Pantheon Report

Generated at 2020-05-29 22:51:42 (UTC).

Tested in mahimahi: `mm-delay 40 mm-link 50mbps.trace 50mbps.trace --uplink-queue=droptail --uplink-queue-args=packets=300`

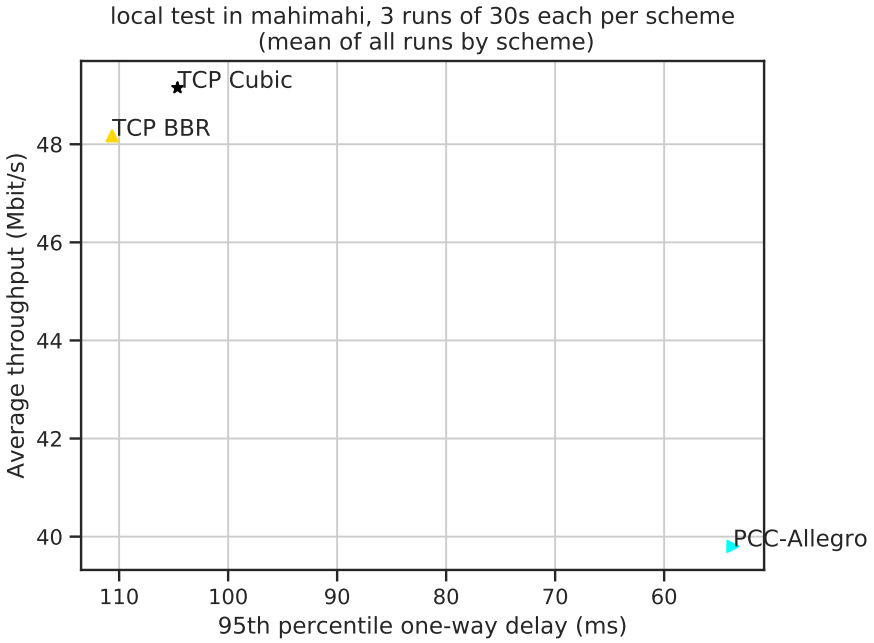
Repeated the test of 3 congestion control schemes 3 times.

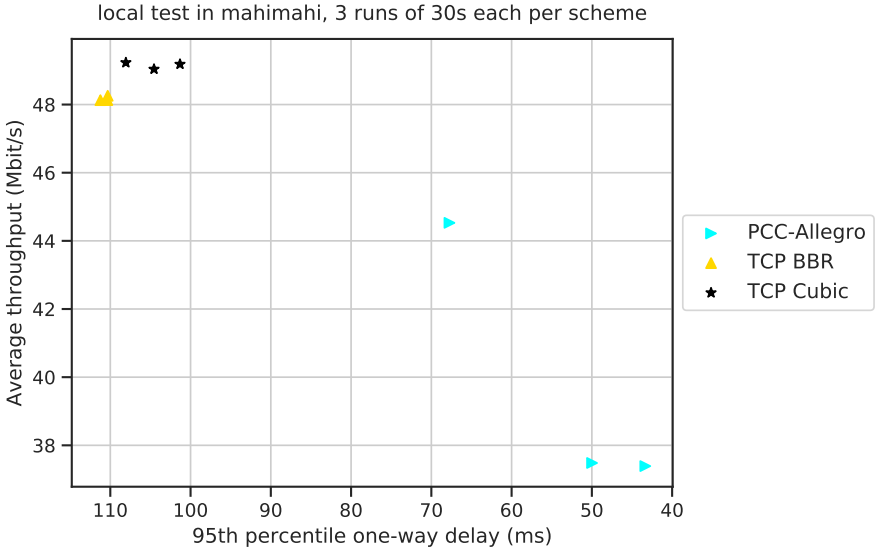
Each test lasted for 30 seconds running 1 flow.

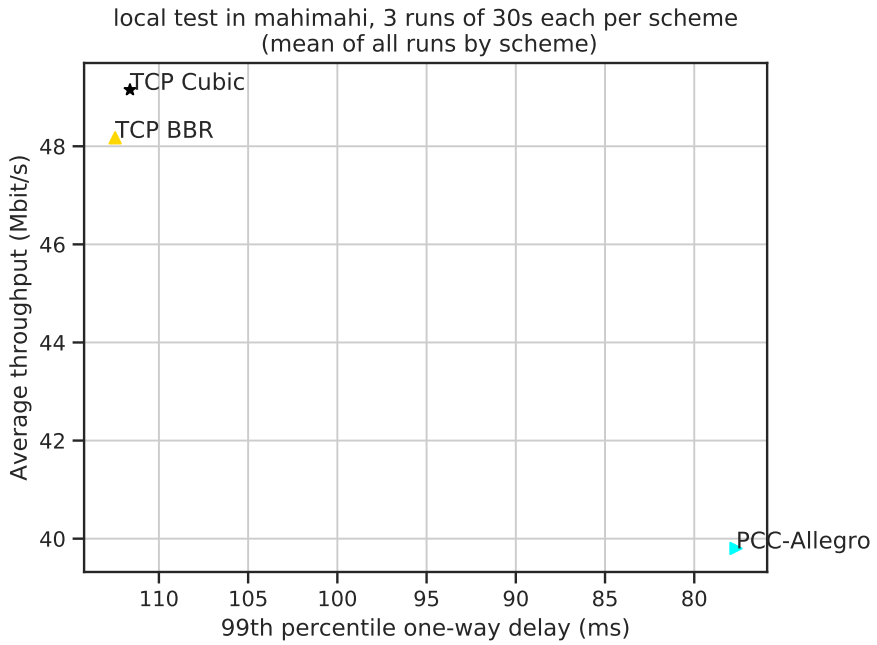
```
System info:
Linux 4.15.0-99-generic
net.core.default_qdisc = fq
net.core.rmem_default = 212992
net.core.rmem_max = 212992
net.core.wmem_default = 212992
net.core.wmem_max = 212992
net.ipv4.tcp_rmem = 4096 131072 6291456
net.ipv4.tcp_wmem = 4096 16384 4194304
```

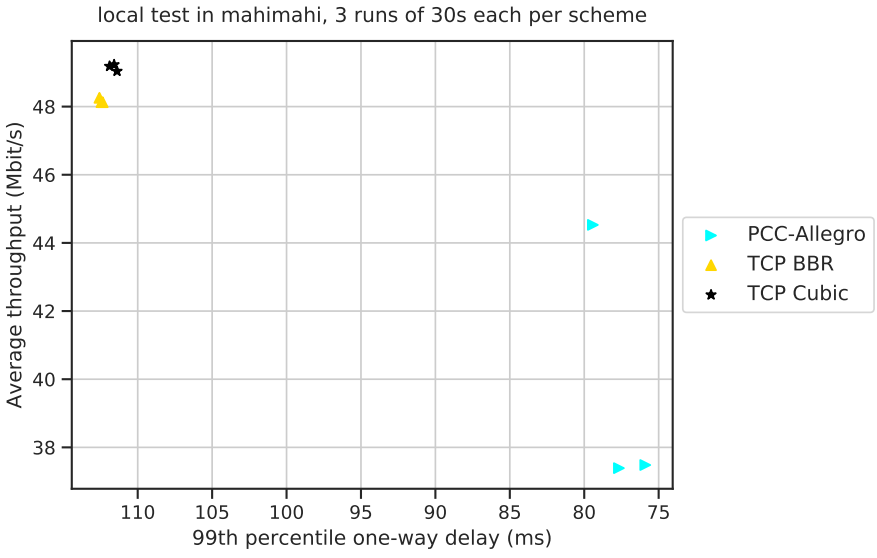
```
Git summary:
branch: master @ de03a85893cd23431bc6546c631762bf3c55dbcb
third_party/aurora @ f3e943d61015b39960854ba6391797e0c7984d74
third_party/aurora-model @ e292c316c23fb837255c4e142e40590d154bbe95
third_party/eagle-plus @ f84a9431dfbfa1640fc82bb6d18e33f0ffe0661a
 M net-em/net-em/net_em/__pycache__/__init__.cpython-36.pyc
 M net-em/net-em/net_em/envs/__pycache__/__init__.cpython-36.pyc
 M net-em/net-em/net_em/envs/__pycache__/helpers.cpython-36.pyc
 M net-em/net-em/net_em/envs/__pycache__/project_root.cpython-36.pyc
 M net-em/net-em/net_em/envs/__pycache__/receiver.cpython-36.pyc
third_party/eagle-v1 @ c68d985e042be5c30704c0aee48c363861951a95
third_party/eagle-v2 @ c8a1737b3c84d7d49eada5b8785045d272a70120
third_party/eagle-v3 @ 50d676bd6e47e3e29a3ce914a6e50b2c6f15136b
third_party/fillp @ d6da1459332fcee56963885d7eba17e6a32d4519
third_party/fillp-sheep @ 0e5bb722943babcd2b090d2c64fcd45e12e923f9
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/indigo @ 2601c92e4aa9d58d38dc4dfe0ecdbf90c077e64d
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/pantheon-tunnel @ f866d3f58d27afd942717625ee3a354cc2e802bd
third_party/pcc @ 1afc958fa0d66d18b623c091a55fec872b4981e1
 M receiver/src/buffer.h
 M receiver/src/core.cpp
 M sender/src/buffer.h
 M sender/src/core.cpp
third_party/pcc-experimental @ cd43e34e3f5f5613e8acd08fab92c4eb24f974ab
third_party/proto-quic @ 77961f1a82733a86b42f1bc8143ebc978f3cff42
third_party/scream-reproduce @ f099118d1421aa3131bf11ff1964974e1da3bdb2
 M src/ScreamClient
```

