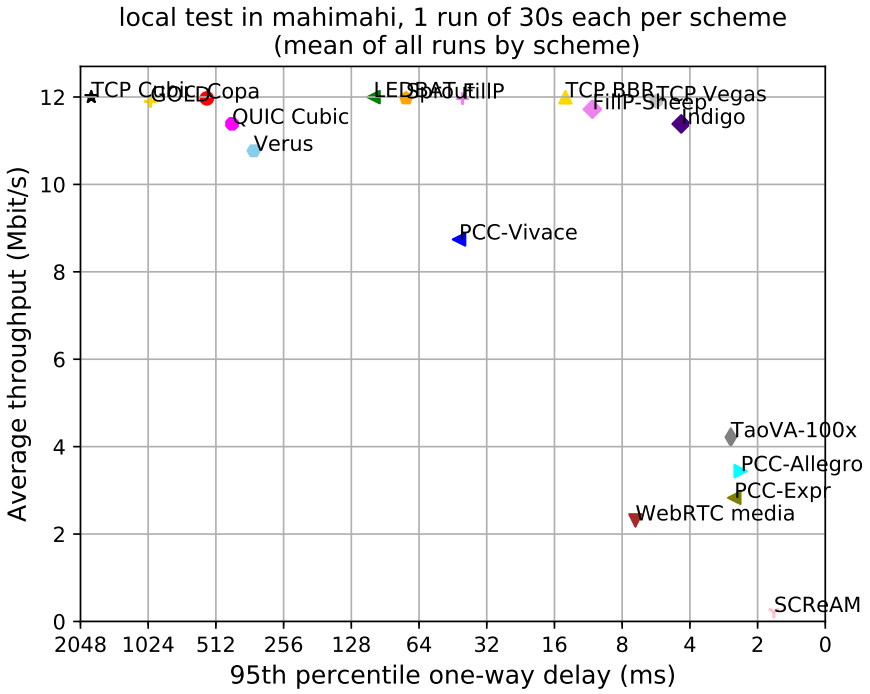
Pantheon Report

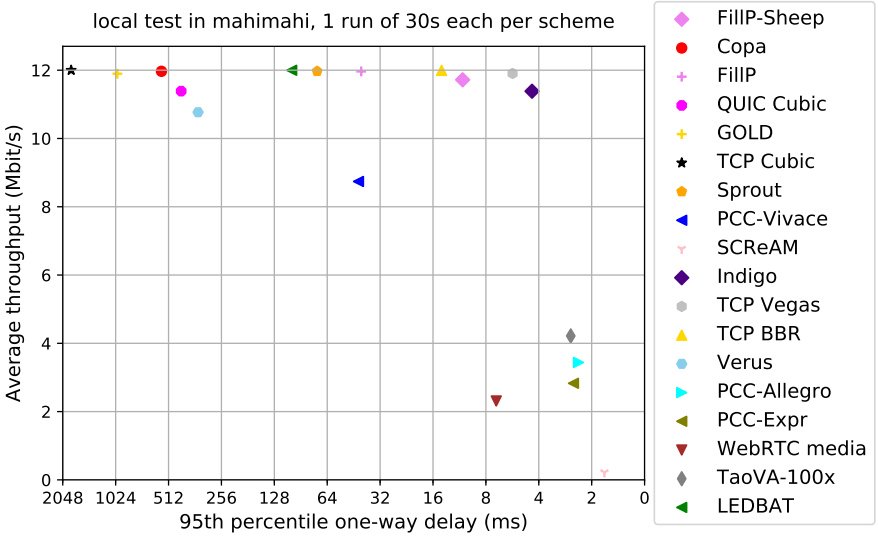
Generated at 2019-06-25 18:01:28 (UTC).
Tested in mahimahi: `mm-link 12mbps.trace 12mbps.trace`
Repeated the test of 18 congestion control schemes once.
Each test lasted for 30 seconds running 1 flow.

```
System info:
Linux 4.15.0-52-generic
net.core.default_qdisc = fq_codel
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 87380 6291456
net.ipv4.tcp_wmem = 4096 16384 4194304
```

```
Git summary:
branch: master @ aecb175d8e37ca8cac365e63ff144fb2d219f97f
third_party/fillp @ d6da1459332fcee56963885d7eba17e6a32d4519
third_party/fillp-sheep @ 0e5bb722943babcd2b090d2c64fcd45e12e923f9
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/gold @ b6948a72b216f2705f13bf3b588bc5ab5ff8ff9a
 M dependencies.sh
 M environment/__pycache__/datagram_pb2.cpython-36.opt-1.pyc
 M environment/__pycache__/datagram_pb2.cpython-36.pyc
 M environment/__pycache__/environment.cpython-36.opt-1.pyc
 M environment/__pycache__/environment.cpython-36.pyc
 M environment/__pycache__/helpers.cpython-36.opt-1.pyc
 M environment/__pycache__/helpers.cpython-36.pyc
 M environment/__pycache__/mahimahi.cpython-36.opt-1.pyc
 M environment/__pycache__/mahimahi.cpython-36.pyc
 M environment/__pycache__/project_root.cpython-36.opt-1.pyc
 M environment/__pycache__/project_root.cpython-36.pyc
 M environment/__pycache__/receiver.cpython-36.opt-1.pyc
 M environment/__pycache__/receiver.cpython-36.pyc
 M environment/environment.py
 M environment/learner.py
 M environment/logs.txt
 M environment/receiver.py
 M environment/run_receiver.py
 M model
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, 1 run of 30s each per scheme
(mean of all runs by scheme)
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
TCP Cubic
GOLD
Copa
QUIC Cubic
Verus
LEDBAT
Sprout
FillP
TCP BBR
FillP-Sheep
TCP Vegas
Indigo
PCC-Vivace
TaoVA-100x
PCC-Allegro
PCC-Expr
WebRTC media
SCReAM


local test in mahimahi, 1 run of 30s each per scheme
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
FillP-Sheep
Copa
FillP
QUIC Cubic
GOLD
TCP Cubic
Sprout
PCC-Vivace
SCReAM
Indigo
TCP Vegas
TCP BBR
Verus
PCC-Allegro
PCC-Expr
WebRTC media
TaoVA-100x
LEDBAT

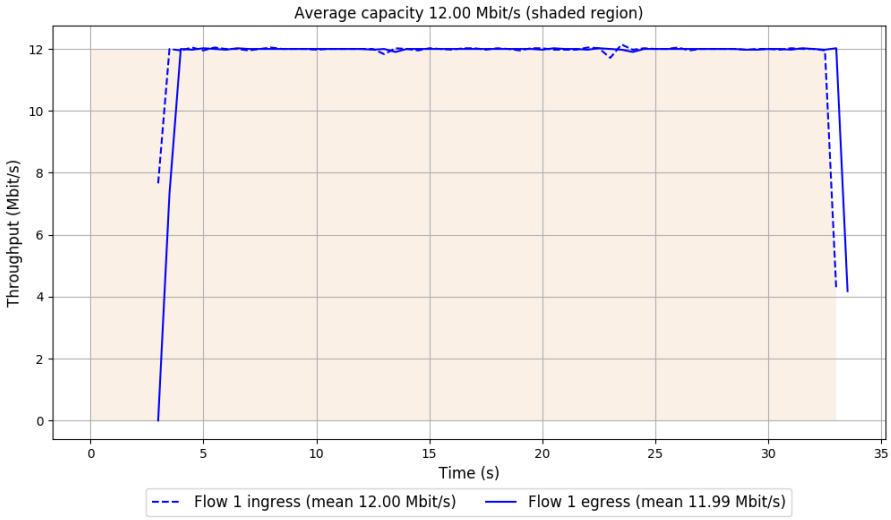
scheme	# runs	mean avg tput (Mbit/s) flow 1	mean 95th-%ile delay (ms) flow 1	mean loss rate (%) flow 1
TCP BBR	1	11.99	14.29	0.04
Copa	1	11.97	561.79	1.55
TCP Cubic	1	12.00	1833.92	5.00
FillP	1	11.96	41.01	0.11
FillP-Sheep	1	11.72	10.85	0.03
GOLD	1	11.90	1001.16	4.96
Indigo	1	11.38	4.37	0.01
LEDBAT	1	12.00	101.98	0.34
PCC-Allegro	1	3.44	2.38	0.00
PCC-Expr	1	2.83	2.54	0.00
QUIC Cubic	1	11.39	433.89	1.58
SCReAM	1	0.22	1.52	0.00
Sprout	1	11.97	73.04	0.21
TaoVA-100x	1	4.22	2.63	0.00
TCP Vegas	1	11.90	5.64	0.02
Verus	1	10.77	347.65	0.35
PCC-Vivace	1	8.74	42.49	0.03
WebRTC media	1	2.31	6.98	0.00

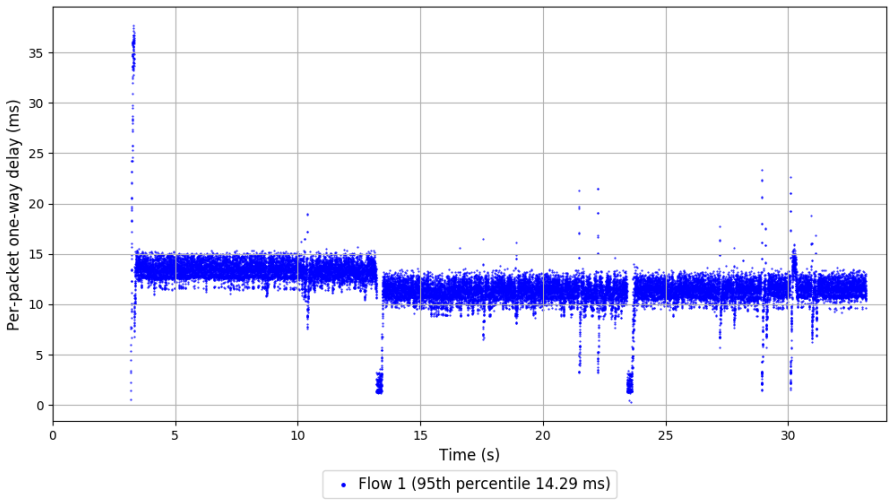
```
Run 1: Statistics of TCP BBR

