Pantheon Report

Generated at 2019-07-31 14:25:44 (UTC).
Tested in mahimahi: `mm-delay 20 mm-link ATT-LTE-driving-2016.up ATT-LTE-driving-2016.down`
Repeated the test of 21 congestion control schemes once.
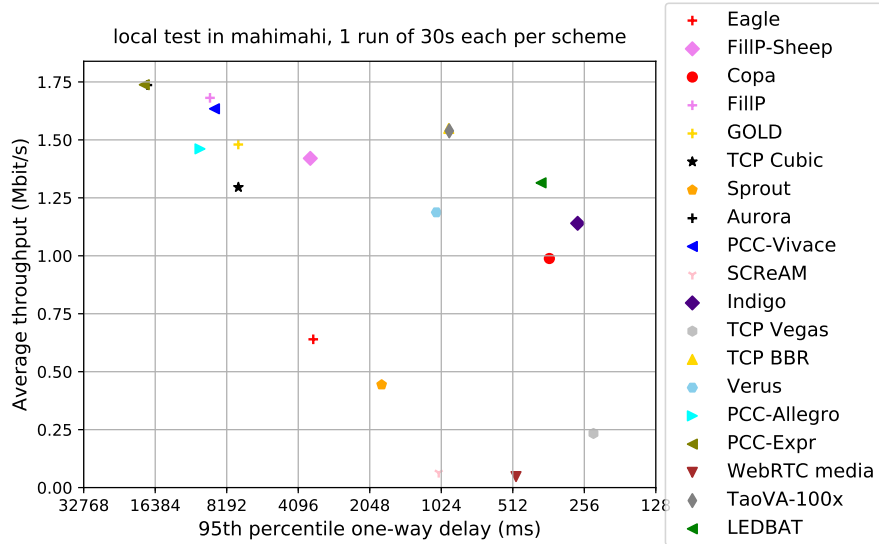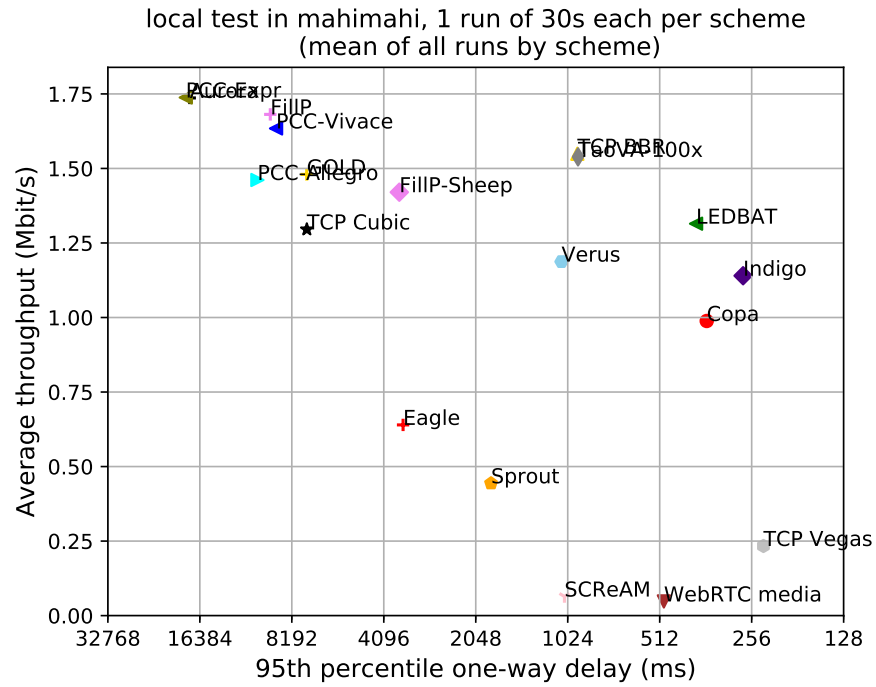Each test lasted for 30 seconds running 1 flow.

```
System info:
Linux 4.15.0-54-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 @ 584d967c80a6c52326a3bb76ea1631b1cd476325
third_party/aurora @ f3e943d61015b39960854ba6391797e0c7984d74
third_party/aurora-model @ e292c316c23fb837255c4e142e40590d154bbe95
third_party/eagle @ f66d3a824f0abdd3b1d0afc0cc323607b2c38eca
 M sender-receiver/sender-receiver/sender_receiver/envs/example-xentropy.py
 D sender-receiver/sender-receiver/sender_receiver/envs/model-xentropy.pt
third_party/fillp @ d6da1459332fcee56963885d7eba17e6a32d4519
third_party/fillp-sheep @ 0e5bb722943babcd2b090d2c64fcd45e12e923f9
third_party/genericCC @ d0153f8e594aa89e93b032143cedbdfe58e562f4
third_party/gold @ e47bed6d7495aa223eec8de2c7a43035967074ef
 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/logs.txt
 M model
third_party/goldLSTM @ 6b512ee75b163fd680d7bf3cde4cf6d6aa7102c4
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

scheme	# runs	mean avg tput (Mbit/s) flow 1	mean 95th-%ile delay (ms) flow 1	mean loss rate (%) flow 1
Aurora	1	1.74	17679.46	68.81
TCP BBR	1	1.55	952.27	0.91
Copa	1	0.99	359.22	0.36
TCP Cubic	1	1.30	7315.68	13.91
Eagle	1	0.64	3541.77	0.07
FillP	1	1.68	9634.62	8.78
FillP-Sheep	1	1.42	3643.82	0.06
GOLD	1	1.48	7322.73	10.33
GoldLSTM	0	N/A	N/A	N/A
Indigo	1	1.14	273.08	0.08
LEDBAT	1	1.31	389.29	0.60
PCC-Allegro	1	1.46	10615.57	38.42
PCC-Expr	1	1.74	18220.21	70.11
QUIC Cubic	0	N/A	N/A	N/A
SCReAM	1	0.06	1049.68	0.17
Sprout	1	0.44	1825.21	0.18
TaoVA-100x	1	1.54	947.49	0.98
TCP Vegas	1	0.23	234.25	0.00
Verus	1	1.19	1073.58	1.51
PCC-Vivace	1	1.63	9226.26	30.49
WebRTC media	1	0.05	496.19	0.00