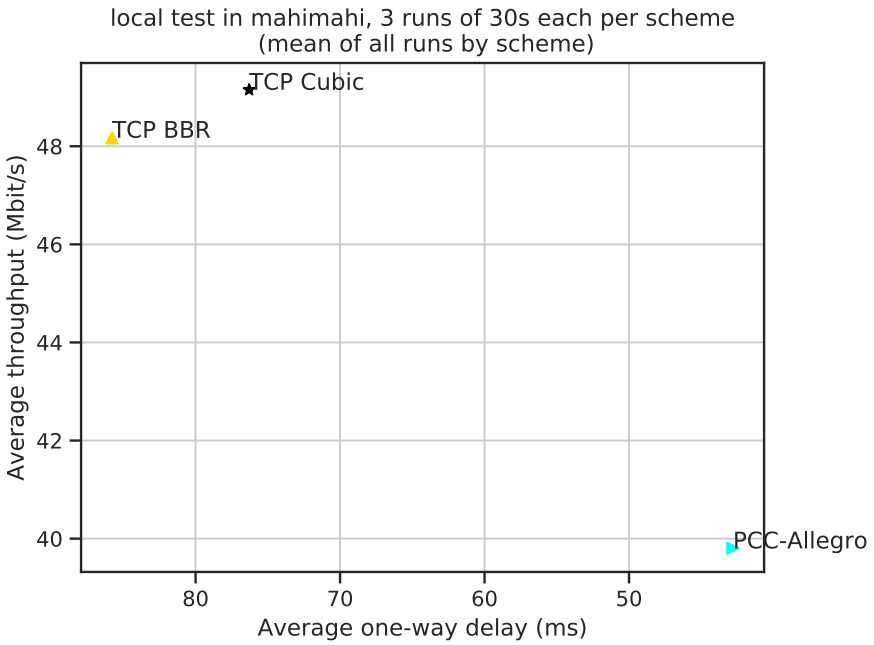
```
 M src/ScreamServer
third_party/sprout @ 366e35c6178b01e31d4a46ad18c74f9415f19a26
 M src/examples/cellsim.cc
 M src/examples/sproutbt2.cc
 M src/network/sproutconn.cc
third_party/verus @ d4b447ea74c6c60a261149af2629562939f9a494
 M src/verus.hpp
 M tools/plot.py
third_party/vivace @ 2baf86211435ae071a32f96b7d8c504587f5d7f4
third_party/webrtc @ 3f0cc2a9061a41b6f9dde4735770d143a1fa2851
```

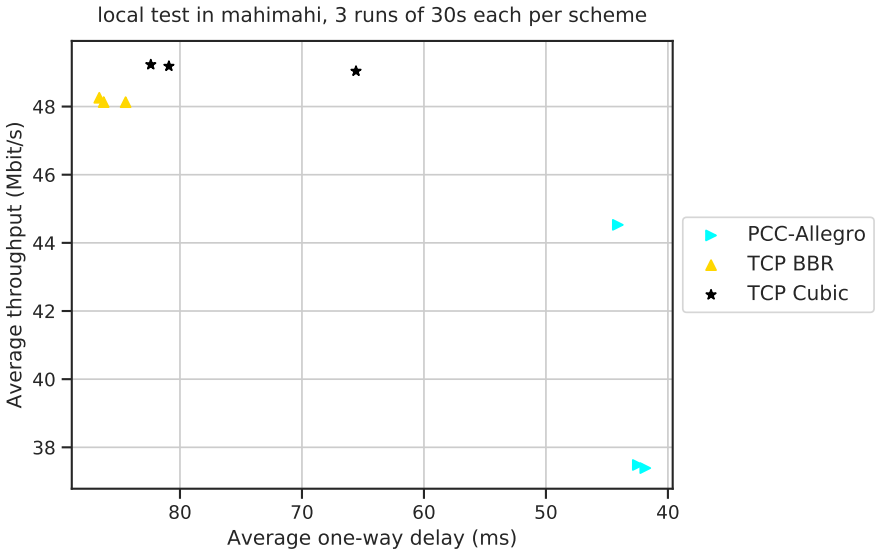

local test in mahimahi, 3 runs of 30s each per scheme
(mean of all runs by scheme)
TCP Cubic
TCP BBR
PCC-Allegro
Average throughput (Mbit/s)
48
46
44
42
40
110
100
90
80
70
60
95th percentile one-way delay (ms)


local test in mahimahi, 3 runs of 30s each per scheme
Average throughput (Mbit/s)
48
46
44
42
40
38
110
100
90
80
70
60
50
40
95th percentile one-way delay (ms)
PCC-Allegro
TCP BBR
TCP Cubic


local test in mahimahi, 3 runs of 30s each per scheme
(mean of all runs by scheme)
TCP Cubic
TCP BBR
PCC-Allegro
Average throughput (Mbit/s)
48
46
44
42
40
110
105
100
95
90
85
80
99th percentile one-way delay (ms)


local test in mahimahi, 3 runs of 30s each per scheme
Average throughput (Mbit/s)
48
46
44
42
40
38
110
105
100
95
90
85
80
75
99th percentile one-way delay (ms)
PCC-Allegro
TCP BBR
TCP Cubic

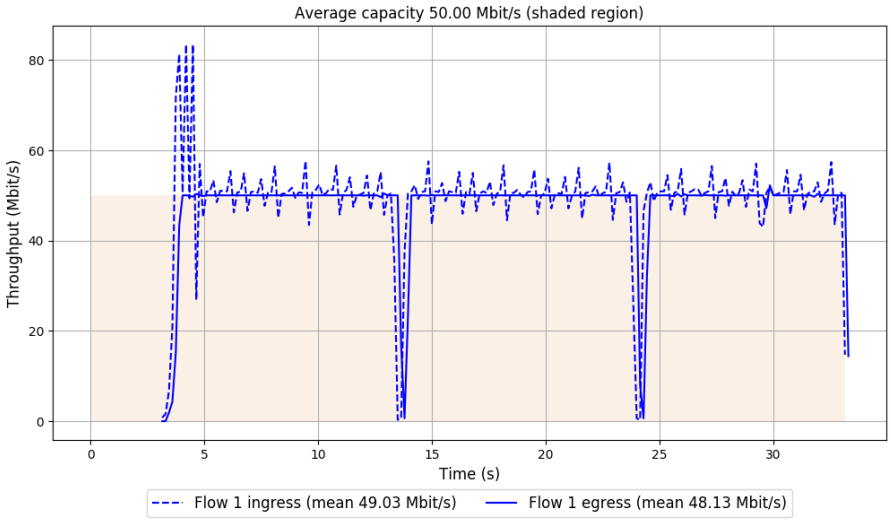

local test in mahimahi, 3 runs of 30s each per scheme
(mean of all runs by scheme)
TCP Cubic
TCP BBR
PCC-Allegro
Average throughput (Mbit/s)
48
46
44
42
40
80
70
60
50
Average one-way delay (ms)

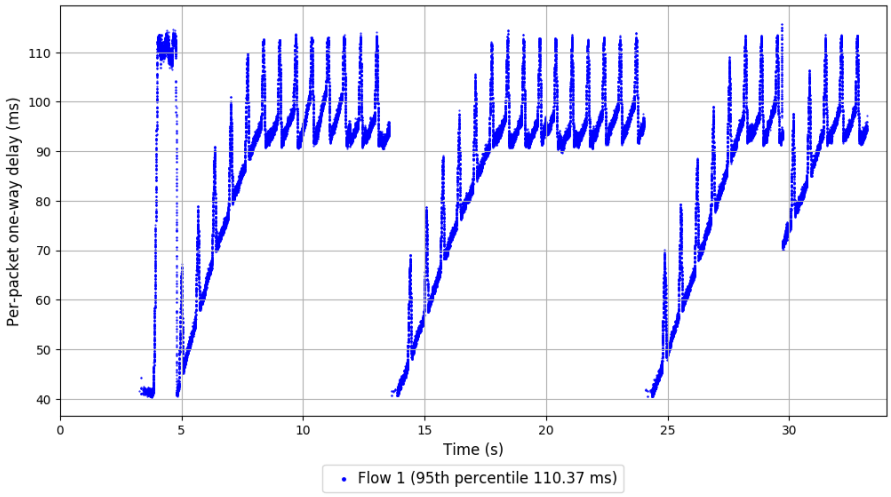

local test in mahimahi, 3 runs of 30s each per scheme
Average throughput (Mbit/s)
48
46
44
42
40
38
80
70
60
50
40
Average one-way delay (ms)
PCC-Allegro
TCP BBR
TCP Cubic

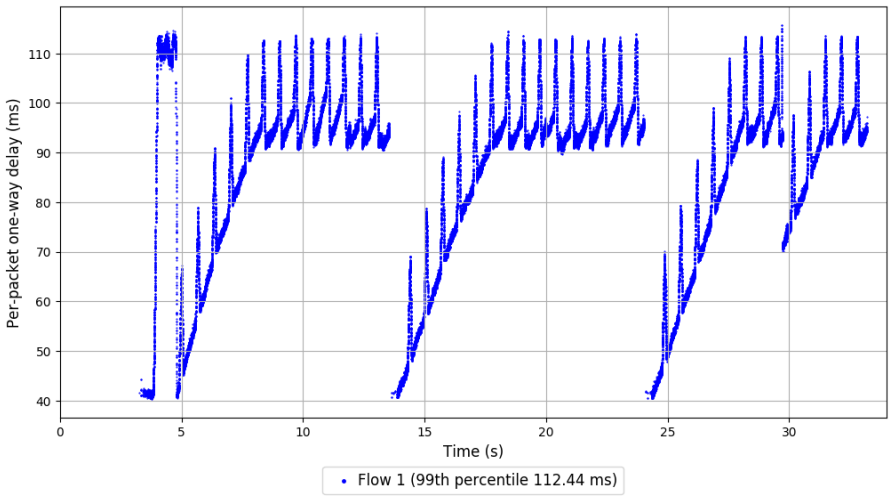
scheme	# runs	mean avg tput (Mbit/s) flow 1	mean 95th-%ile delay (ms) flow 1	mean 99th-%ile delay (ms) flow 1	mean avg delay (ms) flow 1	mean loss rate (%) flow 1
TCP BBR	3	48.17	110.64	112.45	85.78	1.76
TCP Cubic	3	49.15	104.64	111.62	76.29	0.54
PCC-Allegro	3	39.80	53.68	77.66	42.81	0.86

