Pantheon Report

Generated at 2019-06-28 05:23:36 (UTC).
Tested in mahimahi: `mm-link 12mbps.trace 12mbps.trace`
Repeated the test of 19 congestion control schemes once.
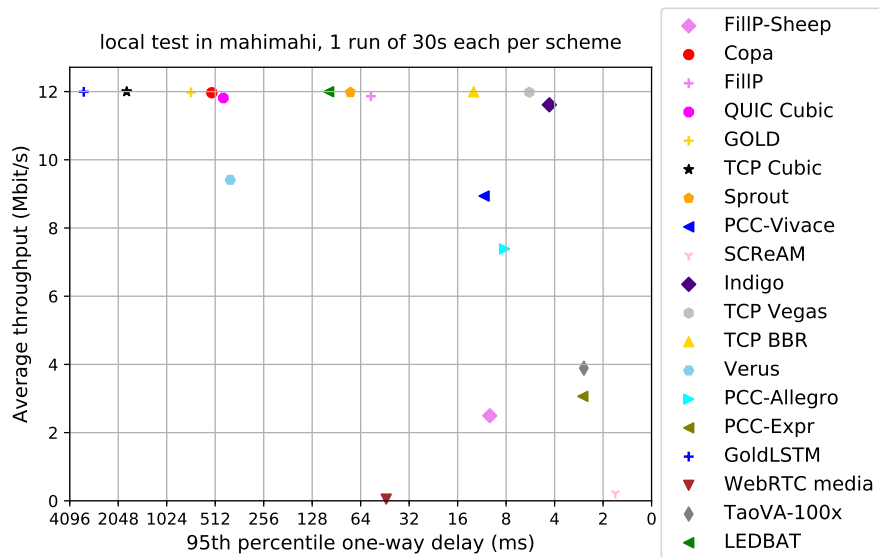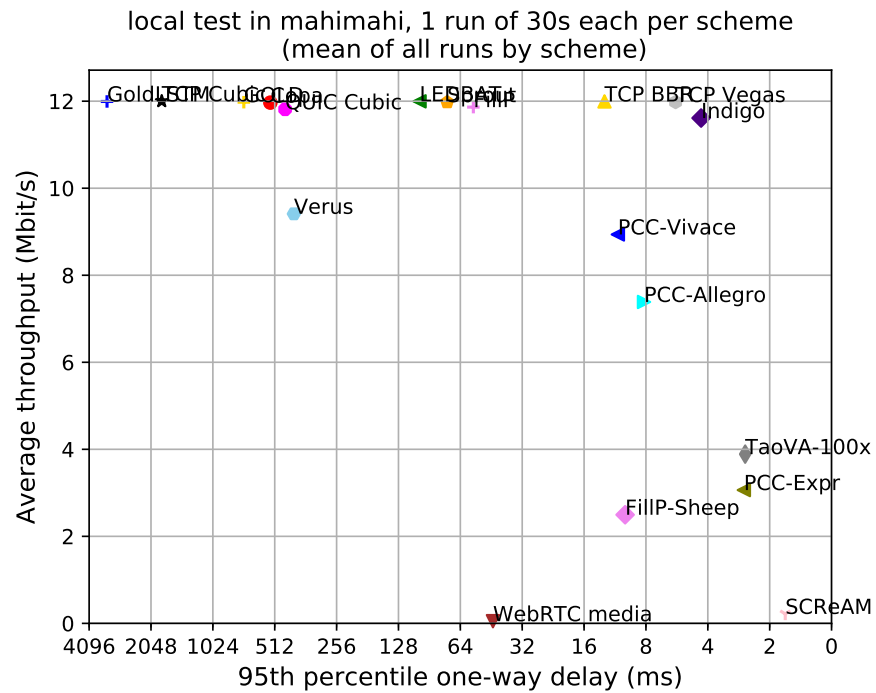Each test lasted for 30 seconds running 1 flow.

```
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 @ 2249379c364e838b4bd11873d0da199b174b7458
third_party/fillp @ d6da1459332fcee56963885d7eba17e6a32d4519
third_party/fillp-sheep @ 0e5bb722943babcd2b090d2c64fcd45e12e923f9
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/gold @ b6948a72b216f2705f13bf3b588bc5ab5ff8ff9a
 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__/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__/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/run_receiver.py
third_party/goldLSTM @ 990886762be451b8f9c117e3eaa22d42692d7abb
 M sender-receiver/sender_receiver/envs/sender_receiver_env.py
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)

local test in mahimahi, 1 run of 30s each per scheme

3

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	12.73	0.04
Copa	1	11.97	537.72	1.75
TCP Cubic	1	12.00	1815.66	5.48
FillP	1	11.86	55.31	0.20
FillP-Sheep	1	2.50	10.10	0.02
GOLD	1	11.98	723.91	2.38
GoldLSTM	1	11.99	3351.25	18.27
Indigo	1	11.61	4.31	0.00
LEDBAT	1	12.00	101.14	0.33
PCC-Allegro	1	7.39	8.18	0.01
PCC-Expr	1	3.06	2.67	0.01
QUIC Cubic	1	11.81	455.74	1.58
SCReAM	1	0.22	1.50	0.00
Sprout	1	11.98	74.17	0.21
TaoVA-100x	1	3.89	2.63	0.00
TCP Vegas	1	11.98	5.74	0.01
Verus	1	9.41	413.06	0.00
PCC-Vivace	1	8.94	10.96	0.00
WebRTC media	1	0.05	44.41	0.00

```
Run 1: Statistics of TCP BBR

Start at: 2019-06-28 05:16:25
End at: 2019-06-28 05:16:55

# Below is generated by plot.py at 2019-06-28 05:23:03
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.99 Mbit/s (100.0% utilization)
95th percentile per-packet one-way delay: 12.727 ms
Loss rate: 0.04%
-- Flow 1:
Average throughput: 11.99 Mbit/s
95th percentile per-packet one-way delay: 12.727 ms
Loss rate: 0.04%
```
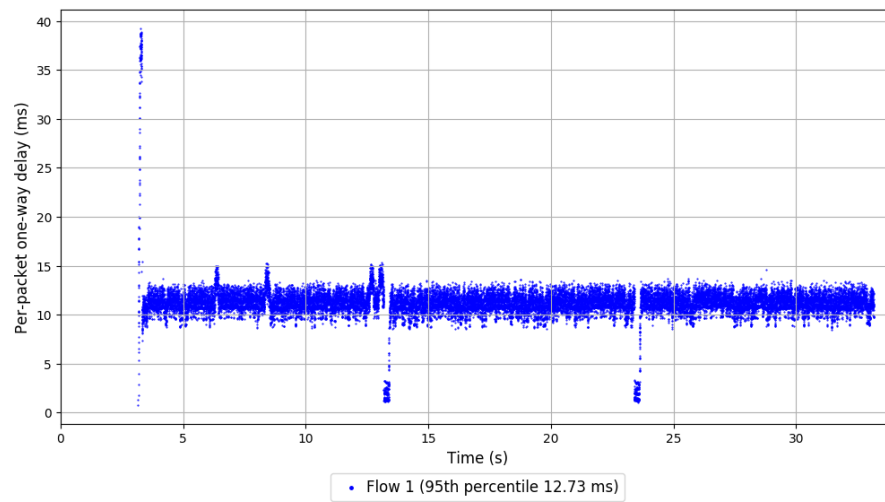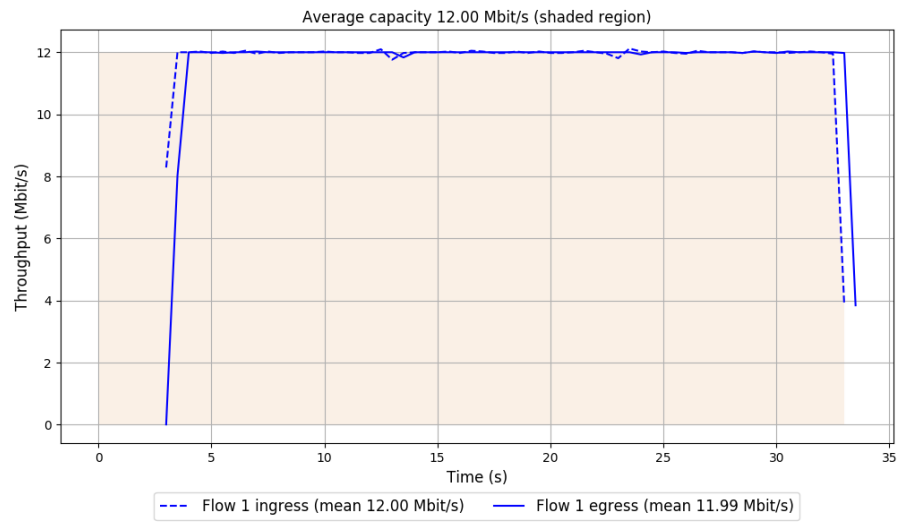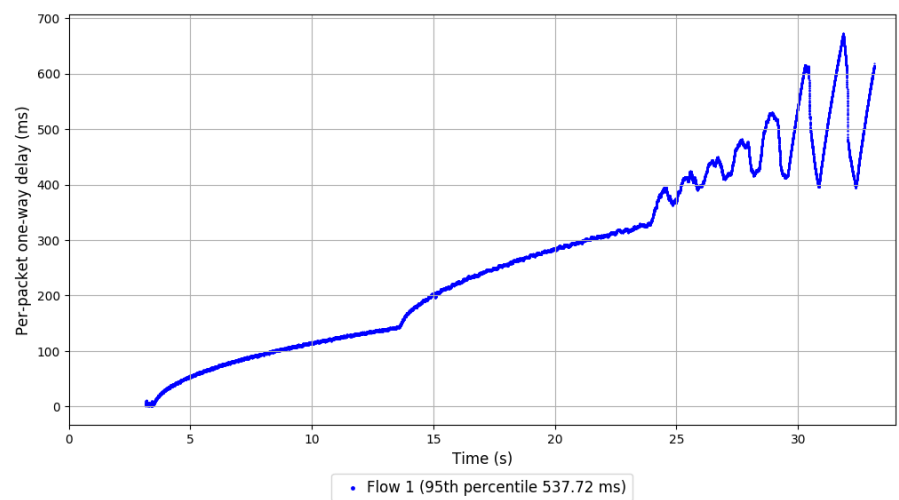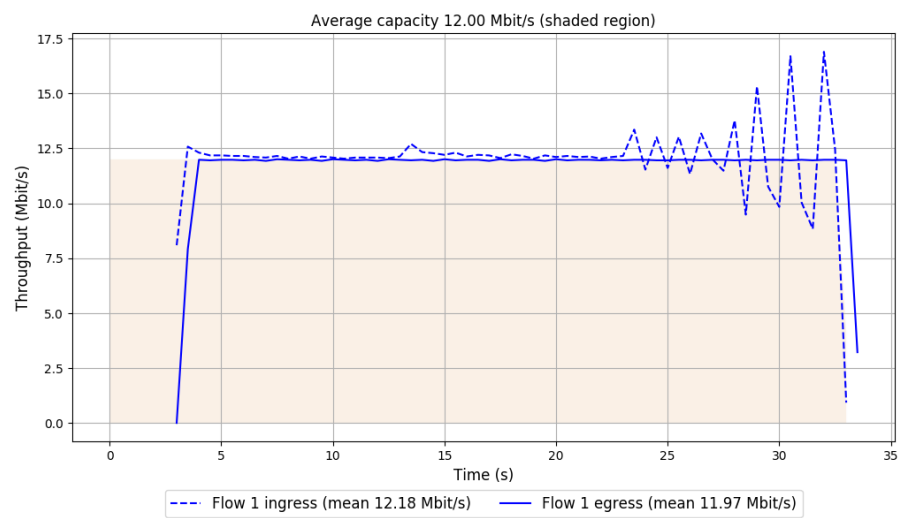
Run 1: Report of TCP BBR — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 12.00 Mbit/s) — — —   Flow 1 egress (mean 11.99 Mbit/s) ———

• Flow 1 (95th percentile 12.73 ms)

6