Start at: 2019-06-25 17:35:47
End at: 2019-06-25 17:36:17

# Below is generated by plot.py at 2019-06-25 18:00:59
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.99 Mbit/s (99.9% utilization)
95th percentile per-packet one-way delay: 14.295 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 11.99 Mbit/s
95th percentile per-packet one-way delay: 14.295 ms
Loss rate: 0.04%
```

Run 1: Report of TCP BBR — Data Link



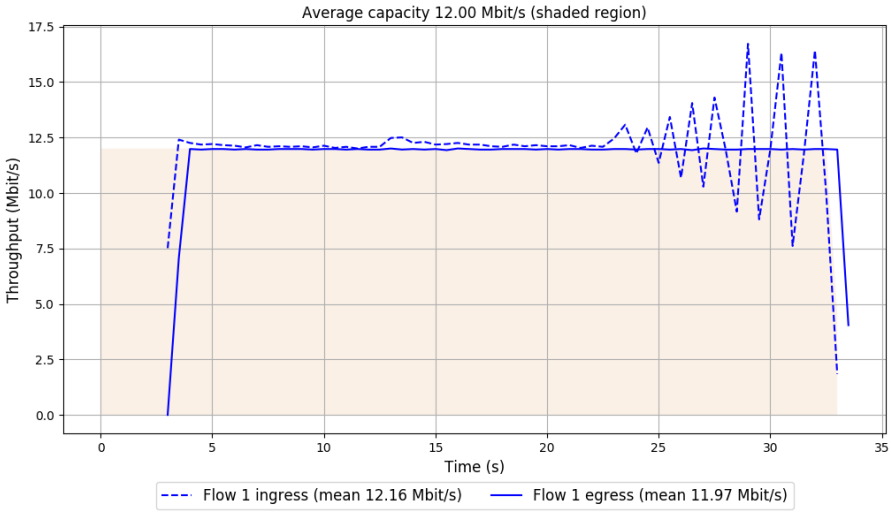


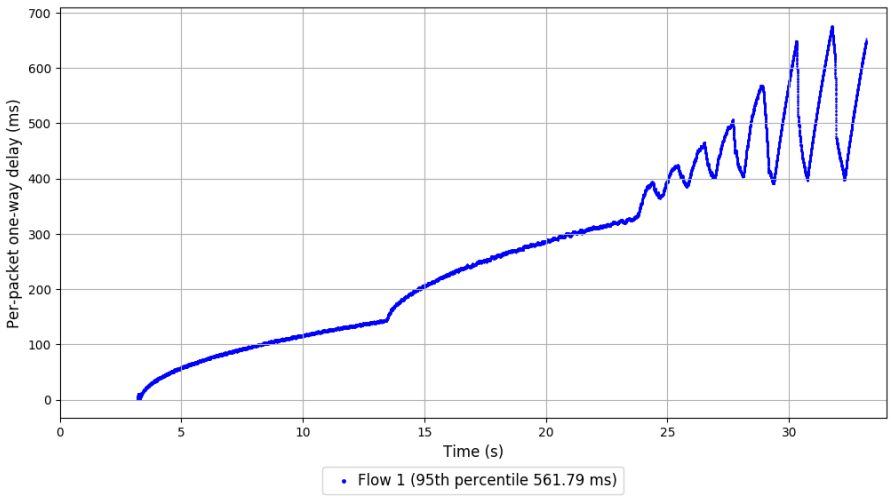
```
Run 1: Statistics of Copa

Start at: 2019-06-25 17:31:13
End at: 2019-06-25 17:31:43

# Below is generated by plot.py at 2019-06-25 18:01:03
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.97 Mbit/s (99.7% utilization)
95th percentile per-packet one-way delay: 561.793 ms
Loss rate: 1.55%
-- Flow 1:
Average throughput: 11.97 Mbit/s
95th percentile per-packet one-way delay: 561.793 ms
Loss rate: 1.55%
```

Run 1: Report of Copa — Data Link



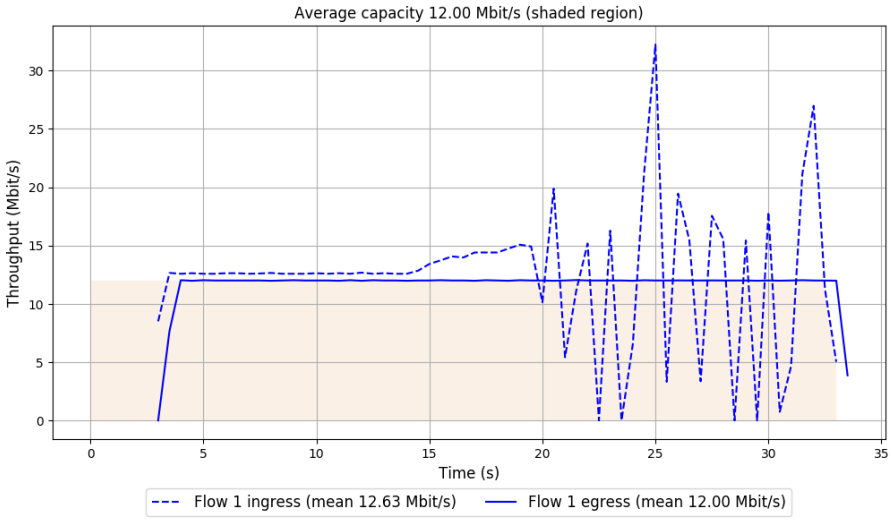


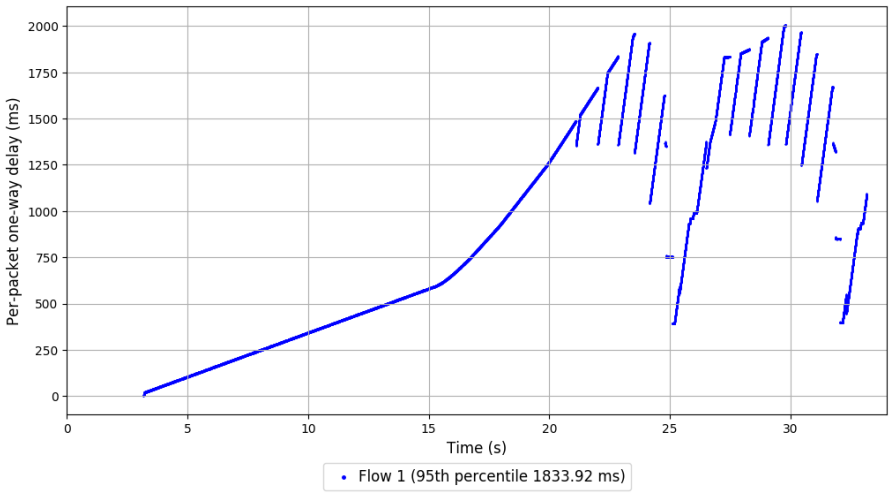
```
Run 1: Statistics of TCP Cubic

