# Pantheon Report

Generated at 2019-10-21 22:28:54 (UTC).

Tested in mahimahi: `mm-delay 28 mm-loss uplink 0.0477 mm-link 10mbps.trace 10mbps.trace --uplink-queue=droptail --uplink-queue-args=packets=14`

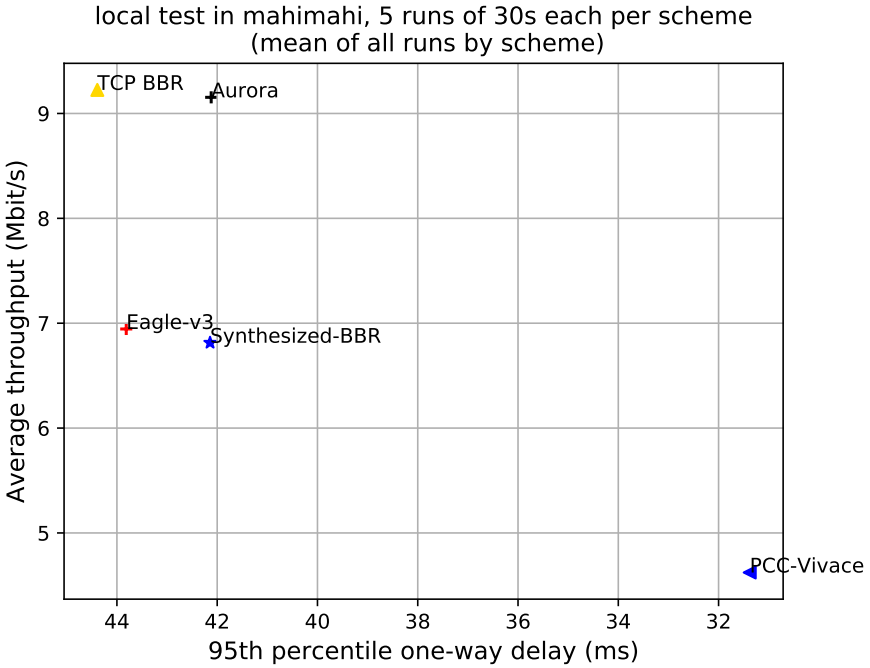
Repeated the test of 5 congestion control schemes 5 times.

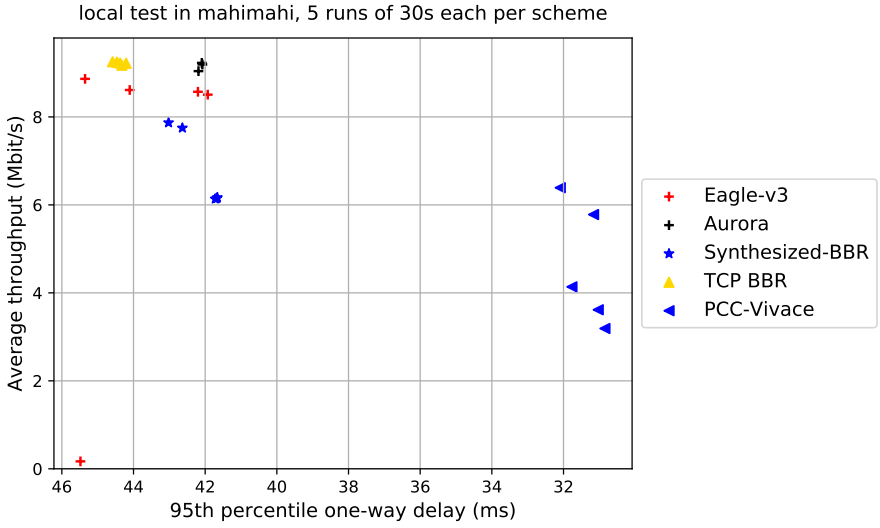
Each test lasted for 30 seconds running 1 flow.

```
System info:
Linux 4.15.0-65-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 87380 6291456
net.ipv4.tcp_wmem = 4096 16384 4194304
```

```
Git summary:
branch: master @ b54fc866b3140559c1fa1782d26fa636f7a43a8d
third_party/aurora @ f3e943d61015b39960854ba6391797e0c7984d74
third_party/aurora-model @ e292c316c23fb837255c4e142e40590d154bbe95
third_party/eagle-v1 @ c68d985e042be5c30704c0aee48c363861951a95
third_party/eagle-v2 @ c8a1737b3c84d7d49eada5b8785045d272a70120
third_party/eagle-v3 @ a63fea7809d9b57a6dbfc95c54181b54157c2b45
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/datagram_pb2.cpython-36.
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/helpers.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/mahimahi.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/project_root.cpython-36.
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/receiver.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/model-xentropy/model-xentropy.pt
 M sender-receiver/sender-receiver/sender_receiver/logs.txt
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/synthesizedBBR @ a63fea7809d9b57a6dbfc95c54181b54157c2b45
 M sender-receiver/sender-receiver/sender_receiver/__pycache__/__init__.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/__init__.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/datagram_pb2.cpython-36.
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/helpers.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/mahimahi.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/project_root.cpython-36.
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/receiver.cpython-36.pyc
 M sender-receiver/sender-receiver/sender_receiver/envs/__pycache__/sender_receiver_env.cpyt
 M sender-receiver/sender-receiver/sender_receiver/envs/model-xentropy/model-xentropy.pt
 M sender-receiver/sender-receiver/sender_receiver/envs/sender_receiver_env.py
 M sender-receiver/sender-receiver/sender_receiver/logs.txt
third_party/verus @ d4b447ea74c6c60a261149af2629562939f9a494
 M src/verus.hpp
 M tools/plot.py
third_party/vivace @ 2baf86211435ae071a32f96b7d8c504587f5d7f4
third_party/webrtc @ 3f0cc2a9061a41b6f9dde4735770d143a1fa2851
```


local test in mahimahi, 5 runs of 30s each per scheme
(mean of all runs by scheme)
TCP BBR
Aurora
Eagle-v3
Synthesized-BBR
PCC-Vivace
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
9
8
7
6
5
44
42
40
38
36
34
32

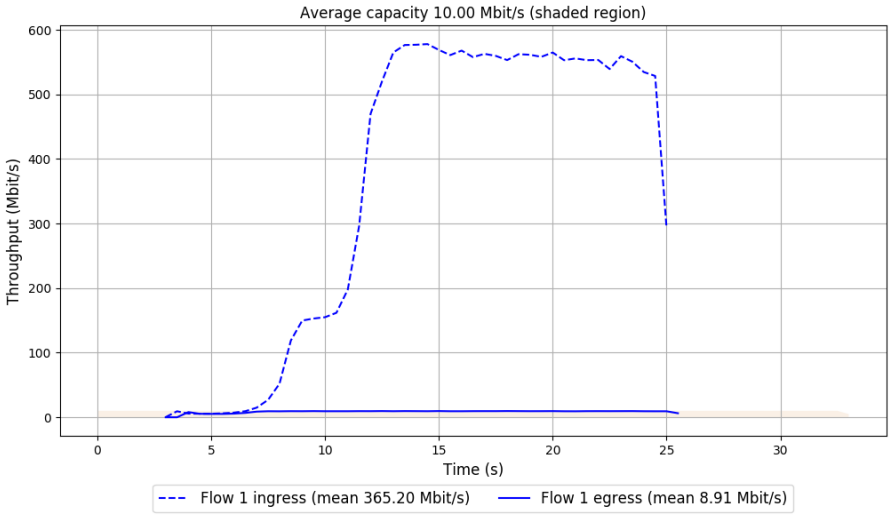

local test in mahimahi, 5 runs of 30s each per scheme
Average throughput (Mbit/s)
95th percentile one-way delay (ms)
Eagle-v3
Aurora
Synthesized-BBR
TCP BBR
PCC-Vivace
0
2
4
6
8
46
44
42
40
38
36
34
32

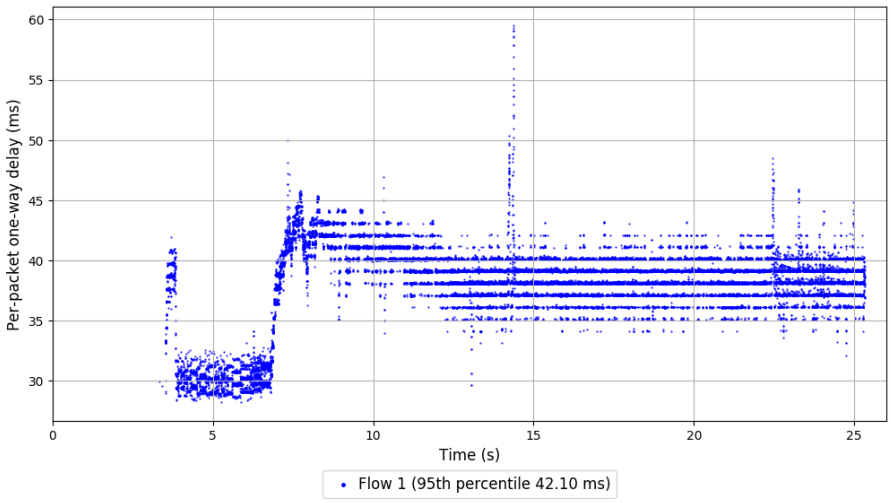
| scheme | # runs | mean avg tput (Mbit/s) flow 1 | mean 95th-%ile delay (ms) flow 1 | mean loss rate (%) flow 1 |
|---|---|---|---|---|
| Aurora | 3 | 9.15 | 42.12 | 97.45 |
| TCP BBR | 5 | 9.23 | 44.39 | 6.84 |
| Eagle-v3 | 5 | 6.95 | 43.81 | 9.79 |
| Synthesized-BBR | 5 | 6.82 | 42.14 | 5.21 |
| PCC-Vivace | 5 | 4.62 | 31.38 | 5.05 |

```
Run 1: Statistics of Aurora

Start at: 2019-10-21 22:09:24
End at: 2019-10-21 22:09:54
```