```
Run 1: Statistics of Copa

Start at: 2019-06-28 05:11:50
End at: 2019-06-28 05:12:20

# Below is generated by plot.py at 2019-06-28 05:23:10
# 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: 537.724 ms
Loss rate: 1.75%
-- Flow 1:
Average throughput: 11.97 Mbit/s
95th percentile per-packet one-way delay: 537.724 ms
Loss rate: 1.75%
```
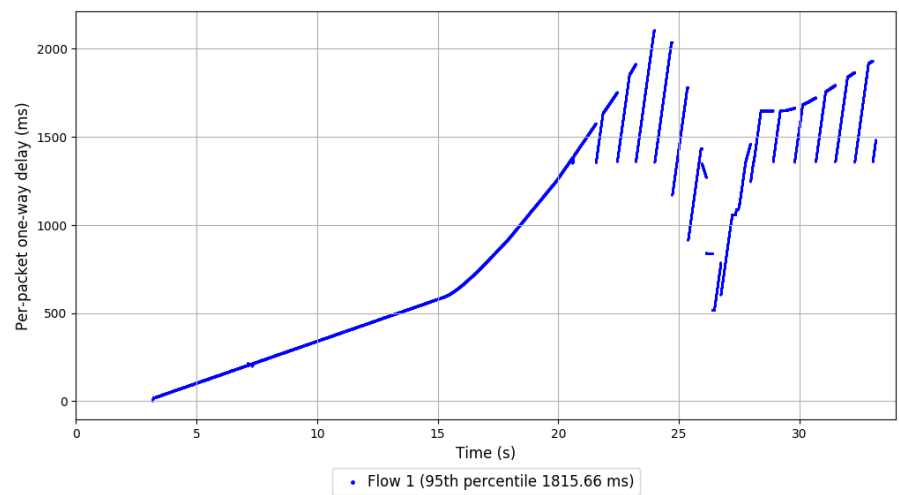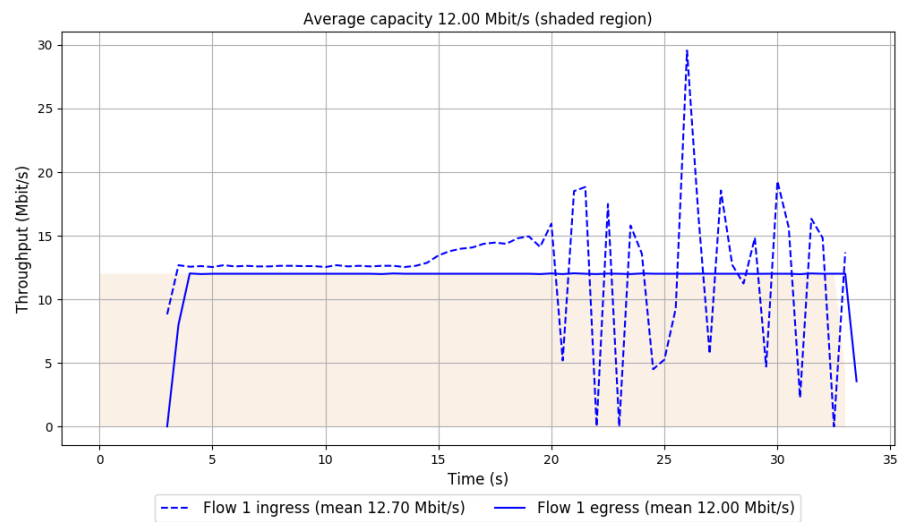
Run 1: Report of Copa — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 12.18 Mbit/s) —— Flow 1 egress (mean 11.97 Mbit/s)

Flow 1 (95th percentile 537.72 ms)

```
Run 1: Statistics of TCP Cubic

Start at: 2019-06-28 05:14:08
End at: 2019-06-28 05:14:38

# Below is generated by plot.py at 2019-06-28 05:23:10
# 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: 1815.656 ms
Loss rate: 5.48%
-- Flow 1:
Average throughput: 12.00 Mbit/s
95th percentile per-packet one-way delay: 1815.656 ms
Loss rate: 5.48%
```

Run 1: Report of TCP Cubic — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 12.70 Mbit/s) — Flow 1 egress (mean 12.00 Mbit/s)
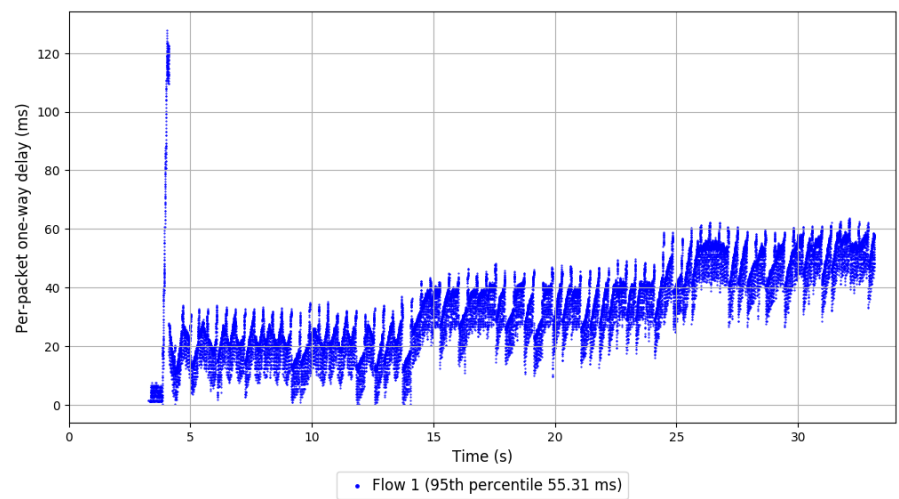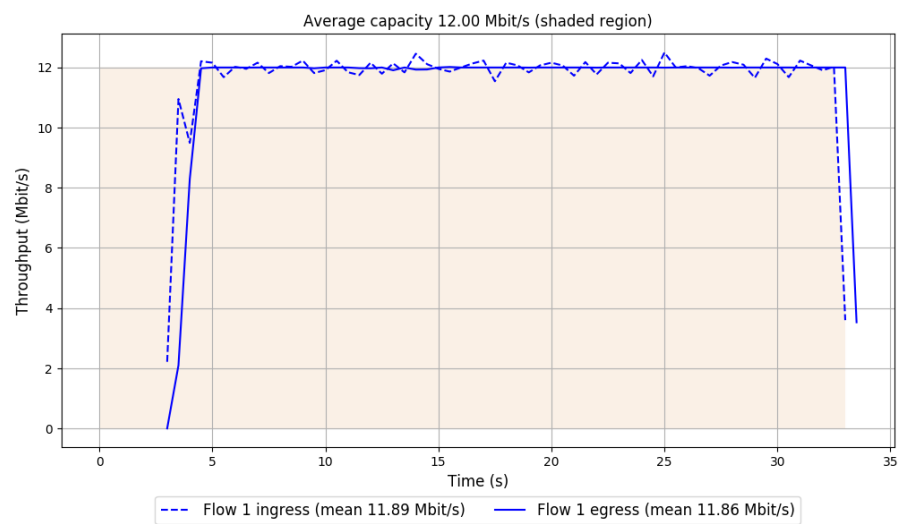

Flow 1 (95th percentile 1815.66 ms)