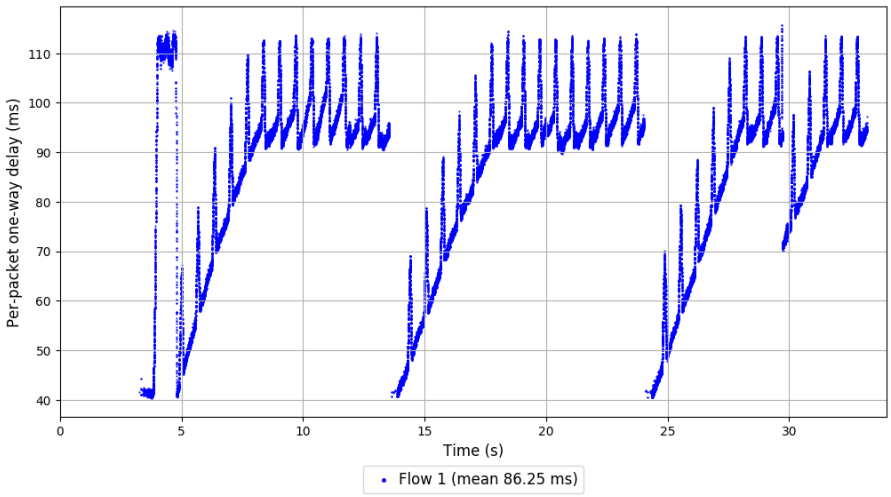
```
Run 1: Statistics of TCP BBR

Start at: 2020-05-29 22:37:57
End at: 2020-05-29 22:38:27

# Below is generated by plot.py at 2020-05-29 22:51:27
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 48.13 Mbit/s (96.3% utilization)
95th percentile per-packet one-way delay: 110.371 ms
99th percentile per-packet one-way delay: 112.437 ms
mean per-packet one-way delay: 86.255 ms
Loss rate: 1.95%
-- Flow 1:
Average throughput: 48.13 Mbit/s
95th percentile per-packet one-way delay: 110.371 ms
99th percentile per-packet one-way delay: 112.437 ms
Average per-packet one-way delay: 86.255 ms
Loss rate: 1.95%
```

Run 1: Report of TCP BBR — Data Link



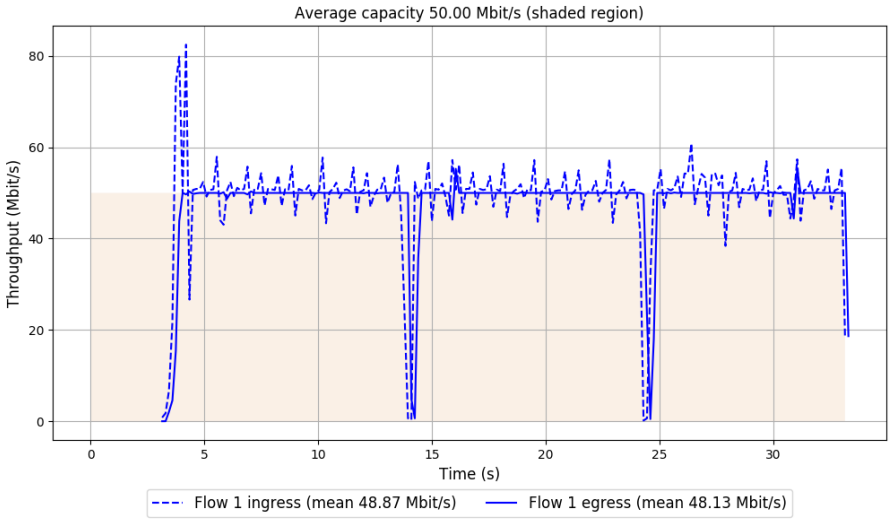


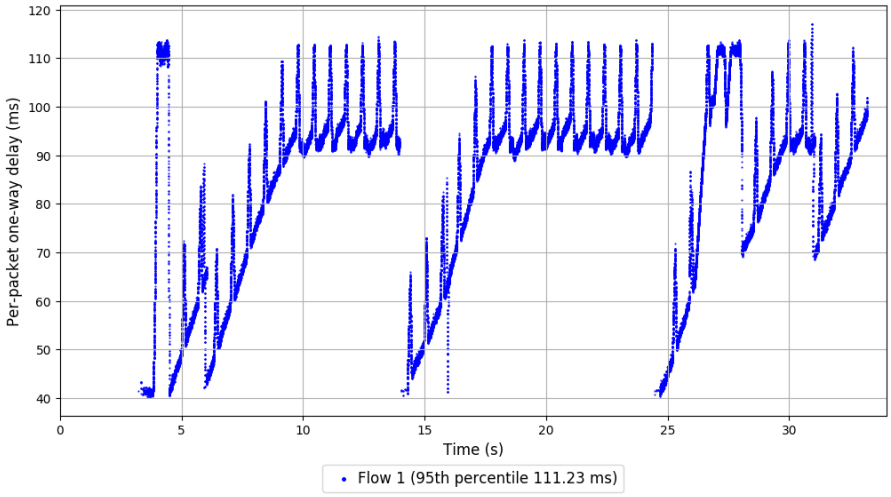

Per-packet one-way delay (ms)
Time (s)
Flow 1 (99th percentile 112.44 ms)

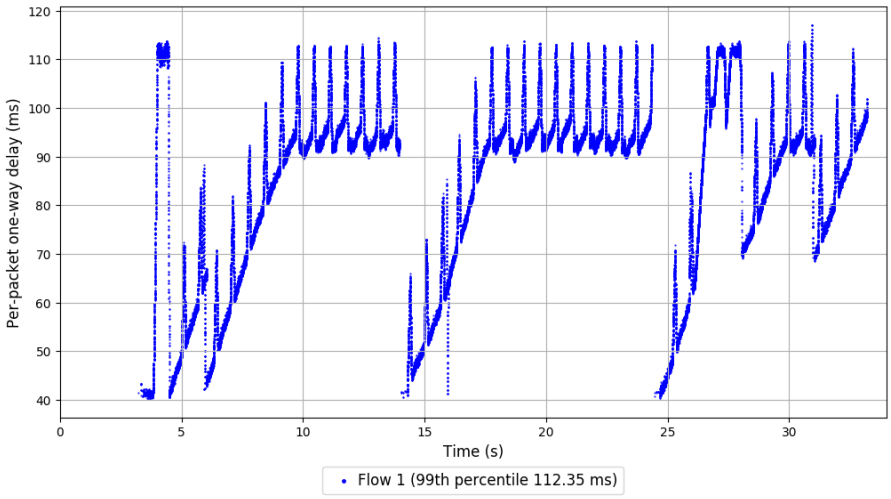

Per-packet one-way delay (ms)
Time (s)
Flow 1 (mean 86.25 ms)

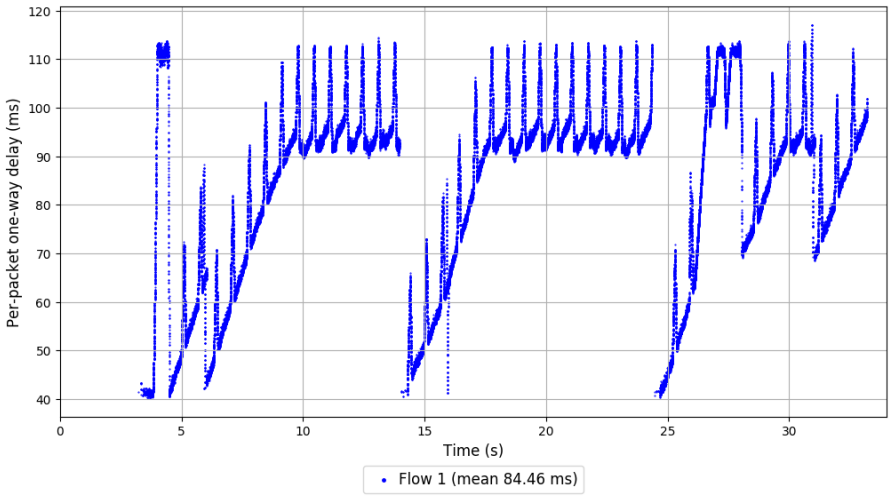
```
Run 2: Statistics of TCP BBR

Start at: 2020-05-29 22:39:46
End at: 2020-05-29 22:40:16

# Below is generated by plot.py at 2020-05-29 22:51:27
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 48.13 Mbit/s (96.3% utilization)
95th percentile per-packet one-way delay: 111.234 ms
99th percentile per-packet one-way delay: 112.351 ms
mean per-packet one-way delay: 84.456 ms
Loss rate: 1.65%
-- Flow 1:
Average throughput: 48.13 Mbit/s
95th percentile per-packet one-way delay: 111.234 ms
99th percentile per-packet one-way delay: 112.351 ms
Average per-packet one-way delay: 84.456 ms
Loss rate: 1.65%
```