Run 1: Report of Aurora — Data Link



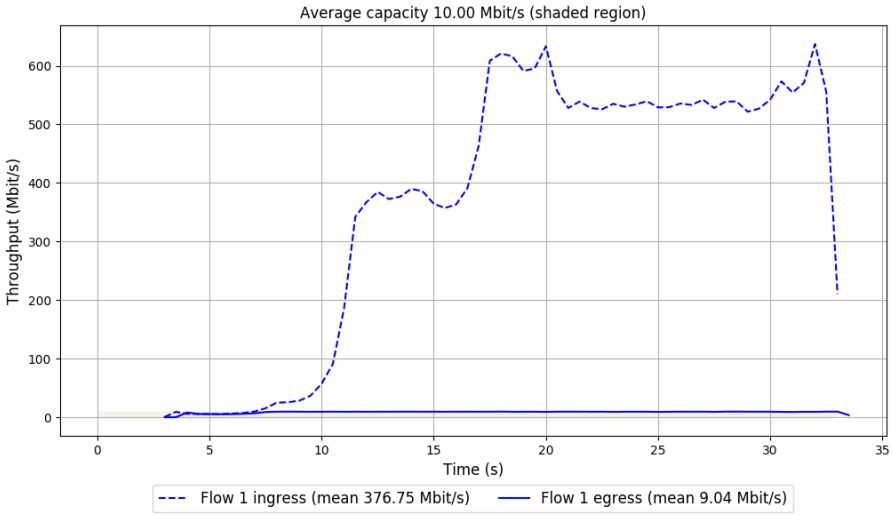



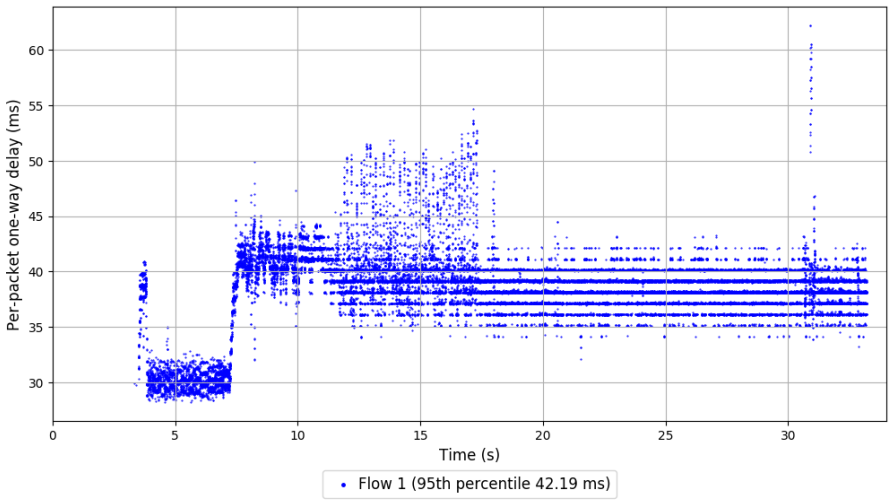
```
Run 2: Statistics of Aurora

Start at: 2019-10-21 22:12:23
End at: 2019-10-21 22:12:53

# Below is generated by plot.py at 2019-10-21 22:28:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.04 Mbit/s (90.4% utilization)
95th percentile per-packet one-way delay: 42.187 ms
Loss rate: 97.60%
-- Flow 1:
Average throughput: 9.04 Mbit/s
95th percentile per-packet one-way delay: 42.187 ms
Loss rate: 97.60%
```

Run 2: Report of Aurora — Data Link



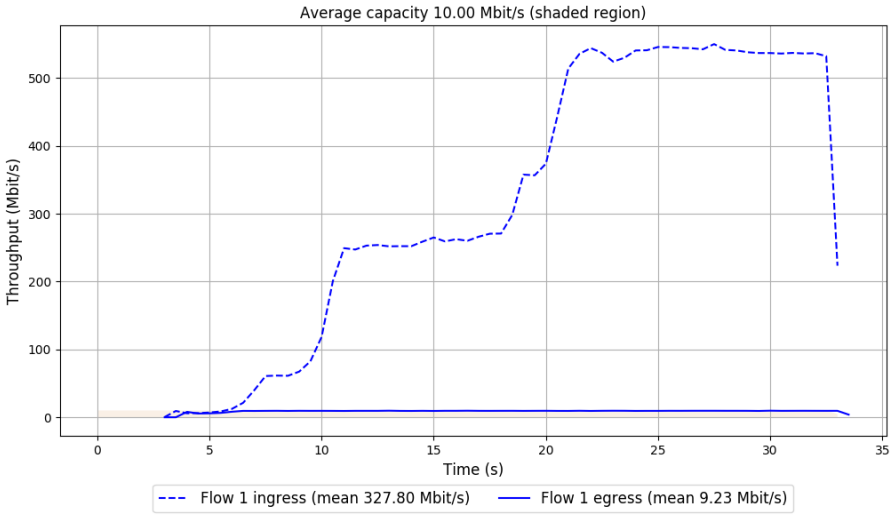



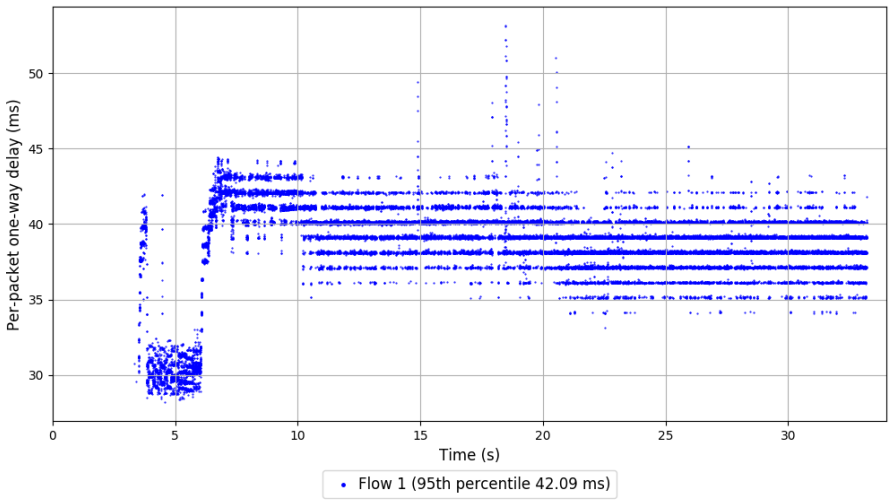
```
Run 3: Statistics of Aurora

Start at: 2019-10-21 22:15:25
End at: 2019-10-21 22:15:55

# Below is generated by plot.py at 2019-10-21 22:28:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.23 Mbit/s (92.3% utilization)
95th percentile per-packet one-way delay: 42.094 ms
Loss rate: 97.19%
-- Flow 1:
Average throughput: 9.23 Mbit/s
95th percentile per-packet one-way delay: 42.094 ms
Loss rate: 97.19%
```

Run 3: Report of Aurora — Data Link

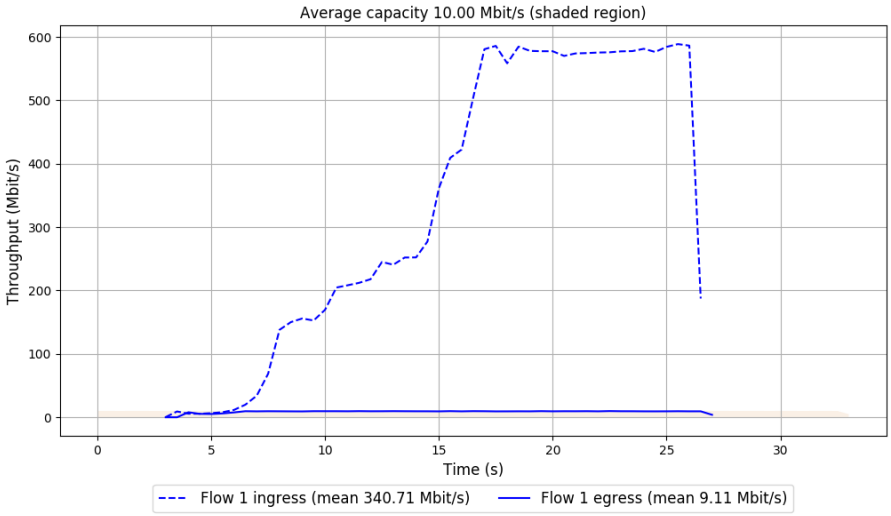


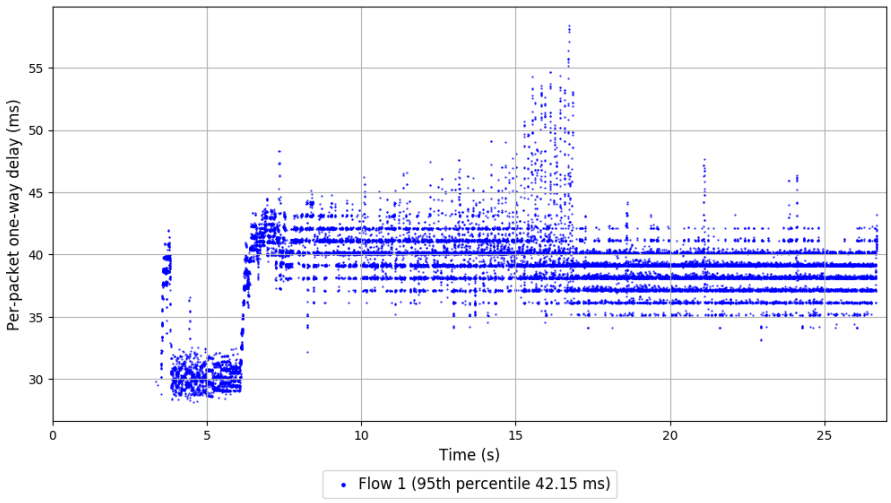



```
Run 4: Statistics of Aurora

Start at: 2019-10-21 22:18:26
End at: 2019-10-21 22:18:56
```

Run 4: Report of Aurora — Data Link



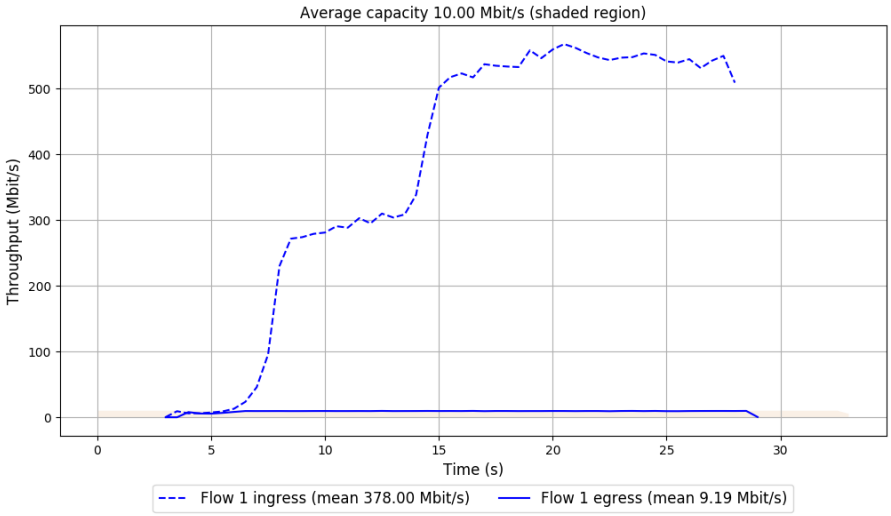



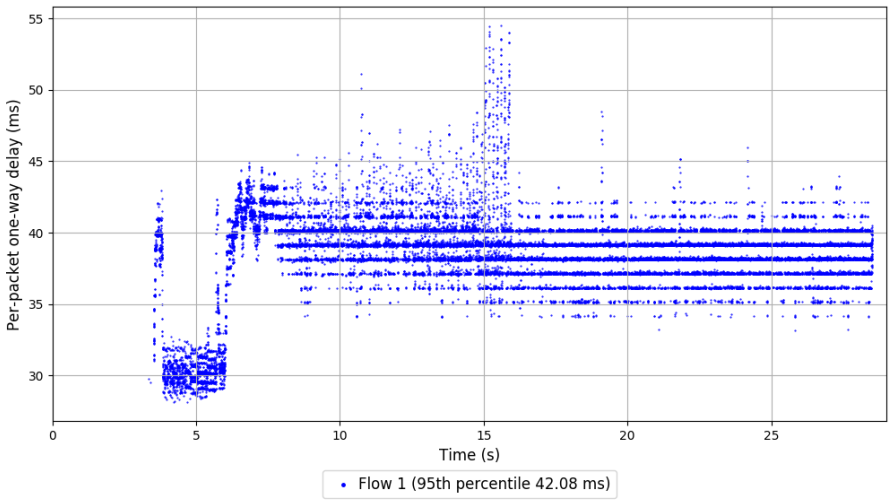
```
Run 5: Statistics of Aurora

Start at: 2019-10-21 22:21:25
End at: 2019-10-21 22:21:55

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.19 Mbit/s (91.9% utilization)
95th percentile per-packet one-way delay: 42.078 ms
Loss rate: 97.57%
-- Flow 1:
Average throughput: 9.19 Mbit/s
95th percentile per-packet one-way delay: 42.078 ms
Loss rate: 97.57%
```