```
Run 1: Statistics of FillP

Start at: 2019-06-28 05:18:09
End at: 2019-06-28 05:18:39

# Below is generated by plot.py at 2019-06-28 05:23:10
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.86 Mbit/s (98.9% utilization)
95th percentile per-packet one-way delay: 55.314 ms
Loss rate: 0.20%
-- Flow 1:
Average throughput: 11.86 Mbit/s
95th percentile per-packet one-way delay: 55.314 ms
Loss rate: 0.20%
```
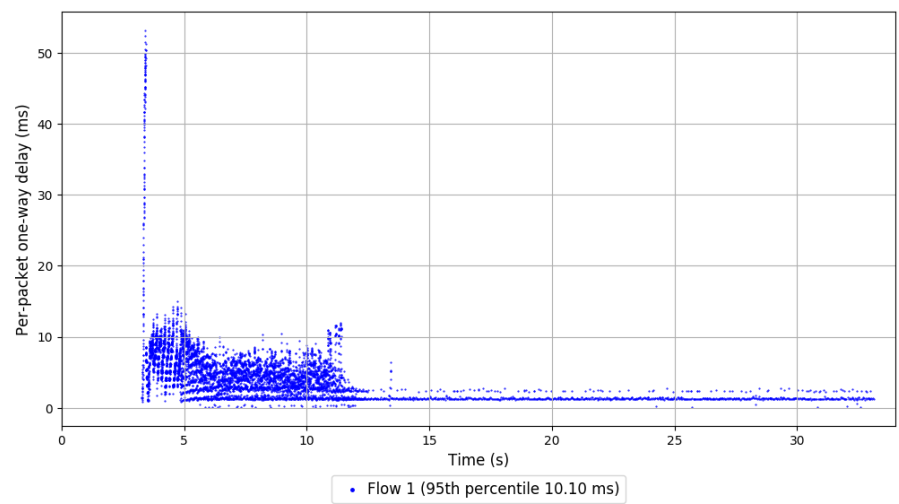
Run 1: Report of FillP — Data Link

Average capacity 12.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 11.89 Mbit/s) —— Flow 1 egress (mean 11.86 Mbit/s)

• Flow 1 (95th percentile 55.31 ms)

```
Run 1: Statistics of FillP-Sheep

Start at: 2019-06-28 05:11:16
End at: 2019-06-28 05:11:46

# Below is generated by plot.py at 2019-06-28 05:23:10
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 2.50 Mbit/s (20.8% utilization)
95th percentile per-packet one-way delay: 10.103 ms
Loss rate: 0.02%
-- Flow 1:
Average throughput: 2.50 Mbit/s
95th percentile per-packet one-way delay: 10.103 ms
Loss rate: 0.02%
```
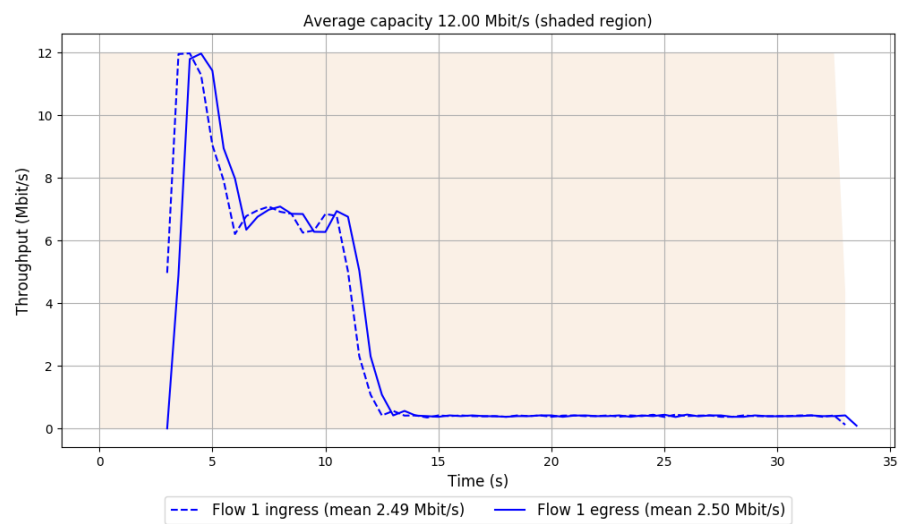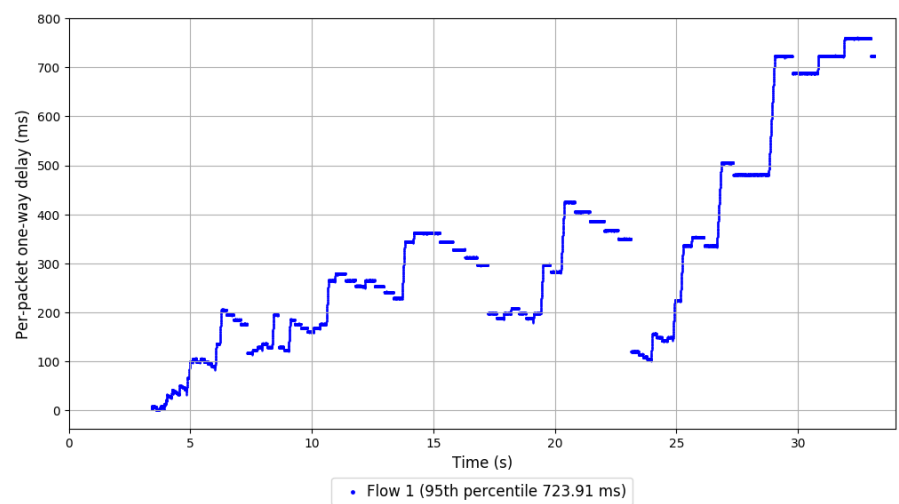
Run 1: Report of FillP-Sheep — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 2.49 Mbit/s)   Flow 1 egress (mean 2.50 Mbit/s)

Flow 1 (95th percentile 10.10 ms)

14