Run 2: Report of TCP BBR — Data Link



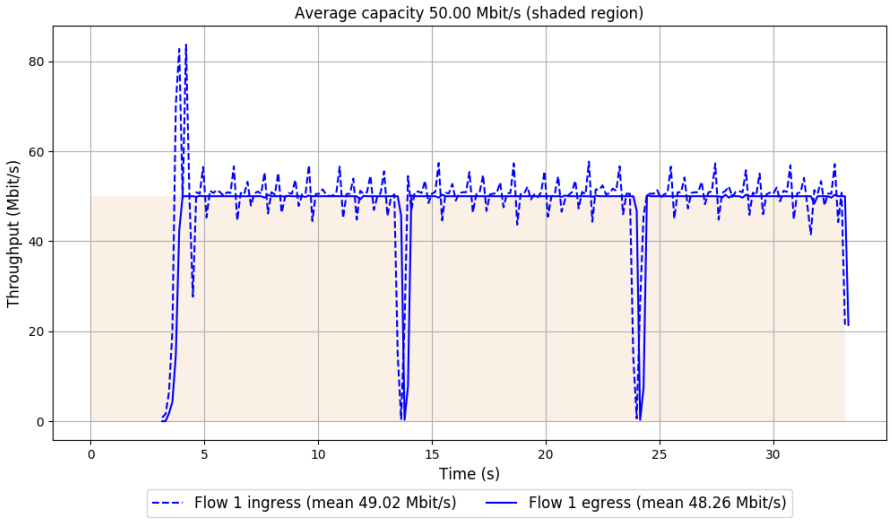


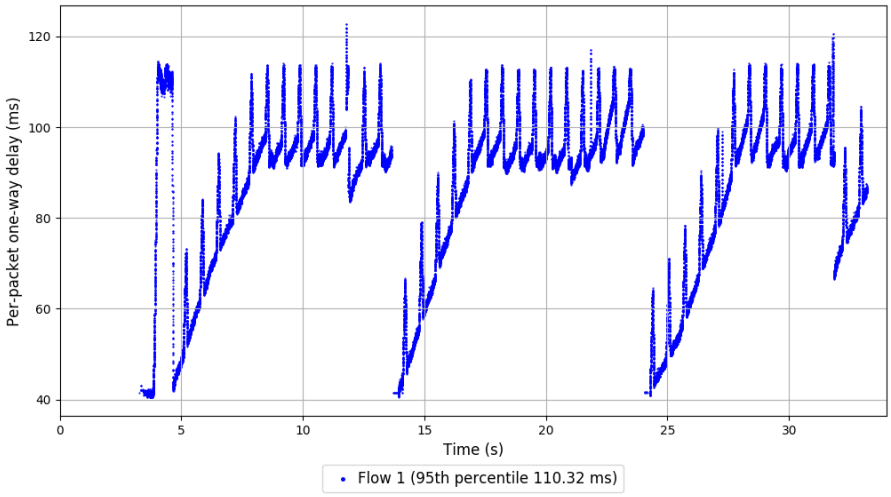

Per-packet one-way delay (ms)
Time (s)
Flow 1 (99th percentile 112.35 ms)

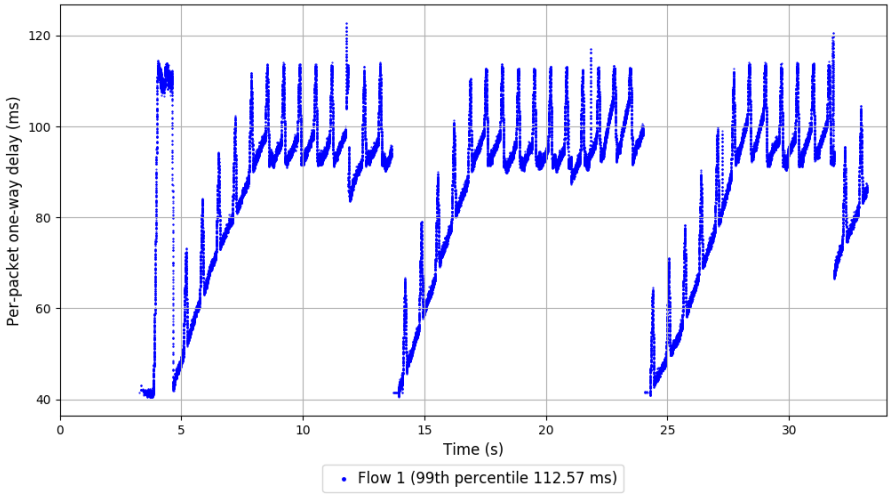

Per-packet one-way delay (ms)
Time (s)
Flow 1 (mean 84.46 ms)

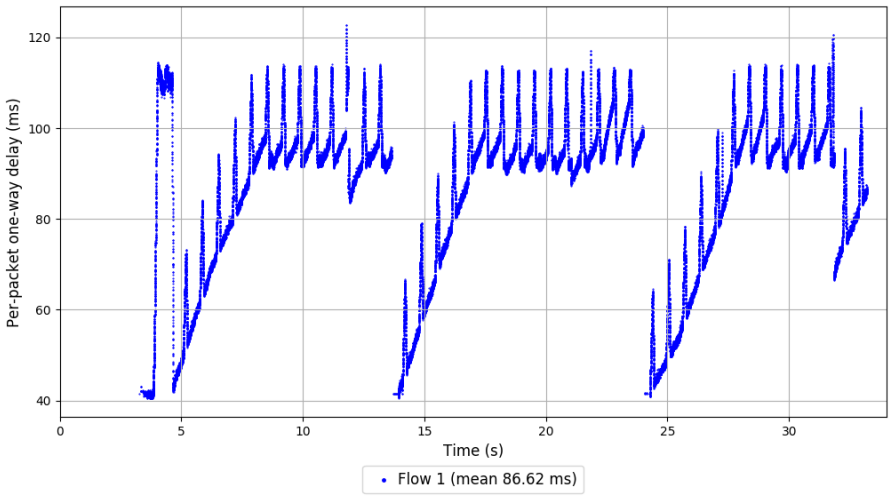
```
Run 3: Statistics of TCP BBR

Start at: 2020-05-29 22:41:35
End at: 2020-05-29 22:42:05

# Below is generated by plot.py at 2020-05-29 22:51:27
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 48.26 Mbit/s (96.5% utilization)
95th percentile per-packet one-way delay: 110.323 ms
99th percentile per-packet one-way delay: 112.571 ms
mean per-packet one-way delay: 86.615 ms
Loss rate: 1.68%
-- Flow 1:
Average throughput: 48.26 Mbit/s
95th percentile per-packet one-way delay: 110.323 ms
99th percentile per-packet one-way delay: 112.571 ms
Average per-packet one-way delay: 86.615 ms
Loss rate: 1.68%
```

Run 3: Report of TCP BBR — Data Link



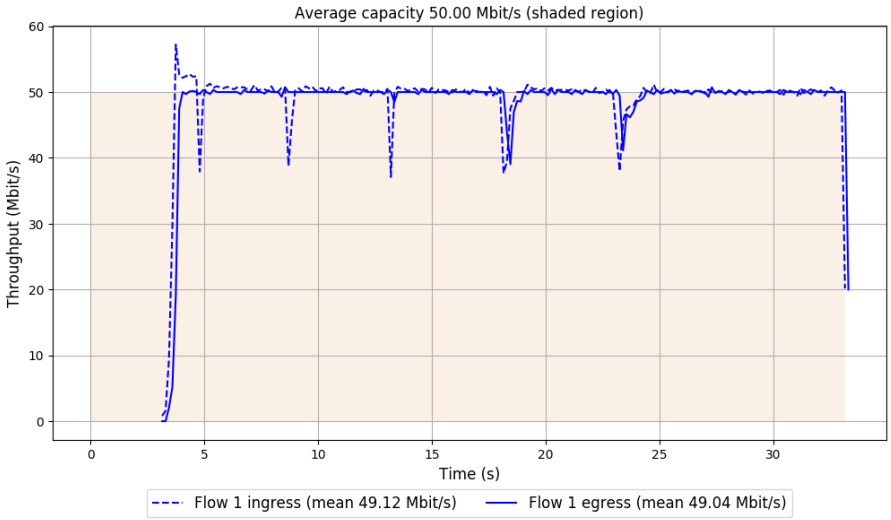


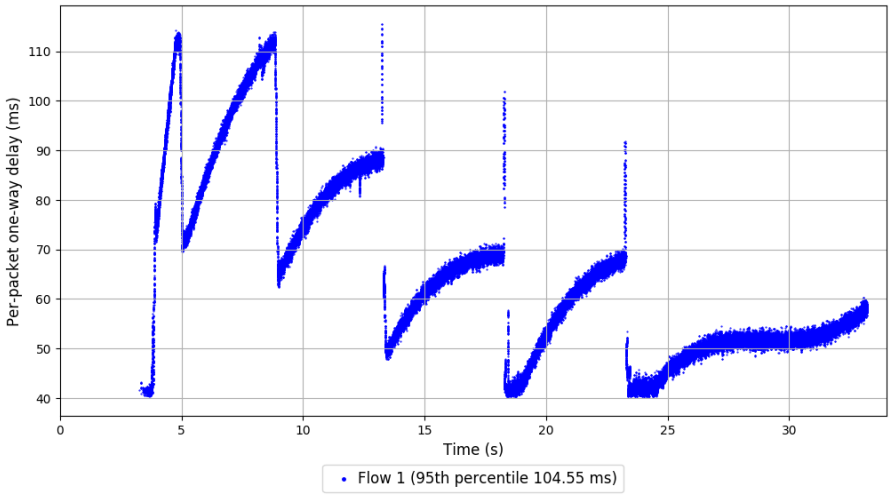

Per-packet one-way delay (ms)
120
100
80
60
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (99th percentile 112.57 ms)

