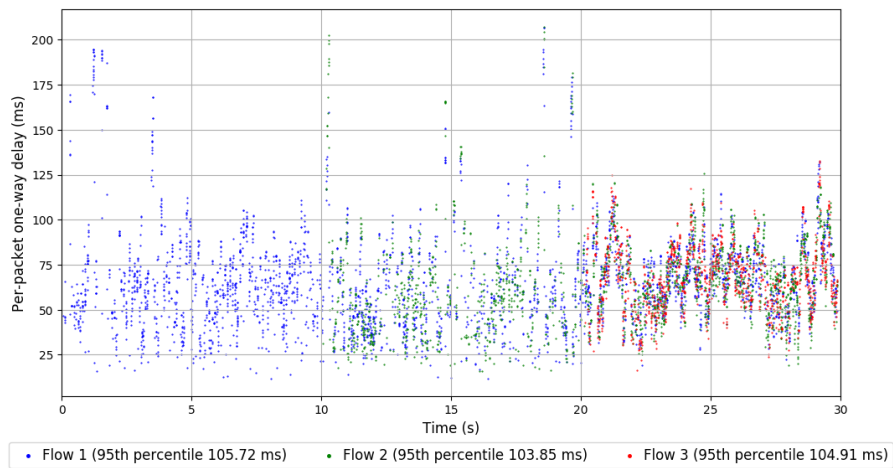
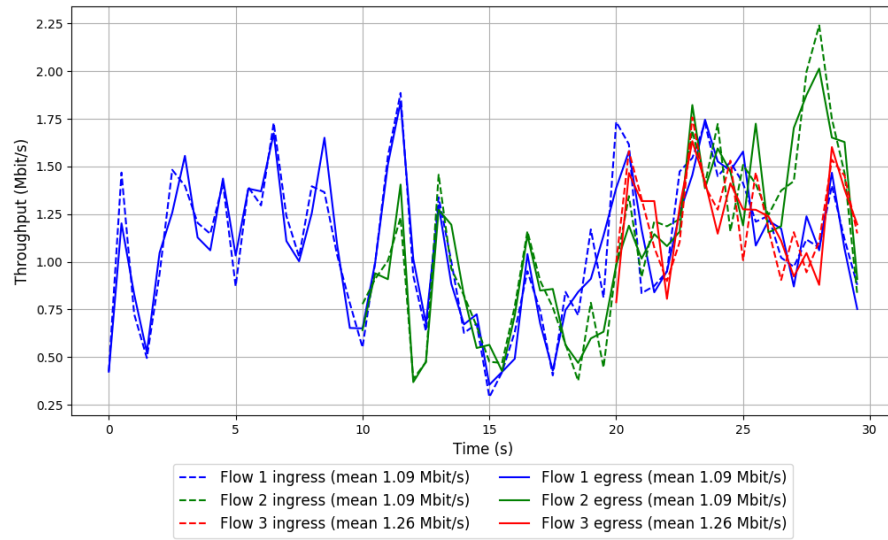
-- Flow 3:

Average throughput: 1.26 Mbit/s

95th percentile per-packet one-way delay: 104.914 ms

Loss rate: 1.29%

Run 2: Report of Sprout — Data Link



Run 3: Statistics of Sprout

Start at: 2018-01-26 02:08:43

End at: 2018-01-26 02:09:13

Local clock offset: 1.983 ms

Below is generated by plot.py at 2018-01-26 05:02:54

Datalink statistics

-- Total of 3 flows:

Average throughput: 3.48 Mbit/s

95th percentile per-packet one-way delay: 106.335 ms

Loss rate: 0.65%

-- Flow 1:

Average throughput: 1.93 Mbit/s

95th percentile per-packet one-way delay: 105.889 ms

Loss rate: 0.74%

-- Flow 2:

Average throughput: 1.54 Mbit/s

95th percentile per-packet one-way delay: 104.395 ms

Loss rate: 0.33%

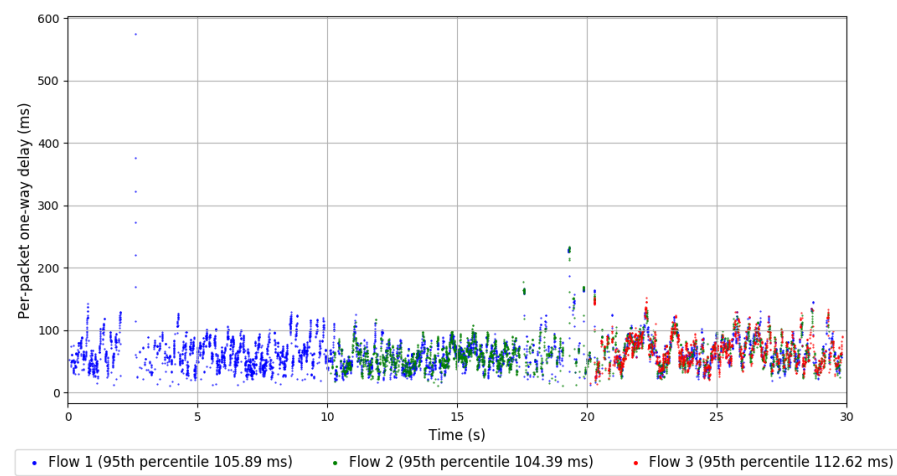
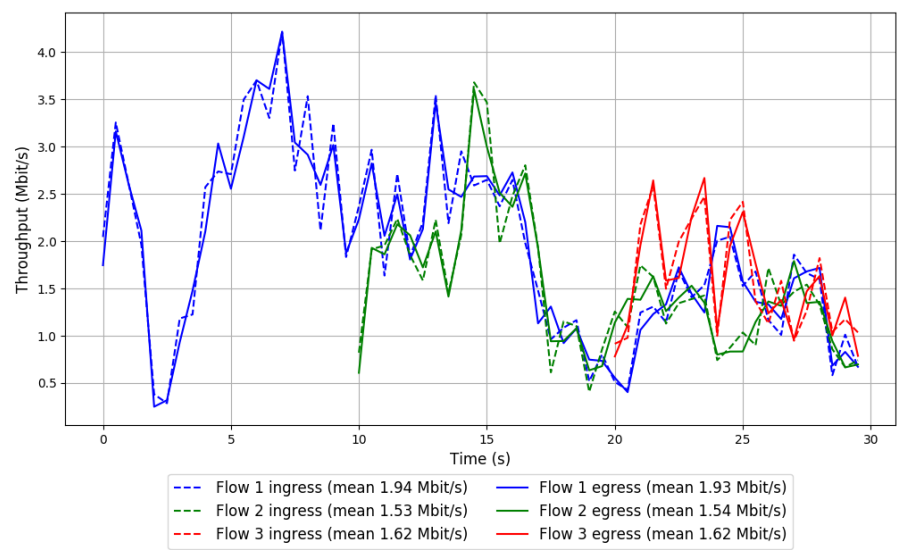
-- Flow 3:

Average throughput: 1.62 Mbit/s

95th percentile per-packet one-way delay: 112.621 ms

Loss rate: 0.92%

Run 3: Report of Sprout — Data Link

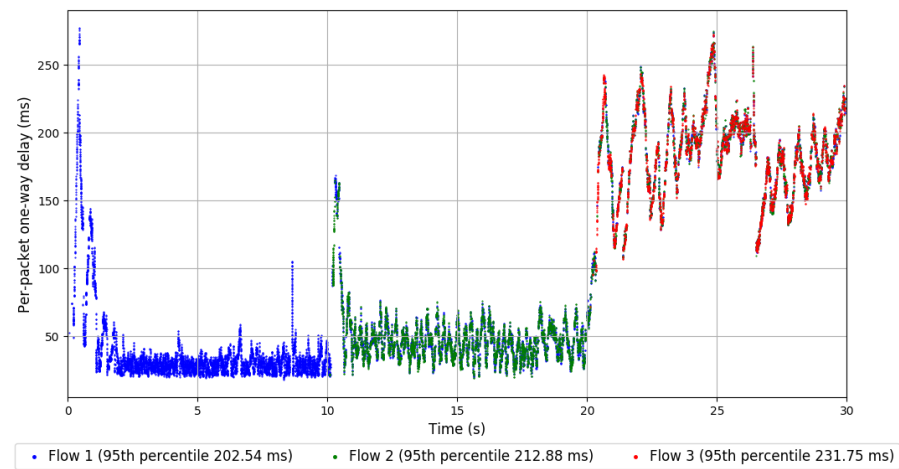
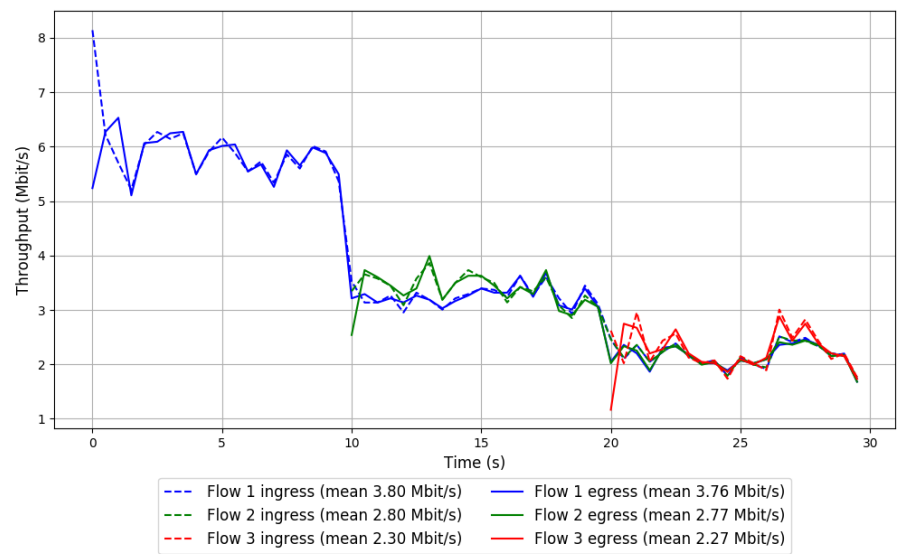


```
Run 1: Statistics of TaoVA-100x

Start at: 2018-01-26 01:07:05
End at: 2018-01-26 01:07:35
Local clock offset: 2.813 ms

# Below is generated by plot.py at 2018-01-26 05:03:08
# Datalink statistics
-- Total of 3 flows:
Average throughput: 6.35 Mbit/s
95th percentile per-packet one-way delay: 211.932 ms
Loss rate: 1.27%
-- Flow 1:
Average throughput: 3.76 Mbit/s
95th percentile per-packet one-way delay: 202.537 ms
Loss rate: 1.22%
-- Flow 2:
Average throughput: 2.77 Mbit/s
95th percentile per-packet one-way delay: 212.881 ms
Loss rate: 1.11%
-- Flow 3:
Average throughput: 2.27 Mbit/s
95th percentile per-packet one-way delay: 231.754 ms
Loss rate: 1.97%
```