Start at: 2019-06-25 17:33:31
End at: 2019-06-25 17:34:01

# Below is generated by plot.py at 2019-06-25 18:01:03
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 12.00 Mbit/s (100.0% utilization)
95th percentile per-packet one-way delay: 1833.923 ms
Loss rate: 5.00%
-- Flow 1:
Average throughput: 12.00 Mbit/s
95th percentile per-packet one-way delay: 1833.923 ms
Loss rate: 5.00%
```

Run 1: Report of TCP Cubic — Data Link



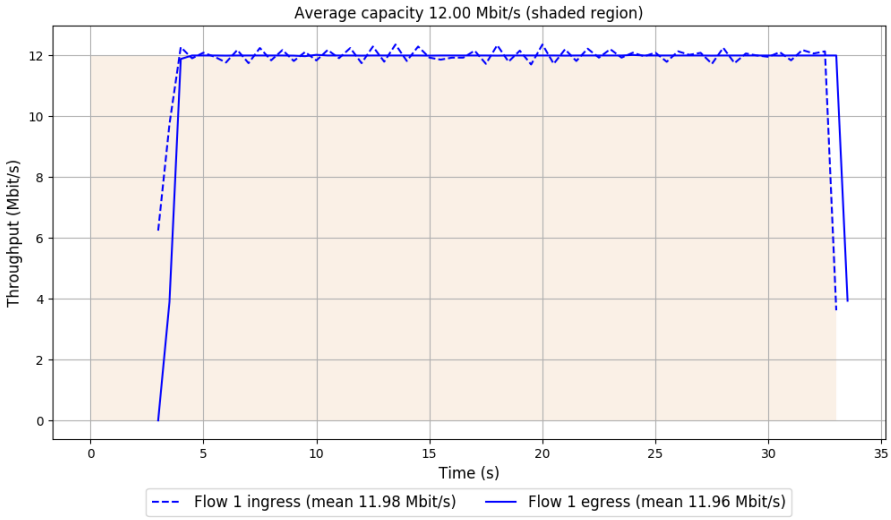


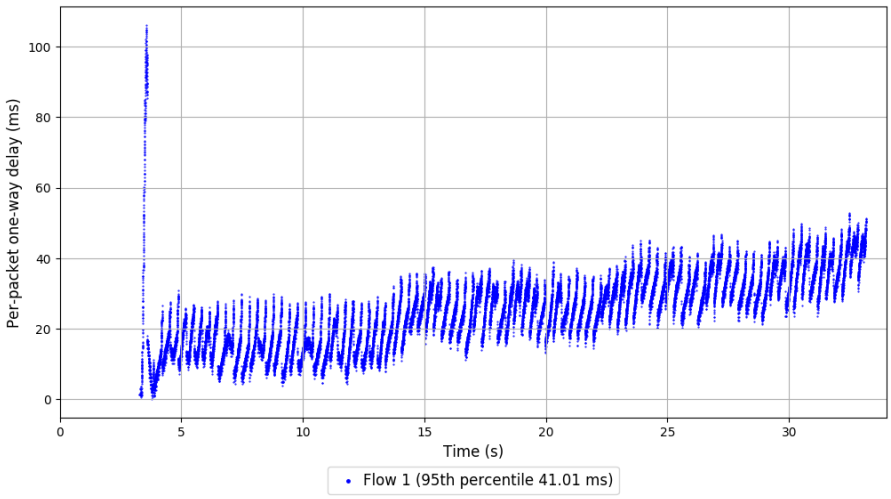
```
Run 1: Statistics of FillP

Start at: 2019-06-25 17:36:55
End at: 2019-06-25 17:37:25

# Below is generated by plot.py at 2019-06-25 18:01:03
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.96 Mbit/s (99.7% utilization)
95th percentile per-packet one-way delay: 41.006 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 11.96 Mbit/s
95th percentile per-packet one-way delay: 41.006 ms
Loss rate: 0.11%
```

Run 1: Report of FillP — Data Link



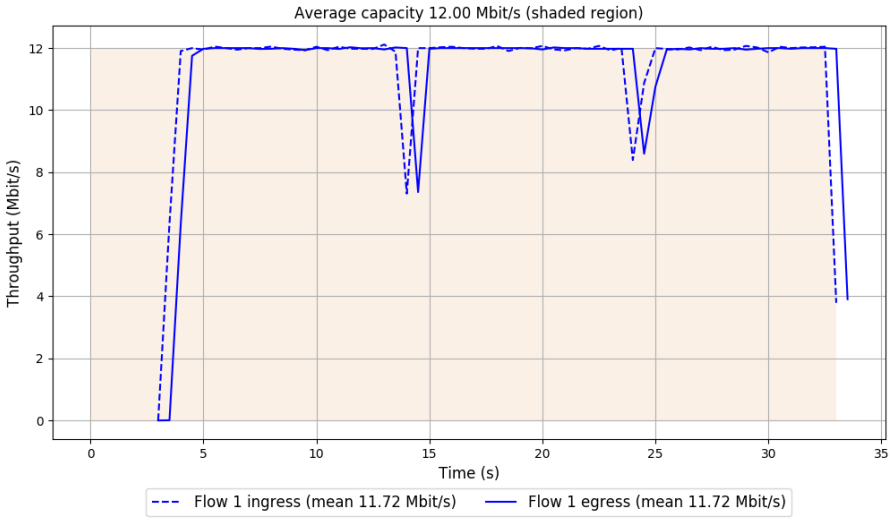


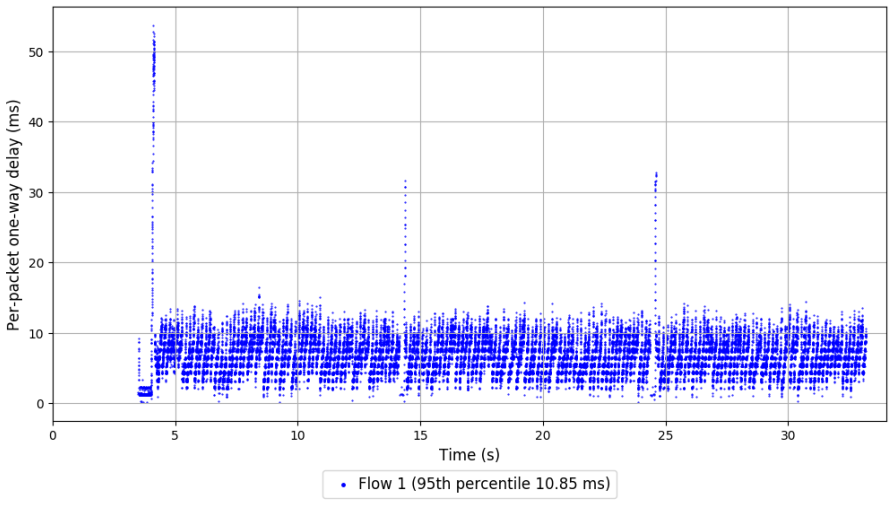
```
Run 1: Statistics of FillP-Sheep