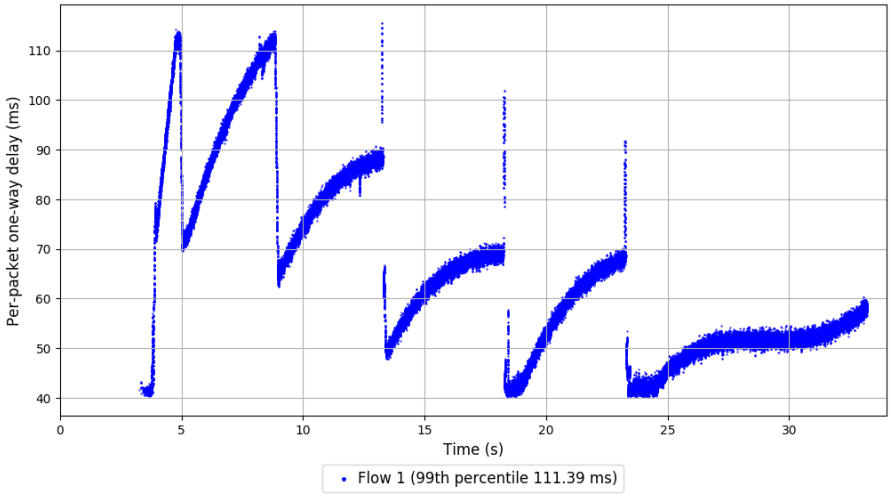

Per-packet one-way delay (ms)
120
100
80
60
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (mean 86.62 ms)

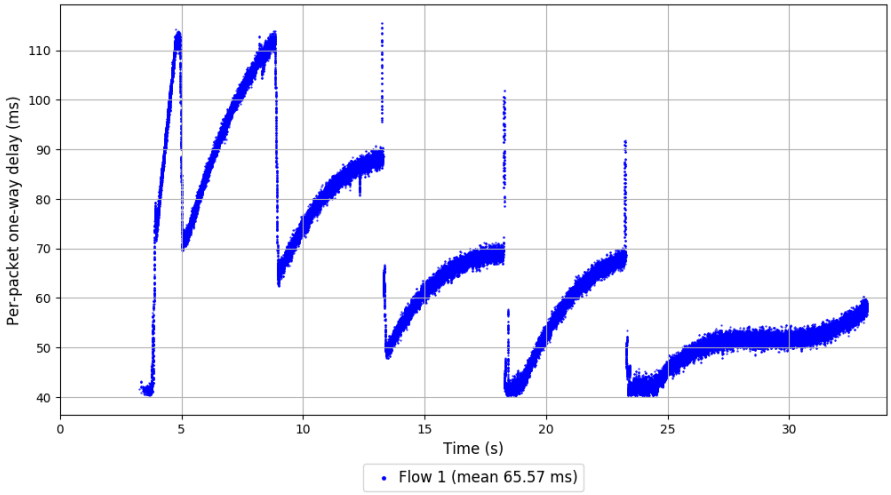
```
Run 1: Statistics of TCP Cubic

Start at: 2020-05-29 22:38:34
End at: 2020-05-29 22:39:04

# Below is generated by plot.py at 2020-05-29 22:51:27
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 49.04 Mbit/s (98.1% utilization)
95th percentile per-packet one-way delay: 104.554 ms
99th percentile per-packet one-way delay: 111.390 ms
mean per-packet one-way delay: 65.569 ms
Loss rate: 0.30%
-- Flow 1:
Average throughput: 49.04 Mbit/s
95th percentile per-packet one-way delay: 104.554 ms
99th percentile per-packet one-way delay: 111.390 ms
Average per-packet one-way delay: 65.569 ms
Loss rate: 0.30%
```

Run 1: Report of TCP Cubic — Data Link



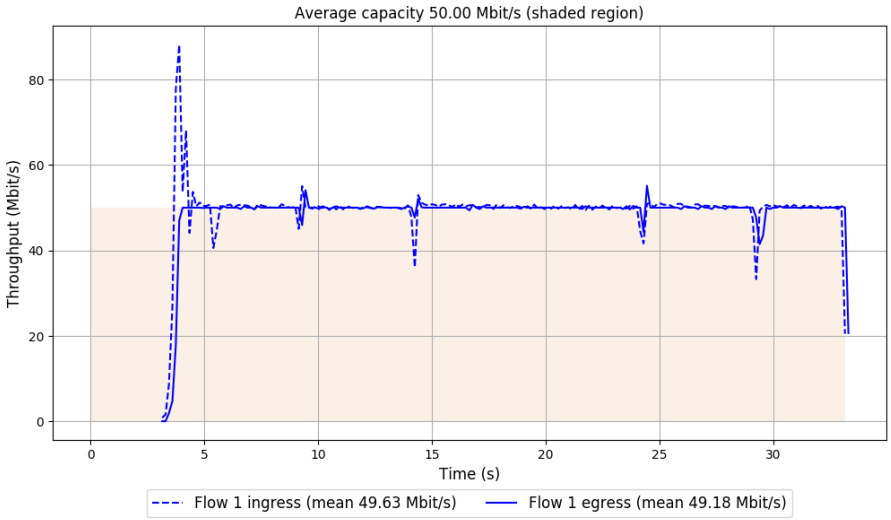


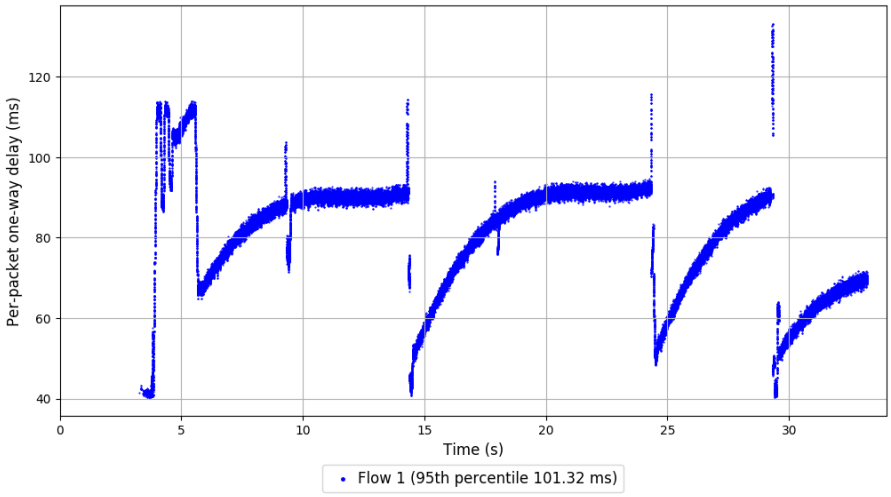

Per-packet one-way delay (ms)
Time (s)
Flow 1 (99th percentile 111.39 ms)

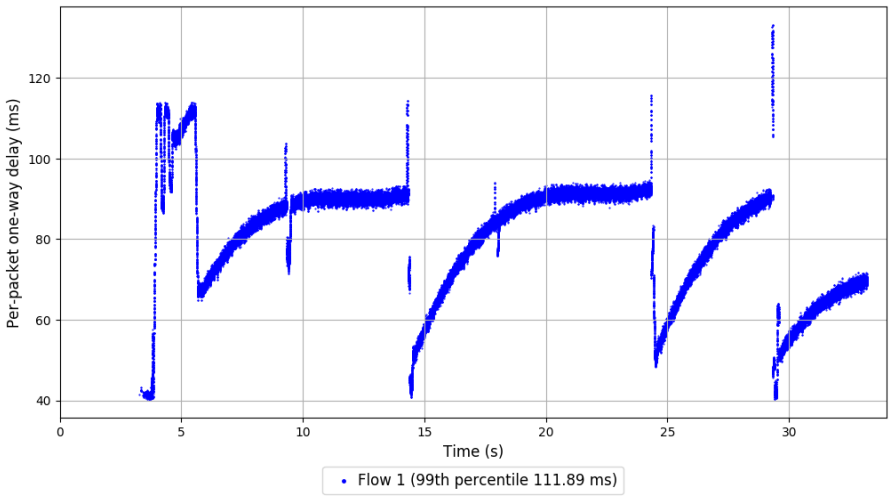

Per-packet one-way delay (ms)
Time (s)
Flow 1 (mean 65.57 ms)