Run 5: Report of Aurora — Data Link



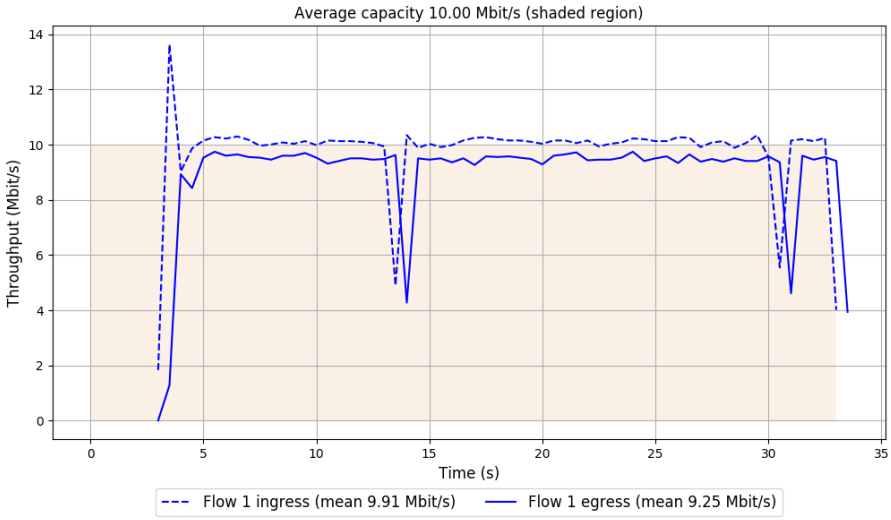



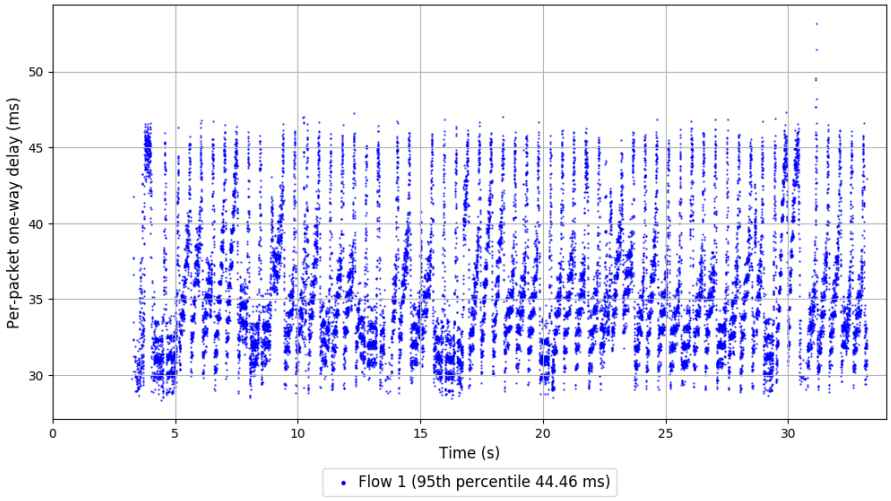
```
Run 1: Statistics of TCP BBR

Start at: 2019-10-21 22:07:40
End at: 2019-10-21 22:08:10

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.25 Mbit/s (92.5% utilization)
95th percentile per-packet one-way delay: 44.464 ms
Loss rate: 6.75%
-- Flow 1:
Average throughput: 9.25 Mbit/s
95th percentile per-packet one-way delay: 44.464 ms
Loss rate: 6.75%
```

Run 1: Report of TCP BBR — Data Link



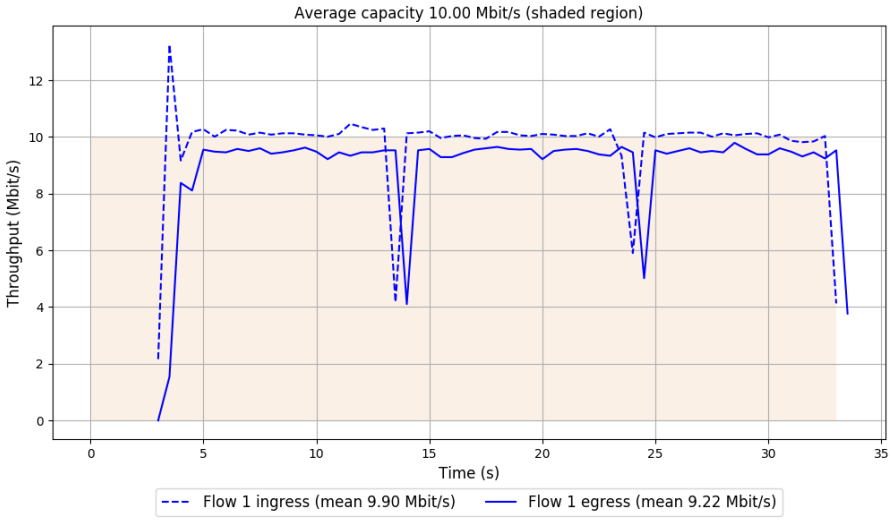



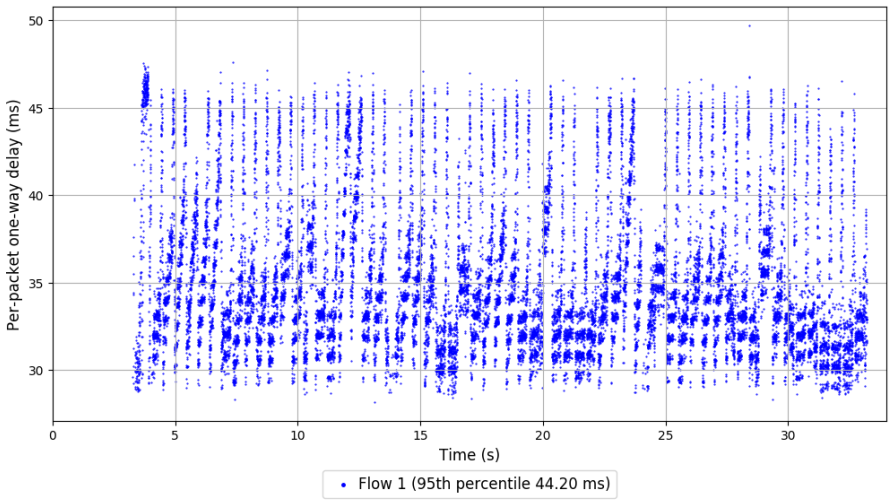
```
Run 2: Statistics of TCP BBR

Start at: 2019-10-21 22:10:40
End at: 2019-10-21 22:11:10

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.22 Mbit/s (92.2% utilization)
95th percentile per-packet one-way delay: 44.205 ms
Loss rate: 6.89%
-- Flow 1:
Average throughput: 9.22 Mbit/s
95th percentile per-packet one-way delay: 44.205 ms
Loss rate: 6.89%
```

Run 2: Report of TCP BBR — Data Link



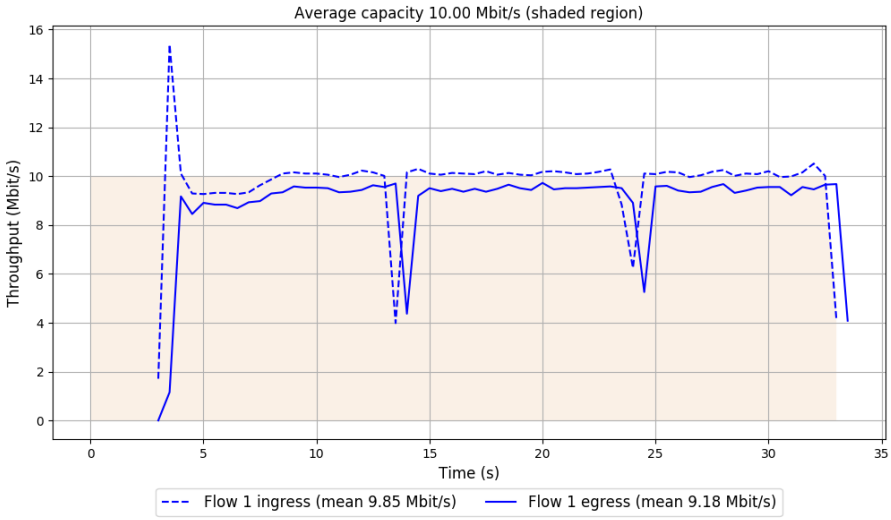



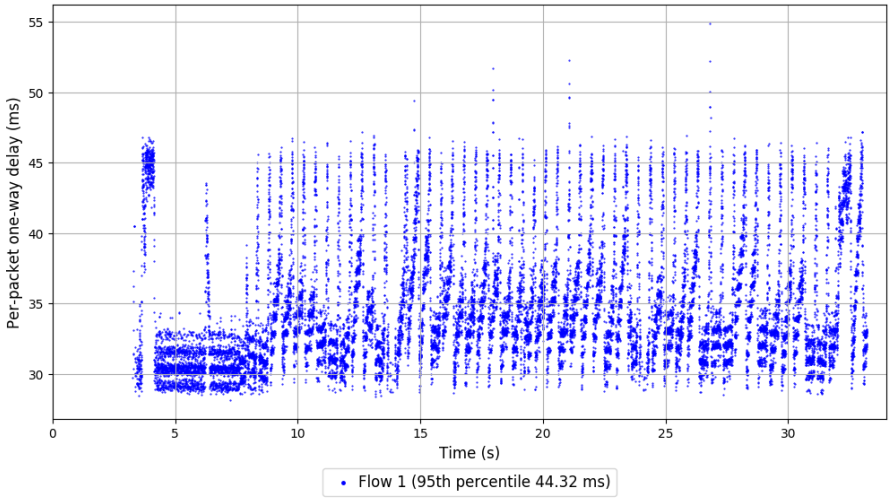
```
Run 3: Statistics of TCP BBR

Start at: 2019-10-21 22:13:41
End at: 2019-10-21 22:14:11

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.18 Mbit/s (91.8% utilization)
95th percentile per-packet one-way delay: 44.324 ms
Loss rate: 6.97%
-- Flow 1:
Average throughput: 9.18 Mbit/s
95th percentile per-packet one-way delay: 44.324 ms
Loss rate: 6.97%
```