Start at: 2019-06-25 17:30:39
End at: 2019-06-25 17:31:09

# Below is generated by plot.py at 2019-06-25 18:01:08
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.72 Mbit/s (97.7% utilization)
95th percentile per-packet one-way delay: 10.850 ms
Loss rate: 0.03%
-- Flow 1:
Average throughput: 11.72 Mbit/s
95th percentile per-packet one-way delay: 10.850 ms
Loss rate: 0.03%
```

Run 1: Report of FillP-Sheep — Data Link



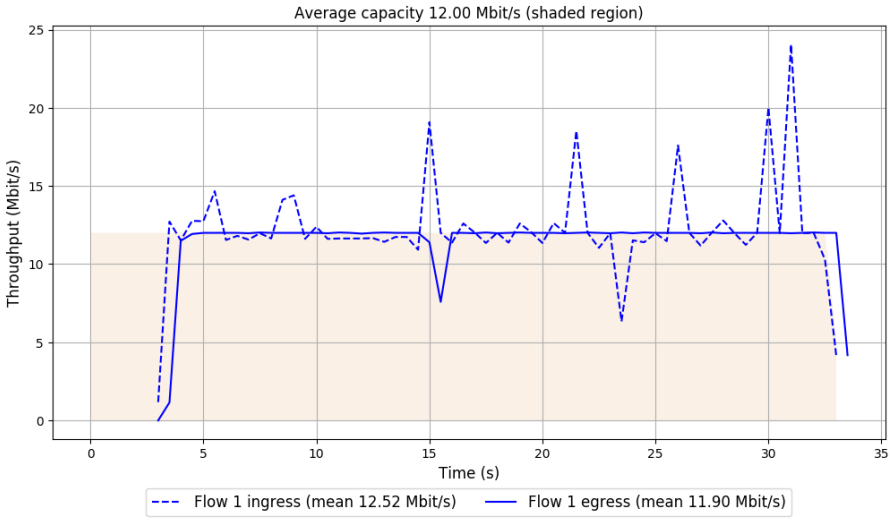


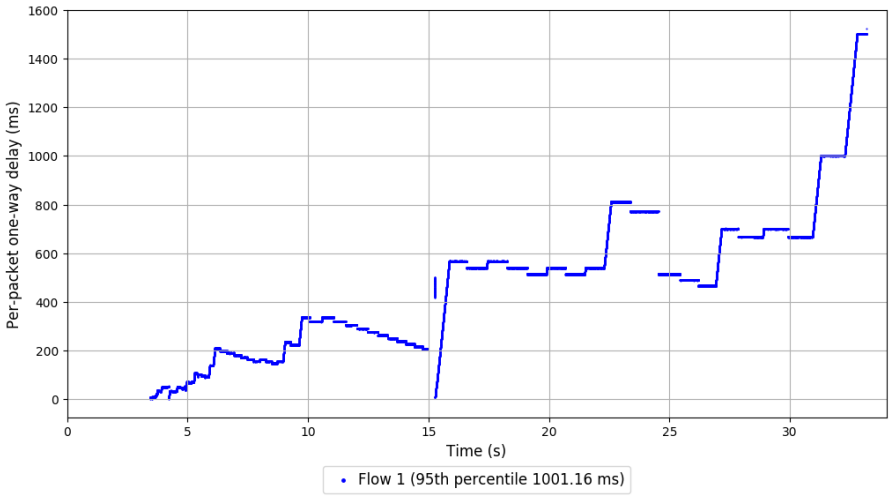
```
Run 1: Statistics of GOLD

Start at: 2019-06-25 17:32:56
End at: 2019-06-25 17:33:26

# Below is generated by plot.py at 2019-06-25 18:01:08
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.90 Mbit/s (99.1% utilization)
95th percentile per-packet one-way delay: 1001.159 ms
Loss rate: 4.96%
-- Flow 1:
Average throughput: 11.90 Mbit/s
95th percentile per-packet one-way delay: 1001.159 ms
Loss rate: 4.96%
```

Run 1: Report of GOLD — Data Link



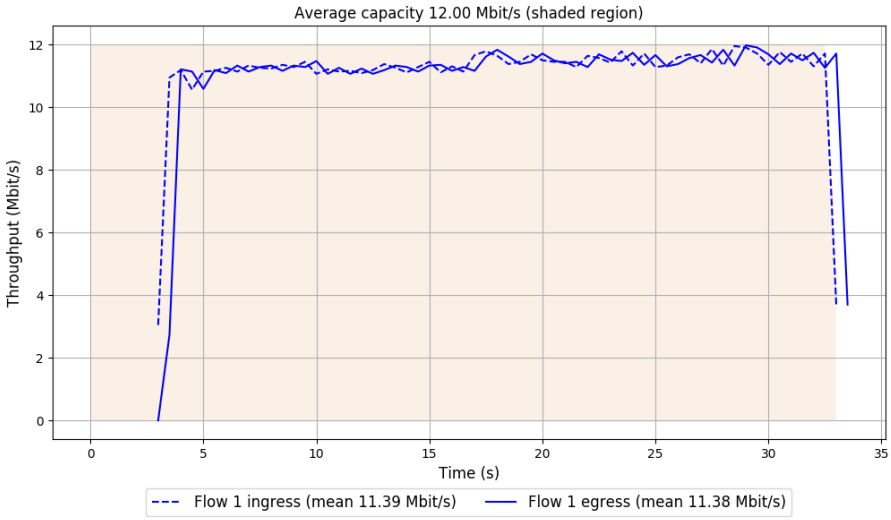


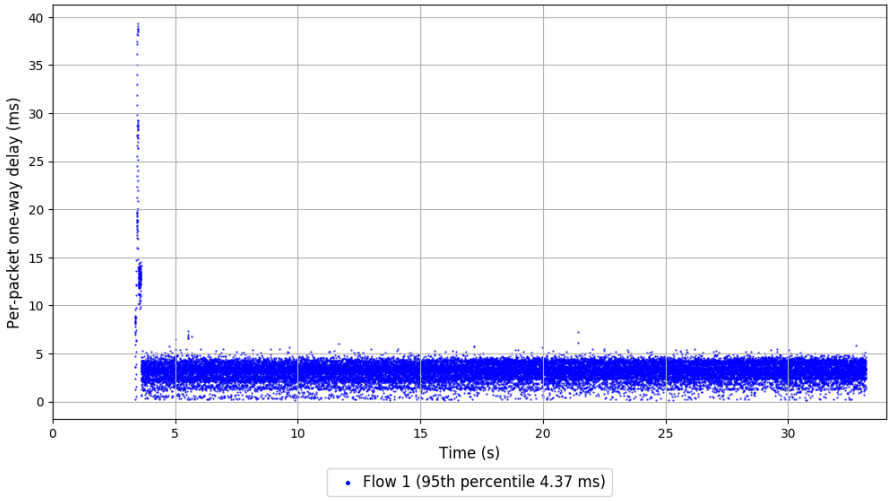
```
Run 1: Statistics of Indigo

Start at: 2019-06-25 17:31:47
End at: 2019-06-25 17:32:17

# Below is generated by plot.py at 2019-06-25 18:01:08
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.38 Mbit/s (94.9% utilization)
95th percentile per-packet one-way delay: 4.370 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 11.38 Mbit/s
95th percentile per-packet one-way delay: 4.370 ms
Loss rate: 0.01%
```

Run 1: Report of Indigo — Data Link



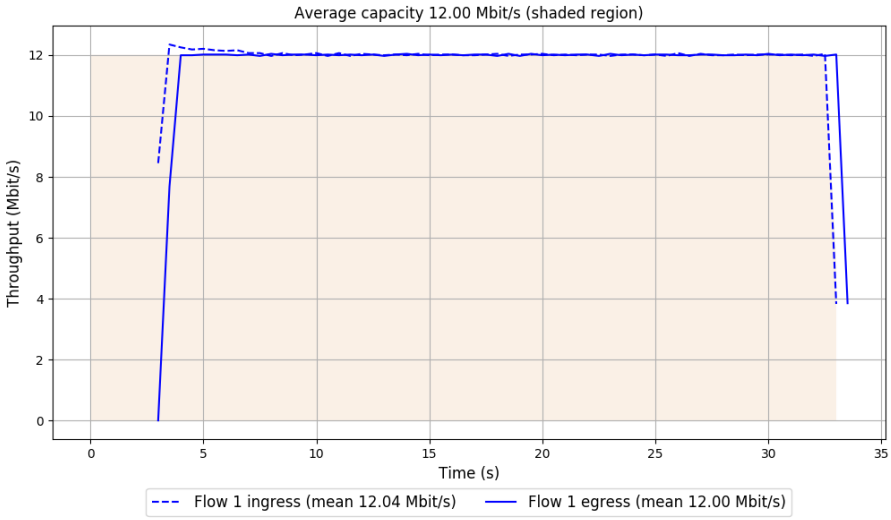


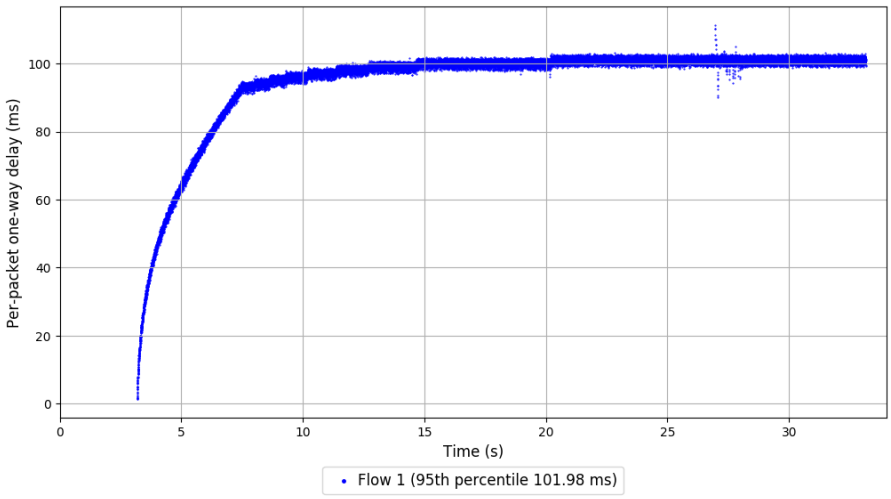
```
Run 1: Statistics of LEDBAT