```
Run 1: Statistics of GOLD

Start at: 2019-06-28 05:13:33
End at: 2019-06-28 05:14:03

# Below is generated by plot.py at 2019-06-28 05:23:13
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.98 Mbit/s (99.8% utilization)
95th percentile per-packet one-way delay: 723.913 ms
Loss rate: 2.38%
-- Flow 1:
Average throughput: 11.98 Mbit/s
95th percentile per-packet one-way delay: 723.913 ms
Loss rate: 2.38%
```
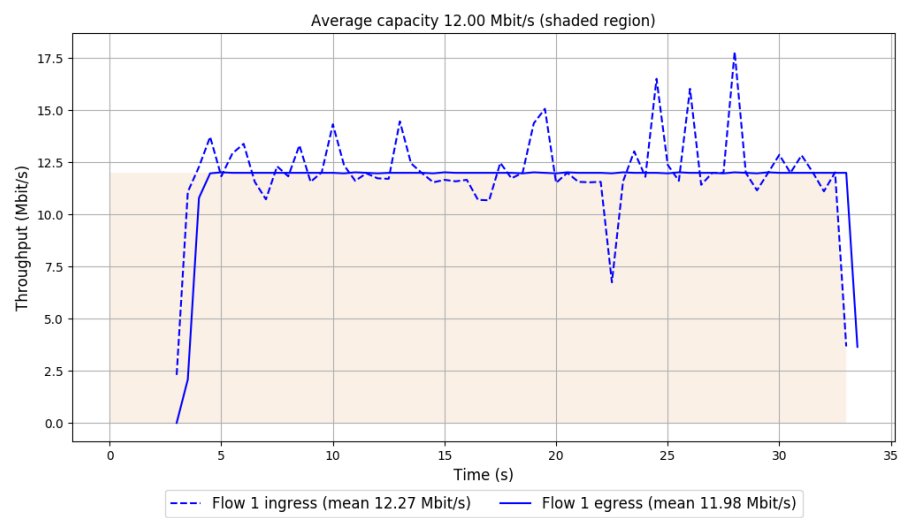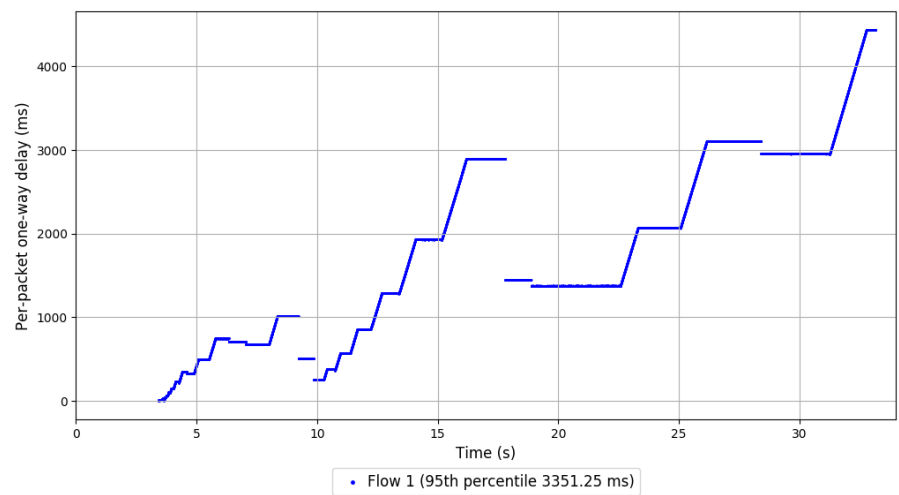
Run 1: Report of GOLD — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 12.27 Mbit/s) Flow 1 egress (mean 11.98 Mbit/s)

Flow 1 (95th percentile 723.91 ms)

16

```
Run 1: Statistics of GoldLSTM

Start at: 2019-06-28 05:17:00
End at: 2019-06-28 05:17:30

# Below is generated by plot.py at 2019-06-28 05:23:14
# 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: 3351.249 ms
Loss rate: 18.27%
-- Flow 1:
Average throughput: 11.99 Mbit/s
95th percentile per-packet one-way delay: 3351.249 ms
Loss rate: 18.27%
```
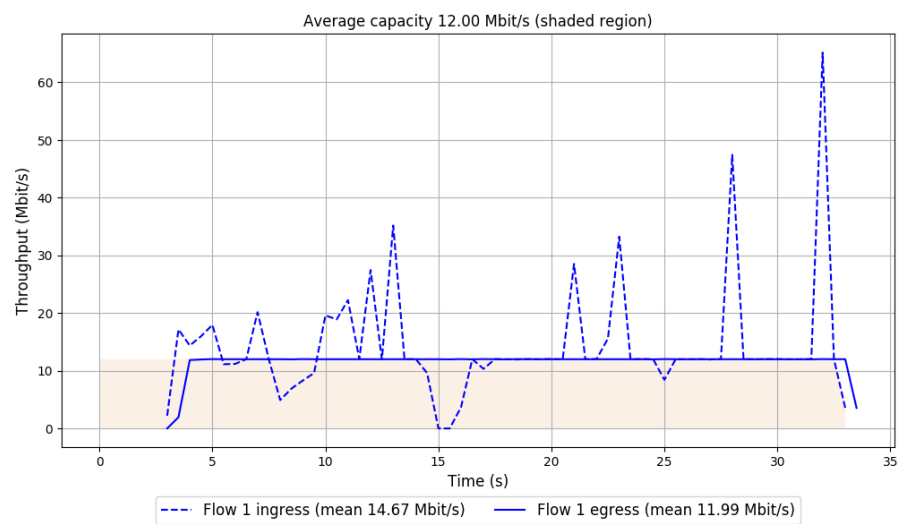
Run 1: Report of GoldLSTM — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 14.67 Mbit/s)   Flow 1 egress (mean 11.99 Mbit/s)
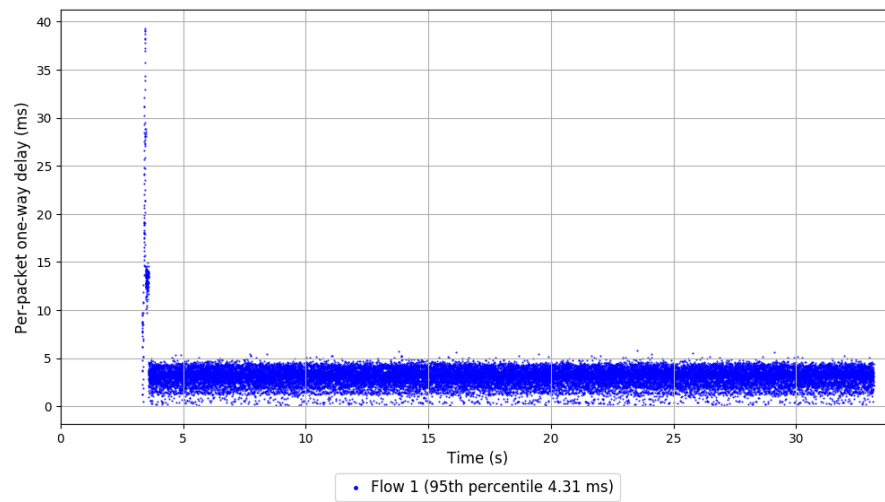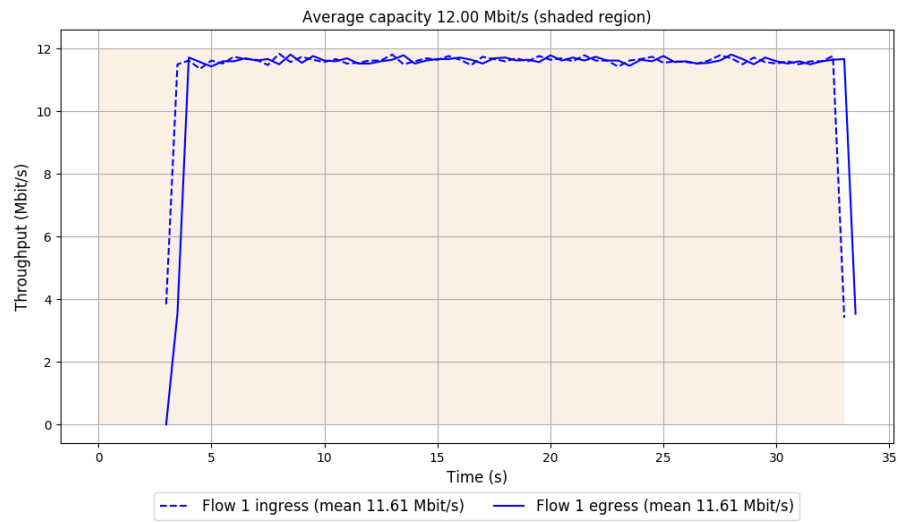

Flow 1 (95th percentile 3351.25 ms)

```
Run 1: Statistics of Indigo

Start at: 2019-06-28 05:12:24
End at: 2019-06-28 05:12:54

# Below is generated by plot.py at 2019-06-28 05:23:16
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.61 Mbit/s (96.8% utilization)
95th percentile per-packet one-way delay: 4.313 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 11.61 Mbit/s
95th percentile per-packet one-way delay: 4.313 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