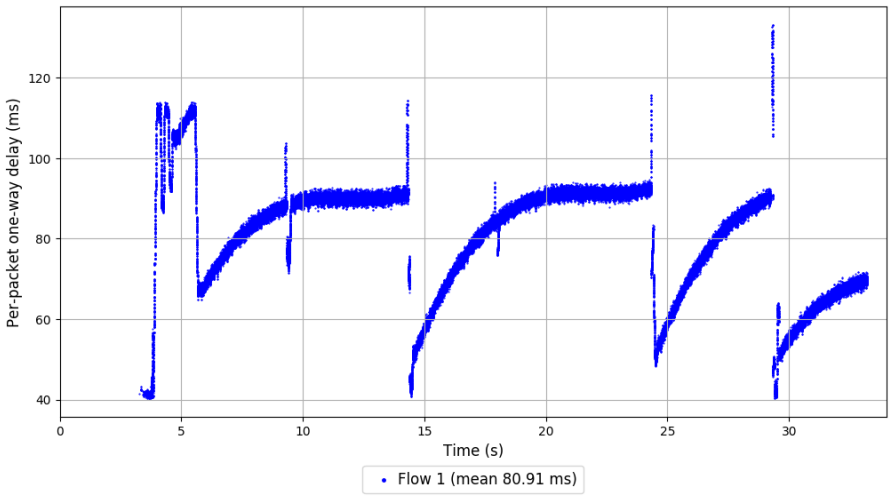
```
Run 2: Statistics of TCP Cubic

Start at: 2020-05-29 22:40:23
End at: 2020-05-29 22:40:53

# Below is generated by plot.py at 2020-05-29 22:51:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 49.18 Mbit/s (98.4% utilization)
95th percentile per-packet one-way delay: 101.317 ms
99th percentile per-packet one-way delay: 111.890 ms
mean per-packet one-way delay: 80.908 ms
Loss rate: 1.03%
-- Flow 1:
Average throughput: 49.18 Mbit/s
95th percentile per-packet one-way delay: 101.317 ms
99th percentile per-packet one-way delay: 111.890 ms
Average per-packet one-way delay: 80.908 ms
Loss rate: 1.03%
```

Run 2: Report of TCP Cubic — Data Link



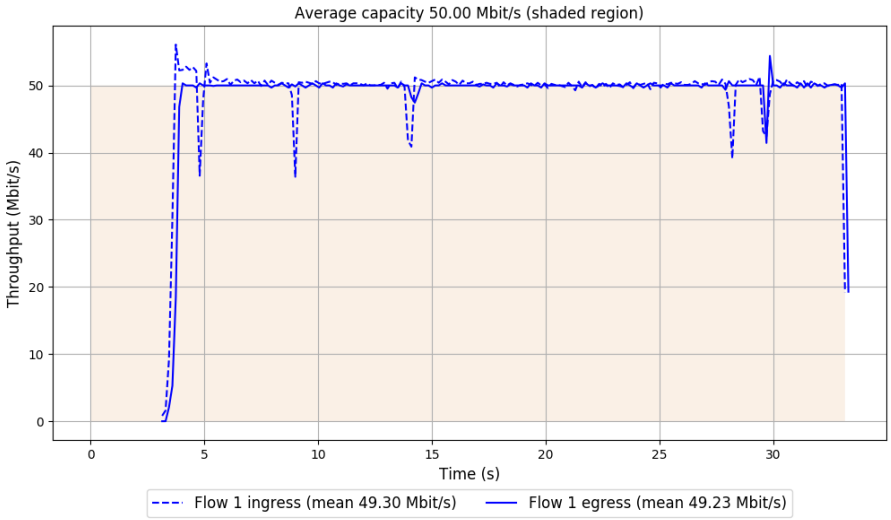


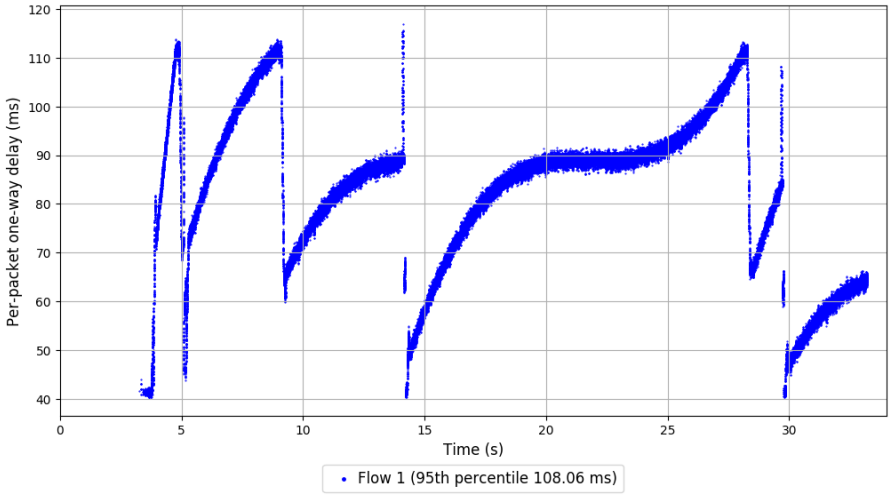

Per-packet one-way delay (ms)
120
100
80
60
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (99th percentile 111.89 ms)

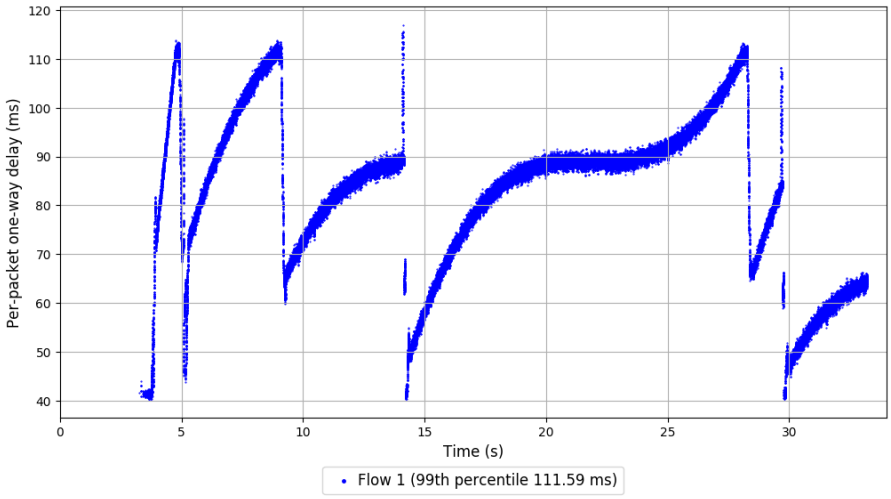

Per-packet one-way delay (ms)
120
100
80
60
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (mean 80.91 ms)

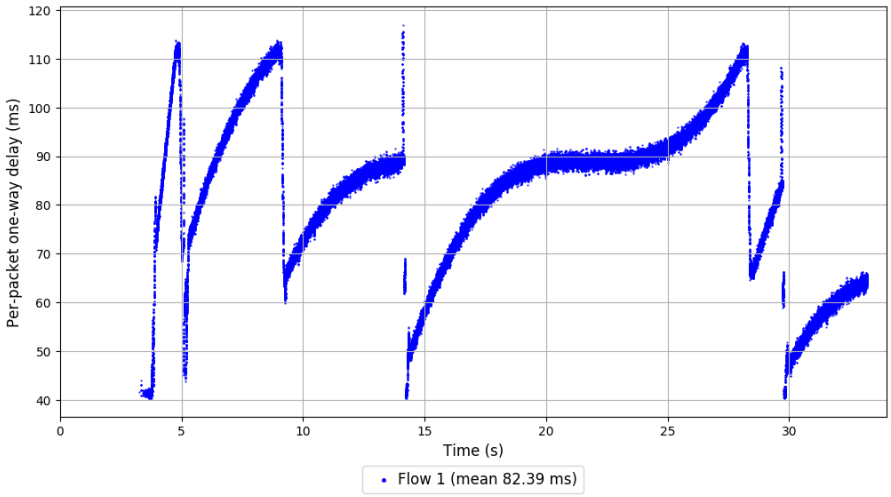
```
Run 3: Statistics of TCP Cubic

Start at: 2020-05-29 22:42:12
End at: 2020-05-29 22:42:42

# Below is generated by plot.py at 2020-05-29 22:51:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 49.23 Mbit/s (98.5% utilization)
95th percentile per-packet one-way delay: 108.060 ms
99th percentile per-packet one-way delay: 111.586 ms
mean per-packet one-way delay: 82.393 ms
Loss rate: 0.28%
-- Flow 1:
Average throughput: 49.23 Mbit/s
95th percentile per-packet one-way delay: 108.060 ms
99th percentile per-packet one-way delay: 111.586 ms
Average per-packet one-way delay: 82.393 ms
Loss rate: 0.28%
```