Start at: 2019-06-25 17:39:45
End at: 2019-06-25 17:40:15

# Below is generated by plot.py at 2019-06-25 18:01:10
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 12.00 Mbit/s (100.0% utilization)
95th percentile per-packet one-way delay: 101.982 ms
Loss rate: 0.34%
-- Flow 1:
Average throughput: 12.00 Mbit/s
95th percentile per-packet one-way delay: 101.982 ms
Loss rate: 0.34%
```

Run 1: Report of LEDBAT — Data Link



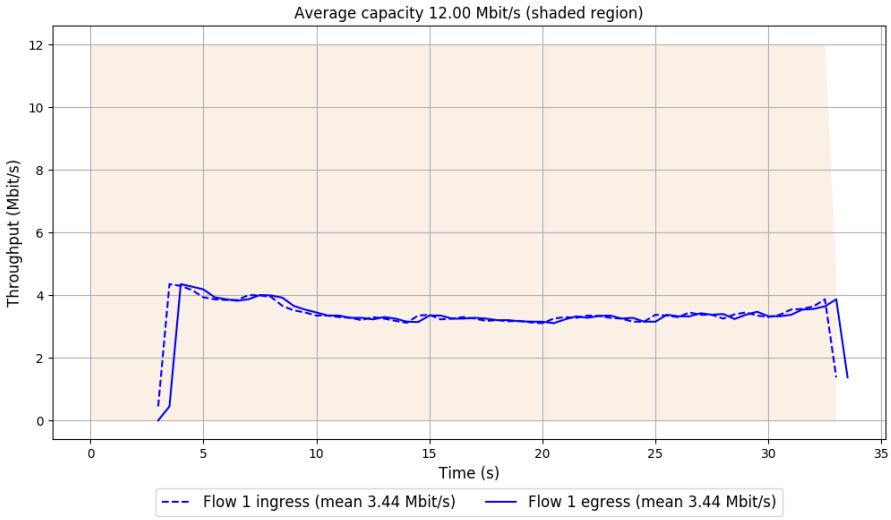


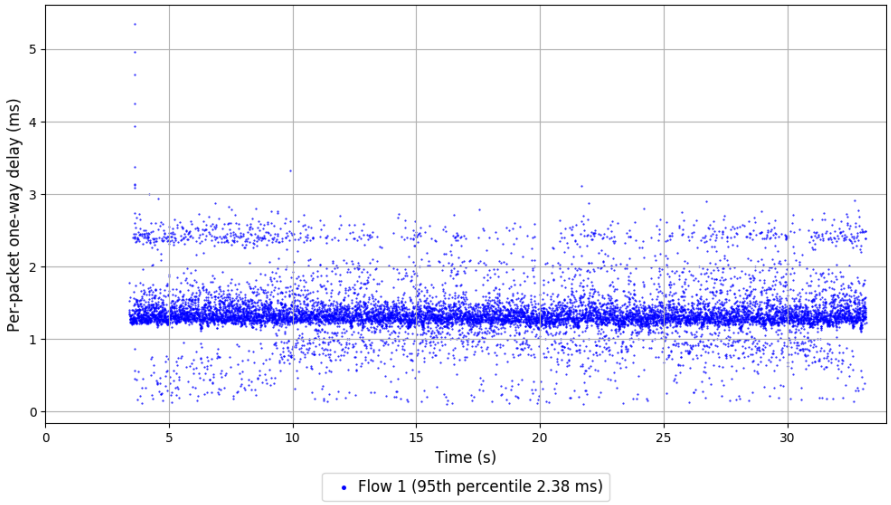
```
Run 1: Statistics of PCC-Allegro

Start at: 2019-06-25 17:38:38
End at: 2019-06-25 17:39:08

# Below is generated by plot.py at 2019-06-25 18:01:12
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 3.44 Mbit/s (28.7% utilization)
95th percentile per-packet one-way delay: 2.377 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 3.44 Mbit/s
95th percentile per-packet one-way delay: 2.377 ms
Loss rate: 0.00%
```

Run 1: Report of PCC-Allegro — Data Link



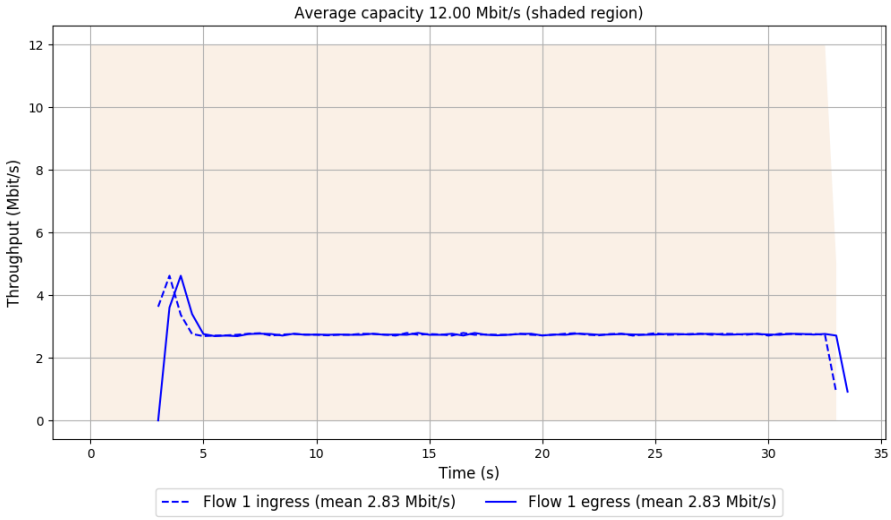


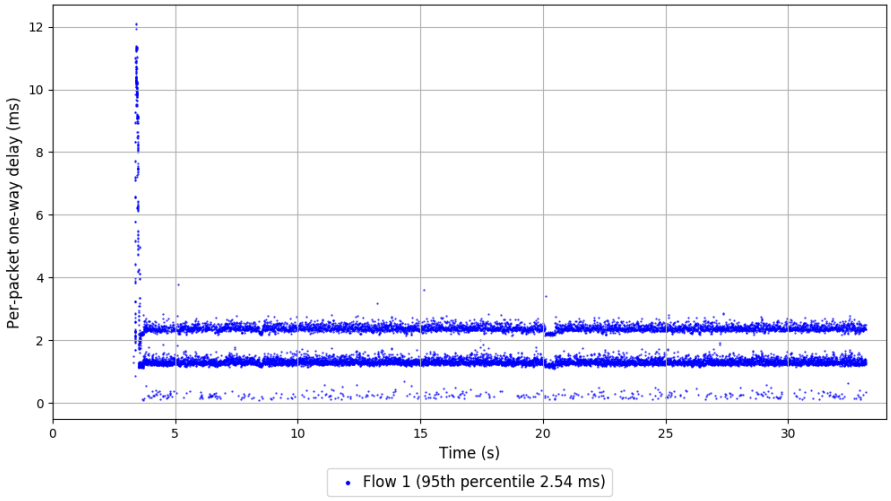
```
Run 1: Statistics of PCC-Expr