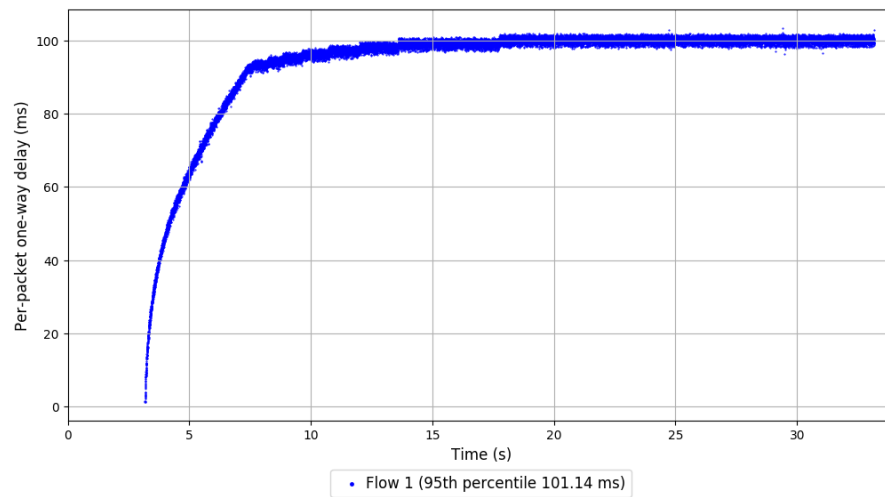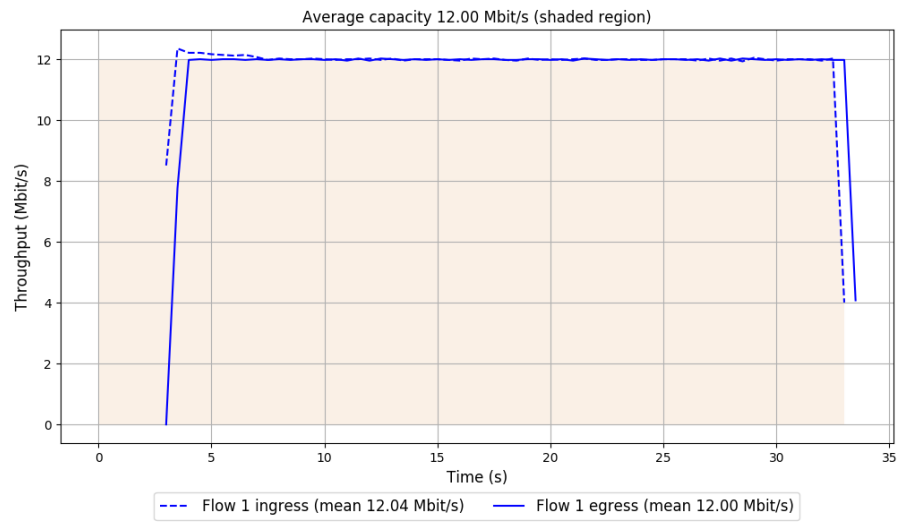Average capacity 12.00 Mbit/s (shaded region)

```
Run 1: Statistics of LEDBAT

Start at: 2019-06-28 05:20:59
End at: 2019-06-28 05:21:29

# Below is generated by plot.py at 2019-06-28 05:23:19
# 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: 101.145 ms
Loss rate: 0.33%
-- Flow 1:
Average throughput: 12.00 Mbit/s
95th percentile per-packet one-way delay: 101.145 ms
Loss rate: 0.33%
```

Run 1: Report of LEDBAT — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 12.04 Mbit/s)   Flow 1 egress (mean 12.00 Mbit/s)
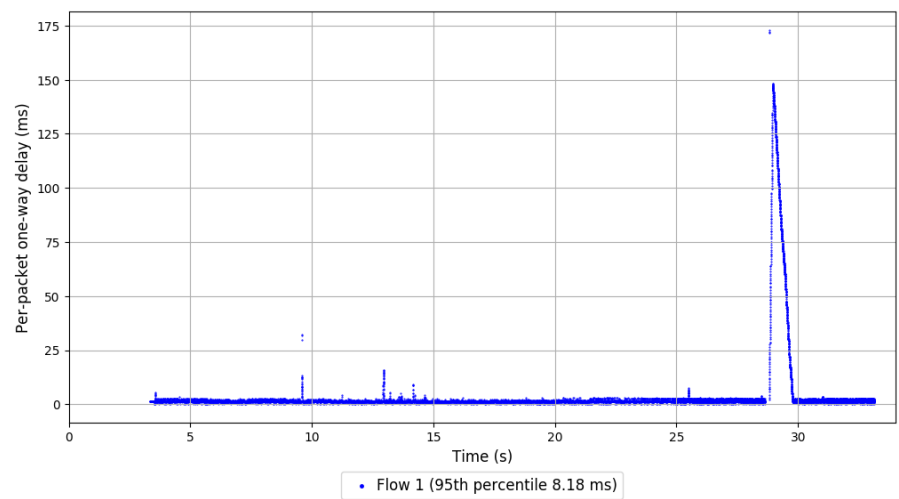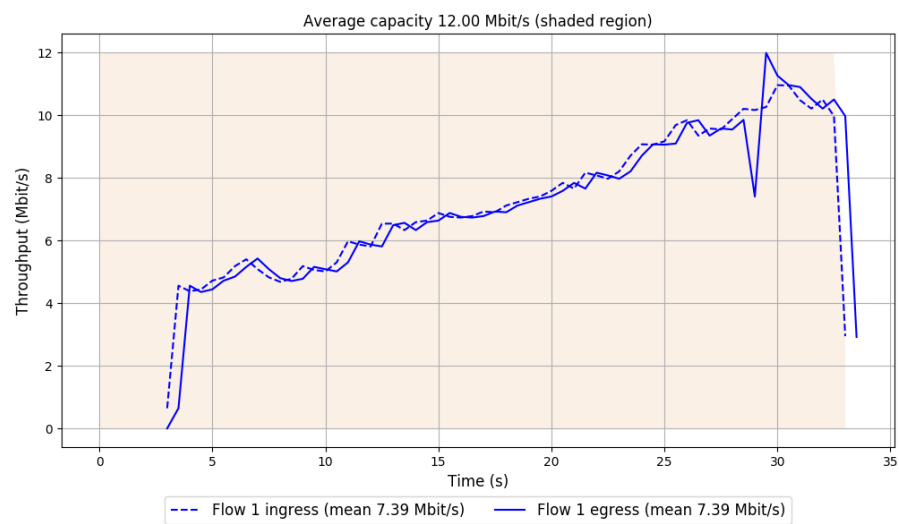

Flow 1 (95th percentile 101.14 ms)

```
Run 1: Statistics of PCC-Allegro

Start at: 2019-06-28 05:19:51
End at: 2019-06-28 05:20:21

# Below is generated by plot.py at 2019-06-28 05:23:20
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 7.39 Mbit/s (61.5% utilization)
95th percentile per-packet one-way delay: 8.175 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 7.39 Mbit/s
95th percentile per-packet one-way delay: 8.175 ms
Loss rate: 0.01%
```

Run 1: Report of PCC-Allegro — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 7.39 Mbit/s) —— Flow 1 egress (mean 7.39 Mbit/s)
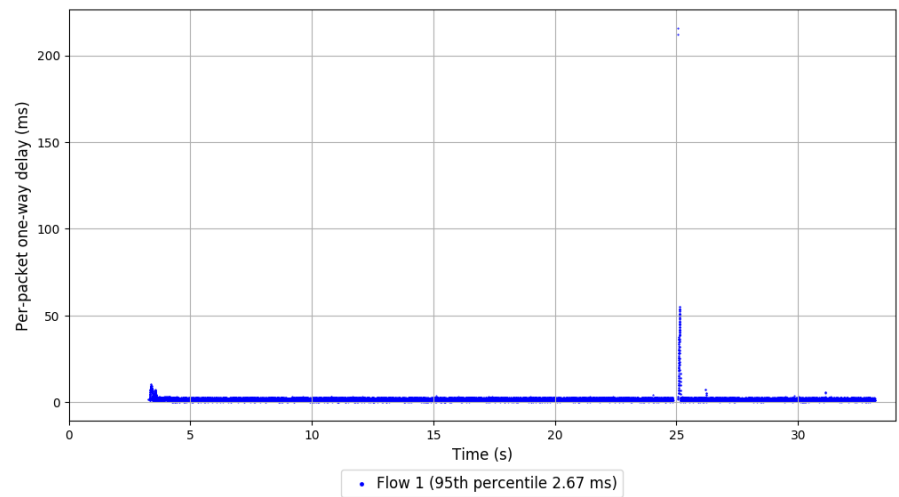

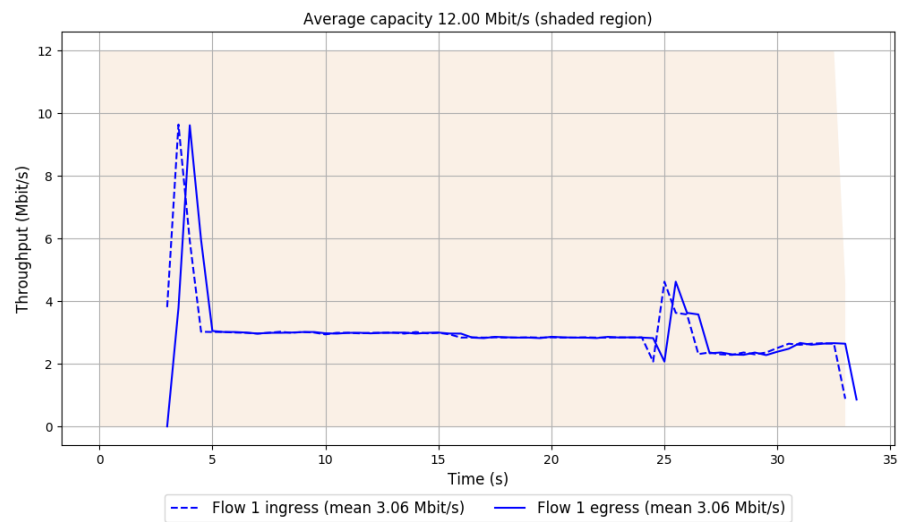• Flow 1 (95th percentile 8.18 ms)

```
Run 1: Statistics of PCC-Expr

Start at: 2019-06-28 05:21:34
End at: 2019-06-28 05:22:04

# Below is generated by plot.py at 2019-06-28 05:23:21
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 3.06 Mbit/s (25.5% utilization)
95th percentile per-packet one-way delay: 2.672 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 3.06 Mbit/s
95th percentile per-packet one-way delay: 2.672 ms
Loss rate: 0.01%
```