```
Run 1: Statistics of Aurora

Start at: 2019-07-31 14:17:24
End at: 2019-07-31 14:17:54

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.74 Mbit/s (77.9% utilization)
95th percentile per-packet one-way delay: 17679.459 ms
Loss rate: 68.81%
-- Flow 1:
Average throughput: 1.74 Mbit/s
95th percentile per-packet one-way delay: 17679.459 ms
Loss rate: 68.81%
```
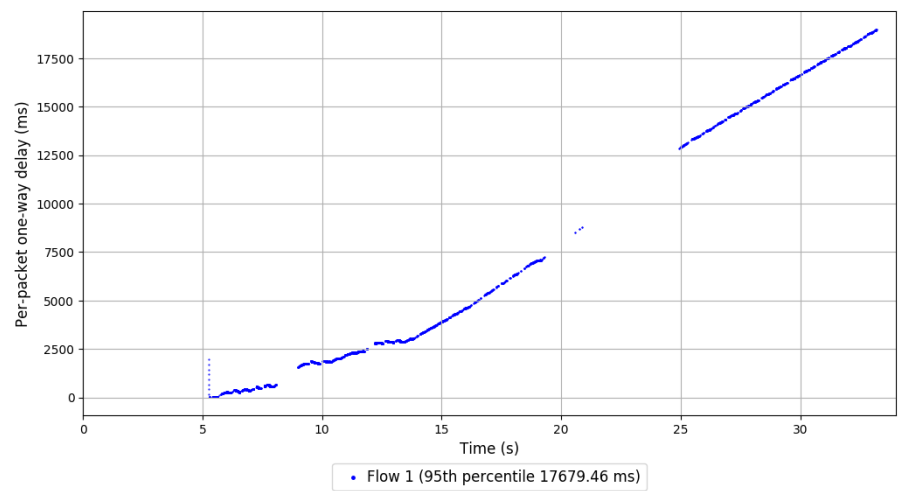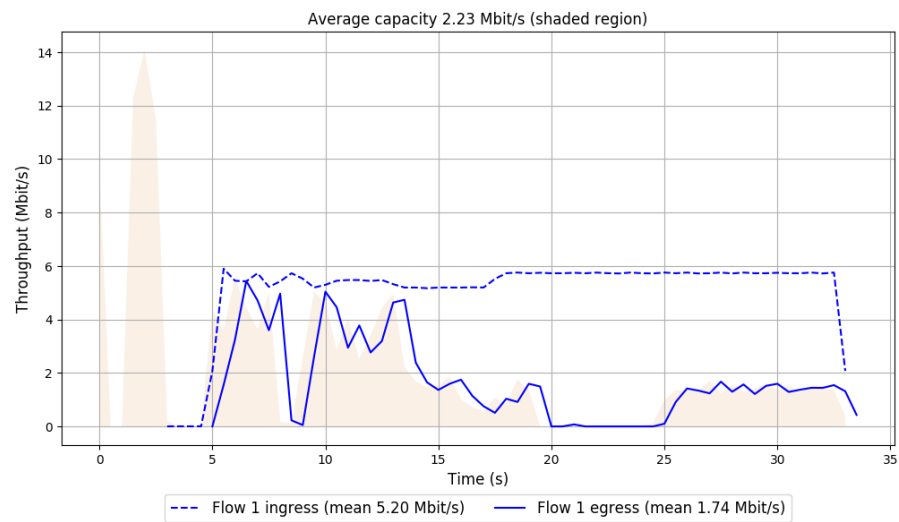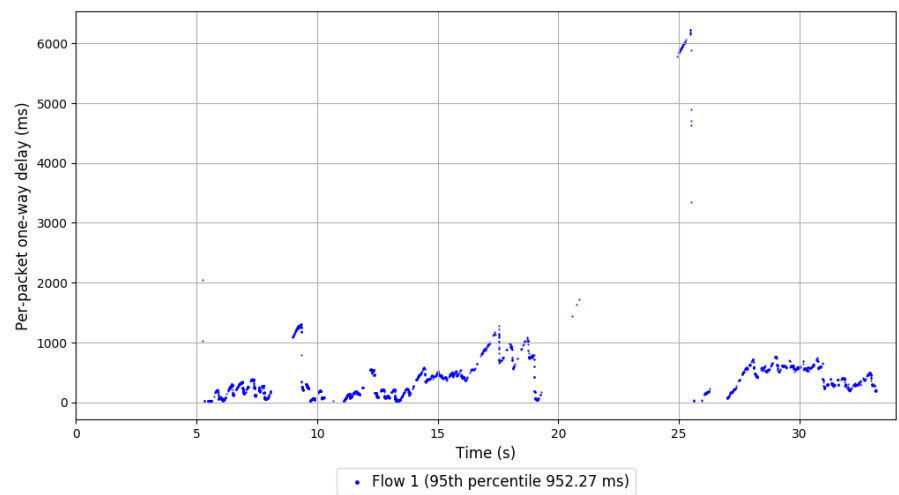
Run 1: Report of Aurora — Data Link

Average capacity 2.23 Mbit/s (shaded region)

Flow 1 ingress (mean 5.20 Mbit/s) — — — — Flow 1 egress (mean 1.74 Mbit/s)

• Flow 1 (95th percentile 17679.46 ms)

```
Run 1: Statistics of TCP BBR

Start at: 2019-07-31 14:19:06
End at: 2019-07-31 14:19:36

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.55 Mbit/s (69.5% utilization)
95th percentile per-packet one-way delay: 952.273 ms
Loss rate: 0.91%
-- Flow 1:
Average throughput: 1.55 Mbit/s
95th percentile per-packet one-way delay: 952.273 ms
Loss rate: 0.91%
```
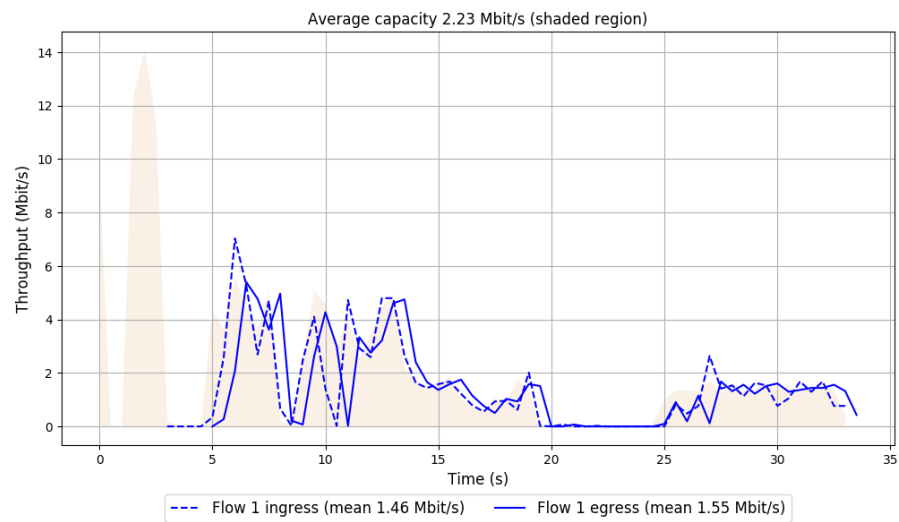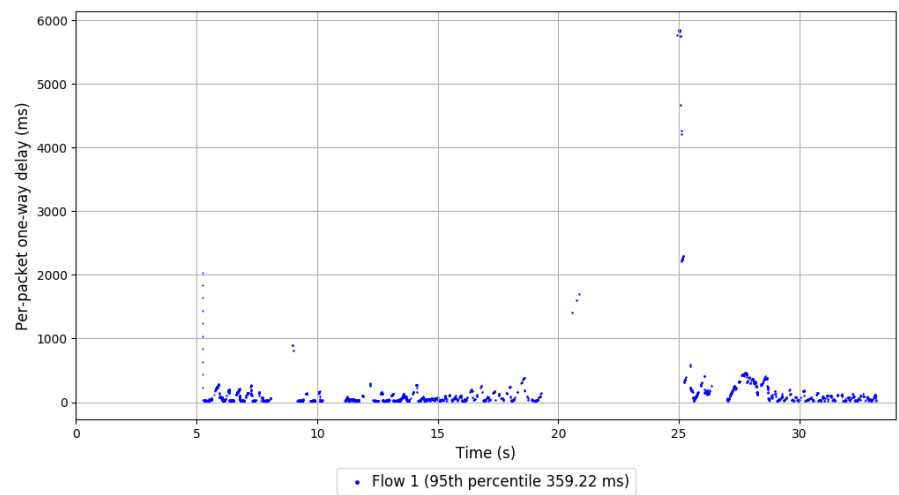
Run 1: Report of TCP BBR — Data Link

Average capacity 2.23 Mbit/s (shaded region)

--- Flow 1 ingress (mean 1.46 Mbit/s) —— Flow 1 egress (mean 1.55 Mbit/s)

· Flow 1 (95th percentile 952.27 ms)

```
Run 1: Statistics of Copa

Start at: 2019-07-31 14:14:00
End at: 2019-07-31 14:14:30

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 0.99 Mbit/s (44.4% utilization)
95th percentile per-packet one-way delay: 359.221 ms
Loss rate: 0.36%
-- Flow 1:
Average throughput: 0.99 Mbit/s
95th percentile per-packet one-way delay: 359.221 ms
Loss rate: 0.36%
```
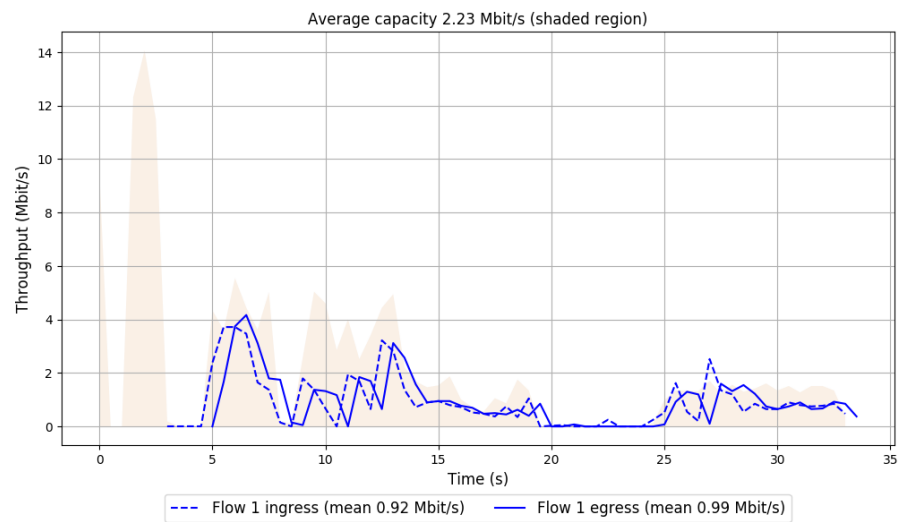
Run 1: Report of Copa — Data Link

Average capacity 2.23 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 0.92 Mbit/s)   —— Flow 1 egress (mean 0.99 Mbit/s)

• Flow 1 (95th percentile 359.22 ms)