Run 3: Report of TCP BBR — Data Link



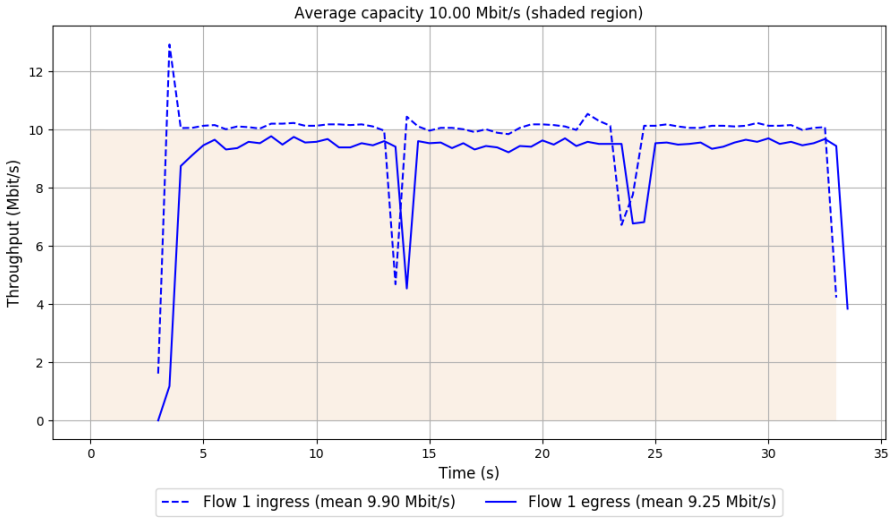



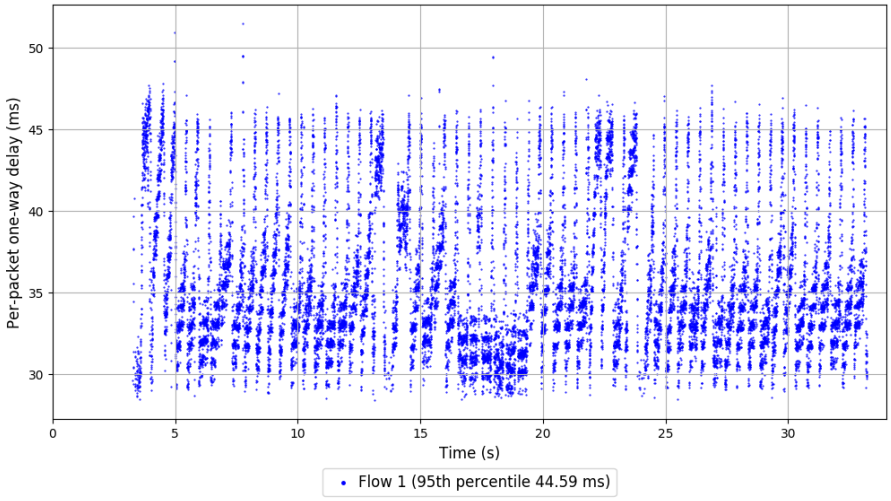
```
Run 4: Statistics of TCP BBR

Start at: 2019-10-21 22:16:42
End at: 2019-10-21 22:17:12

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.25 Mbit/s (92.5% utilization)
95th percentile per-packet one-way delay: 44.585 ms
Loss rate: 6.64%
-- Flow 1:
Average throughput: 9.25 Mbit/s
95th percentile per-packet one-way delay: 44.585 ms
Loss rate: 6.64%
```

Run 4: Report of TCP BBR — Data Link



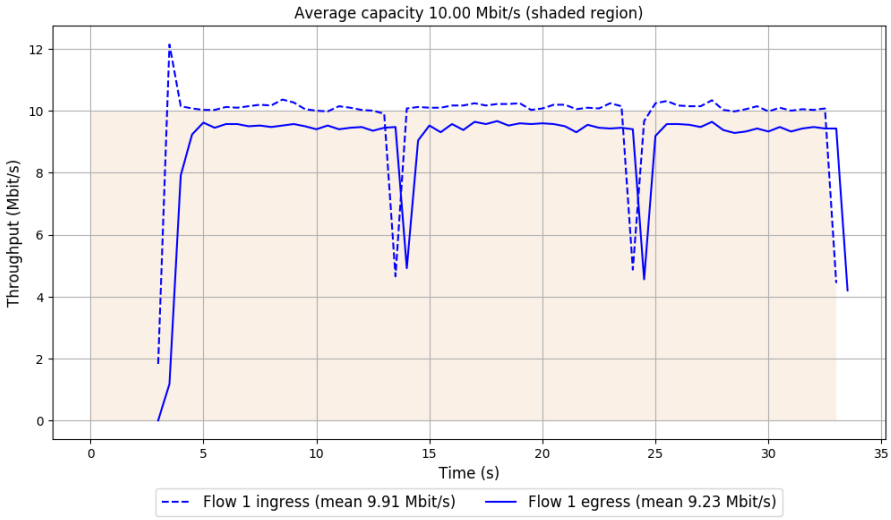



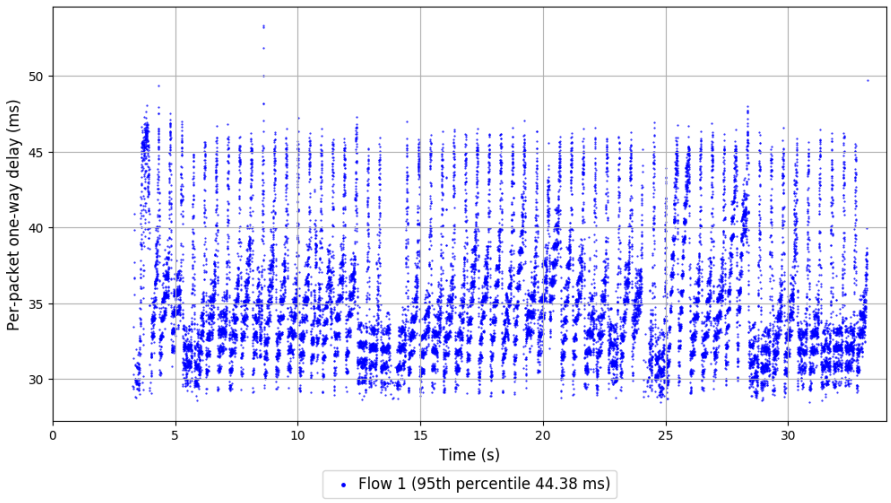
```
Run 5: Statistics of TCP BBR

Start at: 2019-10-21 22:19:41
End at: 2019-10-21 22:20:11

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.23 Mbit/s (92.3% utilization)
95th percentile per-packet one-way delay: 44.376 ms
Loss rate: 6.96%
-- Flow 1:
Average throughput: 9.23 Mbit/s
95th percentile per-packet one-way delay: 44.376 ms
Loss rate: 6.96%
```

Run 5: Report of TCP BBR — Data Link



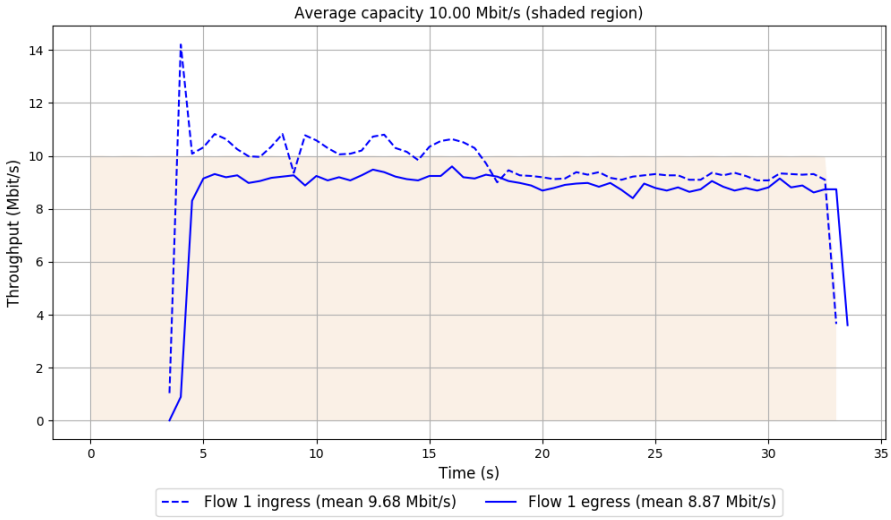



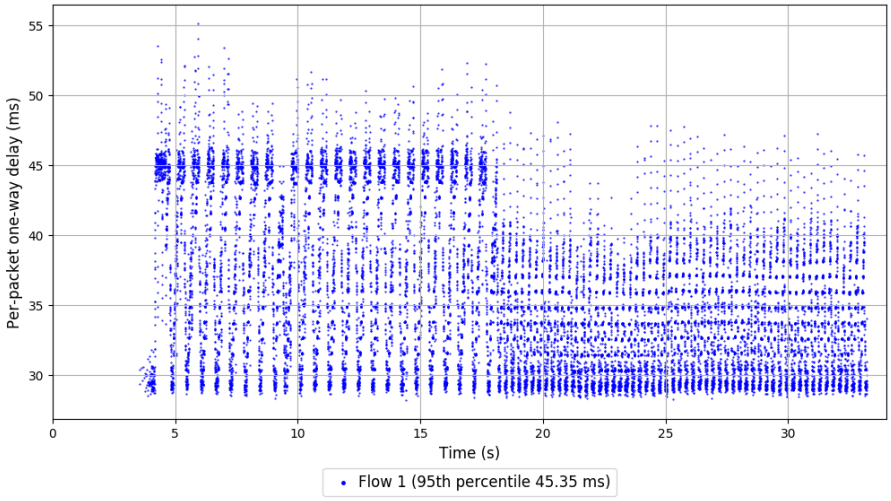
```
Run 1: Statistics of Eagle-v3

Start at: 2019-10-21 22:07:06
End at: 2019-10-21 22:07:36

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 8.87 Mbit/s (88.7% utilization)
95th percentile per-packet one-way delay: 45.352 ms
Loss rate: 8.45%
-- Flow 1:
Average throughput: 8.87 Mbit/s
95th percentile per-packet one-way delay: 45.352 ms
Loss rate: 8.45%
```