Run 1: Report of PCC-Expr — Data Link

Average capacity 12.00 Mbit/s (shaded region)

```
Run 1: Statistics of QUIC Cubic

Start at: 2019-06-28 05:19:17
End at: 2019-06-28 05:19:47

# Below is generated by plot.py at 2019-06-28 05:23:27
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.81 Mbit/s (98.4% utilization)
95th percentile per-packet one-way delay: 455.743 ms
Loss rate: 1.58%
-- Flow 1:
Average throughput: 11.81 Mbit/s
95th percentile per-packet one-way delay: 455.743 ms
Loss rate: 1.58%
```
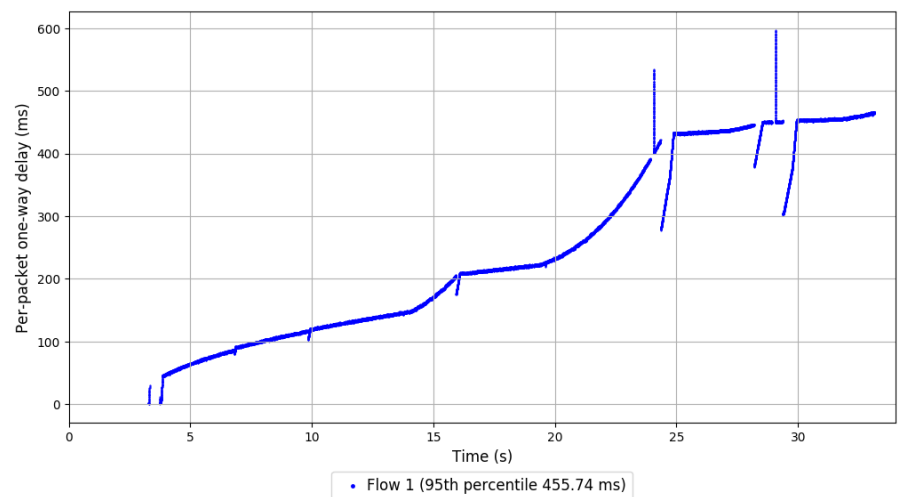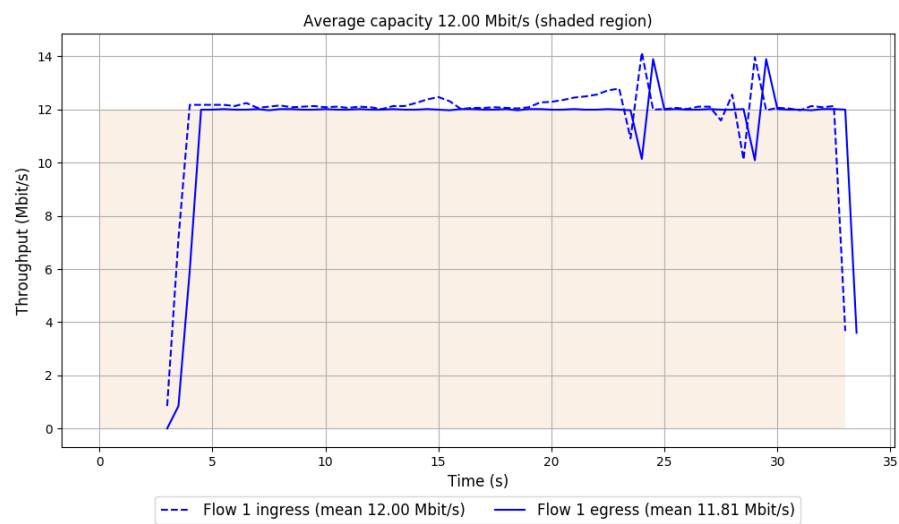
Run 1: Report of QUIC Cubic — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 12.00 Mbit/s)   Flow 1 egress (mean 11.81 Mbit/s)

Flow 1 (95th percentile 455.74 ms)

```
Run 1: Statistics of SCReAM

Start at: 2019-06-28 05:18:43
End at: 2019-06-28 05:19:13

# Below is generated by plot.py at 2019-06-28 05:23:27
# 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: 1.497 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 1.497 ms
Loss rate: 0.00%
```
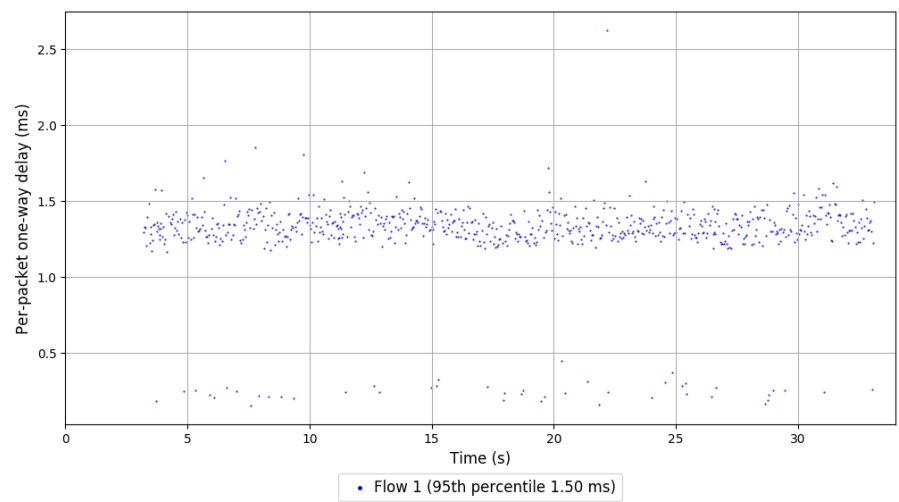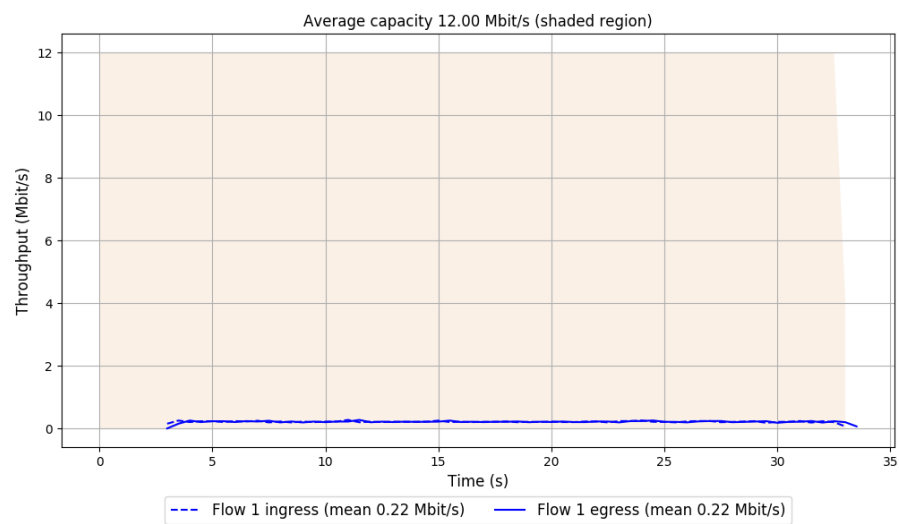
Run 1: Report of SCReAM — Data Link

Average capacity 12.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 0.22 Mbit/s) —— Flow 1 egress (mean 0.22 Mbit/s)