```
Run 1: Statistics of TCP Cubic

Start at: 2019-07-31 14:16:16
End at: 2019-07-31 14:16:46

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.30 Mbit/s (58.1% utilization)
95th percentile per-packet one-way delay: 7315.677 ms
Loss rate: 13.91%
-- Flow 1:
Average throughput: 1.30 Mbit/s
95th percentile per-packet one-way delay: 7315.677 ms
Loss rate: 13.91%
```
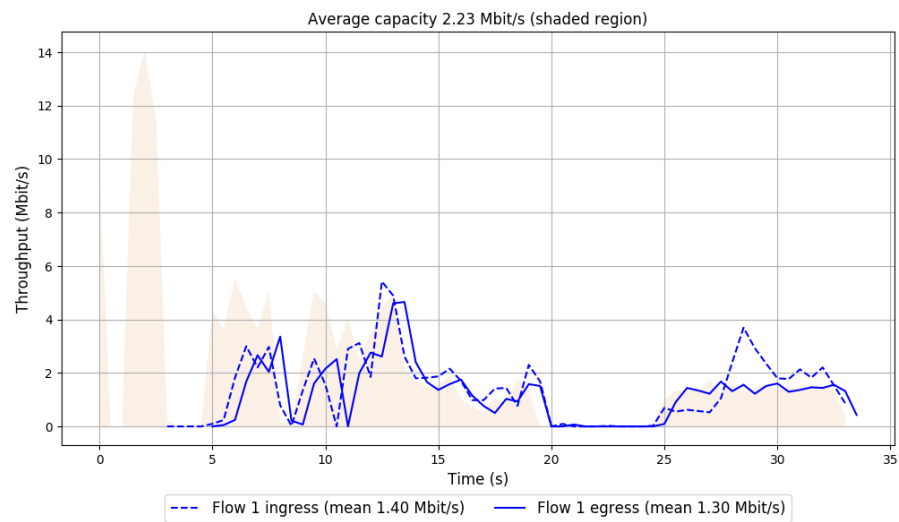
Run 1: Report of TCP Cubic — Data Link

Average capacity 2.23 Mbit/s (shaded region)
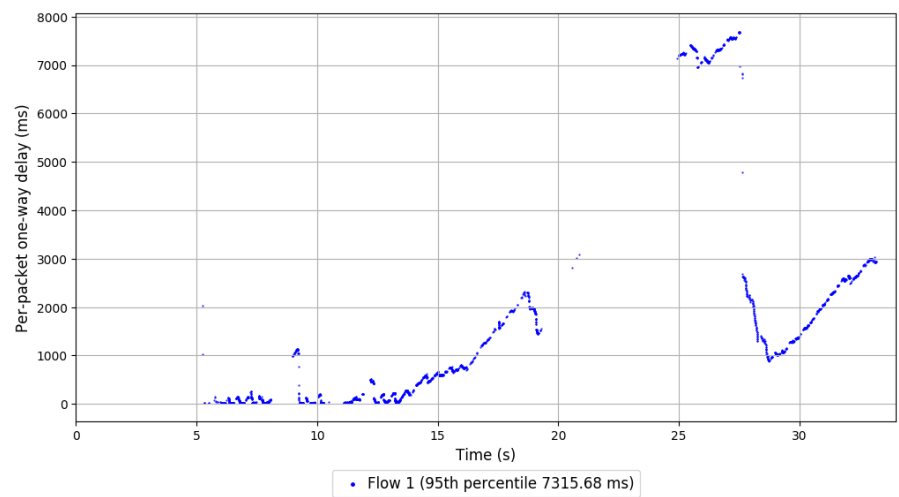
```
Run 1: Statistics of Eagle

Start at: 2019-07-31 14:12:51
End at: 2019-07-31 14:13:21

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.22 Mbit/s
Average throughput: 0.64 Mbit/s (28.8% utilization)
95th percentile per-packet one-way delay: 3541.773 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 0.64 Mbit/s
95th percentile per-packet one-way delay: 3541.773 ms
Loss rate: 0.07%
```
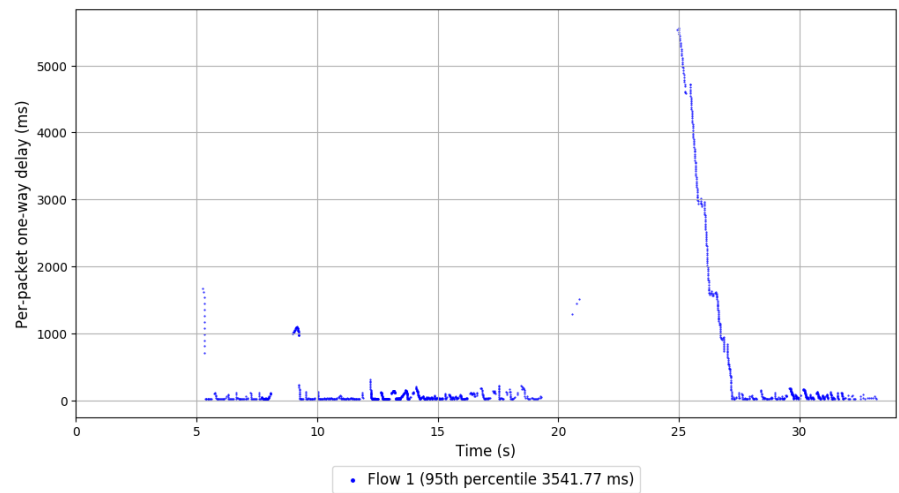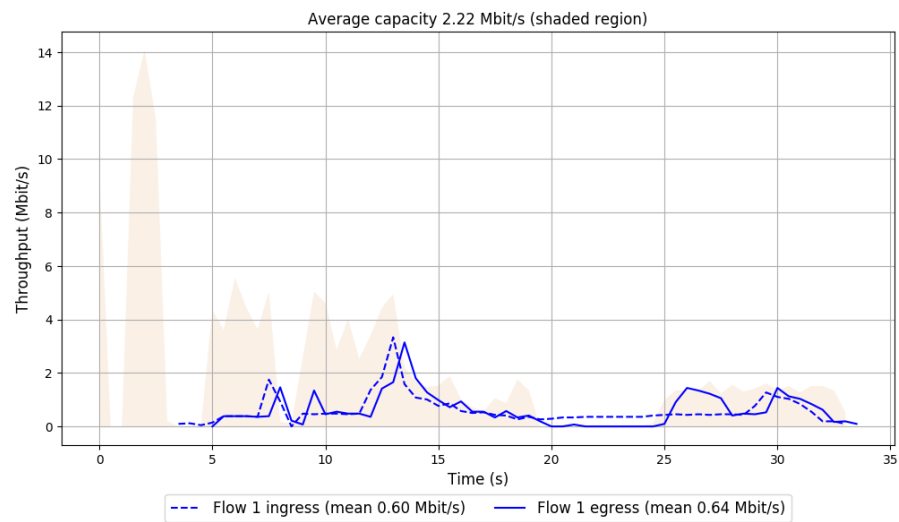
Run 1: Report of Eagle — Data Link

Average capacity 2.22 Mbit/s (shaded region)

Flow 1 ingress (mean 0.60 Mbit/s) —— Flow 1 egress (mean 0.64 Mbit/s)

• Flow 1 (95th percentile 3541.77 ms)