Run 3: Report of TCP Cubic — Data Link



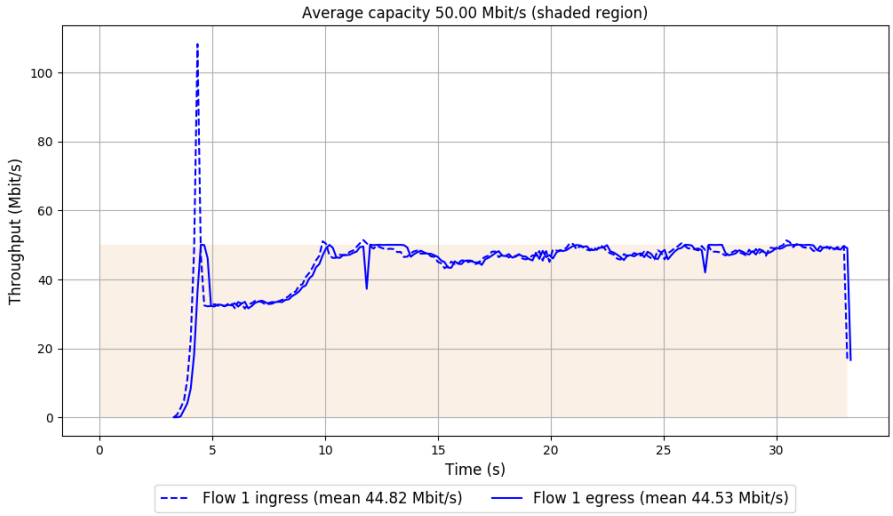


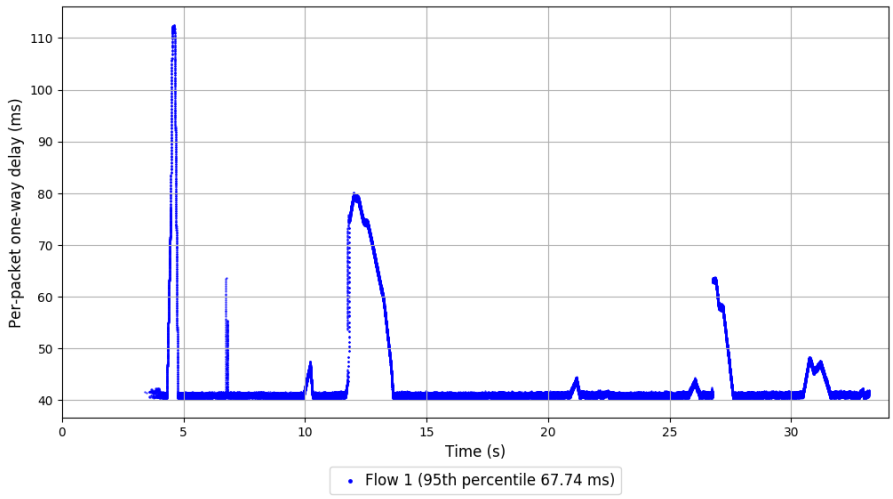

Per-packet one-way delay (ms)
Time (s)
Flow 1 (99th percentile 111.59 ms)

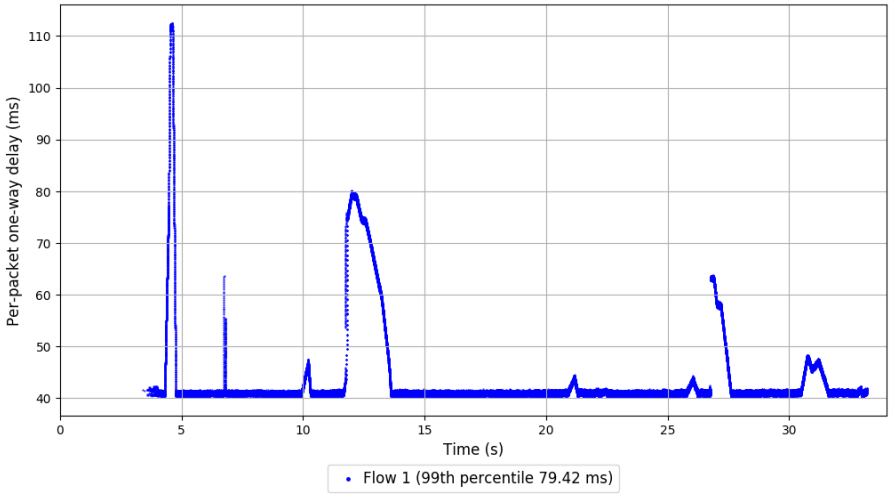

Per-packet one-way delay (ms)
Time (s)
Flow 1 (mean 82.39 ms)

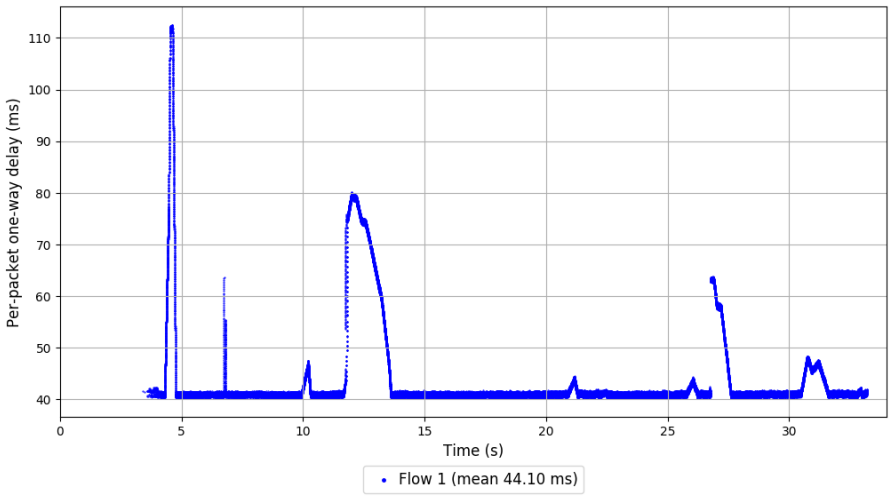
```
Run 1: Statistics of PCC-Allegro

Start at: 2020-05-29 22:39:10
End at: 2020-05-29 22:39:40

# Below is generated by plot.py at 2020-05-29 22:51:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 44.53 Mbit/s (89.1% utilization)
95th percentile per-packet one-way delay: 67.741 ms
99th percentile per-packet one-way delay: 79.418 ms
mean per-packet one-way delay: 44.103 ms
Loss rate: 0.79%
-- Flow 1:
Average throughput: 44.53 Mbit/s
95th percentile per-packet one-way delay: 67.741 ms
99th percentile per-packet one-way delay: 79.418 ms
Average per-packet one-way delay: 44.103 ms
Loss rate: 0.79%
```

Run 1: Report of PCC-Allegro — Data Link



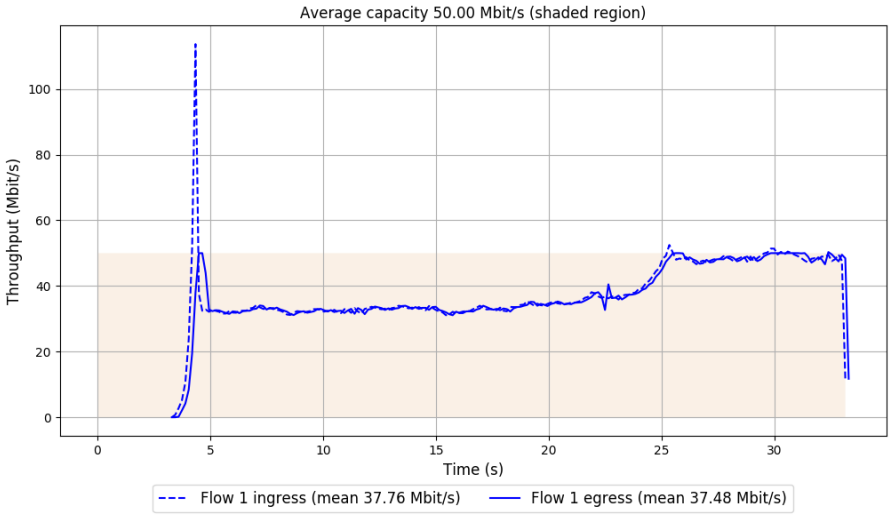


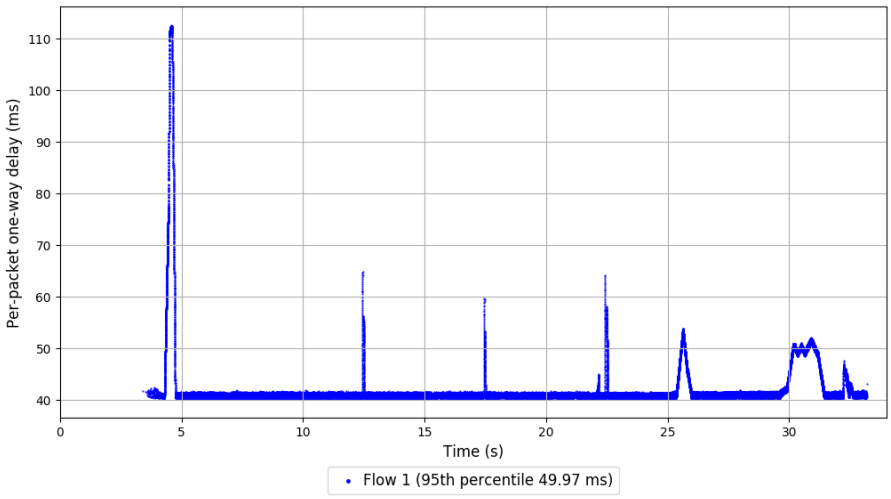

Per-packet one-way delay (ms)
110
100
90
80
70
60
50
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (99th percentile 79.42 ms)

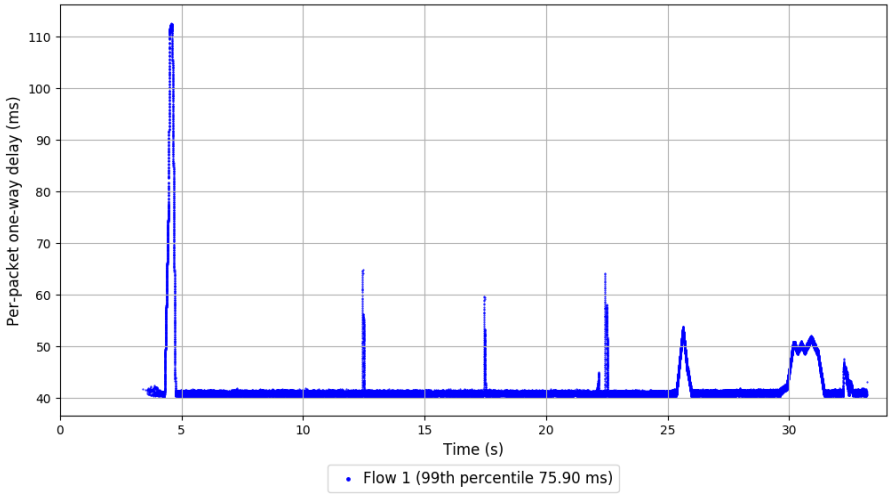

Per-packet one-way delay (ms)
110
100
90
80
70
60
50
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (mean 44.10 ms)