· Flow 1 (95th percentile 1.50 ms)

```
Run 1: Statistics of Sprout

Start at: 2019-06-28 05:14:42
End at: 2019-06-28 05:15:12

# Below is generated by plot.py at 2019-06-28 05:23:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.98 Mbit/s (99.8% utilization)
95th percentile per-packet one-way delay: 74.173 ms
Loss rate: 0.21%
-- Flow 1:
Average throughput: 11.98 Mbit/s
95th percentile per-packet one-way delay: 74.173 ms
Loss rate: 0.21%
```
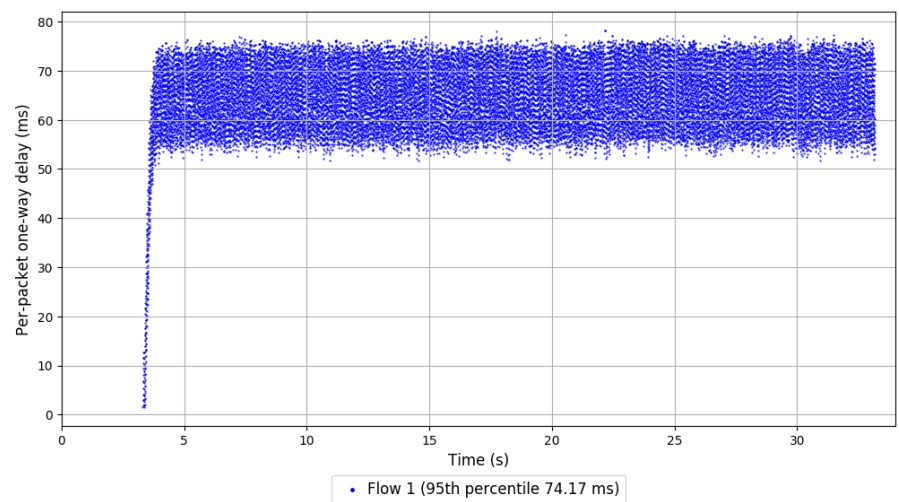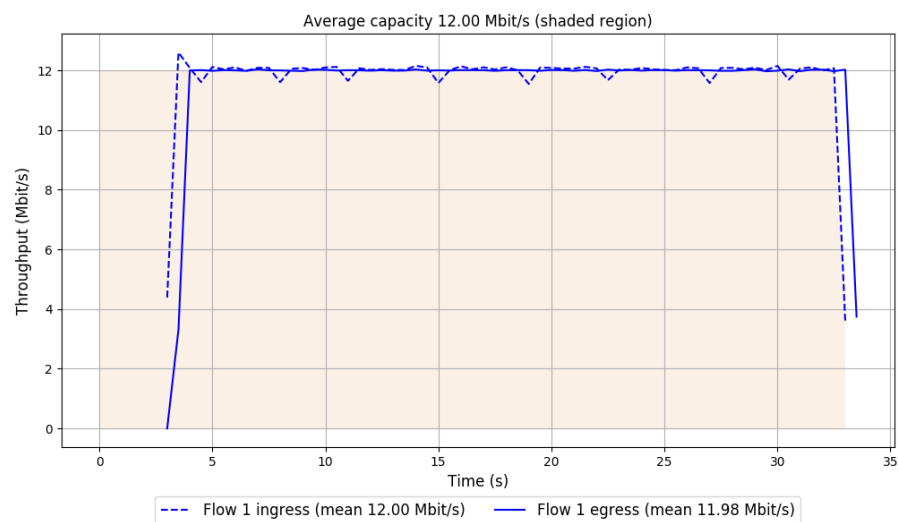
Run 1: Report of Sprout — Data Link

Average capacity 12.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 12.00 Mbit/s) ——— Flow 1 egress (mean 11.98 Mbit/s)

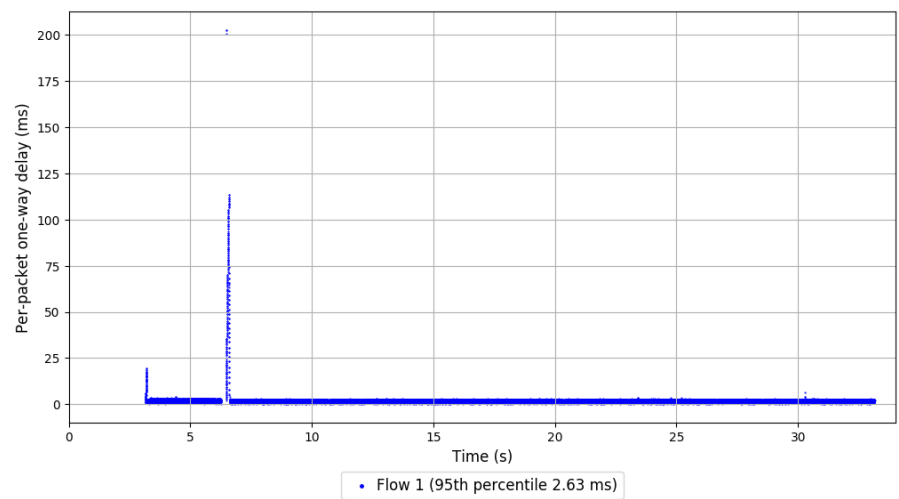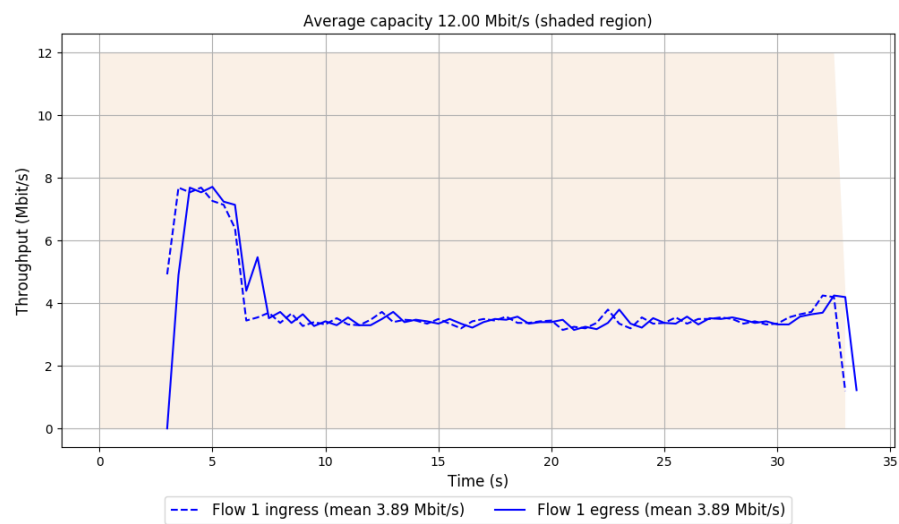• Flow 1 (95th percentile 74.17 ms)

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

Start at: 2019-06-28 05:17:34
End at: 2019-06-28 05:18:04

# Below is generated by plot.py at 2019-06-28 05:23:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 3.89 Mbit/s (32.4% utilization)
95th percentile per-packet one-way delay: 2.632 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 3.89 Mbit/s
95th percentile per-packet one-way delay: 2.632 ms
Loss rate: 0.00%
```

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

Average capacity 12.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 3.89 Mbit/s) —— Flow 1 egress (mean 3.89 Mbit/s)

• Flow 1 (95th percentile 2.63 ms)

34

```
Run 1: Statistics of TCP Vegas

Start at: 2019-06-28 05:15:51
End at: 2019-06-28 05:16:21

# Below is generated by plot.py at 2019-06-28 05:23:30
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 11.98 Mbit/s (99.8% utilization)
95th percentile per-packet one-way delay: 5.739 ms
Loss rate: 0.01%
-- Flow 1:
Average throughput: 11.98 Mbit/s
95th percentile per-packet one-way delay: 5.739 ms
Loss rate: 0.01%
```
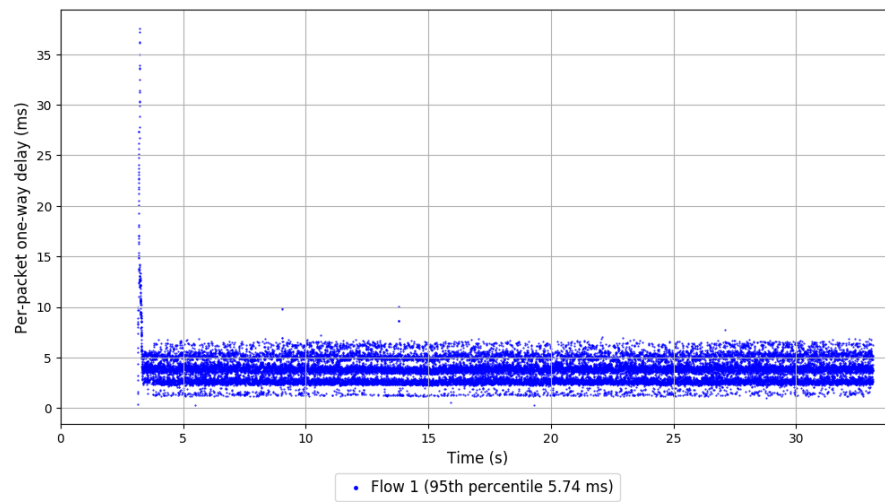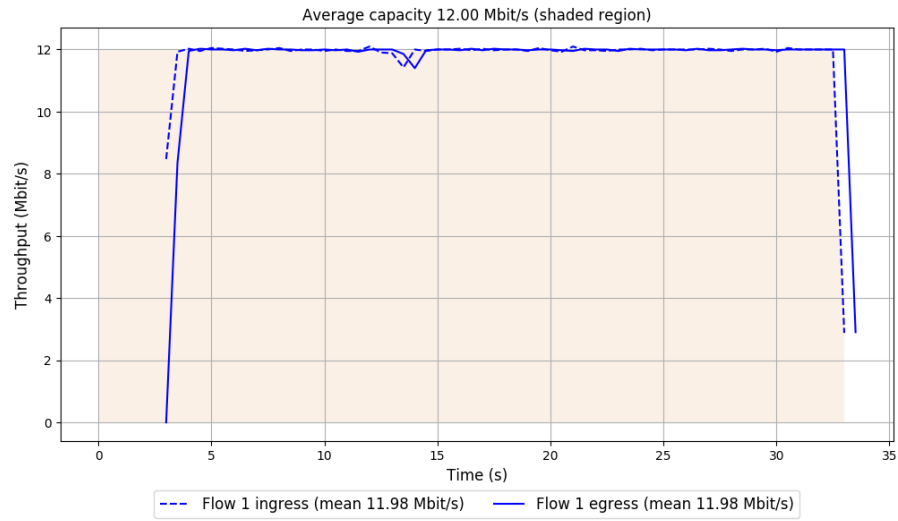
Run 1: Report of TCP Vegas — Data Link