Run 1: Report of Eagle-v3 — Data Link



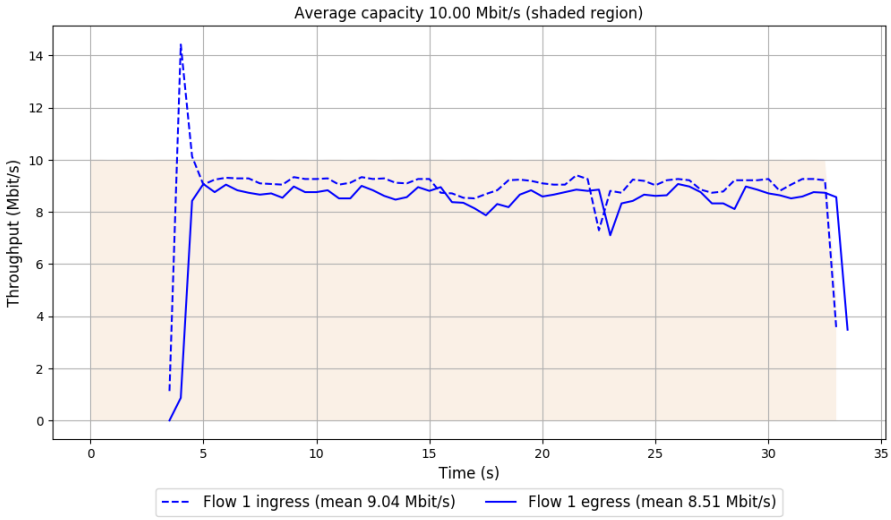



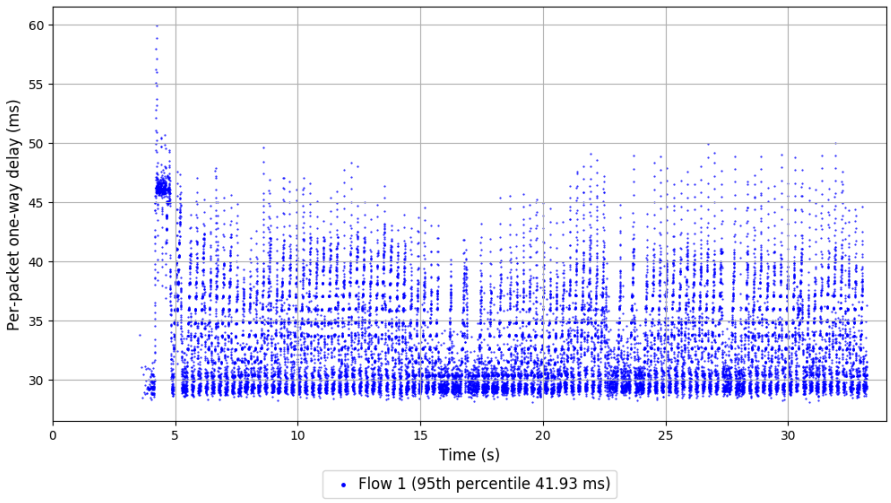
```
Run 2: Statistics of Eagle-v3

Start at: 2019-10-21 22:10:05
End at: 2019-10-21 22:10:35

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 8.51 Mbit/s (85.1% utilization)
95th percentile per-packet one-way delay: 41.928 ms
Loss rate: 6.02%
-- Flow 1:
Average throughput: 8.51 Mbit/s
95th percentile per-packet one-way delay: 41.928 ms
Loss rate: 6.02%
```

Run 2: Report of Eagle-v3 — Data Link



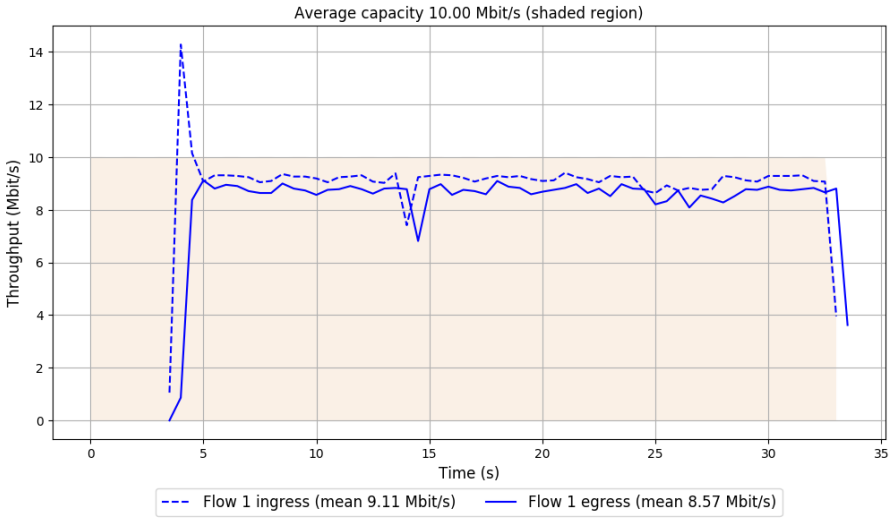



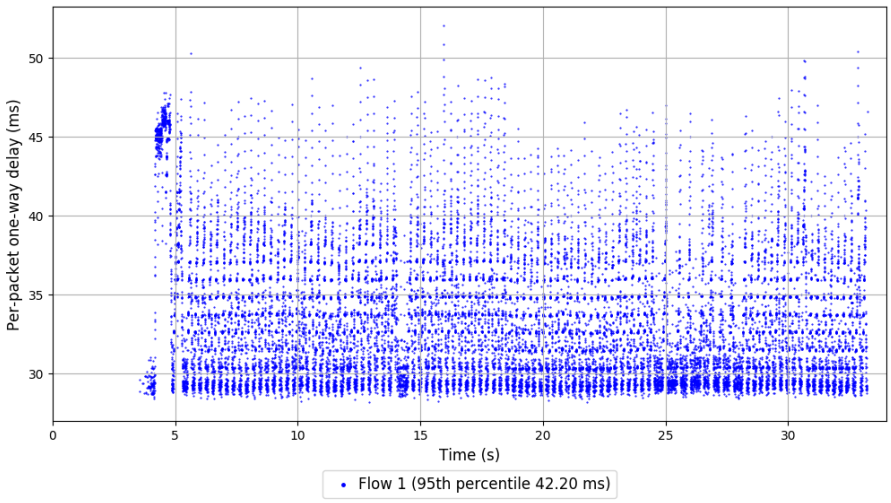
```
Run 3: Statistics of Eagle-v3

Start at: 2019-10-21 22:13:07
End at: 2019-10-21 22:13:37

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 8.57 Mbit/s (85.7% utilization)
95th percentile per-packet one-way delay: 42.202 ms
Loss rate: 5.94%
-- Flow 1:
Average throughput: 8.57 Mbit/s
95th percentile per-packet one-way delay: 42.202 ms
Loss rate: 5.94%
```

Run 3: Report of Eagle-v3 — Data Link



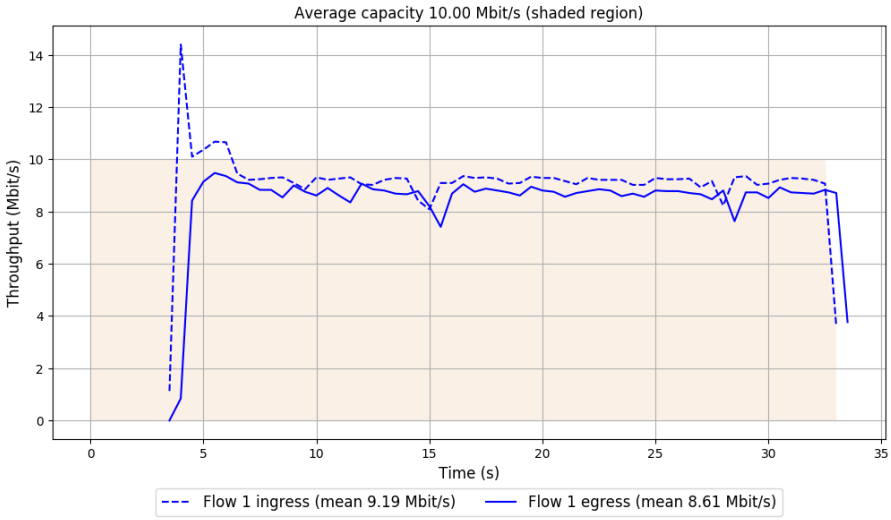



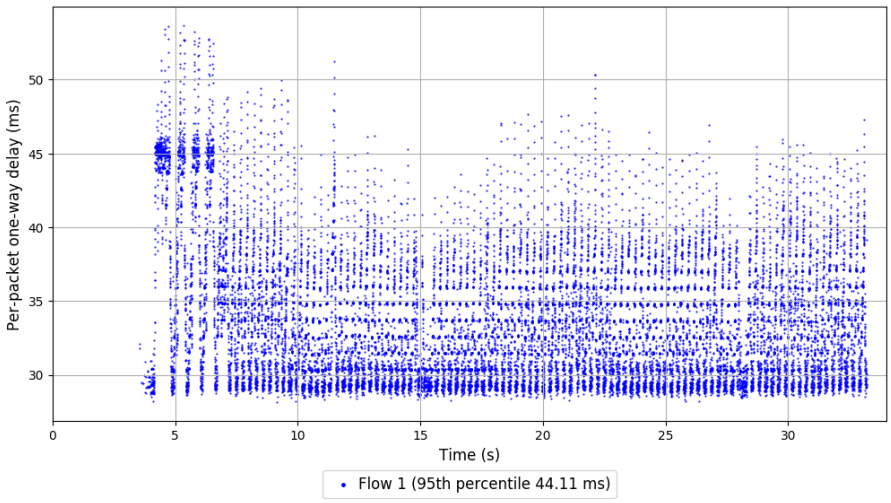
```
Run 4: Statistics of Eagle-v3

Start at: 2019-10-21 22:16:08
End at: 2019-10-21 22:16:38

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 8.61 Mbit/s (86.1% utilization)
95th percentile per-packet one-way delay: 44.106 ms
Loss rate: 6.36%
-- Flow 1:
Average throughput: 8.61 Mbit/s
95th percentile per-packet one-way delay: 44.106 ms
Loss rate: 6.36%
```