Start at: 2019-06-25 17:40:20
End at: 2019-06-25 17:40:50

# Below is generated by plot.py at 2019-06-25 18:01:12
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 2.83 Mbit/s (23.6% utilization)
95th percentile per-packet one-way delay: 2.540 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 2.83 Mbit/s
95th percentile per-packet one-way delay: 2.540 ms
Loss rate: 0.00%
```

Run 1: Report of PCC-Expr — Data Link



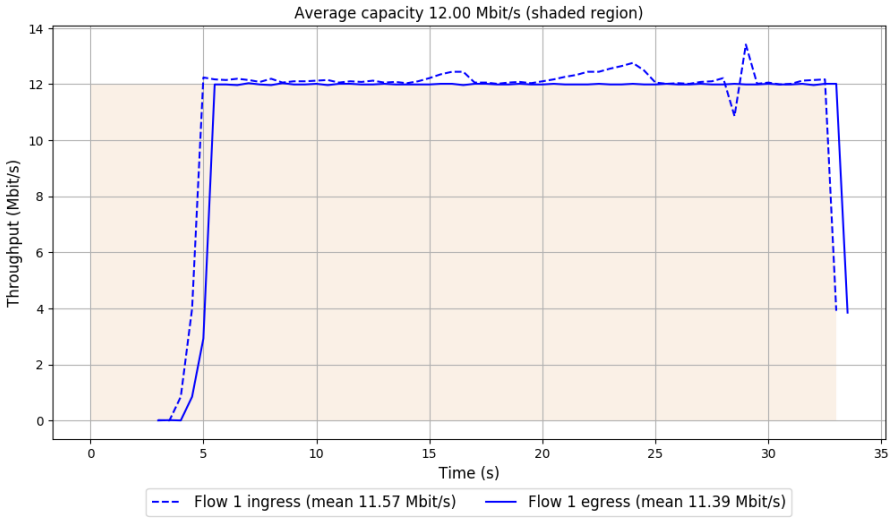


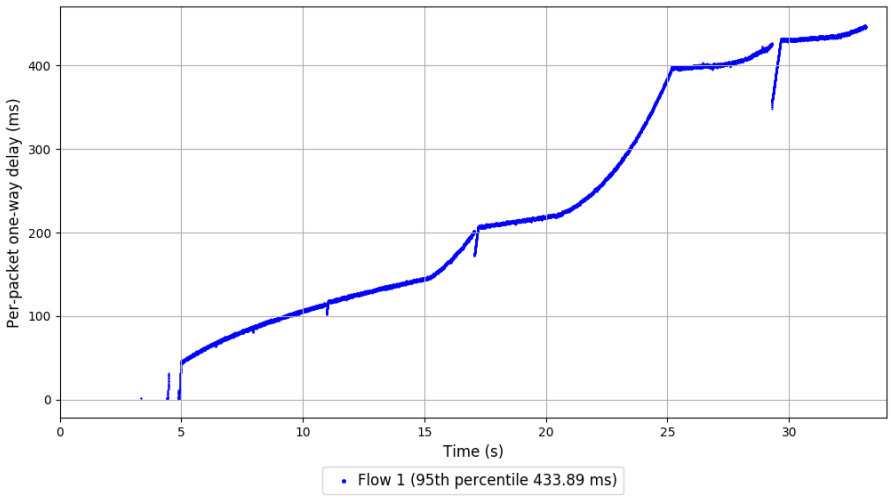
```
Run 1: Statistics of QUIC Cubic

Start at: 2019-06-25 17:38:03
End at: 2019-06-25 17:38:33

# Below is generated by plot.py at 2019-06-25 18:01:16
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.39 Mbit/s (94.9% utilization)
95th percentile per-packet one-way delay: 433.887 ms
Loss rate: 1.58%
-- Flow 1:
Average throughput: 11.39 Mbit/s
95th percentile per-packet one-way delay: 433.887 ms
Loss rate: 1.58%
```

Run 1: Report of QUIC Cubic — Data Link



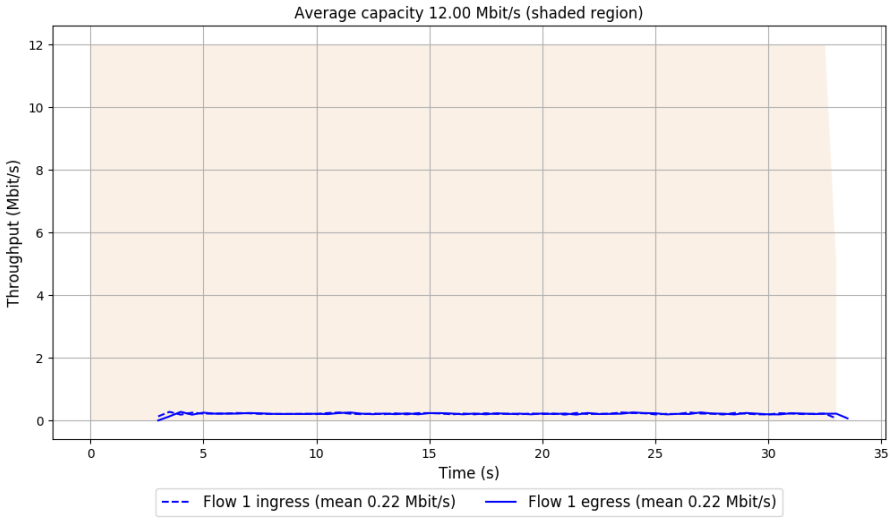


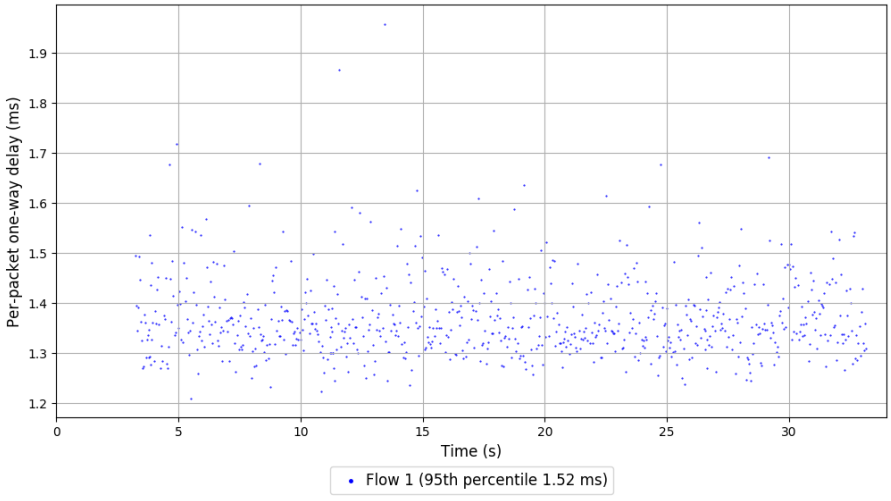
```
Run 1: Statistics of SCReAM