```
Run 1: Statistics of Verus

Start at: 2019-06-28 05:12:59
End at: 2019-06-28 05:13:29

# Below is generated by plot.py at 2019-06-28 05:23:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 9.41 Mbit/s (78.4% utilization)
95th percentile per-packet one-way delay: 413.064 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 9.41 Mbit/s
95th percentile per-packet one-way delay: 413.064 ms
Loss rate: 0.00%
```
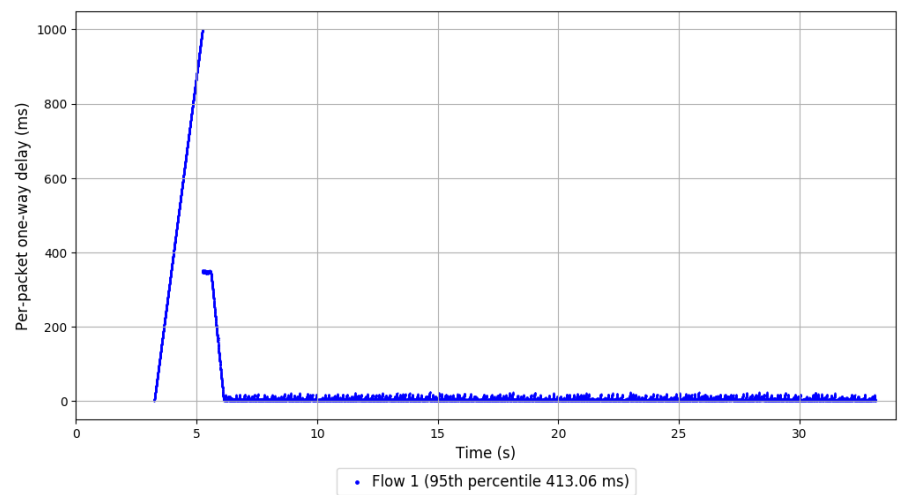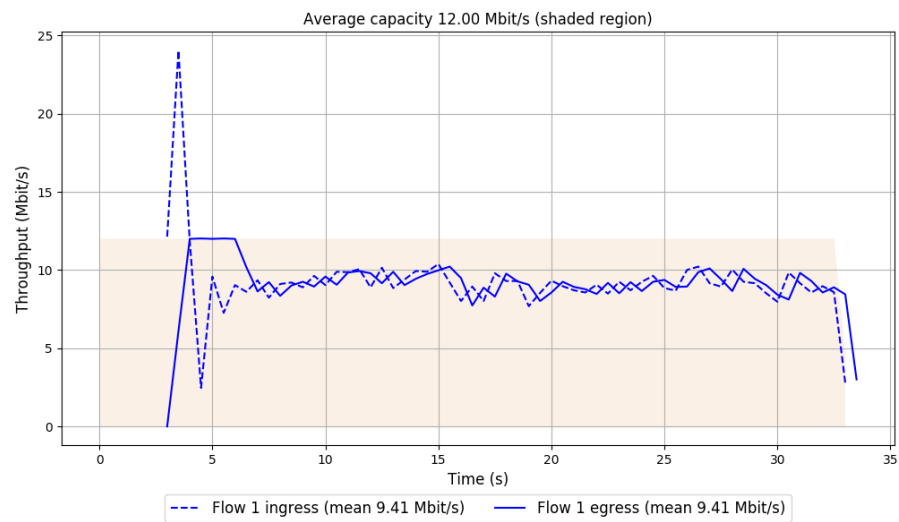
Run 1: Report of Verus — Data Link

Average capacity 12.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 9.41 Mbit/s) —— Flow 1 egress (mean 9.41 Mbit/s)

• Flow 1 (95th percentile 413.06 ms)

```
Run 1: Statistics of PCC-Vivace

Start at: 2019-06-28 05:15:17
End at: 2019-06-28 05:15:47

# Below is generated by plot.py at 2019-06-28 05:23:33
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 8.94 Mbit/s (74.5% utilization)
95th percentile per-packet one-way delay: 10.962 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 8.94 Mbit/s
95th percentile per-packet one-way delay: 10.962 ms
Loss rate: 0.00%
```
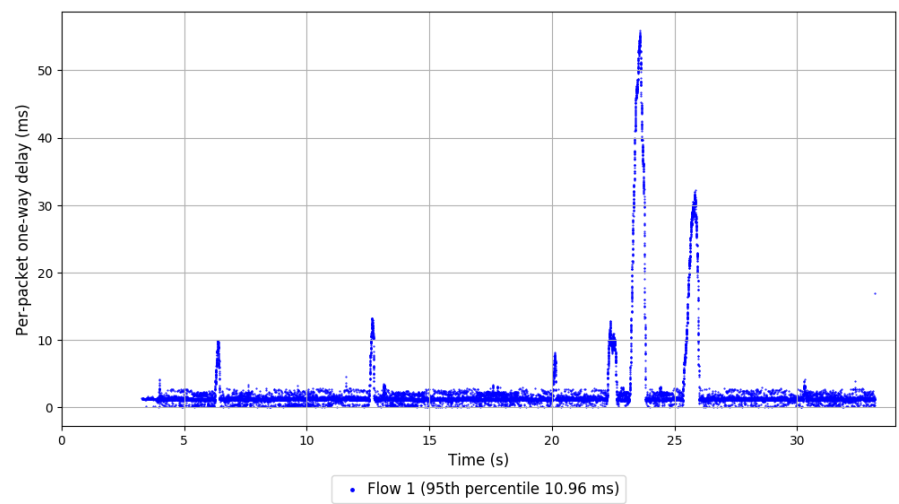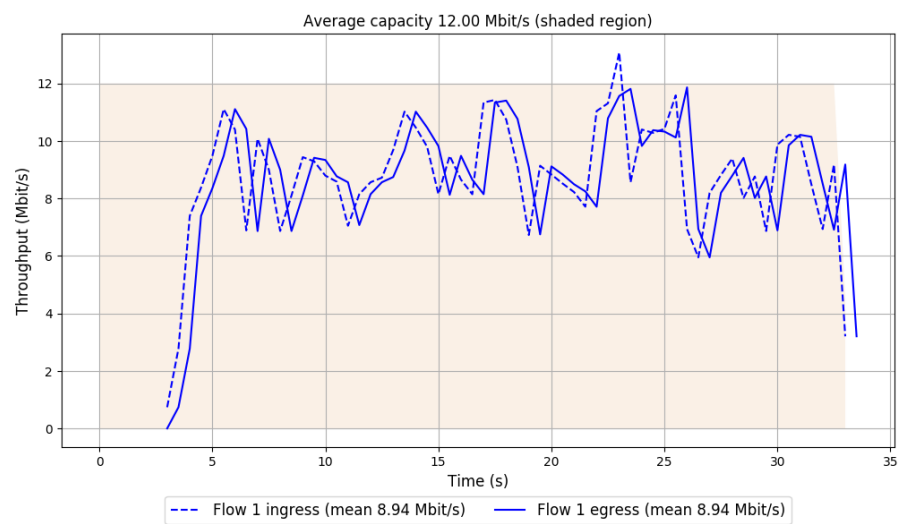
Run 1: Report of PCC-Vivace — Data Link

Average capacity 12.00 Mbit/s (shaded region)

Flow 1 ingress (mean 8.94 Mbit/s) ----   Flow 1 egress (mean 8.94 Mbit/s) ——

• Flow 1 (95th percentile 10.96 ms)

```
Run 1: Statistics of WebRTC media

Start at: 2019-06-28 05:20:25
End at: 2019-06-28 05:20:55

# Below is generated by plot.py at 2019-06-28 05:23:33
# Datalink statistics
-- Total of 1 flow:
Average capacity: 12.00 Mbit/s
Average throughput: 0.05 Mbit/s (0.4% utilization)
95th percentile per-packet one-way delay: 44.415 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.05 Mbit/s
95th percentile per-packet one-way delay: 44.415 ms
Loss rate: 0.00%
```

Run 1: Report of WebRTC media — Data Link

Average capacity 12.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 0.05 Mbit/s) —— Flow 1 egress (mean 0.05 Mbit/s)

• Flow 1 (95th percentile 44.41 ms)