Run 4: Report of Eagle-v3 — Data Link



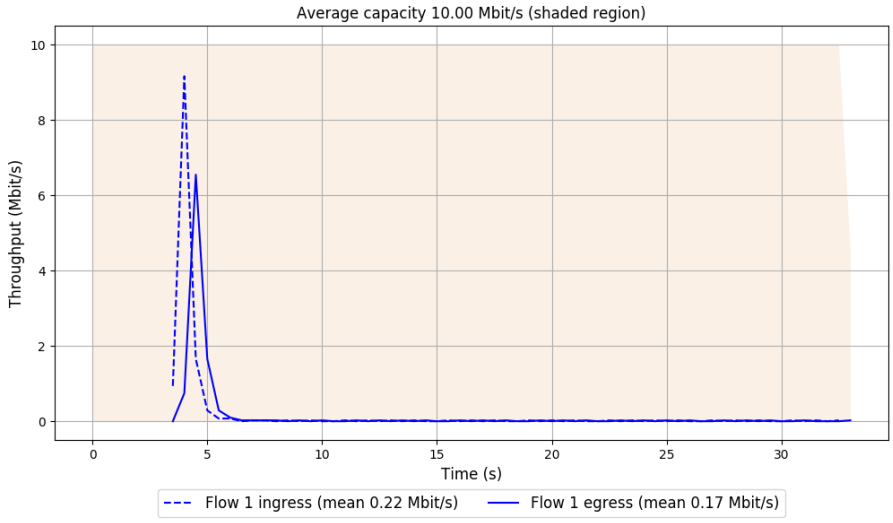



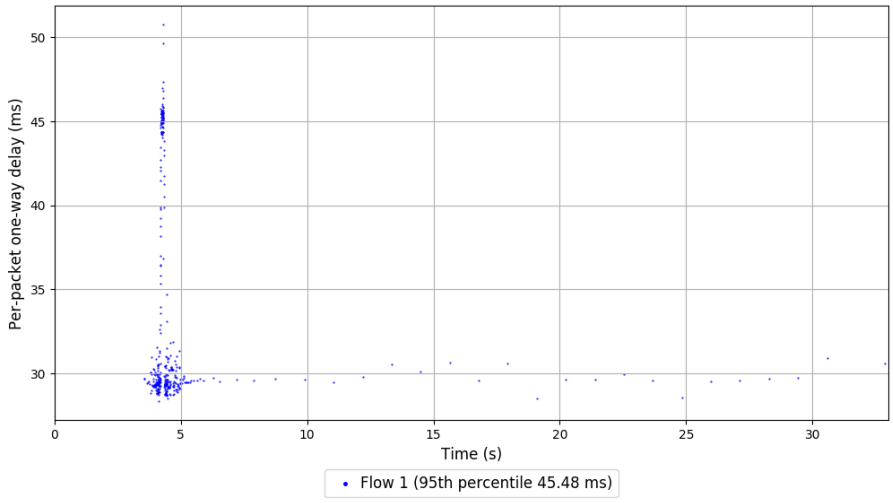
```
Run 5: Statistics of Eagle-v3

Start at: 2019-10-21 22:19:07
End at: 2019-10-21 22:19:37

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 0.17 Mbit/s (1.7% utilization)
95th percentile per-packet one-way delay: 45.481 ms
Loss rate: 22.18%
-- Flow 1:
Average throughput: 0.17 Mbit/s
95th percentile per-packet one-way delay: 45.481 ms
Loss rate: 22.18%
```

Run 5: Report of Eagle-v3 — Data Link



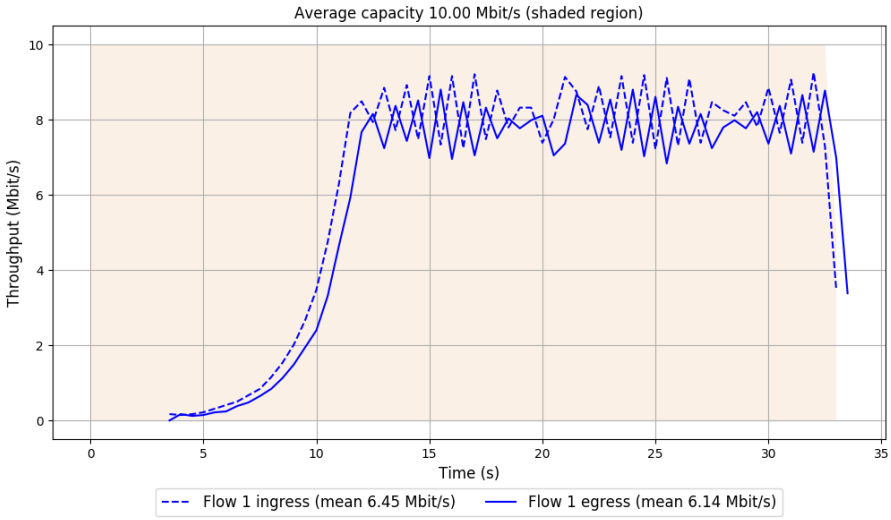



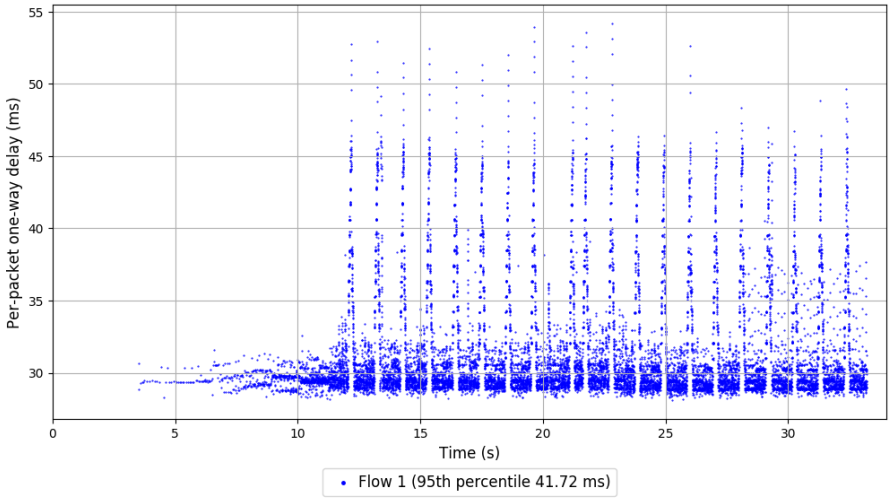
```
Run 1: Statistics of Synthesized-BBR

Start at: 2019-10-21 22:08:15
End at: 2019-10-21 22:08:45

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 6.14 Mbit/s (61.4% utilization)
95th percentile per-packet one-way delay: 41.719 ms
Loss rate: 5.01%
-- Flow 1:
Average throughput: 6.14 Mbit/s
95th percentile per-packet one-way delay: 41.719 ms
Loss rate: 5.01%
```

Run 1: Report of Synthesized-BBR — Data Link



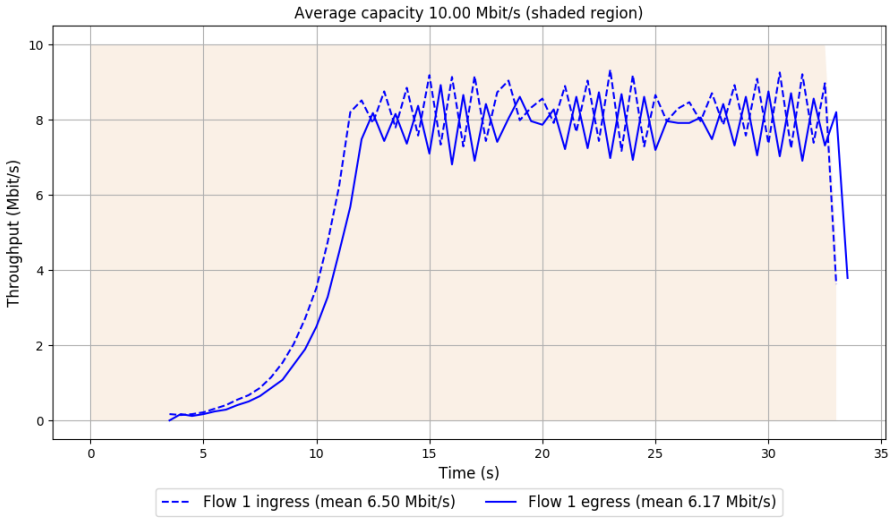



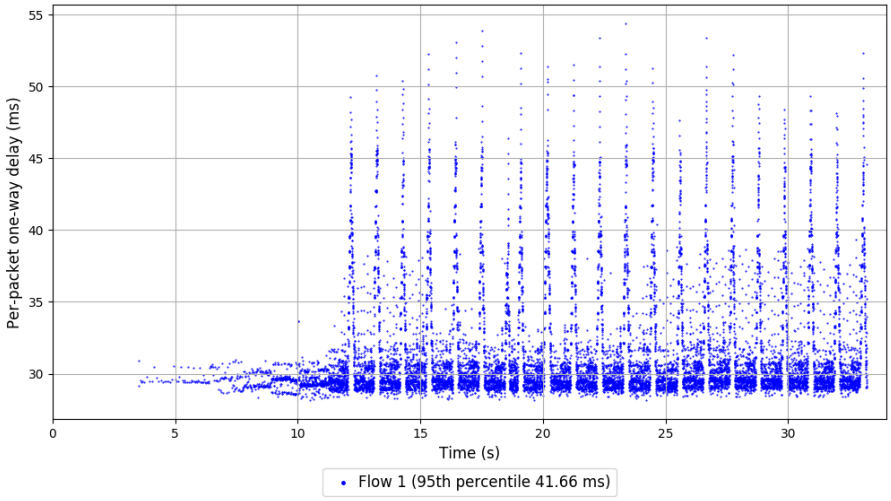
```
Run 2: Statistics of Synthesized-BBR

Start at: 2019-10-21 22:11:14
End at: 2019-10-21 22:11:44

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 6.17 Mbit/s (61.7% utilization)
95th percentile per-packet one-way delay: 41.661 ms
Loss rate: 5.13%
-- Flow 1:
Average throughput: 6.17 Mbit/s
95th percentile per-packet one-way delay: 41.661 ms
Loss rate: 5.13%
```

Run 2: Report of Synthesized-BBR — Data Link



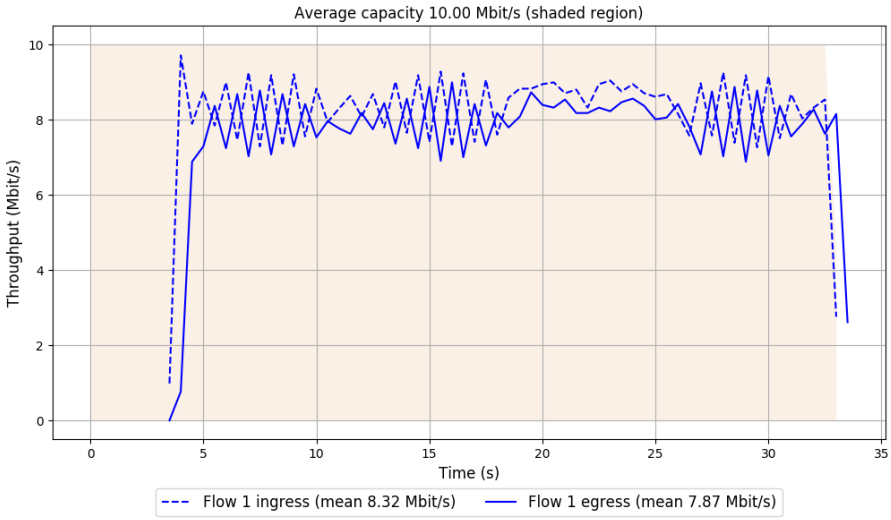



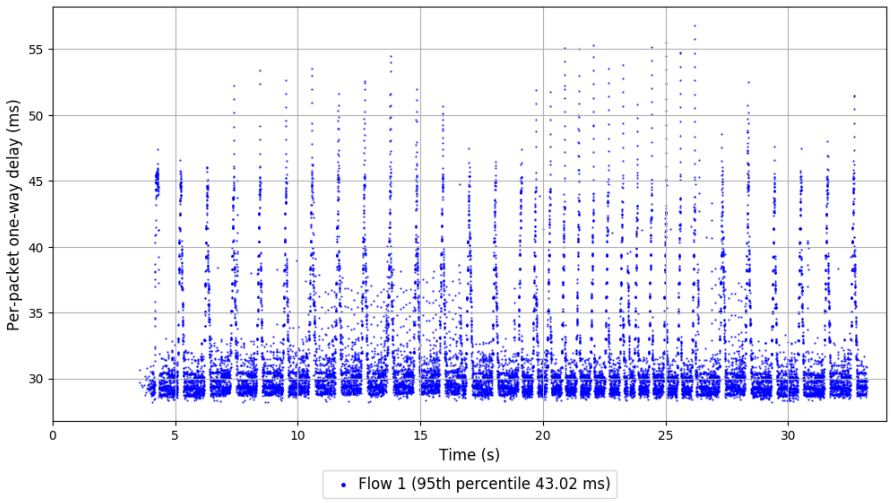
```
Run 3: Statistics of Synthesized-BBR

Start at: 2019-10-21 22:14:16
End at: 2019-10-21 22:14:46

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 7.87 Mbit/s (78.7% utilization)
95th percentile per-packet one-way delay: 43.022 ms
Loss rate: 5.46%
-- Flow 1:
Average throughput: 7.87 Mbit/s
95th percentile per-packet one-way delay: 43.022 ms
Loss rate: 5.46%
```