Start at: 2019-06-25 17:37:29
End at: 2019-06-25 17:38:00

# Below is generated by plot.py at 2019-06-25 18:01:16
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 0.22 Mbit/s (1.8% utilization)
95th percentile per-packet one-way delay: 1.518 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 1.518 ms
Loss rate: 0.00%
```

Run 1: Report of SCReAM — Data Link



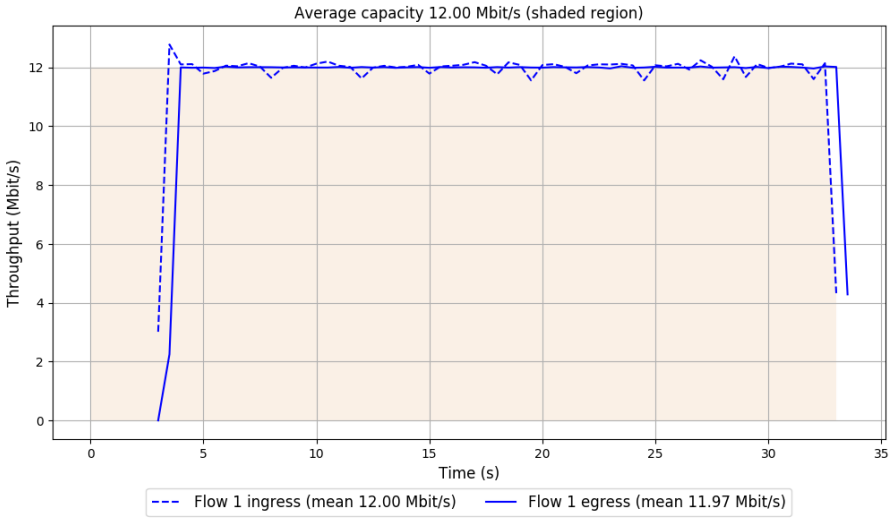


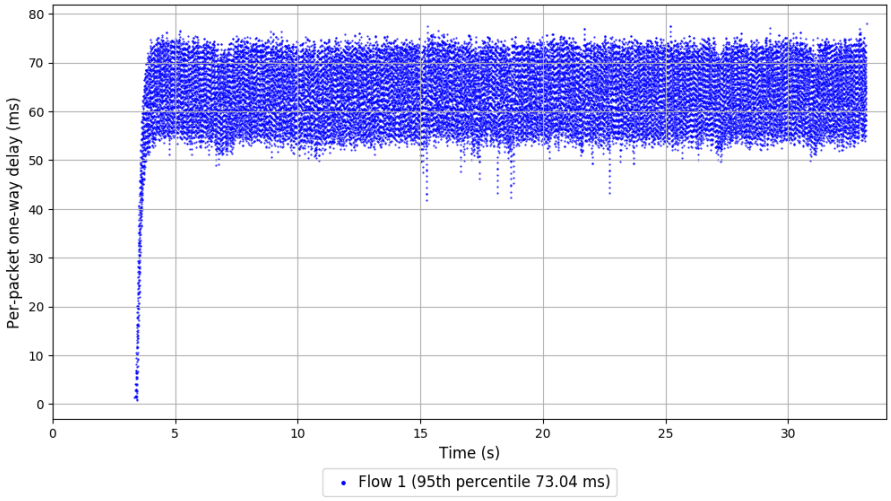
```
Run 1: Statistics of Sprout

Start at: 2019-06-25 17:34:05
End at: 2019-06-25 17:34:35

# Below is generated by plot.py at 2019-06-25 18:01:20
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.97 Mbit/s (99.8% utilization)
95th percentile per-packet one-way delay: 73.038 ms
Loss rate: 0.21%
-- Flow 1:
Average throughput: 11.97 Mbit/s
95th percentile per-packet one-way delay: 73.038 ms
Loss rate: 0.21%
```

Run 1: Report of Sprout — Data Link



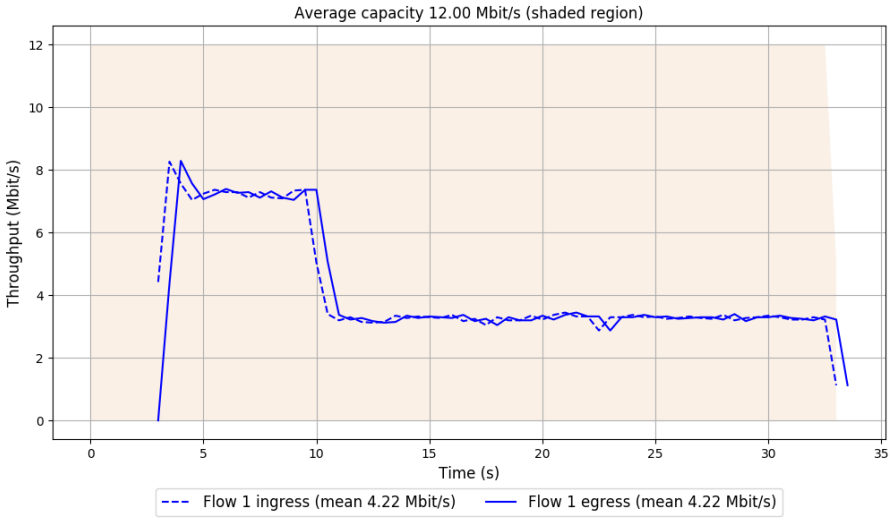


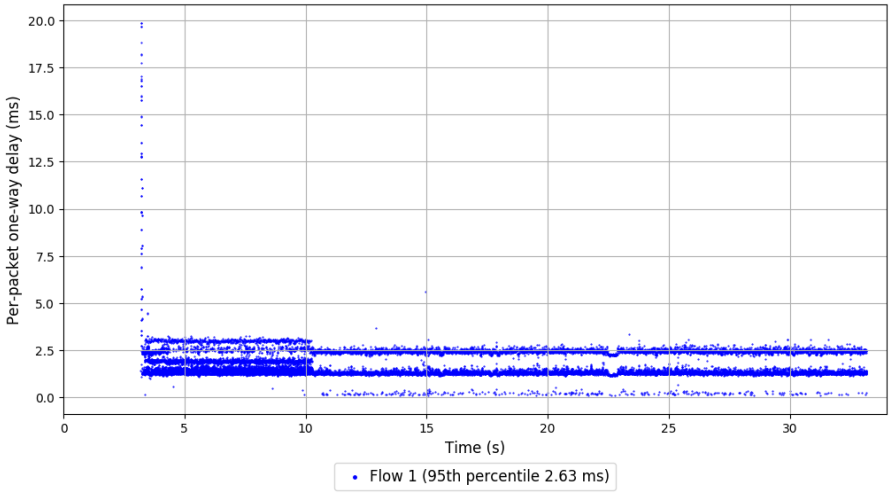
```
Run 1: Statistics of TaoVA-100x

Start at: 2019-06-25 17:36:21
End at: 2019-06-25 17:36:51

# Below is generated by plot.py at 2019-06-25 18:01:20
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 4.22 Mbit/s (35.1% utilization)
95th percentile per-packet one-way delay: 2.631 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 4.22 Mbit/s
95th percentile per-packet one-way delay: 2.631 ms
Loss rate: 0.00%
```

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



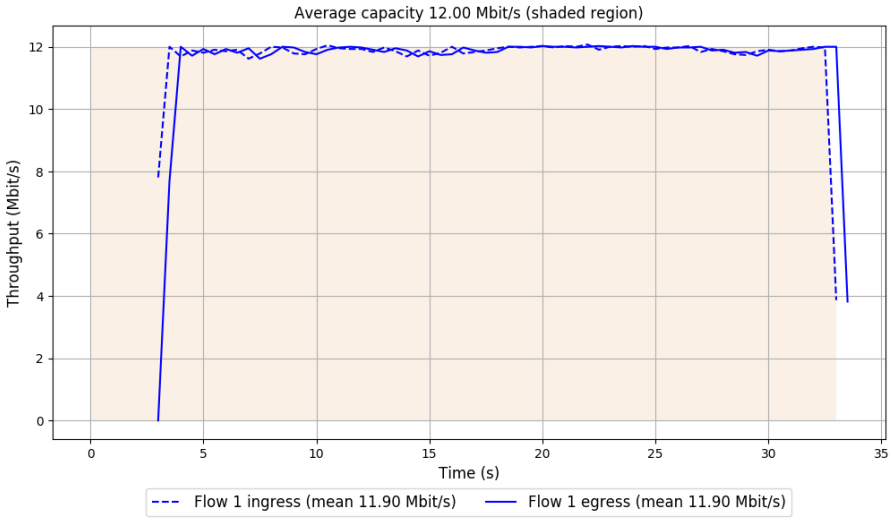


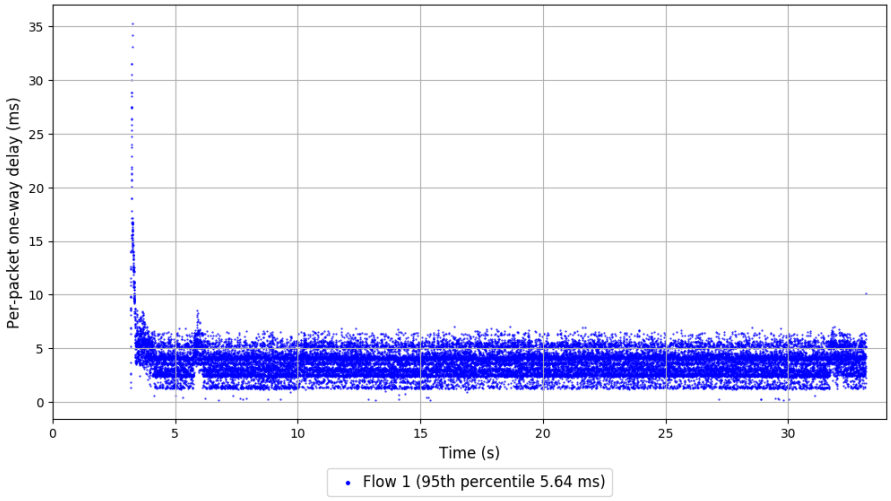
```
Run 1: Statistics of TCP Vegas