```
Run 1: Statistics of FillP

Start at: 2019-07-31 14:20:49
End at: 2019-07-31 14:21:19

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.68 Mbit/s (75.5% utilization)
95th percentile per-packet one-way delay: 9634.617 ms
Loss rate: 8.78%
-- Flow 1:
Average throughput: 1.68 Mbit/s
95th percentile per-packet one-way delay: 9634.617 ms
Loss rate: 8.78%
```
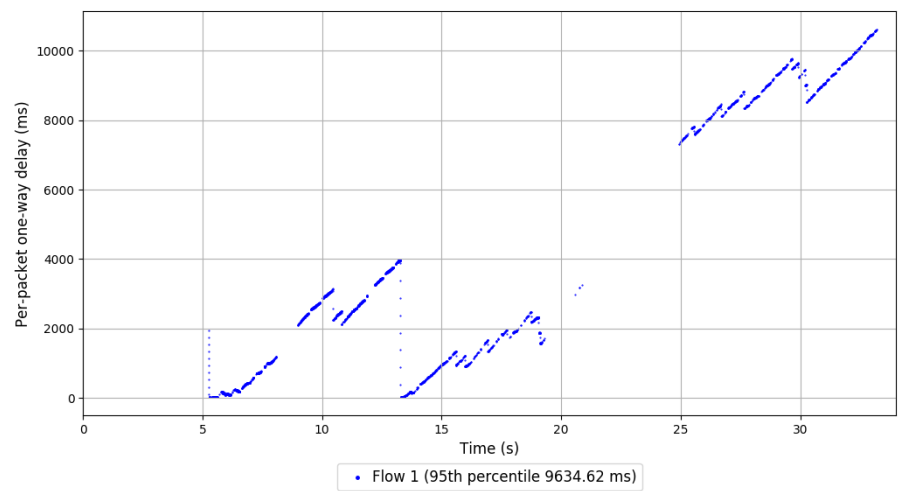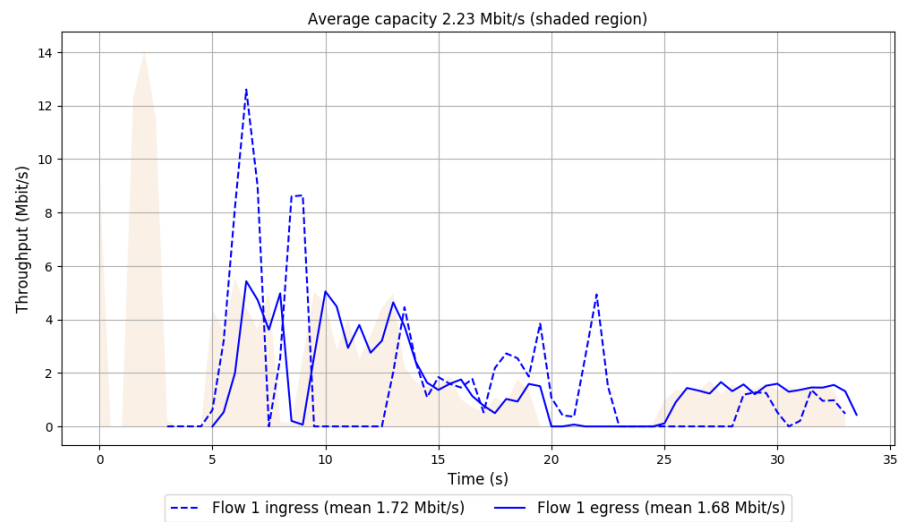
Run 1: Report of FillP — Data Link

Average capacity 2.23 Mbit/s (shaded region)

Flow 1 ingress (mean 1.72 Mbit/s) — Flow 1 egress (mean 1.68 Mbit/s)

Flow 1 (95th percentile 9634.62 ms)

```
Run 1: Statistics of FillP-Sheep

Start at: 2019-07-31 14:13:26
End at: 2019-07-31 14:13:56


# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.22 Mbit/s
Average throughput: 1.42 Mbit/s (63.9% utilization)
95th percentile per-packet one-way delay: 3643.815 ms
Loss rate: 0.06%
-- Flow 1:
Average throughput: 1.42 Mbit/s
95th percentile per-packet one-way delay: 3643.815 ms
Loss rate: 0.06%
```
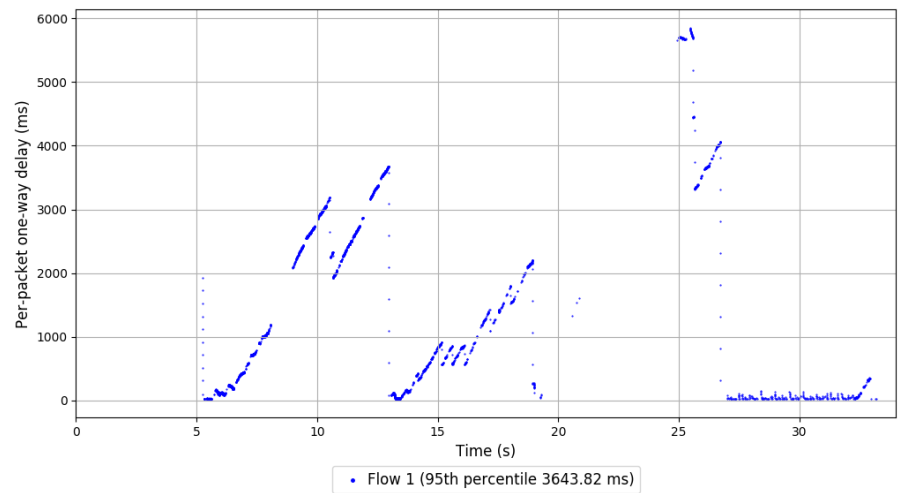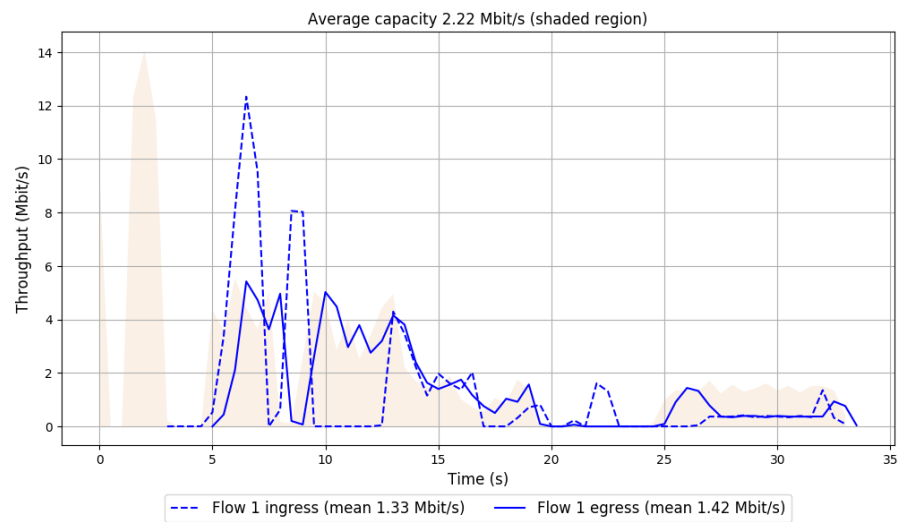
Run 1: Report of FillP-Sheep — Data Link

Average capacity 2.22 Mbit/s (shaded region)

Flow 1 ingress (mean 1.33 Mbit/s) —— Flow 1 egress (mean 1.42 Mbit/s)

• Flow 1 (95th percentile 3643.82 ms)