Run 3: Report of Synthesized-BBR — Data Link



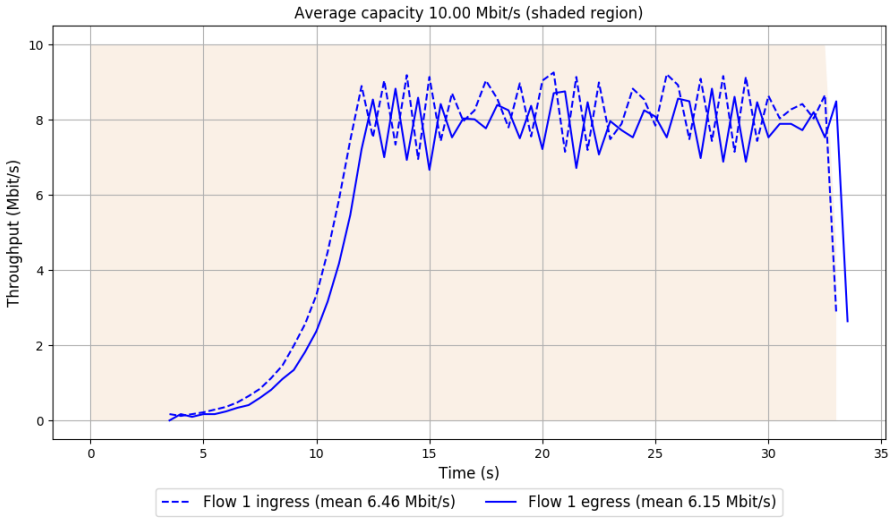



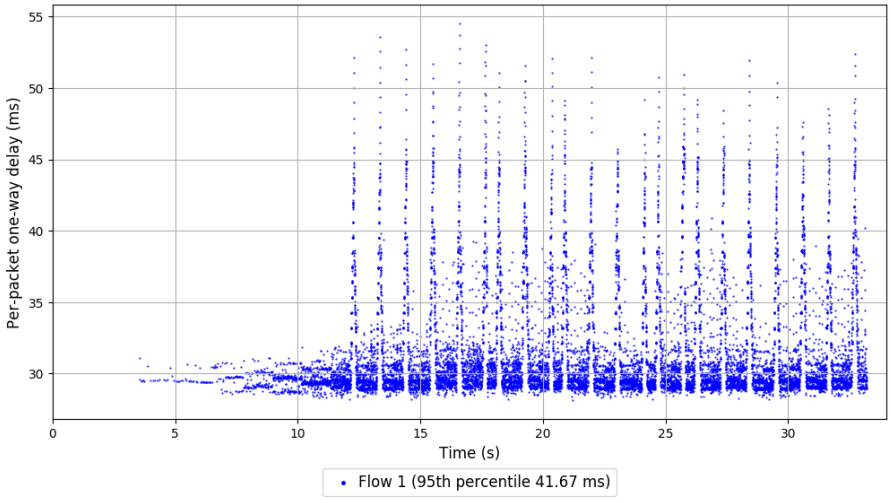
```
Run 4: Statistics of Synthesized-BBR

Start at: 2019-10-21 22:17:17
End at: 2019-10-21 22:17:47

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 6.15 Mbit/s (61.5% utilization)
95th percentile per-packet one-way delay: 41.674 ms
Loss rate: 4.99%
-- Flow 1:
Average throughput: 6.15 Mbit/s
95th percentile per-packet one-way delay: 41.674 ms
Loss rate: 4.99%
```

Run 4: Report of Synthesized-BBR — Data Link



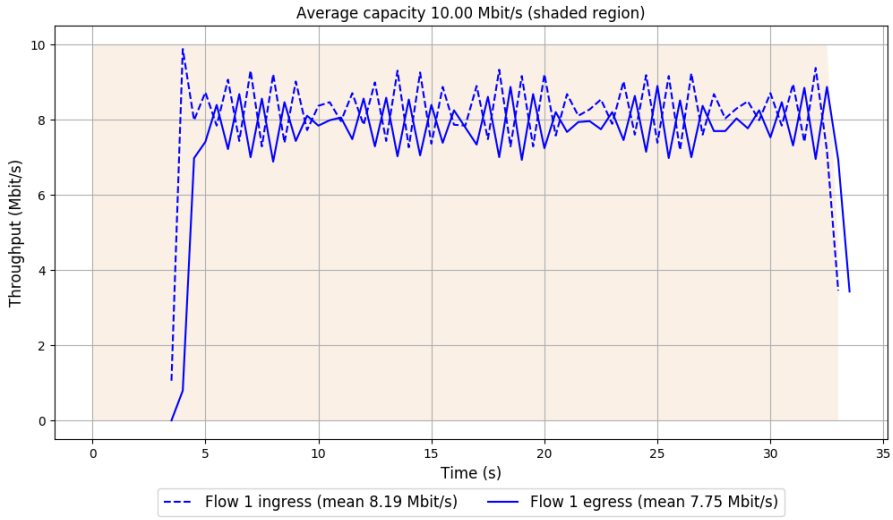



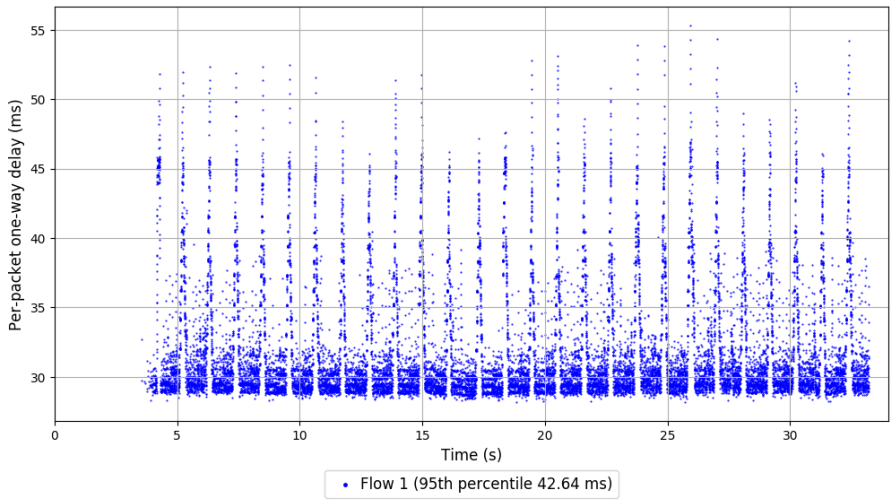
```
Run 5: Statistics of Synthesized-BBR

Start at: 2019-10-21 22:20:16
End at: 2019-10-21 22:20:46

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 7.75 Mbit/s (77.5% utilization)
95th percentile per-packet one-way delay: 42.636 ms
Loss rate: 5.48%
-- Flow 1:
Average throughput: 7.75 Mbit/s
95th percentile per-packet one-way delay: 42.636 ms
Loss rate: 5.48%
```

Run 5: Report of Synthesized-BBR — Data Link



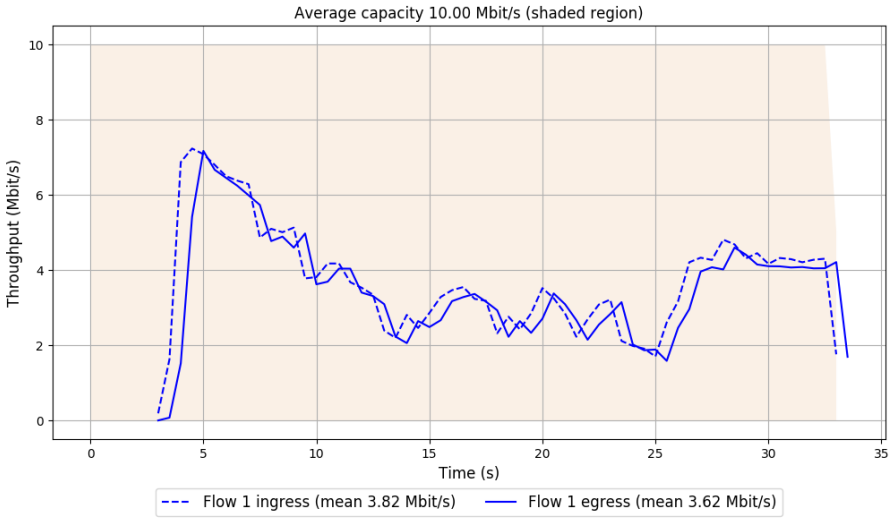



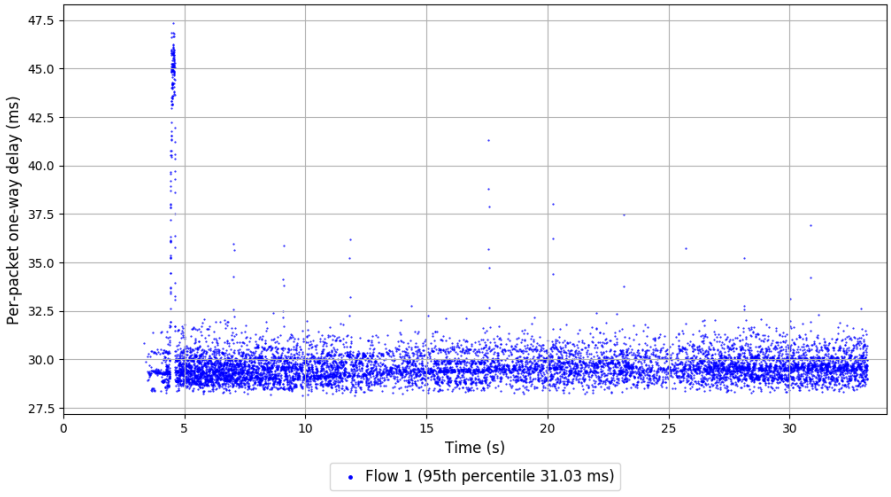
```
Run 1: Statistics of PCC-Vivace

Start at: 2019-10-21 22:08:50
End at: 2019-10-21 22:09:20

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 3.62 Mbit/s (36.2% utilization)
95th percentile per-packet one-way delay: 31.032 ms
Loss rate: 5.39%
-- Flow 1:
Average throughput: 3.62 Mbit/s
95th percentile per-packet one-way delay: 31.032 ms
Loss rate: 5.39%
```