Start at: 2019-06-25 17:35:13
End at: 2019-06-25 17:35:43

# Below is generated by plot.py at 2019-06-25 18:01:22
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.90 Mbit/s (99.2% utilization)
95th percentile per-packet one-way delay: 5.640 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 11.90 Mbit/s
95th percentile per-packet one-way delay: 5.640 ms
Loss rate: 0.02%
```

Run 1: Report of TCP Vegas — Data Link



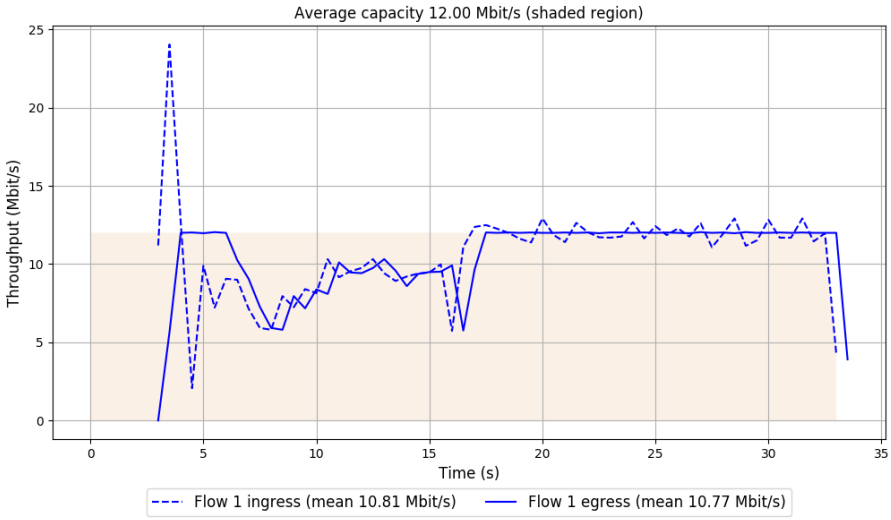


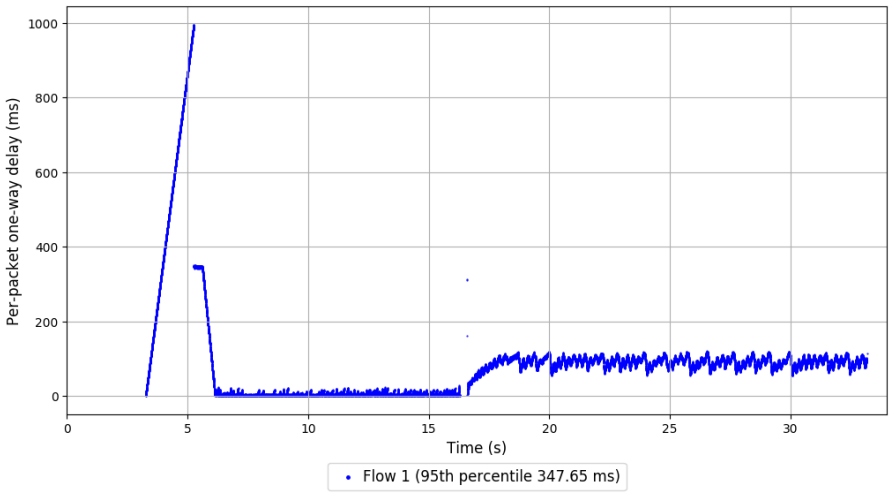
```
Run 1: Statistics of Verus

Start at: 2019-06-25 17:32:22
End at: 2019-06-25 17:32:52

# Below is generated by plot.py at 2019-06-25 18:01:25
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 10.77 Mbit/s (89.7% utilization)
95th percentile per-packet one-way delay: 347.649 ms
Loss rate: 0.35%
-- Flow 1:
Average throughput: 10.77 Mbit/s
95th percentile per-packet one-way delay: 347.649 ms
Loss rate: 0.35%
```

Run 1: Report of Verus — Data Link



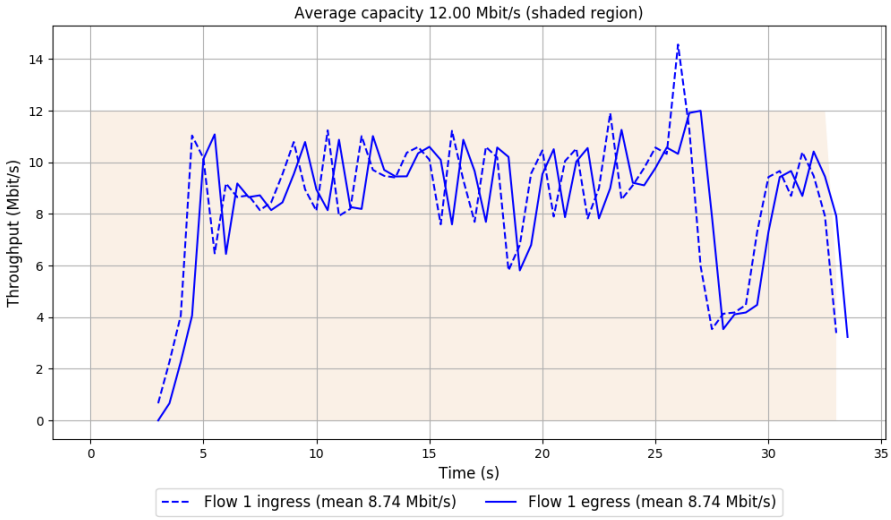


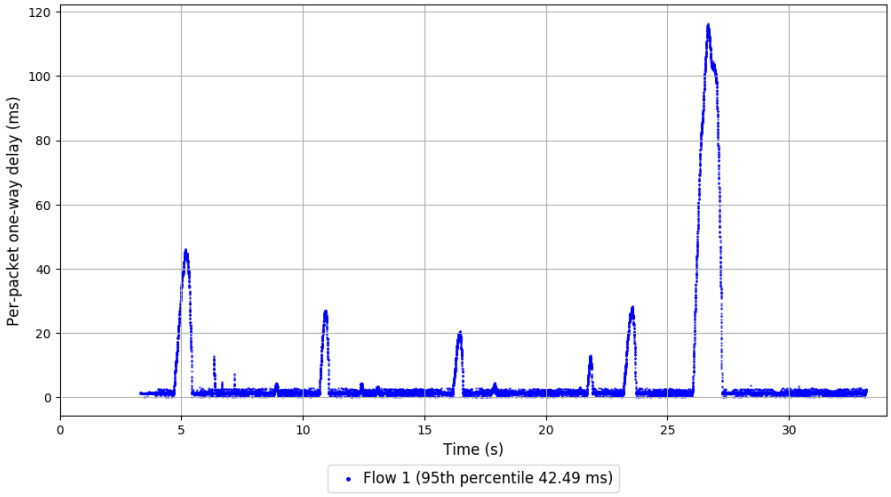
```
Run 1: Statistics of PCC-Vivace

Start at: 2019-06-25 17:34:39
End at: 2019-06-25 17:35:09

# Below is generated by plot.py at 2019-06-25 18:01:25
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 8.74 Mbit/s (72.8% utilization)
95th percentile per-packet one-way delay: 42.495 ms
Loss rate: 0.03%
-- Flow 1:
Average throughput: 8.74 Mbit/s
95th percentile per-packet one-way delay: 42.495 ms
Loss rate: 0.03%
```

Run 1: Report of PCC-Vivace — Data Link





```
Run 1: Statistics of WebRTC media

Start at: 2019-06-25 17:39:11
End at: 2019-06-25 17:39:41

# Below is generated by plot.py at 2019-06-25 18:01:25
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 2.31 Mbit/s (19.3% utilization)
95th percentile per-packet one-way delay: 6.984 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 2.31 Mbit/s
95th percentile per-packet one-way delay: 6.984 ms
Loss rate: 0.00%
```

Run 1: Report of WebRTC media — Data Link