```
Run 1: Statistics of GOLD

Start at: 2019-07-31 14:15:42
End at: 2019-07-31 14:16:12

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.48 Mbit/s (66.4% utilization)
95th percentile per-packet one-way delay: 7322.734 ms
Loss rate: 10.33%
-- Flow 1:
Average throughput: 1.48 Mbit/s
95th percentile per-packet one-way delay: 7322.734 ms
Loss rate: 10.33%
```
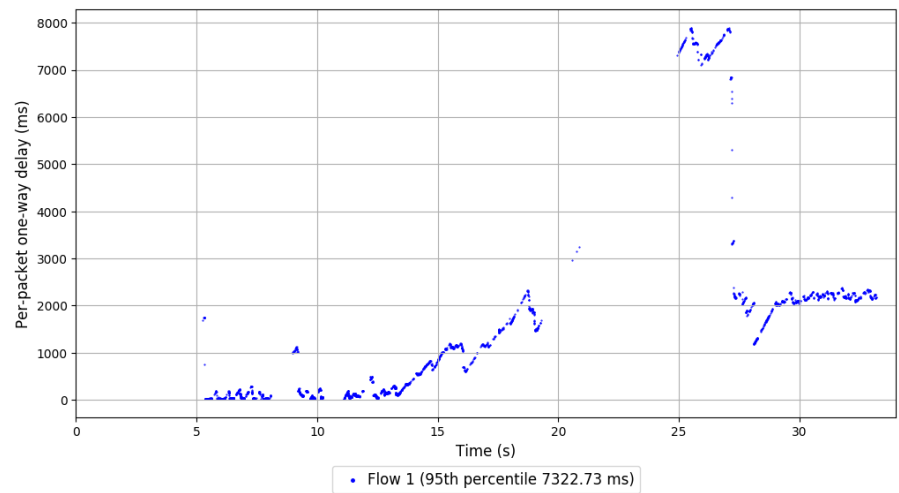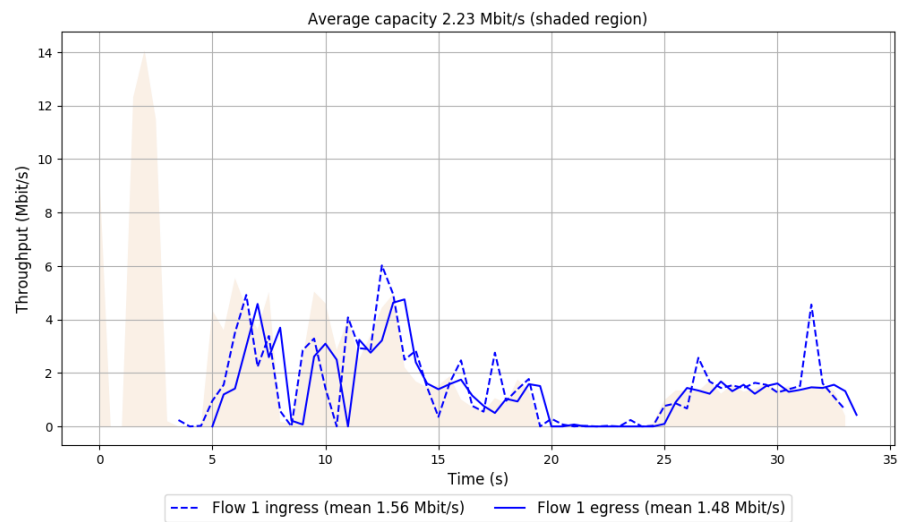
Run 1: Report of GOLD — Data Link

Average capacity 2.23 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 1.56 Mbit/s) —— Flow 1 egress (mean 1.48 Mbit/s)
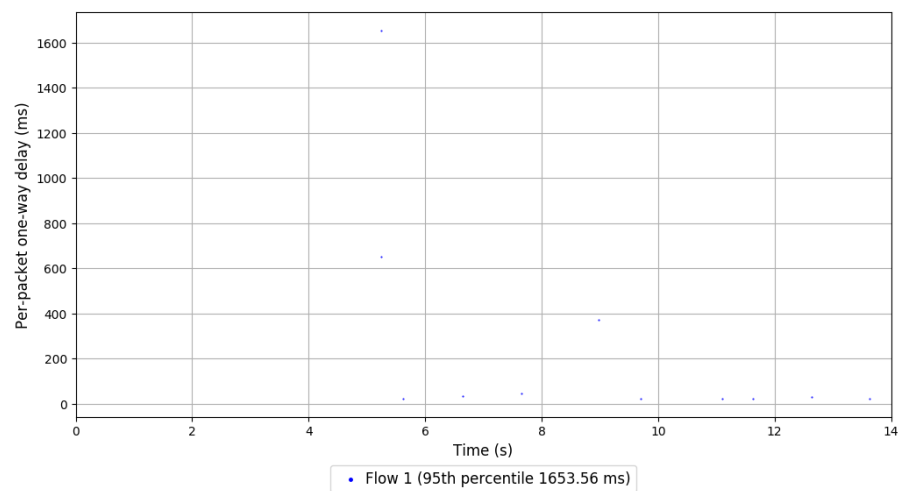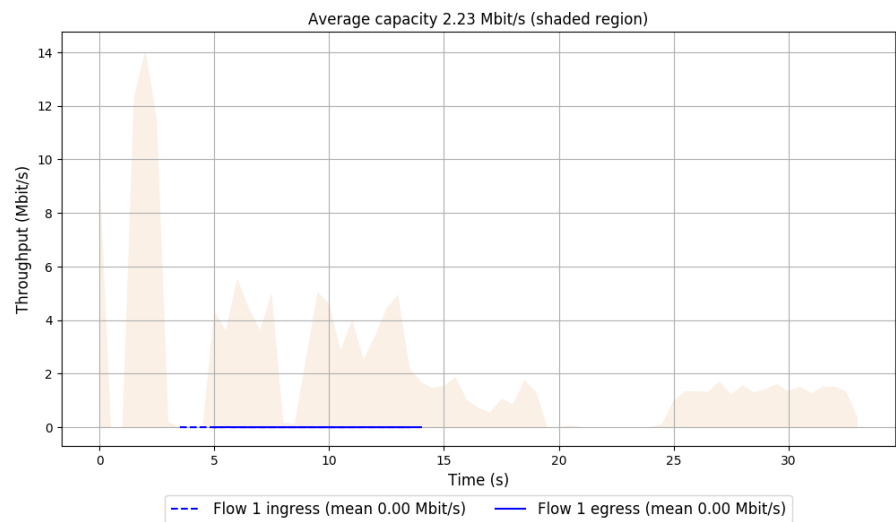

• Flow 1 (95th percentile 7322.73 ms)

Run 1: Statistics of GoldLSTM

Start at: 2019-07-31 14:19:40
End at: 2019-07-31 14:20:10

Run 1: Report of GoldLSTM — Data Link

Average capacity 2.23 Mbit/s (shaded region)

- - - - Flow 1 ingress (mean 0.00 Mbit/s)   —— Flow 1 egress (mean 0.00 Mbit/s)

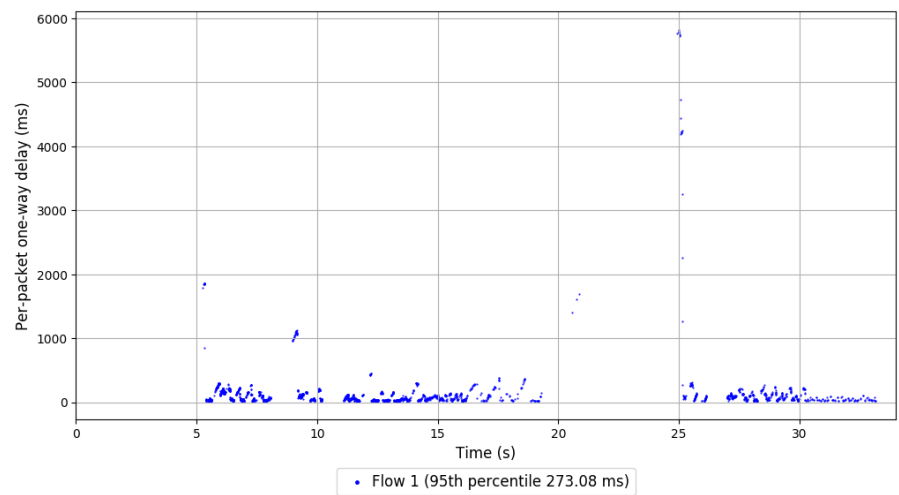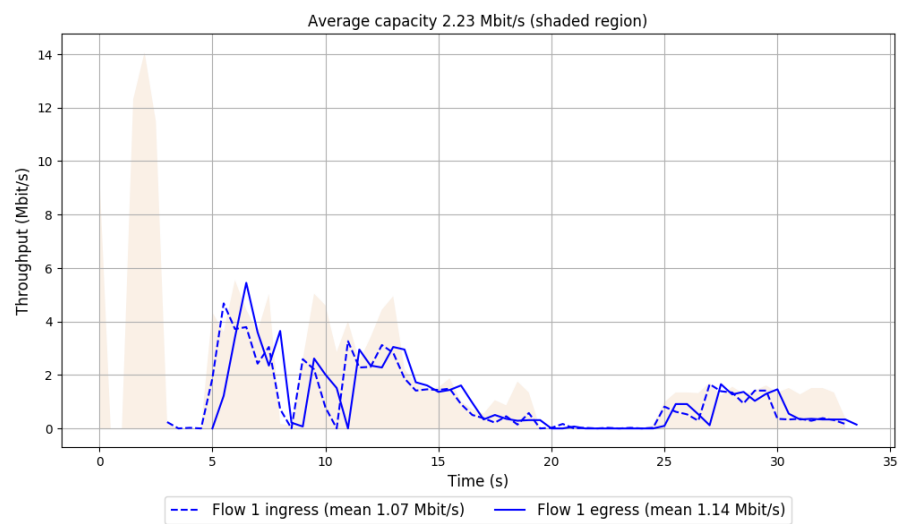

• Flow 1 (95th percentile 1653.56 ms)