Run 1: Report of PCC-Vivace — Data Link



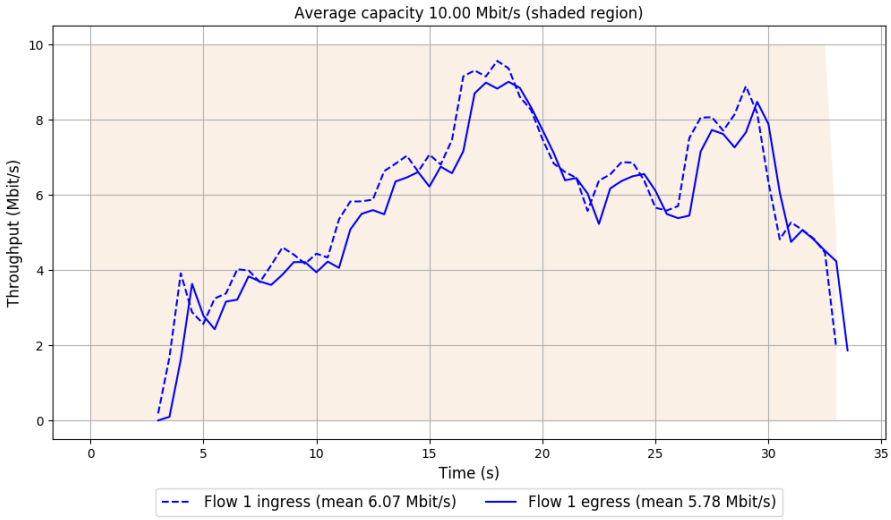



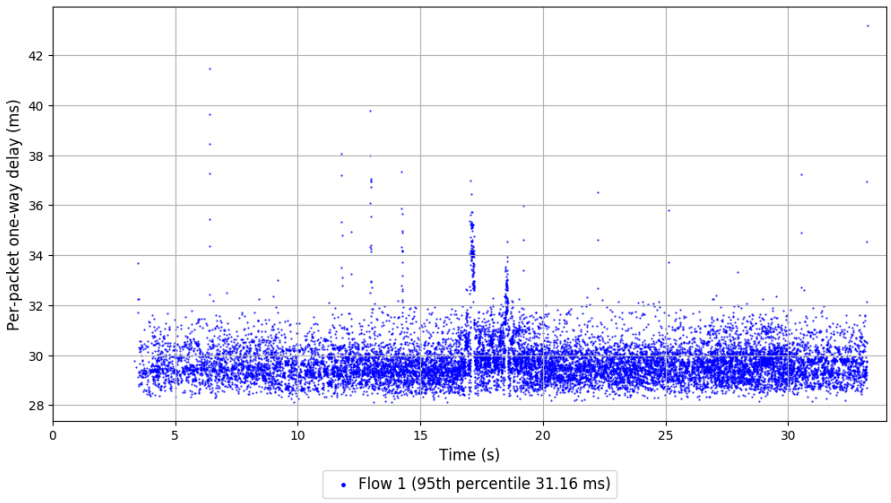
```
Run 2: Statistics of PCC-Vivace

Start at: 2019-10-21 22:11:49
End at: 2019-10-21 22:12:19

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 5.78 Mbit/s (57.8% utilization)
95th percentile per-packet one-way delay: 31.162 ms
Loss rate: 4.82%
-- Flow 1:
Average throughput: 5.78 Mbit/s
95th percentile per-packet one-way delay: 31.162 ms
Loss rate: 4.82%
```

Run 2: Report of PCC-Vivace — Data Link



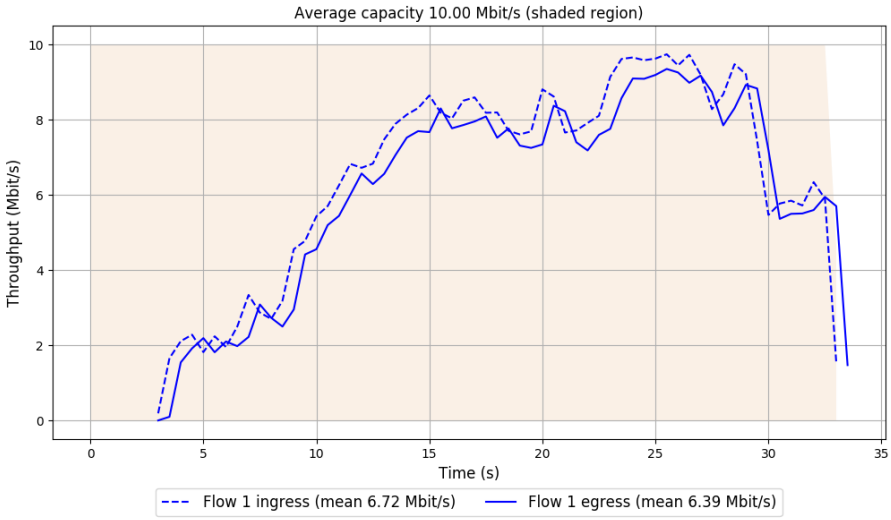



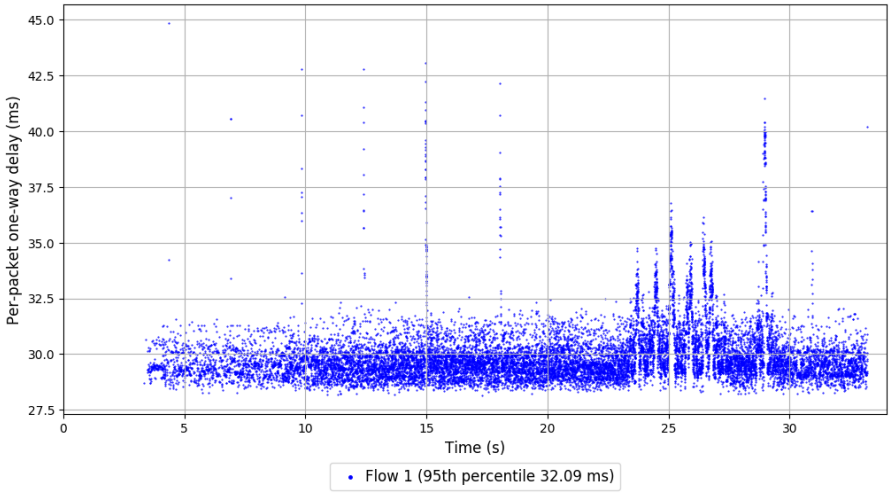
```
Run 3: Statistics of PCC-Vivace

Start at: 2019-10-21 22:14:51
End at: 2019-10-21 22:15:21

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 6.39 Mbit/s (63.9% utilization)
95th percentile per-packet one-way delay: 32.092 ms
Loss rate: 4.95%
-- Flow 1:
Average throughput: 6.39 Mbit/s
95th percentile per-packet one-way delay: 32.092 ms
Loss rate: 4.95%
```

Run 3: Report of PCC-Vivace — Data Link



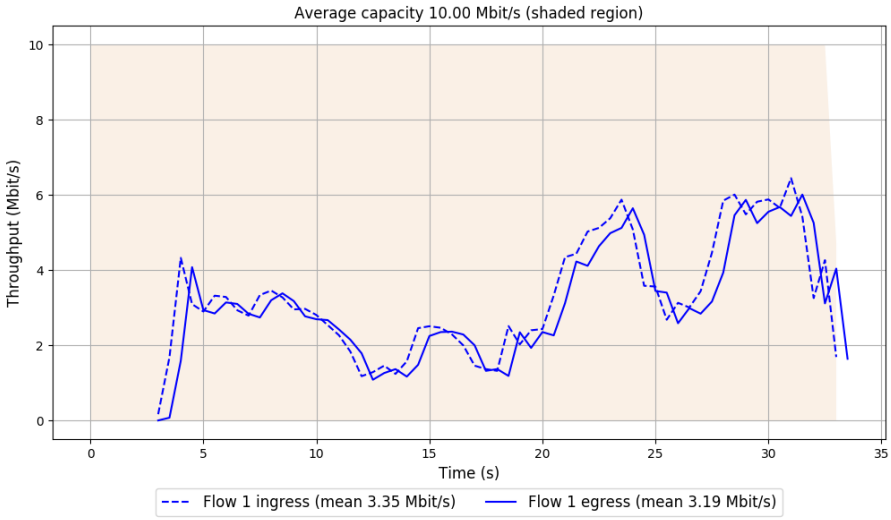



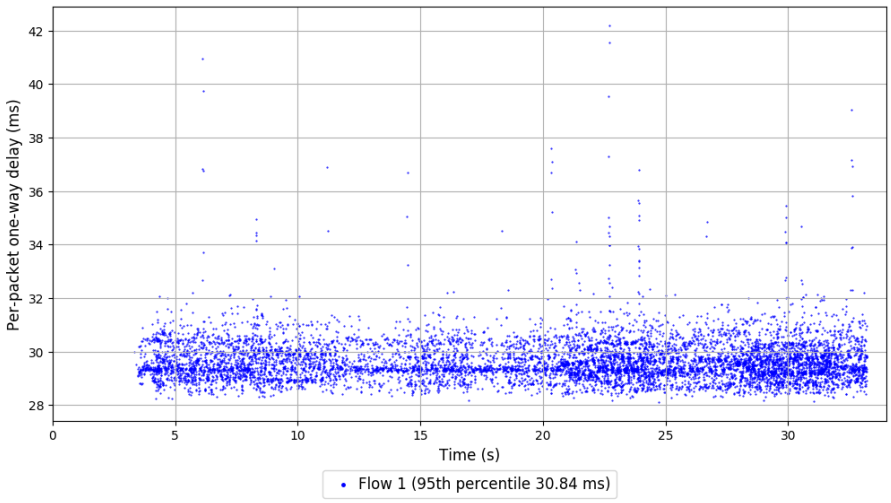
```
Run 4: Statistics of PCC-Vivace

Start at: 2019-10-21 22:17:51
End at: 2019-10-21 22:18:21

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 3.19 Mbit/s (31.9% utilization)
95th percentile per-packet one-way delay: 30.845 ms
Loss rate: 4.84%
-- Flow 1:
Average throughput: 3.19 Mbit/s
95th percentile per-packet one-way delay: 30.845 ms
Loss rate: 4.84%
```

Run 4: Report of PCC-Vivace — Data Link



```
Run 5: Statistics of PCC-Vivace

Start at: 2019-10-21 22:20:50
End at: 2019-10-21 22:21:20

# Below is generated by plot.py at 2019-10-21 22:28:53
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 4.14 Mbit/s (41.4% utilization)
95th percentile per-packet one-way delay: 31.766 ms
Loss rate: 5.24%
-- Flow 1:
Average throughput: 4.14 Mbit/s
95th percentile per-packet one-way delay: 31.766 ms
Loss rate: 5.24%
```

Run 5: Report of PCC-Vivace — Data Link