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



Run 2: Statistics of TaoVA-100x

Start at: 2018-01-26 01:53:59

End at: 2018-01-26 01:54:29

Local clock offset: -2.736 ms

Below is generated by plot.py at 2018-01-26 05:03:08

Datalink statistics

-- Total of 3 flows:

Average throughput: 4.38 Mbit/s

95th percentile per-packet one-way delay: 307.881 ms

Loss rate: 3.77%

-- Flow 1:

Average throughput: 2.69 Mbit/s

95th percentile per-packet one-way delay: 302.597 ms

Loss rate: 1.73%

-- Flow 2:

Average throughput: 1.89 Mbit/s

95th percentile per-packet one-way delay: 308.470 ms

Loss rate: 4.21%

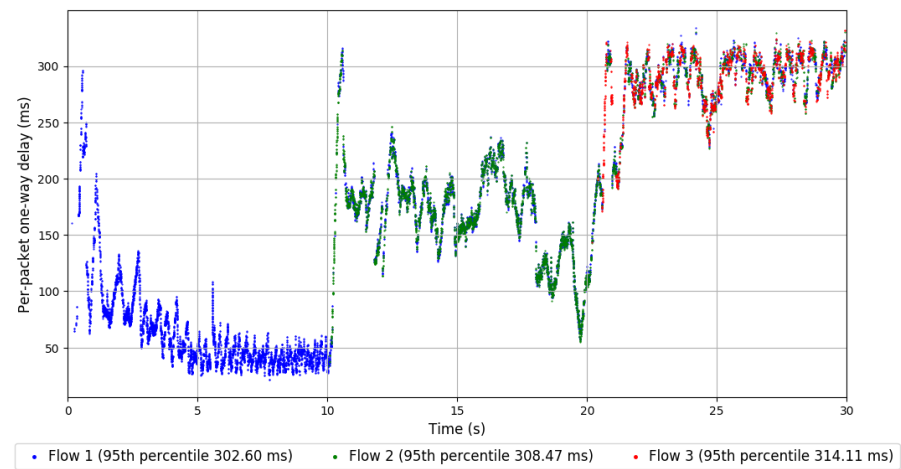
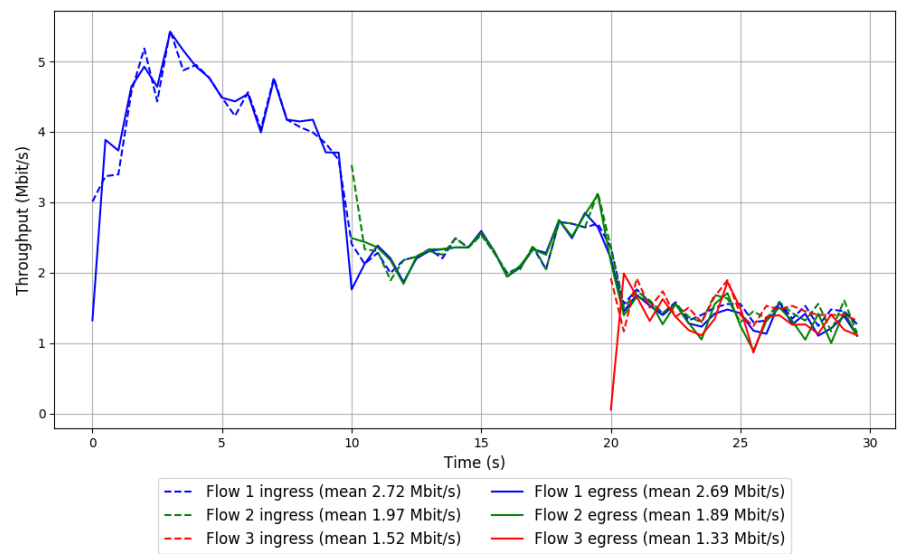
-- Flow 3:

Average throughput: 1.33 Mbit/s

95th percentile per-packet one-way delay: 314.109 ms

Loss rate: 13.63%

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



Run 3: Statistics of TaoVA-100x

Start at: 2018-01-26 02:40:56

End at: 2018-01-26 02:41:26

Local clock offset: 2.938 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 6.38 Mbit/s

95th percentile per-packet one-way delay: 193.025 ms

Loss rate: 1.60%

-- Flow 1:

Average throughput: 3.64 Mbit/s

95th percentile per-packet one-way delay: 181.155 ms

Loss rate: 0.60%

-- Flow 2:

Average throughput: 2.94 Mbit/s

95th percentile per-packet one-way delay: 210.393 ms

Loss rate: 3.04%

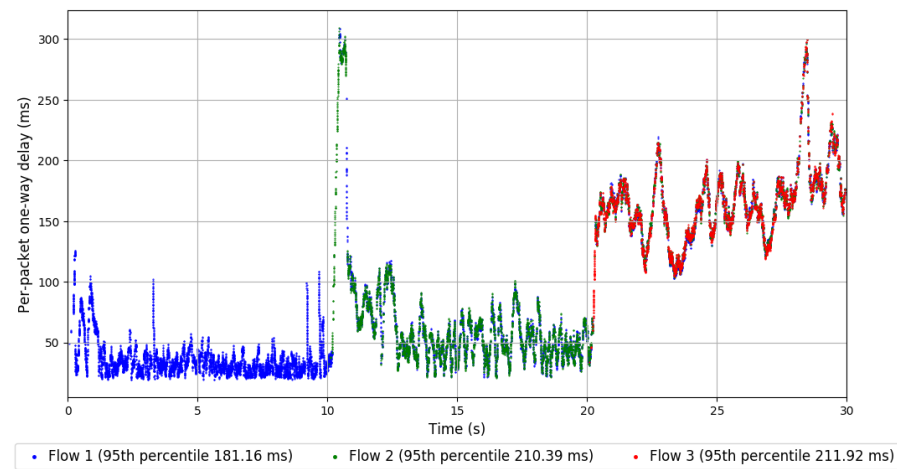
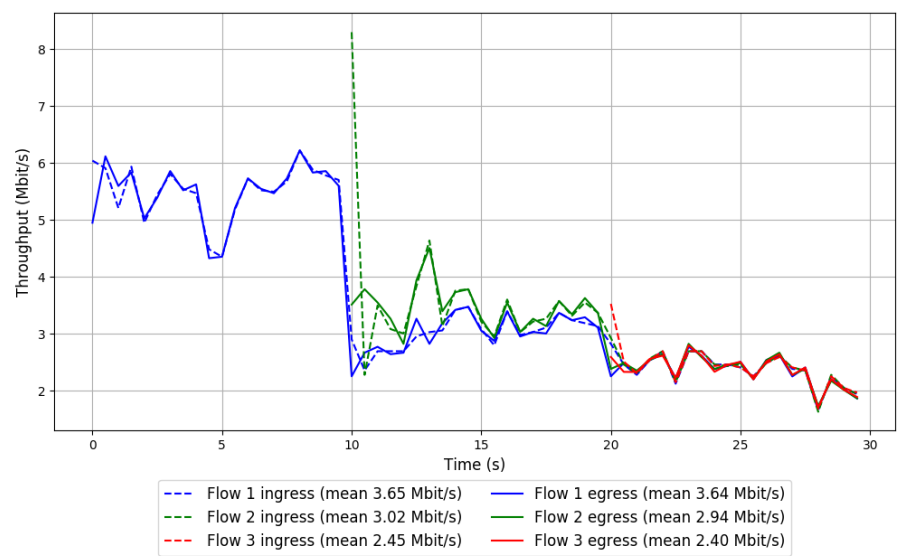
-- Flow 3:

Average throughput: 2.40 Mbit/s

95th percentile per-packet one-way delay: 211.922 ms

Loss rate: 2.56%

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



Run 1: Statistics of TCP Vegas

Start at: 2018-01-26 00:31:55

End at: 2018-01-26 00:32:25

Local clock offset: -3.149 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 2.36 Mbit/s

95th percentile per-packet one-way delay: 125.942 ms

Loss rate: 1.64%

-- Flow 1:

Average throughput: 1.13 Mbit/s

95th percentile per-packet one-way delay: 187.750 ms

Loss rate: 2.98%

-- Flow 2:

Average throughput: 1.40 Mbit/s

95th percentile per-packet one-way delay: 108.318 ms

Loss rate: 0.17%

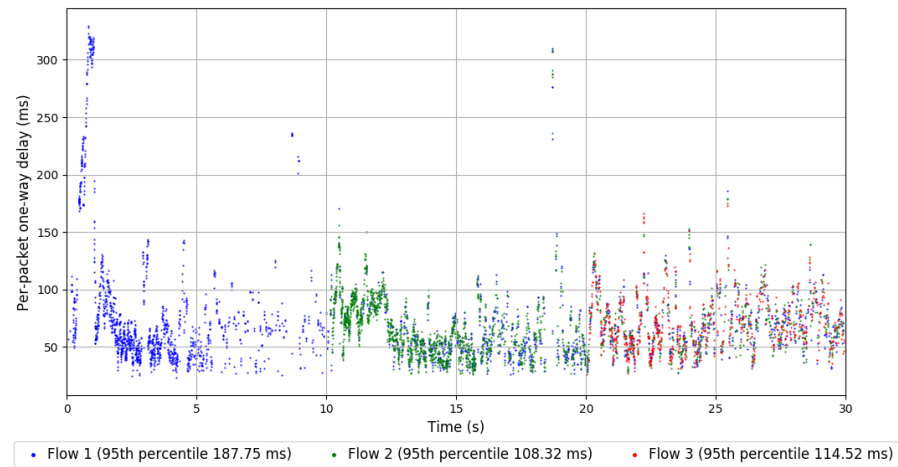
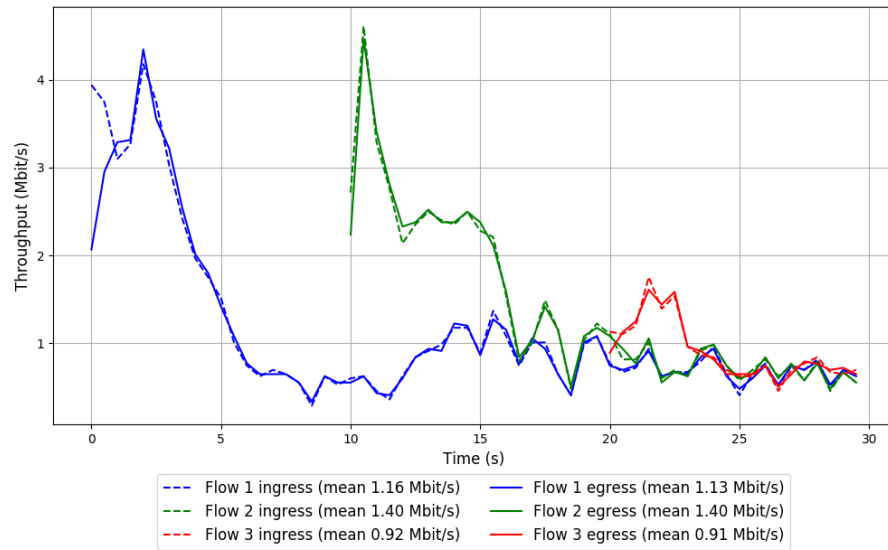
-- Flow 3:

Average throughput: 0.91 Mbit/s

95th percentile per-packet one-way delay: 114.519 ms

Loss rate: 1.05%

Run 1: Report of TCP Vegas — Data Link



Run 2: Statistics of TCP Vegas

Start at: 2018-01-26 01:18:49

End at: 2018-01-26 01:19:19

Local clock offset: 4.011 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 3.83 Mbit/s

95th percentile per-packet one-way delay: 123.592 ms

Loss rate: 0.19%

-- Flow 1:

Average throughput: 2.17 Mbit/s

95th percentile per-packet one-way delay: 134.861 ms

Loss rate: 0.09%

-- Flow 2:

Average throughput: 1.51 Mbit/s

95th percentile per-packet one-way delay: 85.475 ms

Loss rate: 0.28%

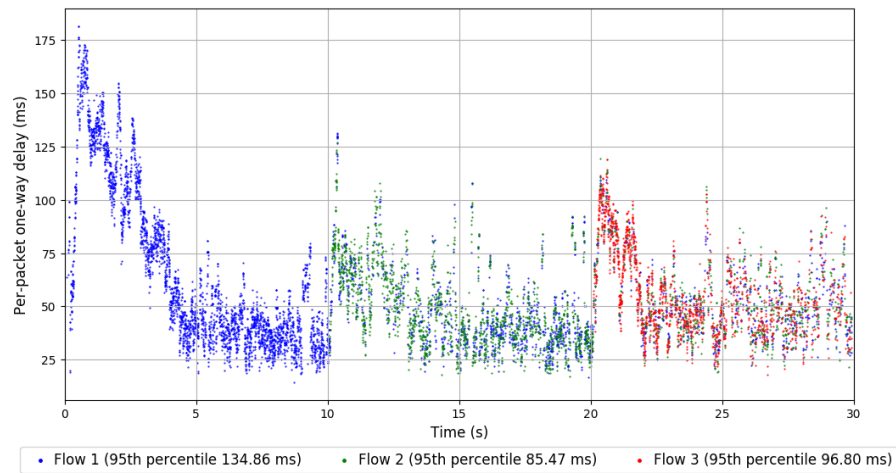
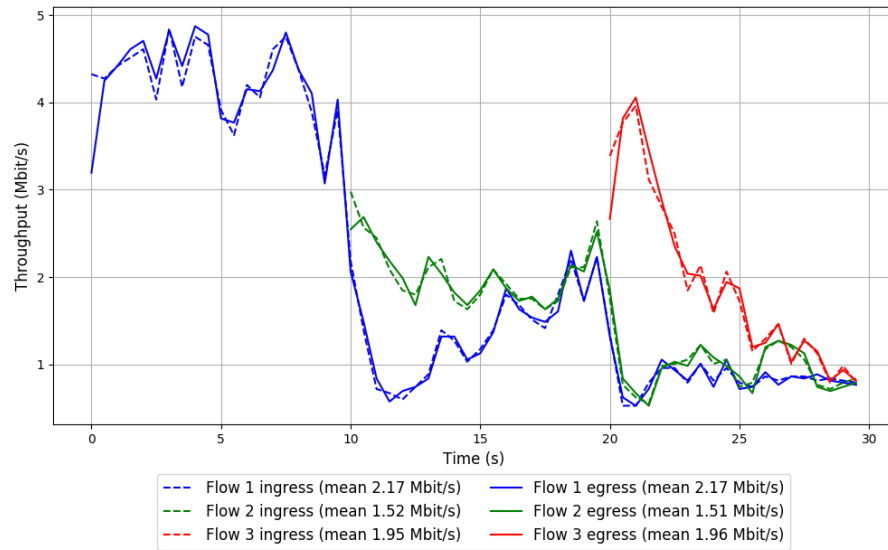
-- Flow 3:

Average throughput: 1.96 Mbit/s

95th percentile per-packet one-way delay: 96.796 ms

Loss rate: 0.37%

Run 2: Report of TCP Vegas — Data Link



Run 3: Statistics of TCP Vegas

Start at: 2018-01-26 02:05:47

End at: 2018-01-26 02:06:17

Local clock offset: 1.38 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 4.08 Mbit/s

95th percentile per-packet one-way delay: 135.955 ms

Loss rate: 0.21%

-- Flow 1:

Average throughput: 1.54 Mbit/s

95th percentile per-packet one-way delay: 99.366 ms

Loss rate: 0.13%

-- Flow 2:

Average throughput: 2.16 Mbit/s

95th percentile per-packet one-way delay: 147.700 ms

Loss rate: 0.25%

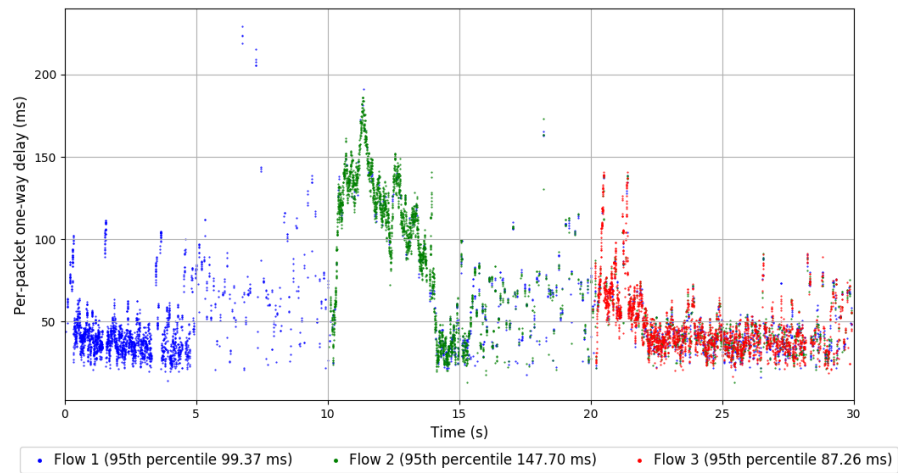
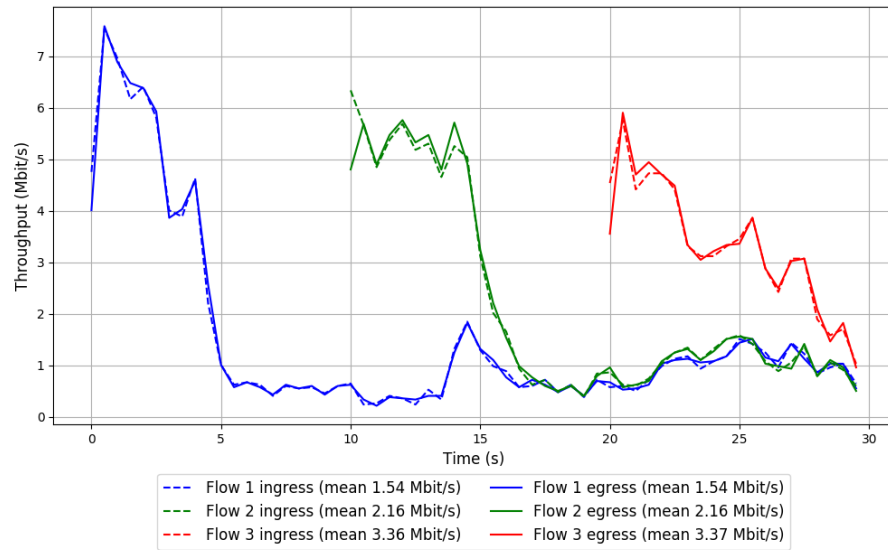
-- Flow 3:

Average throughput: 3.37 Mbit/s

95th percentile per-packet one-way delay: 87.258 ms

Loss rate: 0.25%

Run 3: Report of TCP Vegas — Data Link



Run 1: Statistics of Verus

Start at: 2018-01-26 01:01:13

End at: 2018-01-26 01:01:43

Local clock offset: 1.911 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.24 Mbit/s

95th percentile per-packet one-way delay: 377.356 ms

Loss rate: 12.72%

-- Flow 1:

Average throughput: 3.38 Mbit/s

95th percentile per-packet one-way delay: 374.095 ms

Loss rate: 12.75%

-- Flow 2:

Average throughput: 2.03 Mbit/s

95th percentile per-packet one-way delay: 403.136 ms

Loss rate: 11.01%

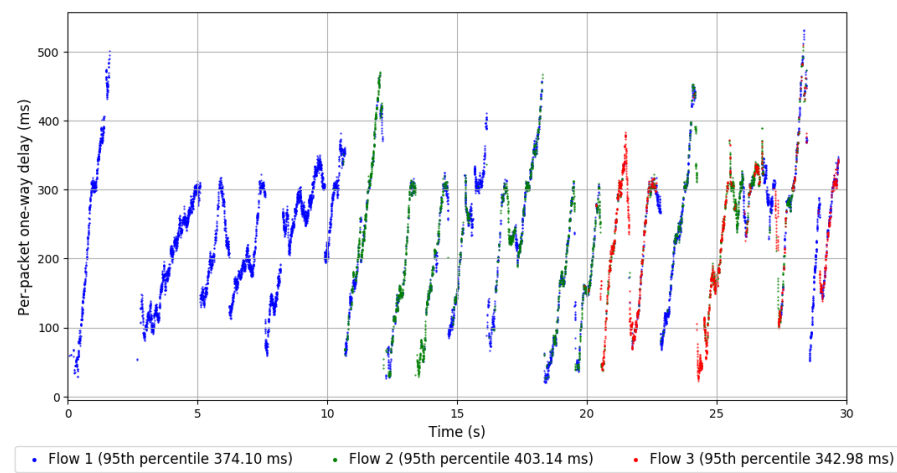
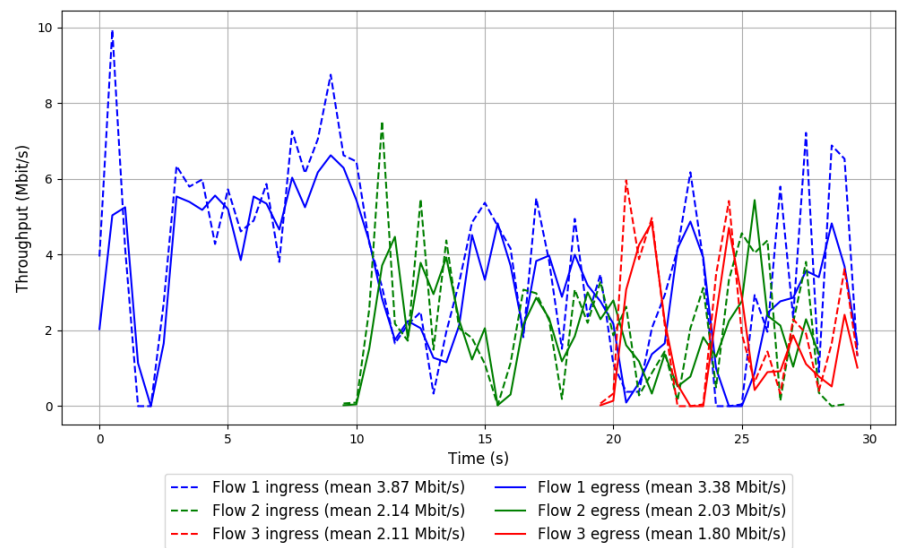
-- Flow 3:

Average throughput: 1.80 Mbit/s

95th percentile per-packet one-way delay: 342.984 ms

Loss rate: 16.05%

Run 1: Report of Verus — Data Link



Run 2: Statistics of Verus

Start at: 2018-01-26 01:48:07

End at: 2018-01-26 01:48:37

Local clock offset: -2.449 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 6.08 Mbit/s

95th percentile per-packet one-way delay: 362.698 ms

Loss rate: 10.04%

-- Flow 1:

Average throughput: 4.46 Mbit/s

95th percentile per-packet one-way delay: 345.215 ms

Loss rate: 6.53%

-- Flow 2:

Average throughput: 1.77 Mbit/s

95th percentile per-packet one-way delay: 365.435 ms

Loss rate: 16.74%

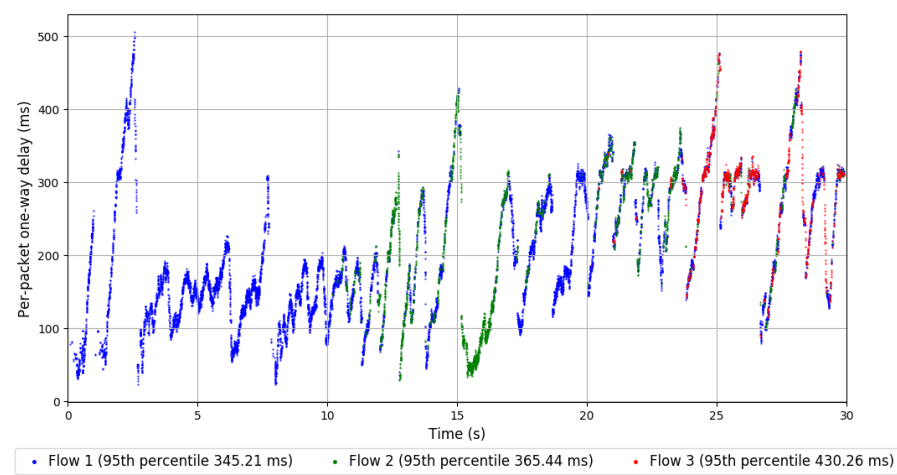
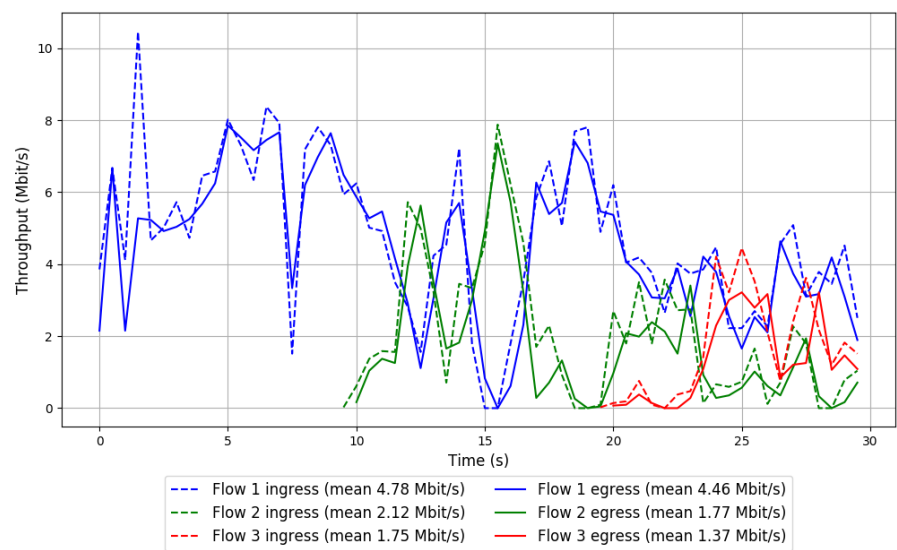
-- Flow 3:

Average throughput: 1.37 Mbit/s

95th percentile per-packet one-way delay: 430.263 ms

Loss rate: 22.63%

Run 2: Report of Verus — Data Link



Run 3: Statistics of Verus

Start at: 2018-01-26 02:35:04

End at: 2018-01-26 02:35:34

Local clock offset: 3.373 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 5.81 Mbit/s

95th percentile per-packet one-way delay: 410.620 ms

Loss rate: 12.87%

-- Flow 1:

Average throughput: 3.38 Mbit/s

95th percentile per-packet one-way delay: 397.646 ms

Loss rate: 9.31%

-- Flow 2:

Average throughput: 3.34 Mbit/s

95th percentile per-packet one-way delay: 412.006 ms

Loss rate: 14.72%

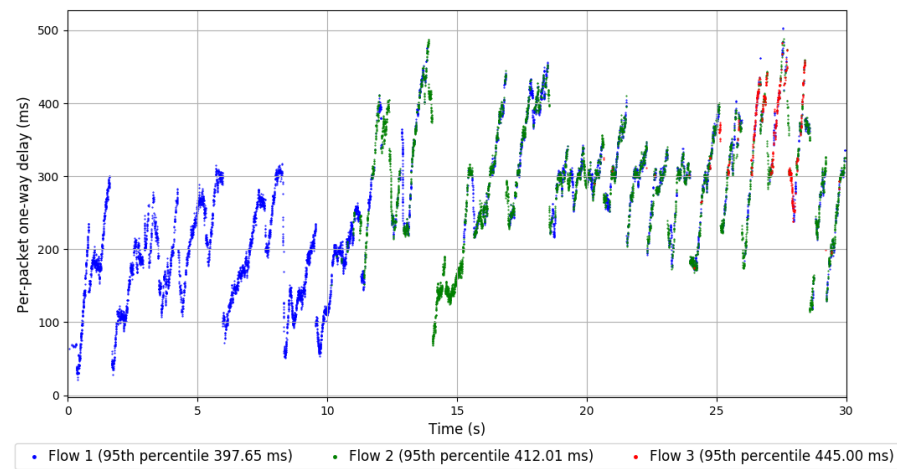
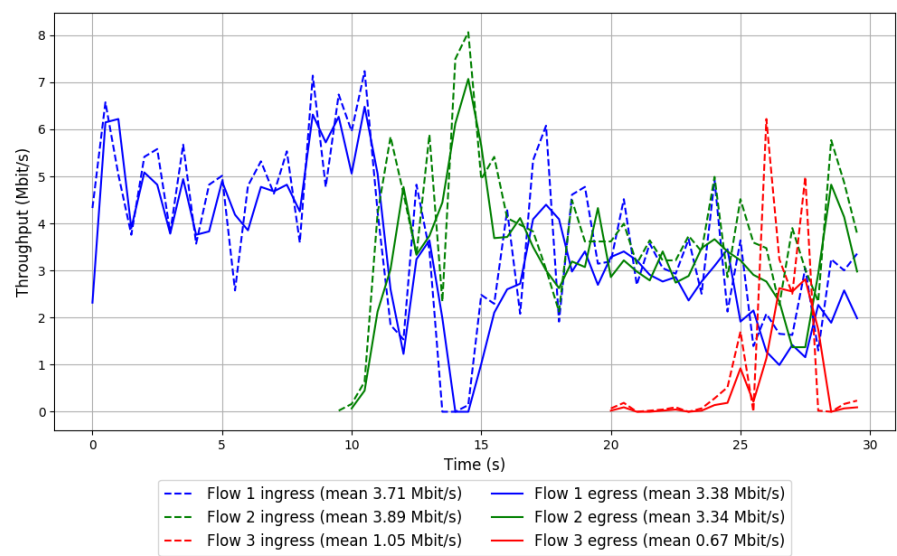
-- Flow 3:

Average throughput: 0.67 Mbit/s

95th percentile per-packet one-way delay: 444.995 ms

Loss rate: 37.59%

Run 3: Report of Verus — Data Link



Run 1: Statistics of Copa

Start at: 2018-01-26 00:49:30

End at: 2018-01-26 00:50:00

Local clock offset: -1.694 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 1.96 Mbit/s

95th percentile per-packet one-way delay: 88.933 ms

Loss rate: 0.59%

-- Flow 1:

Average throughput: 0.96 Mbit/s

95th percentile per-packet one-way delay: 84.512 ms

Loss rate: 0.72%

-- Flow 2:

Average throughput: 1.01 Mbit/s

95th percentile per-packet one-way delay: 82.531 ms

Loss rate: 0.39%

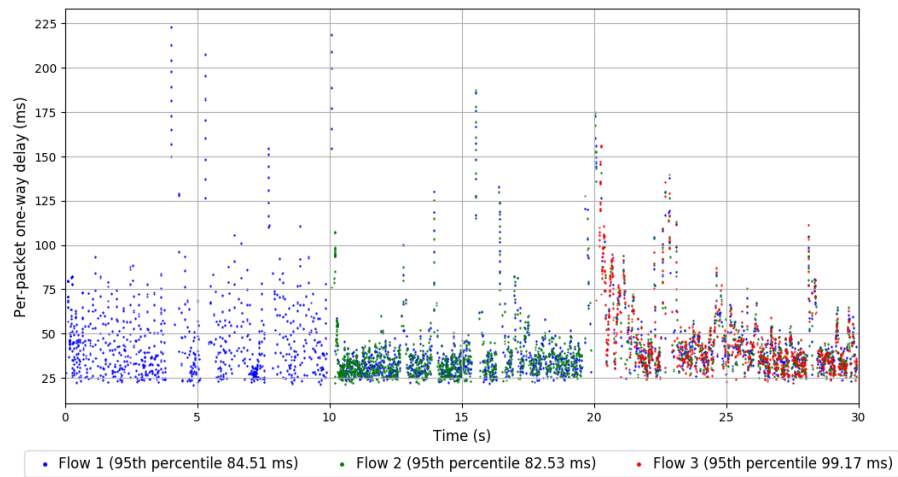
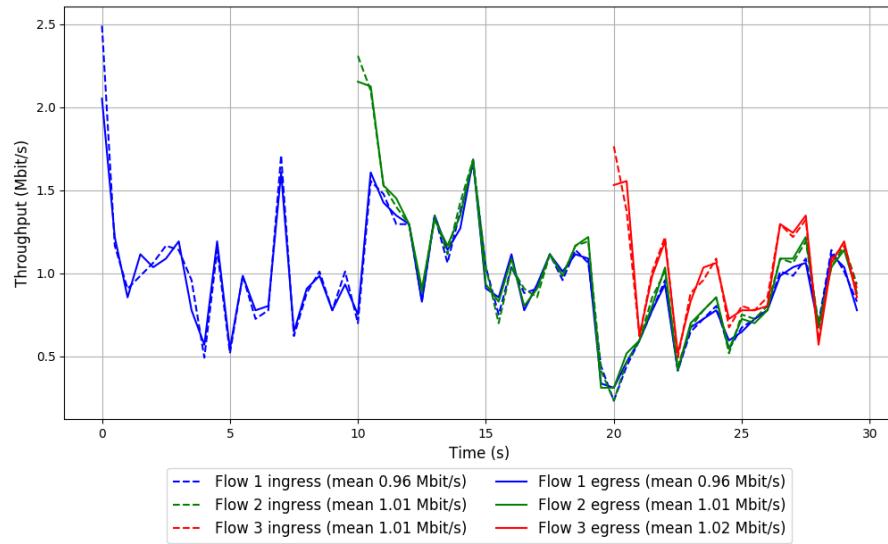
-- Flow 3:

Average throughput: 1.02 Mbit/s

95th percentile per-packet one-way delay: 99.165 ms

Loss rate: 0.64%

Run 1: Report of Copa — Data Link



Run 2: Statistics of Copa

Start at: 2018-01-26 01:36:23

End at: 2018-01-26 01:36:53

Local clock offset: -1.486 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 2.23 Mbit/s

95th percentile per-packet one-way delay: 67.397 ms

Loss rate: 0.93%

-- Flow 1:

Average throughput: 1.07 Mbit/s

95th percentile per-packet one-way delay: 71.511 ms

Loss rate: 0.30%

-- Flow 2:

Average throughput: 1.06 Mbit/s

95th percentile per-packet one-way delay: 66.000 ms

Loss rate: 0.69%

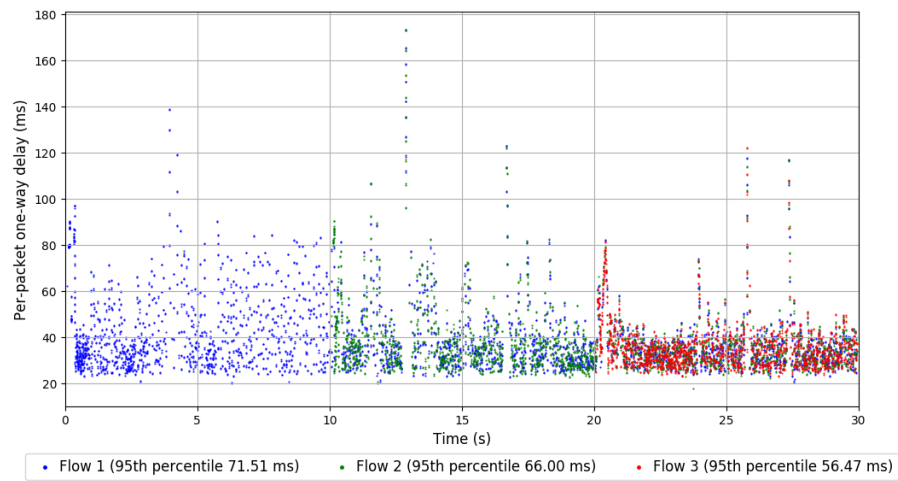
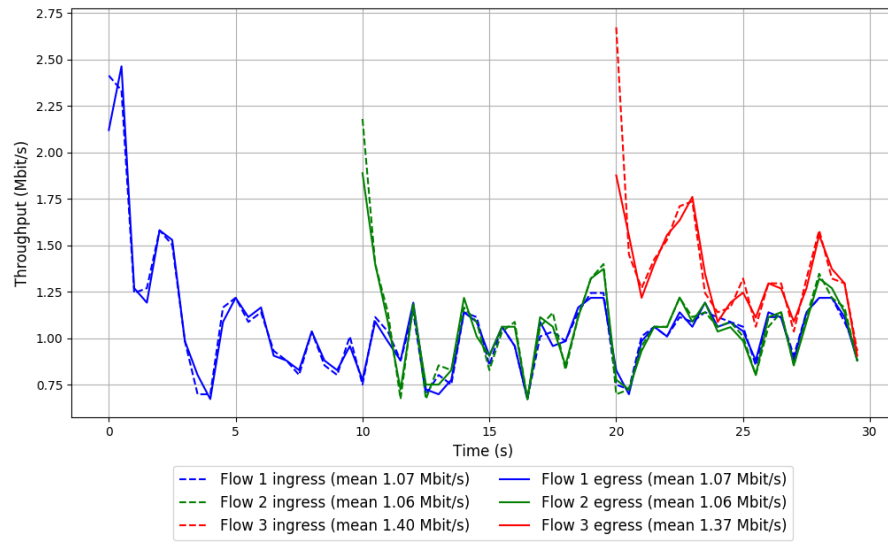
-- Flow 3:

Average throughput: 1.37 Mbit/s

95th percentile per-packet one-way delay: 56.469 ms

Loss rate: 2.77%

Run 2: Report of Copa — Data Link



Run 3: Statistics of Copa

Start at: 2018-01-26 02:23:21

End at: 2018-01-26 02:23:51

Local clock offset: 3.669 ms

Below is generated by plot.py at 2018-01-26 05:03:10

Datalink statistics

-- Total of 3 flows:

Average throughput: 2.37 Mbit/s

95th percentile per-packet one-way delay: 59.608 ms

Loss rate: 0.68%

-- Flow 1:

Average throughput: 1.18 Mbit/s

95th percentile per-packet one-way delay: 64.380 ms

Loss rate: 0.30%

-- Flow 2:

Average throughput: 1.16 Mbit/s

95th percentile per-packet one-way delay: 56.386 ms

Loss rate: 0.17%

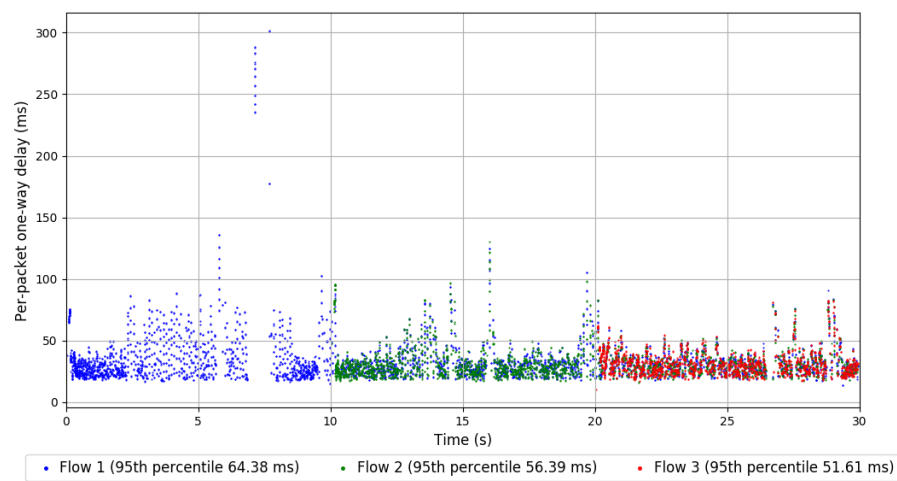
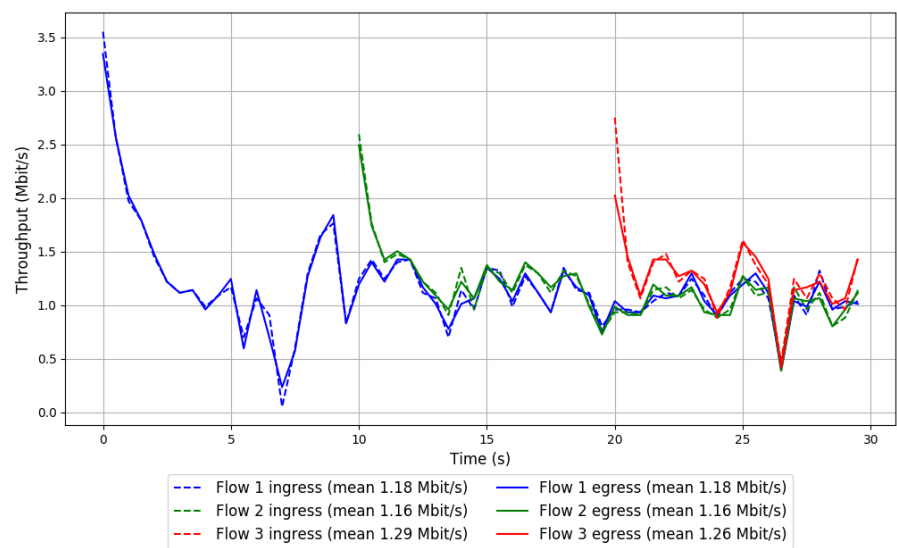
-- Flow 3:

Average throughput: 1.26 Mbit/s

95th percentile per-packet one-way delay: 51.611 ms

Loss rate: 2.64%

Run 3: Report of Copa — Data Link

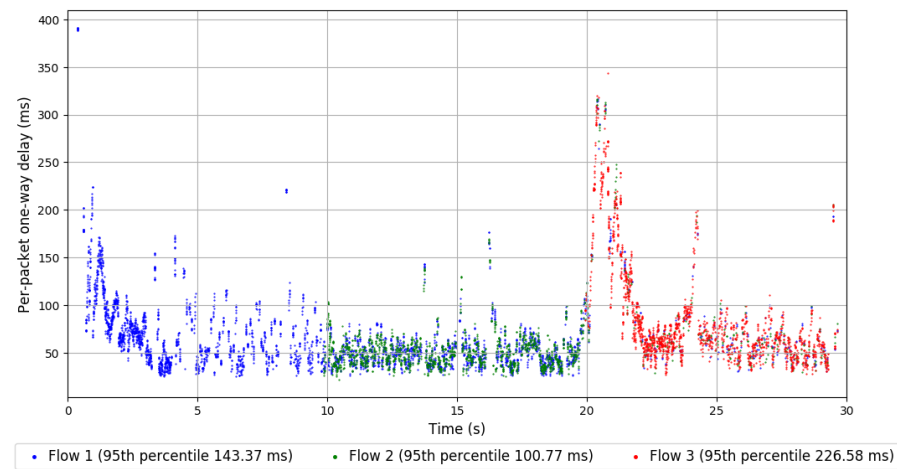
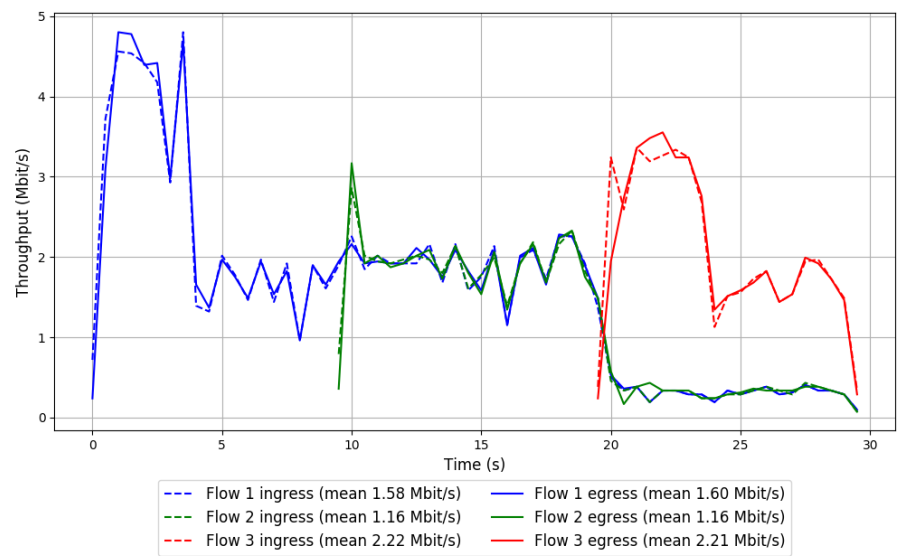


```
Run 1: Statistics of Indigo-2-256

Start at: 2018-01-26 00:43:38
End at: 2018-01-26 00:44:08
Local clock offset: -3.131 ms

# Below is generated by plot.py at 2018-01-26 05:03:10
# Datalink statistics
-- Total of 3 flows:
Average throughput: 3.12 Mbit/s
95th percentile per-packet one-way delay: 162.698 ms
Loss rate: 0.41%
-- Flow 1:
Average throughput: 1.60 Mbit/s
95th percentile per-packet one-way delay: 143.368 ms
Loss rate: 0.08%
-- Flow 2:
Average throughput: 1.16 Mbit/s
95th percentile per-packet one-way delay: 100.772 ms
Loss rate: 0.10%
-- Flow 3:
Average throughput: 2.21 Mbit/s
95th percentile per-packet one-way delay: 226.581 ms
Loss rate: 1.43%
```

Run 1: Report of Indigo-2-256 — Data Link



Run 2: Statistics of Indigo-2-256

Start at: 2018-01-26 01:30:32

End at: 2018-01-26 01:31:02

Local clock offset: -0.192 ms

Below is generated by plot.py at 2018-01-26 05:03:15

Datalink statistics

-- Total of 3 flows:

Average throughput: 3.81 Mbit/s

95th percentile per-packet one-way delay: 116.804 ms

Loss rate: 0.39%

-- Flow 1:

Average throughput: 1.91 Mbit/s

95th percentile per-packet one-way delay: 116.701 ms

Loss rate: 0.28%

-- Flow 2:

Average throughput: 1.43 Mbit/s

95th percentile per-packet one-way delay: 106.467 ms

Loss rate: 0.63%

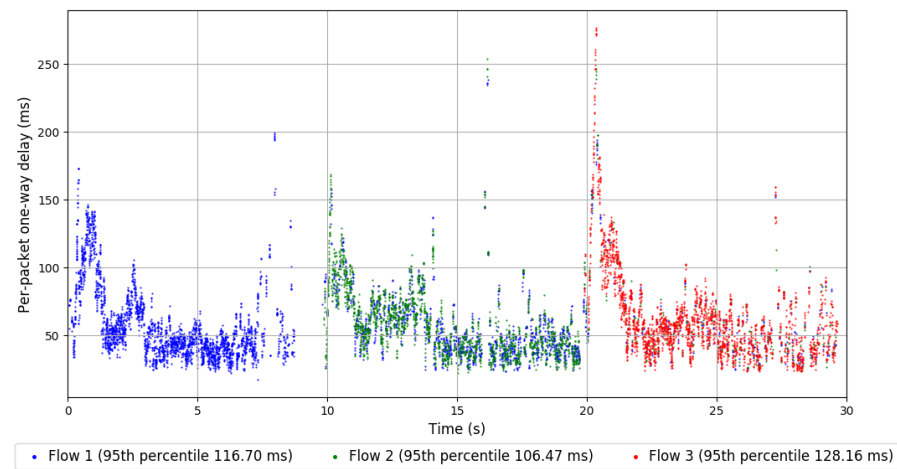
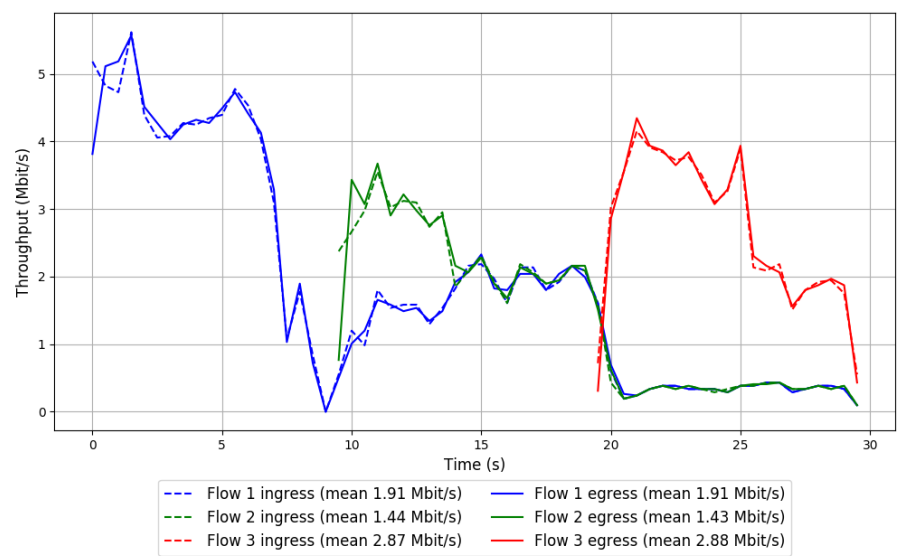
-- Flow 3:

Average throughput: 2.88 Mbit/s

95th percentile per-packet one-way delay: 128.159 ms

Loss rate: 0.38%

Run 2: Report of Indigo-2-256 — Data Link



Run 3: Statistics of Indigo-2-256

Start at: 2018-01-26 02:17:30

End at: 2018-01-26 02:18:00

Local clock offset: 3.155 ms

Below is generated by plot.py at 2018-01-26 05:03:15

Datalink statistics

-- Total of 3 flows:

Average throughput: 3.63 Mbit/s

95th percentile per-packet one-way delay: 96.759 ms

Loss rate: 0.63%

-- Flow 1:

Average throughput: 1.35 Mbit/s

95th percentile per-packet one-way delay: 107.693 ms

Loss rate: 0.92%

-- Flow 2:

Average throughput: 1.17 Mbit/s

95th percentile per-packet one-way delay: 102.822 ms

Loss rate: 0.31%

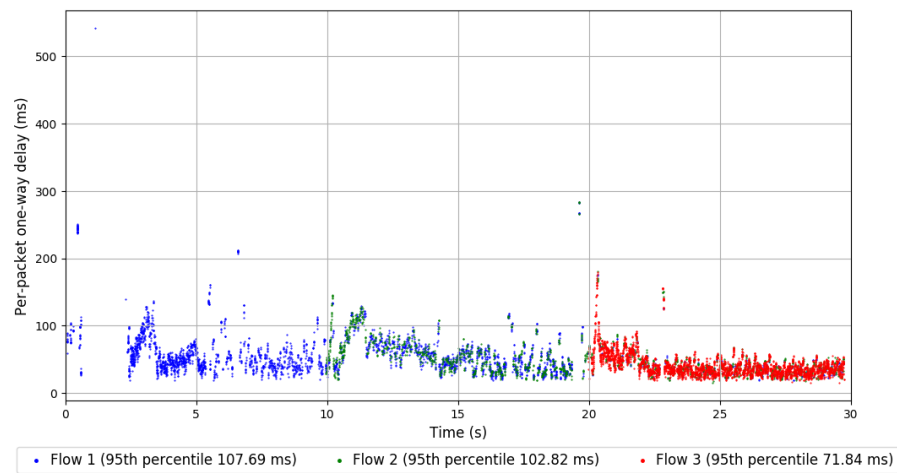
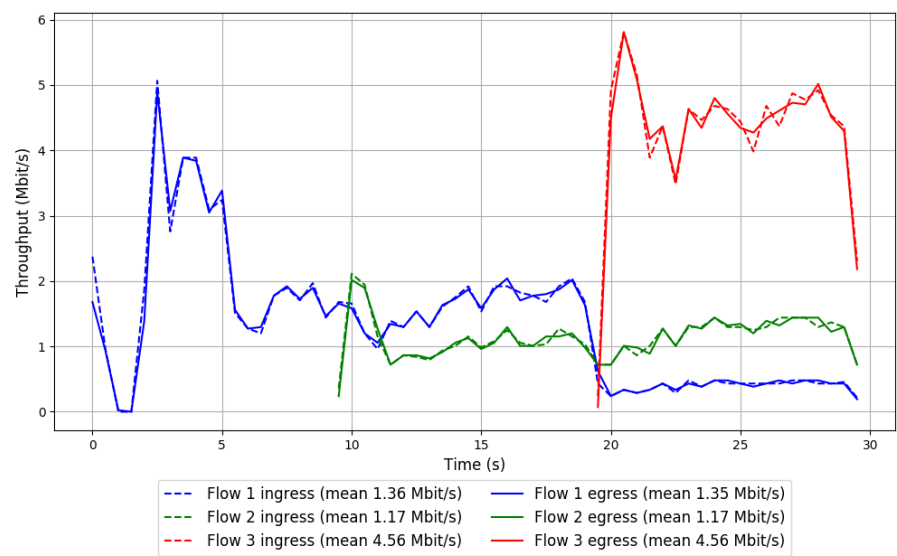
-- Flow 3:

Average throughput: 4.56 Mbit/s

95th percentile per-packet one-way delay: 71.842 ms

Loss rate: 0.54%

Run 3: Report of Indigo-2-256 — Data Link

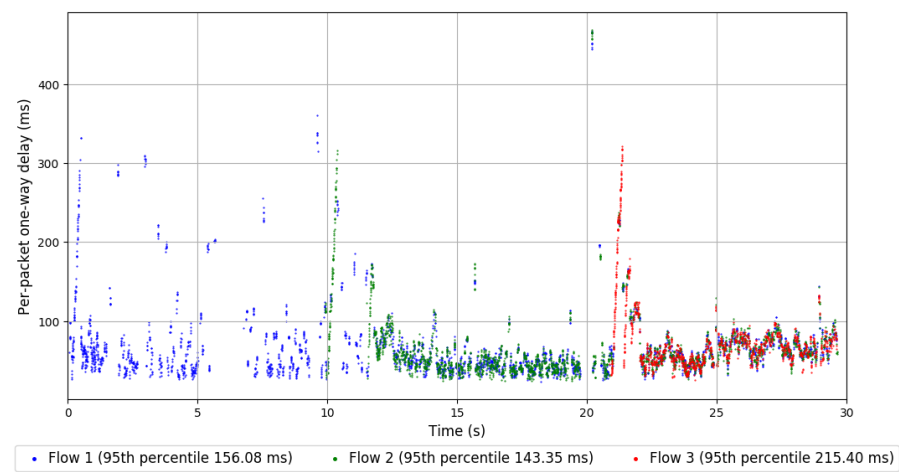
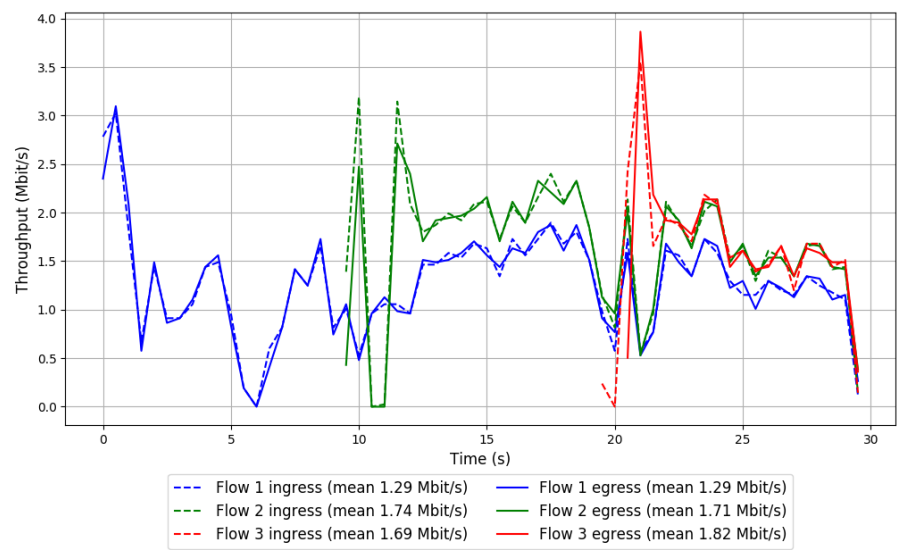


```
Run 1: Statistics of Indigo-1-32

Start at: 2018-01-26 00:37:47
End at: 2018-01-26 00:38:17
Local clock offset: -3.247 ms

# Below is generated by plot.py at 2018-01-26 05:03:15
# Datalink statistics
-- Total of 3 flows:
Average throughput: 2.96 Mbit/s
95th percentile per-packet one-way delay: 157.487 ms
Loss rate: 1.67%
-- Flow 1:
Average throughput: 1.29 Mbit/s
95th percentile per-packet one-way delay: 156.081 ms
Loss rate: 0.25%
-- Flow 2:
Average throughput: 1.71 Mbit/s
95th percentile per-packet one-way delay: 143.350 ms
Loss rate: 2.44%
-- Flow 3:
Average throughput: 1.82 Mbit/s
95th percentile per-packet one-way delay: 215.401 ms
Loss rate: 3.34%
```

Run 1: Report of Indigo-1-32 — Data Link



Run 2: Statistics of Indigo-1-32

Start at: 2018-01-26 01:24:40

End at: 2018-01-26 01:25:10

Local clock offset: 2.0 ms

Below is generated by plot.py at 2018-01-26 05:03:16

Datalink statistics

-- Total of 3 flows:

Average throughput: 3.37 Mbit/s

95th percentile per-packet one-way delay: 94.989 ms

Loss rate: 1.34%

-- Flow 1:

Average throughput: 1.67 Mbit/s

95th percentile per-packet one-way delay: 95.474 ms

Loss rate: 2.24%

-- Flow 2:

Average throughput: 1.65 Mbit/s

95th percentile per-packet one-way delay: 83.497 ms

Loss rate: 0.26%

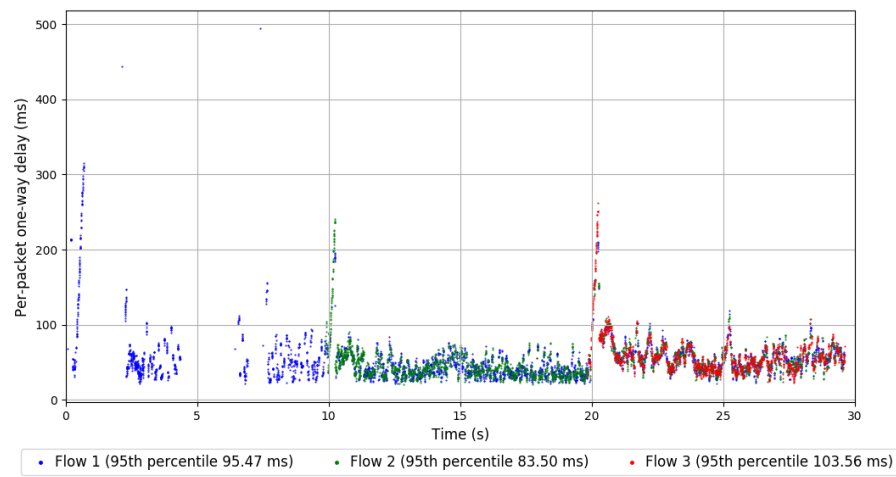
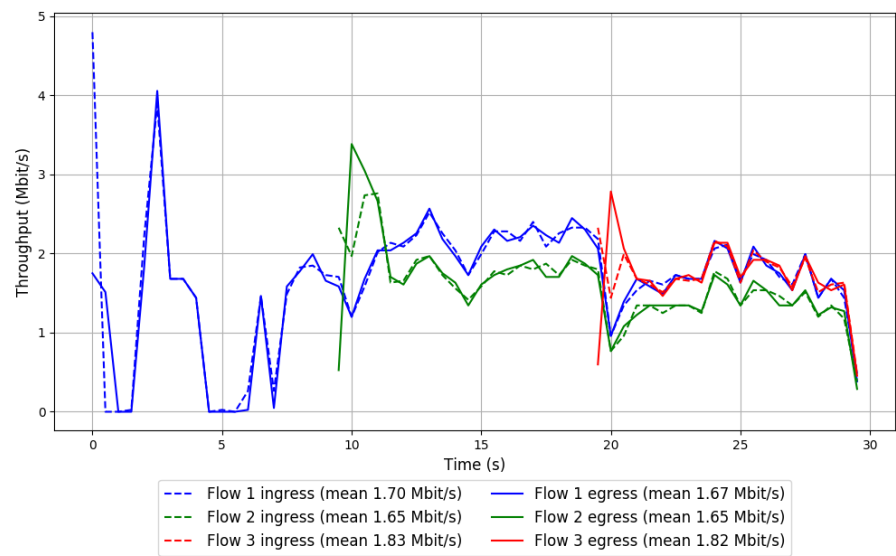
-- Flow 3:

Average throughput: 1.82 Mbit/s

95th percentile per-packet one-way delay: 103.559 ms

Loss rate: 0.80%

Run 2: Report of Indigo-1-32 — Data Link



Run 3: Statistics of Indigo-1-32

Start at: 2018-01-26 02:11:39

End at: 2018-01-26 02:12:09

Local clock offset: 2.593 ms

Below is generated by plot.py at 2018-01-26 05:03:16

Datalink statistics

-- Total of 3 flows:

Average throughput: 2.95 Mbit/s

95th percentile per-packet one-way delay: 107.768 ms

Loss rate: 0.58%

-- Flow 1:

Average throughput: 1.51 Mbit/s

95th percentile per-packet one-way delay: 96.833 ms

Loss rate: 0.95%

-- Flow 2:

Average throughput: 1.44 Mbit/s

95th percentile per-packet one-way delay: 93.790 ms

Loss rate: 0.08%

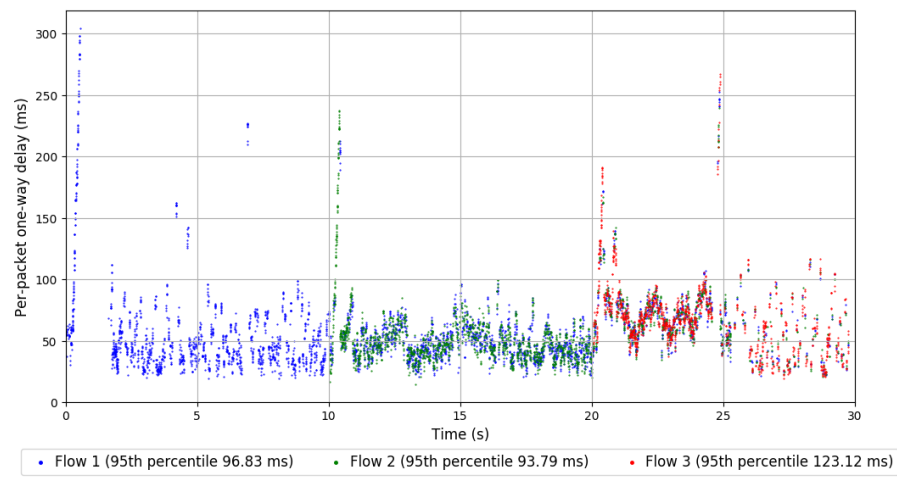
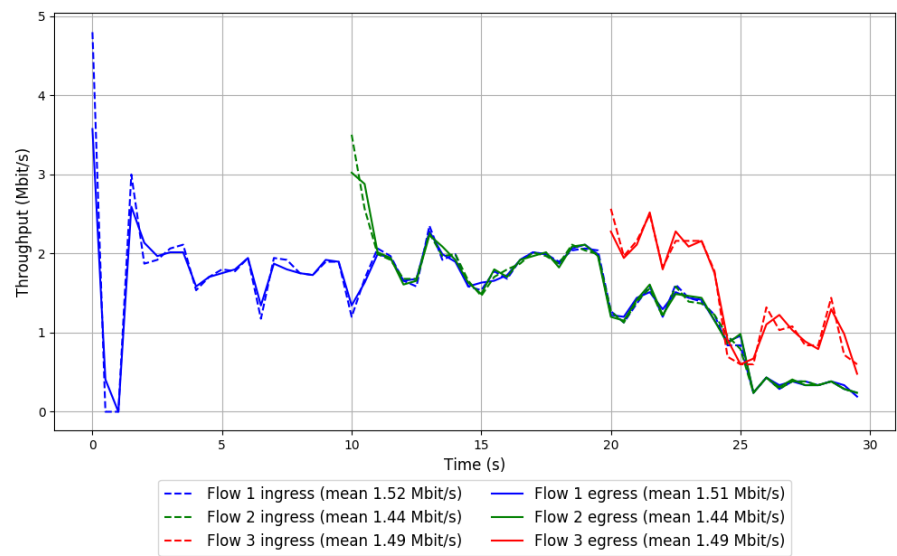
-- Flow 3:

Average throughput: 1.49 Mbit/s

95th percentile per-packet one-way delay: 123.118 ms

Loss rate: 0.41%

Run 3: Report of Indigo-1-32 — Data Link

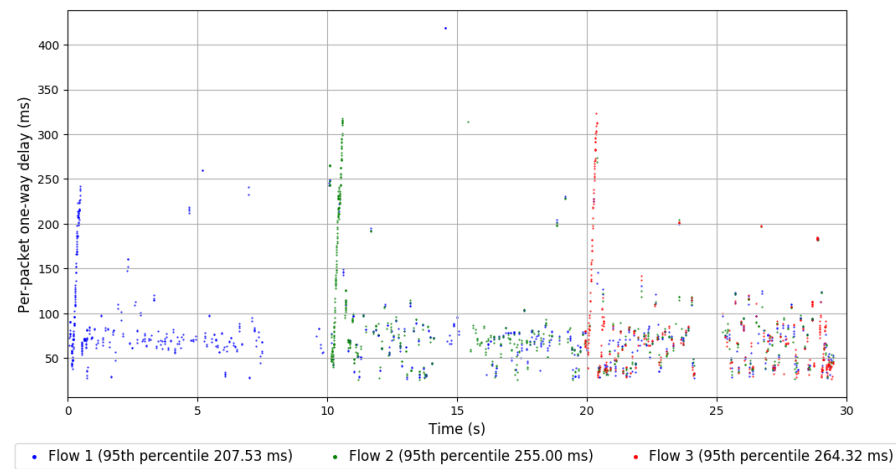
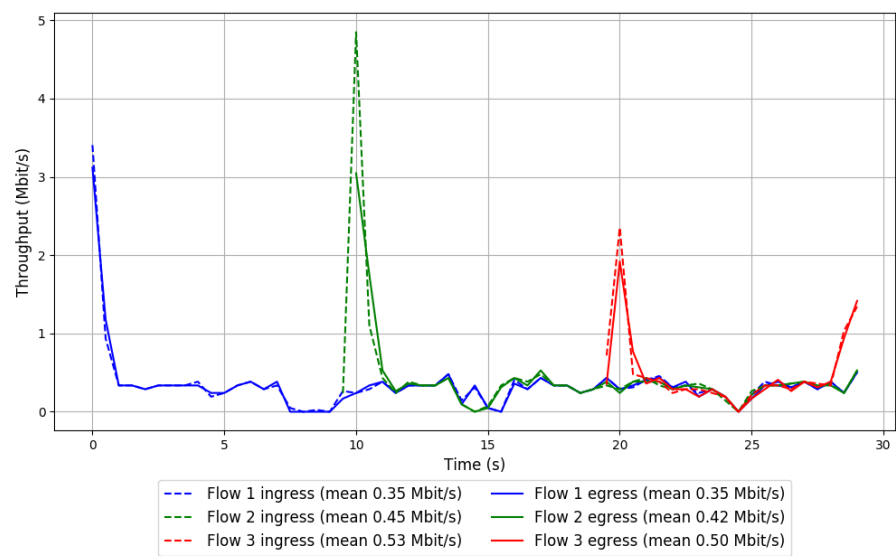


```
Run 1: Statistics of Indigo-1-128

Start at: 2018-01-26 00:26:04
End at: 2018-01-26 00:26:34
Local clock offset: -3.265 ms

# Below is generated by plot.py at 2018-01-26 05:03:16
# Datalink statistics
-- Total of 3 flows:
Average throughput: 0.79 Mbit/s
95th percentile per-packet one-way delay: 231.685 ms
Loss rate: 4.60%
-- Flow 1:
Average throughput: 0.35 Mbit/s
95th percentile per-packet one-way delay: 207.529 ms
Loss rate: 1.17%
-- Flow 2:
Average throughput: 0.42 Mbit/s
95th percentile per-packet one-way delay: 255.001 ms
Loss rate: 7.88%
-- Flow 3:
Average throughput: 0.50 Mbit/s
95th percentile per-packet one-way delay: 264.316 ms
Loss rate: 5.86%
```


Run 1: Report of Indigo-1-128 — Data Link



Run 2: Statistics of Indigo-1-128

Start at: 2018-01-26 01:12:57

End at: 2018-01-26 01:13:27

Local clock offset: 3.449 ms

Below is generated by plot.py at 2018-01-26 05:03:16

Datalink statistics

-- Total of 3 flows:

Average throughput: 0.79 Mbit/s

95th percentile per-packet one-way delay: 148.490 ms

Loss rate: 3.22%

-- Flow 1:

Average throughput: 0.35 Mbit/s

95th percentile per-packet one-way delay: 132.518 ms

Loss rate: 3.22%

-- Flow 2:

Average throughput: 0.42 Mbit/s

95th percentile per-packet one-way delay: 157.815 ms

Loss rate: 4.05%

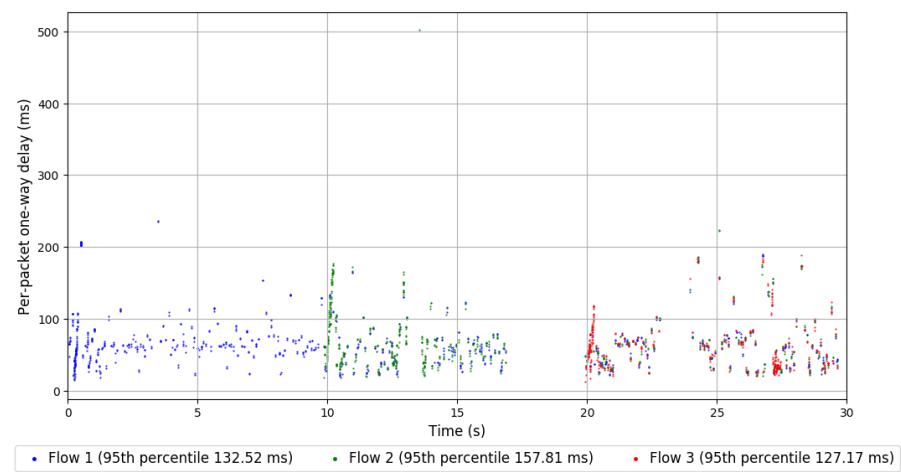
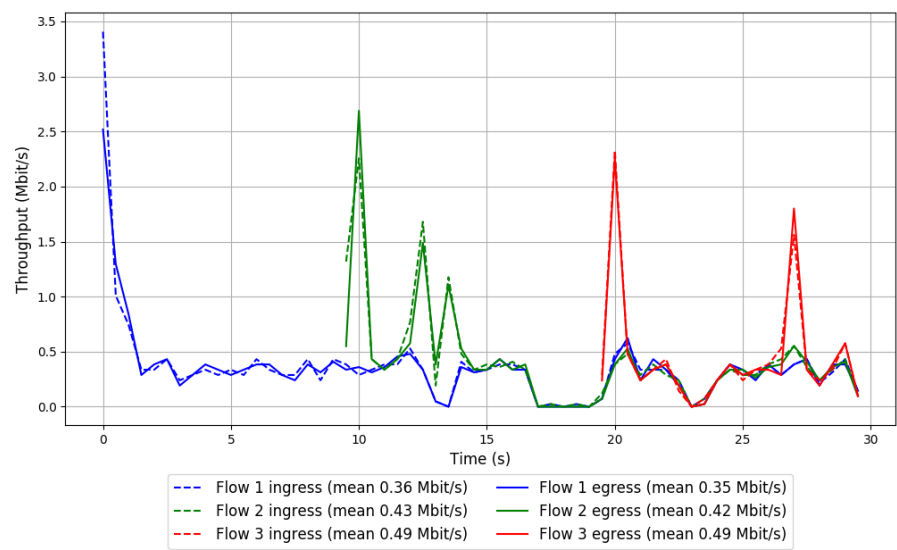
-- Flow 3:

Average throughput: 0.49 Mbit/s

95th percentile per-packet one-way delay: 127.166 ms

Loss rate: 1.75%

Run 2: Report of Indigo-1-128 — Data Link



Run 3: Statistics of Indigo-1-128

Start at: 2018-01-26 01:59:56

End at: 2018-01-26 02:00:26

Local clock offset: -0.398 ms

Below is generated by plot.py at 2018-01-26 05:03:16

Datalink statistics

-- Total of 3 flows:

Average throughput: 0.76 Mbit/s

95th percentile per-packet one-way delay: 178.792 ms

Loss rate: 4.20%

-- Flow 1:

Average throughput: 0.32 Mbit/s

95th percentile per-packet one-way delay: 139.929 ms

Loss rate: 4.02%

-- Flow 2:

Average throughput: 0.45 Mbit/s

95th percentile per-packet one-way delay: 148.482 ms

Loss rate: 5.55%

-- Flow 3:

Average throughput: 0.43 Mbit/s

95th percentile per-packet one-way delay: 215.027 ms

Loss rate: 1.69%

Run 3: Report of Indigo-1-128 — Data Link