```
Run 1: Statistics of Indigo

Start at: 2019-07-31 14:14:34
End at: 2019-07-31 14:15:04

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.14 Mbit/s (51.2% utilization)
95th percentile per-packet one-way delay: 273.084 ms
Loss rate: 0.08%
-- Flow 1:
Average throughput: 1.14 Mbit/s
95th percentile per-packet one-way delay: 273.084 ms
Loss rate: 0.08%
```

Run 1: Report of Indigo — Data Link

Average capacity 2.23 Mbit/s (shaded region)

--- Flow 1 ingress (mean 1.07 Mbit/s) ⎯⎯ Flow 1 egress (mean 1.14 Mbit/s)

• Flow 1 (95th percentile 273.08 ms)

```
Run 1: Statistics of LEDBAT

Start at: 2019-07-31 14:23:39
End at: 2019-07-31 14:24:09

# Below is generated by plot.py at 2019-07-31 14:25:32
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.31 Mbit/s (59.0% utilization)
95th percentile per-packet one-way delay: 389.290 ms
Loss rate: 0.60%
-- Flow 1:
Average throughput: 1.31 Mbit/s
95th percentile per-packet one-way delay: 389.290 ms
Loss rate: 0.60%
```
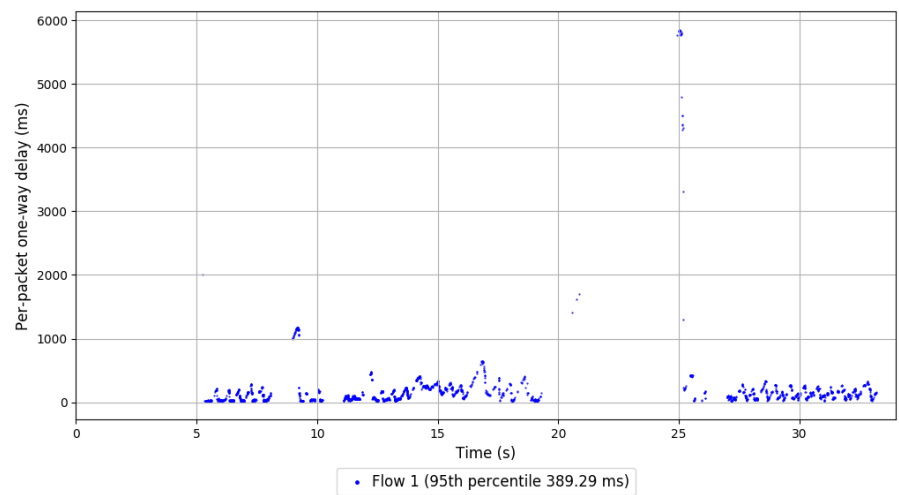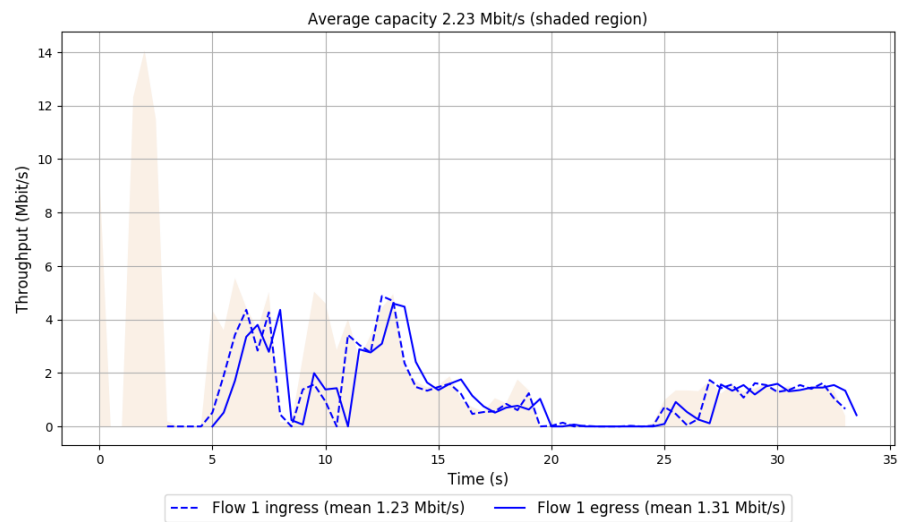
Run 1: Report of LEDBAT — Data Link

Average capacity 2.23 Mbit/s (shaded region)

--- Flow 1 ingress (mean 1.23 Mbit/s) —— Flow 1 egress (mean 1.31 Mbit/s)

• Flow 1 (95th percentile 389.29 ms)

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```
Run 1: Statistics of PCC-Allegro

Start at: 2019-07-31 14:22:31
End at: 2019-07-31 14:23:01

# Below is generated by plot.py at 2019-07-31 14:25:34
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.22 Mbit/s
Average throughput: 1.46 Mbit/s (65.7% utilization)
95th percentile per-packet one-way delay: 10615.574 ms
Loss rate: 38.42%
-- Flow 1:
Average throughput: 1.46 Mbit/s
95th percentile per-packet one-way delay: 10615.574 ms
Loss rate: 38.42%
```
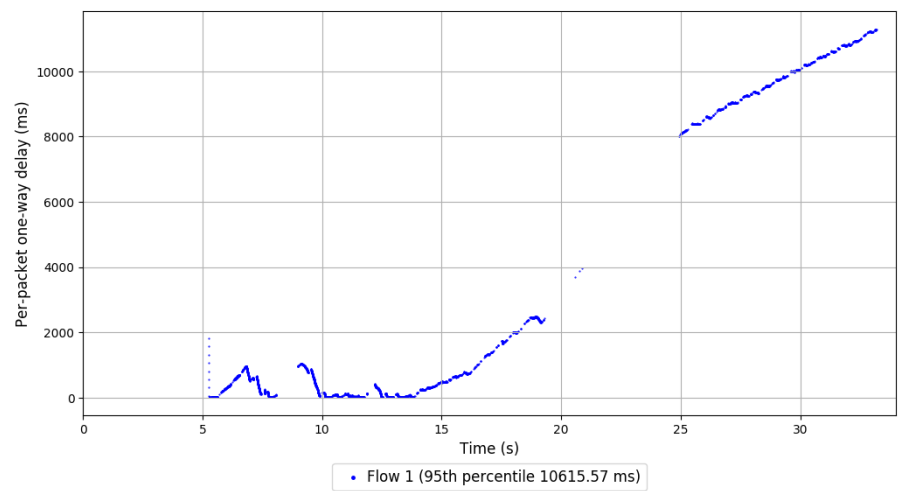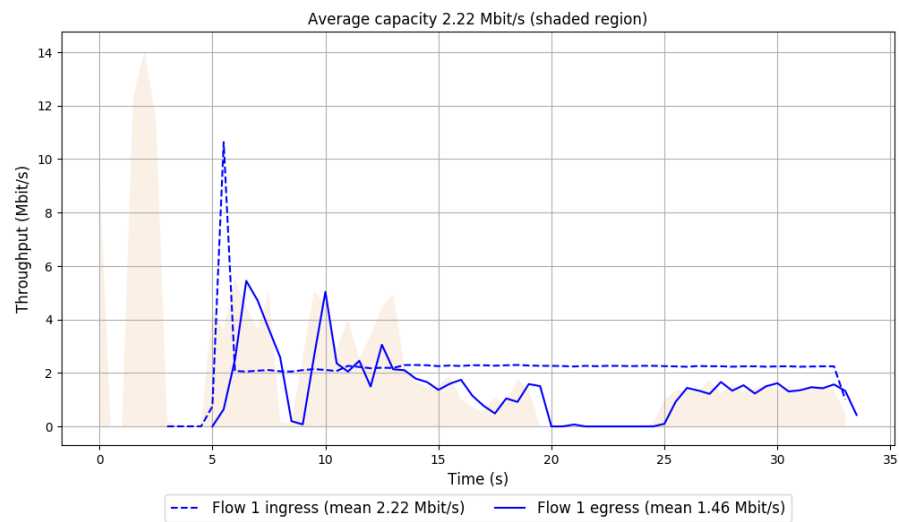
Run 1: Report of PCC-Allegro — Data Link