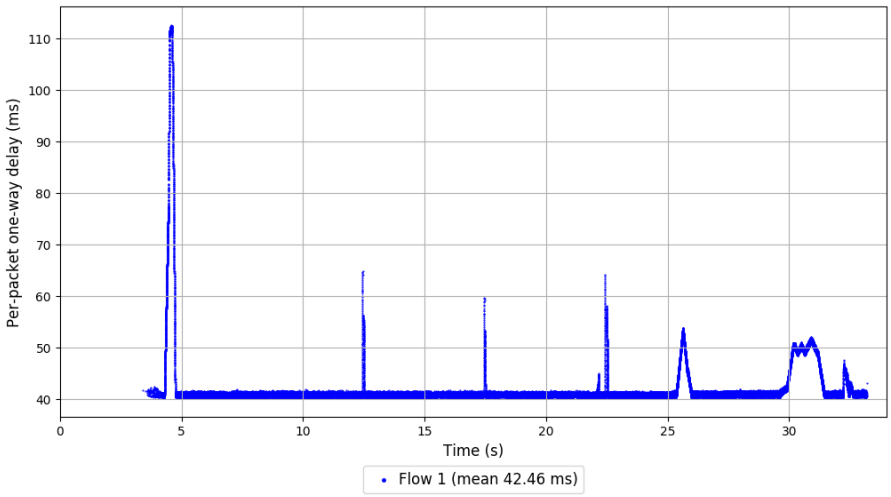
```
Run 2: Statistics of PCC-Allegro

Start at: 2020-05-29 22:41:00
End at: 2020-05-29 22:41:30

# Below is generated by plot.py at 2020-05-29 22:51:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 37.48 Mbit/s (75.0% utilization)
95th percentile per-packet one-way delay: 49.972 ms
99th percentile per-packet one-way delay: 75.898 ms
mean per-packet one-way delay: 42.464 ms
Loss rate: 0.88%
-- Flow 1:
Average throughput: 37.48 Mbit/s
95th percentile per-packet one-way delay: 49.972 ms
99th percentile per-packet one-way delay: 75.898 ms
Average per-packet one-way delay: 42.464 ms
Loss rate: 0.88%
```

Run 2: Report of PCC-Allegro — Data Link



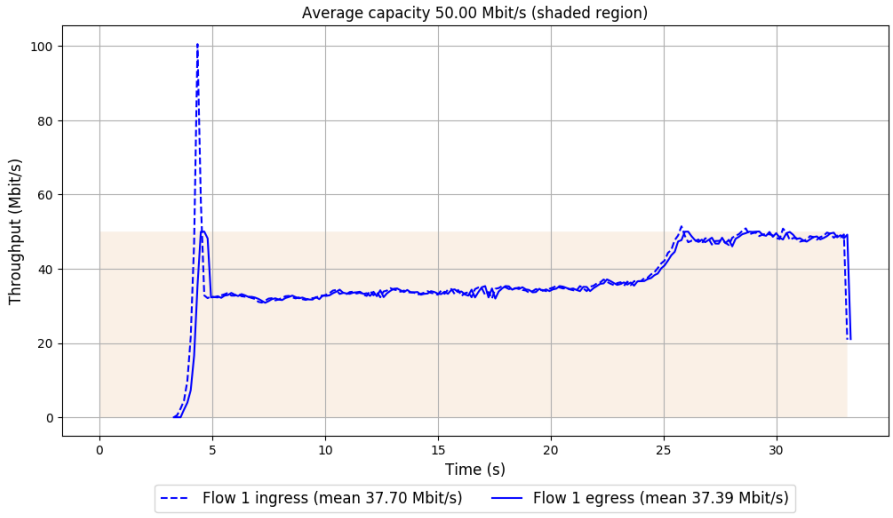


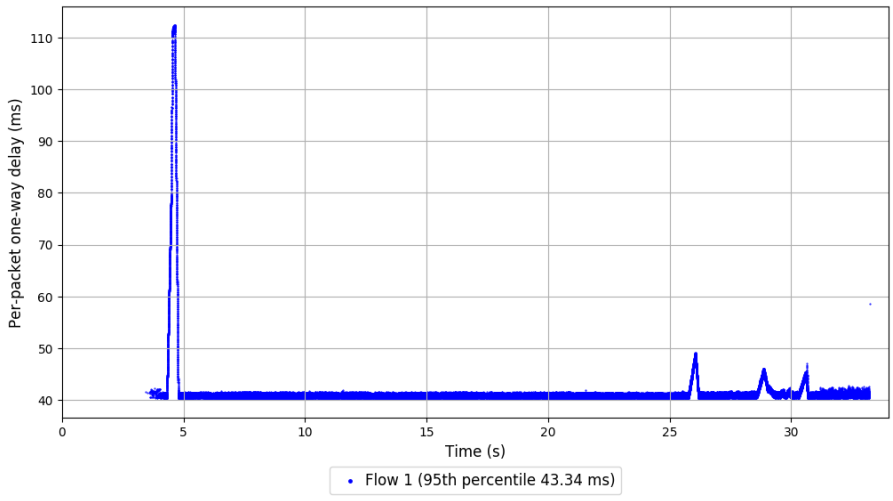

Per-packet one-way delay (ms)
110
100
90
80
70
60
50
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (99th percentile 75.90 ms)

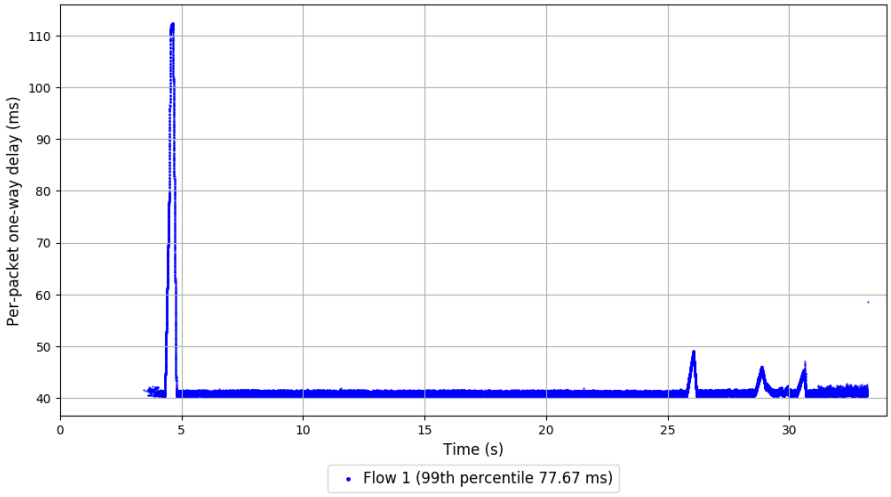

Per-packet one-way delay (ms)
110
100
90
80
70
60
50
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (mean 42.46 ms)

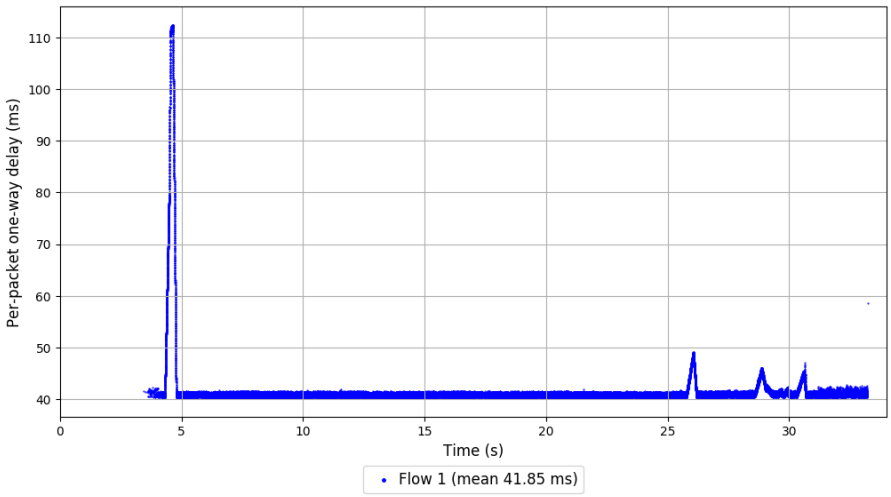
```
Run 3: Statistics of PCC-Allegro

Start at: 2020-05-29 22:42:49
End at: 2020-05-29 22:43:19

# Below is generated by plot.py at 2020-05-29 22:51:30
# Datalink statistics
-- Total of 1 flow:
Average capacity: 50.00 Mbit/s
Average throughput: 37.39 Mbit/s (74.8% utilization)
95th percentile per-packet one-way delay: 43.339 ms
99th percentile per-packet one-way delay: 77.668 ms
mean per-packet one-way delay: 41.853 ms
Loss rate: 0.90%
-- Flow 1:
Average throughput: 37.39 Mbit/s
95th percentile per-packet one-way delay: 43.339 ms
99th percentile per-packet one-way delay: 77.668 ms
Average per-packet one-way delay: 41.853 ms
Loss rate: 0.90%
```

Run 3: Report of PCC-Allegro — Data Link






Per-packet one-way delay (ms)
110
100
90
80
70
60
50
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (99th percentile 77.67 ms)


Per-packet one-way delay (ms)
110
100
90
80
70
60
50
40
0
5
10
15
20
25
30
Time (s)
Flow 1 (mean 41.85 ms)