Average capacity 2.22 Mbit/s (shaded region)

Flow 1 ingress (mean 2.22 Mbit/s) — — — Flow 1 egress (mean 1.46 Mbit/s)
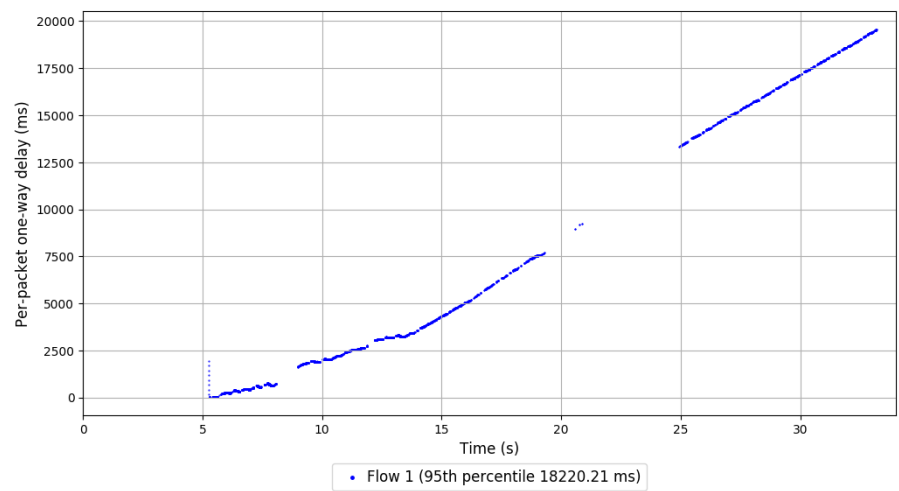

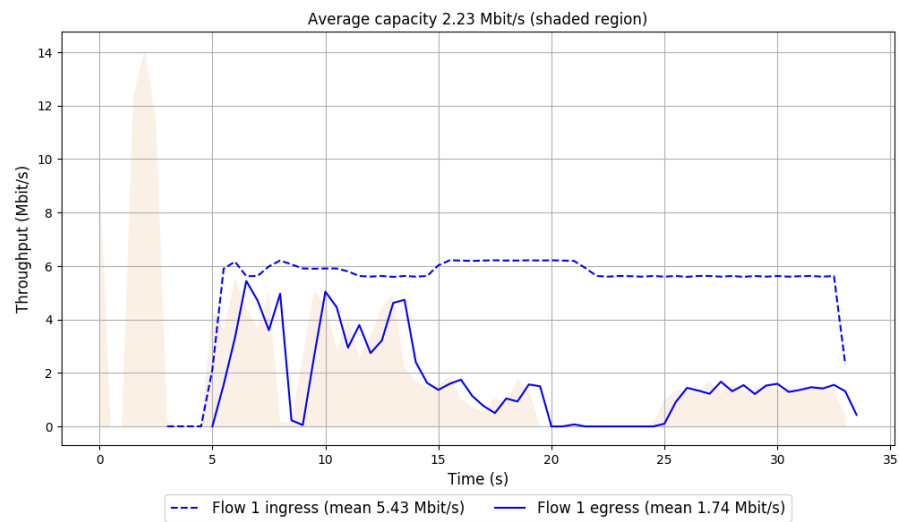Flow 1 (95th percentile 10615.57 ms)

```
Run 1: Statistics of PCC-Expr

Start at: 2019-07-31 14:24:13
End at: 2019-07-31 14:24:43

# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.74 Mbit/s (78.0% utilization)
95th percentile per-packet one-way delay: 18220.211 ms
Loss rate: 70.11%
-- Flow 1:
Average throughput: 1.74 Mbit/s
95th percentile per-packet one-way delay: 18220.211 ms
Loss rate: 70.11%
```

Run 1: Report of PCC-Expr — Data Link

Average capacity 2.23 Mbit/s (shaded region)

- - - - Flow 1 ingress (mean 5.43 Mbit/s)   —— Flow 1 egress (mean 1.74 Mbit/s)

• Flow 1 (95th percentile 18220.21 ms)

```
Run 1: Statistics of QUIC Cubic

Start at: 2019-07-31 14:21:57
End at: 2019-07-31 14:22:27
```

Run 1: Report of QUIC Cubic — Data Link

Figure is missing

Figure is missing

```
Run 1: Statistics of SCReAM

Start at: 2019-07-31 14:21:23
End at: 2019-07-31 14:21:53

# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 0.06 Mbit/s (2.9% utilization)
95th percentile per-packet one-way delay: 1049.677 ms
Loss rate: 0.17%
-- Flow 1:
Average throughput: 0.06 Mbit/s
95th percentile per-packet one-way delay: 1049.677 ms
Loss rate: 0.17%
```

Run 1: Report of SCReAM — Data Link

Average capacity 2.23 Mbit/s (shaded region)
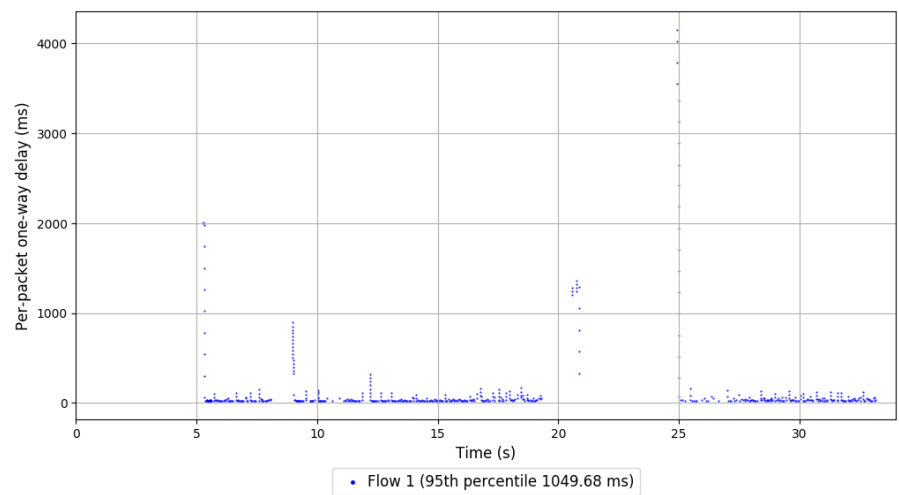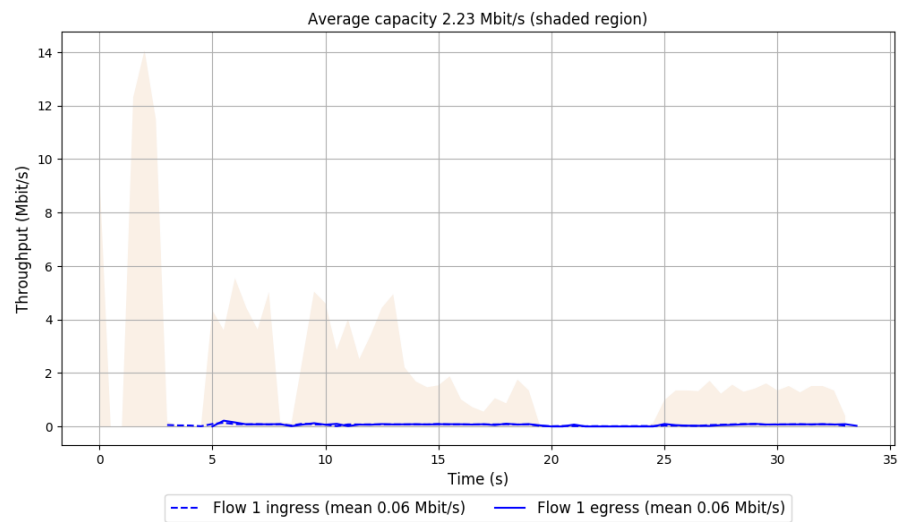
```
Run 1: Statistics of Sprout

Start at: 2019-07-31 14:16:50
End at: 2019-07-31 14:17:20


# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 0.44 Mbit/s (19.9% utilization)
95th percentile per-packet one-way delay: 1825.215 ms
Loss rate: 0.18%
-- Flow 1:
Average throughput: 0.44 Mbit/s
95th percentile per-packet one-way delay: 1825.215 ms
Loss rate: 0.18%
```
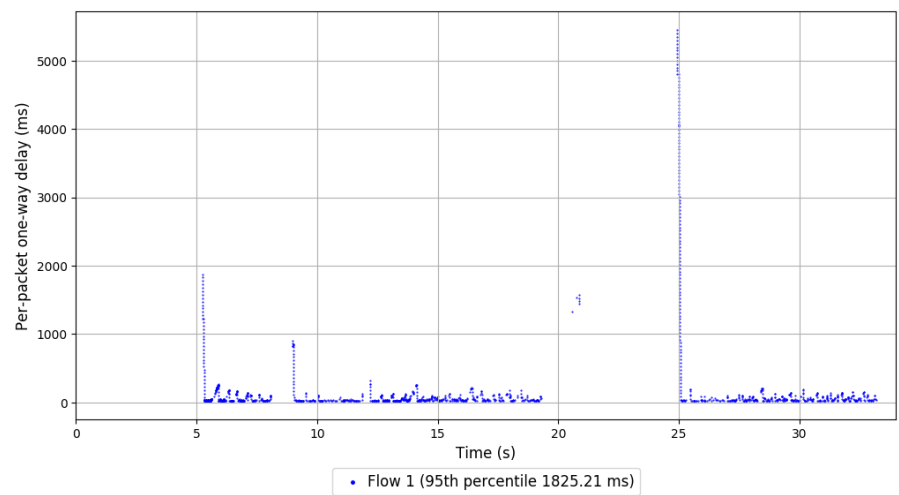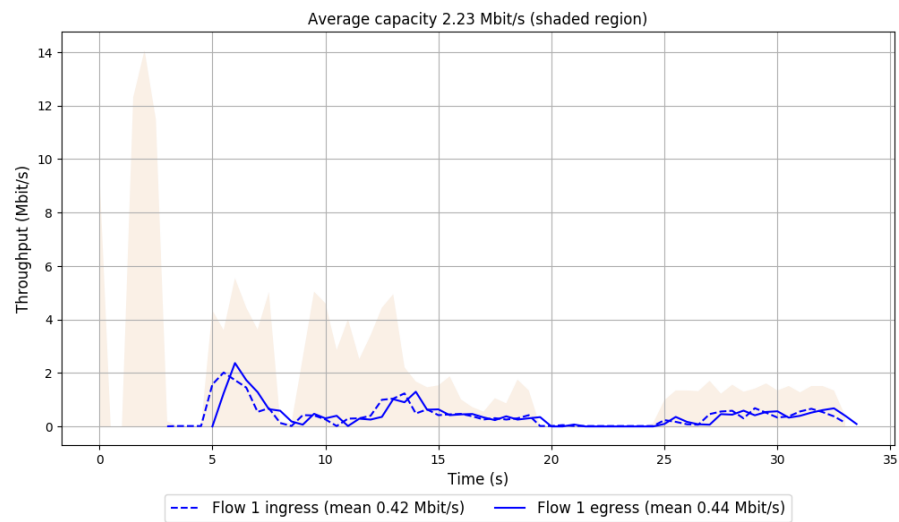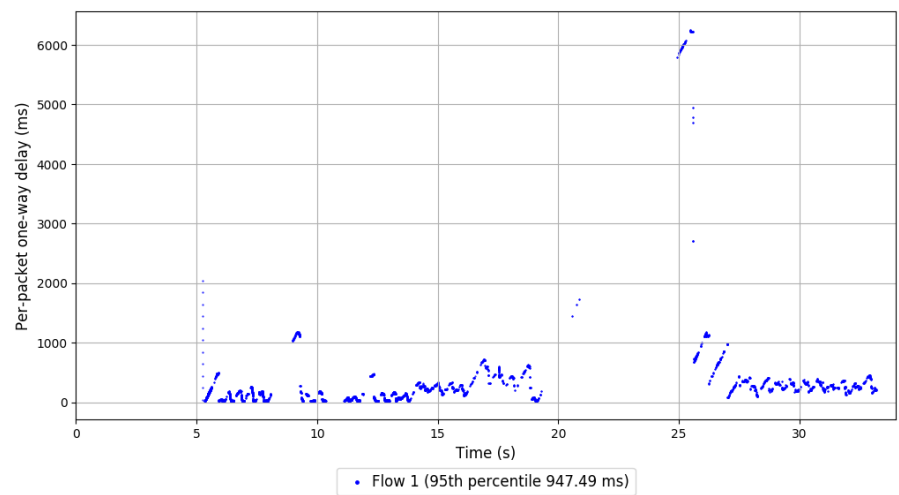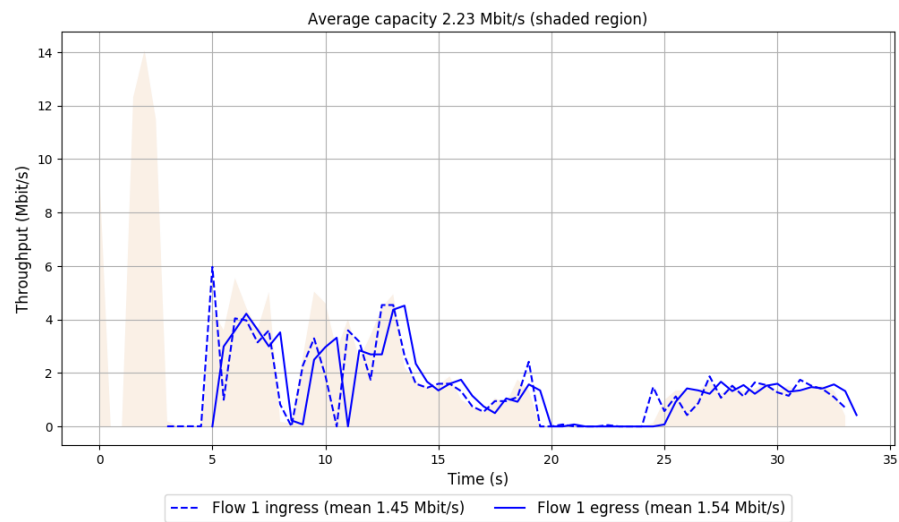
Run 1: Report of Sprout — Data Link

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

Start at: 2019-07-31 14:20:14
End at: 2019-07-31 14:20:44

# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.54 Mbit/s (69.1% utilization)
95th percentile per-packet one-way delay: 947.487 ms
Loss rate: 0.98%
-- Flow 1:
Average throughput: 1.54 Mbit/s
95th percentile per-packet one-way delay: 947.487 ms
Loss rate: 0.98%
```

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

Average capacity 2.23 Mbit/s (shaded region)

--- Flow 1 ingress (mean 1.45 Mbit/s) —— Flow 1 egress (mean 1.54 Mbit/s)

· Flow 1 (95th percentile 947.49 ms)

```
Run 1: Statistics of TCP Vegas

Start at: 2019-07-31 14:18:32
End at: 2019-07-31 14:19:03

# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 0.23 Mbit/s (10.5% utilization)
95th percentile per-packet one-way delay: 234.255 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.23 Mbit/s
95th percentile per-packet one-way delay: 234.255 ms
Loss rate: 0.00%
```
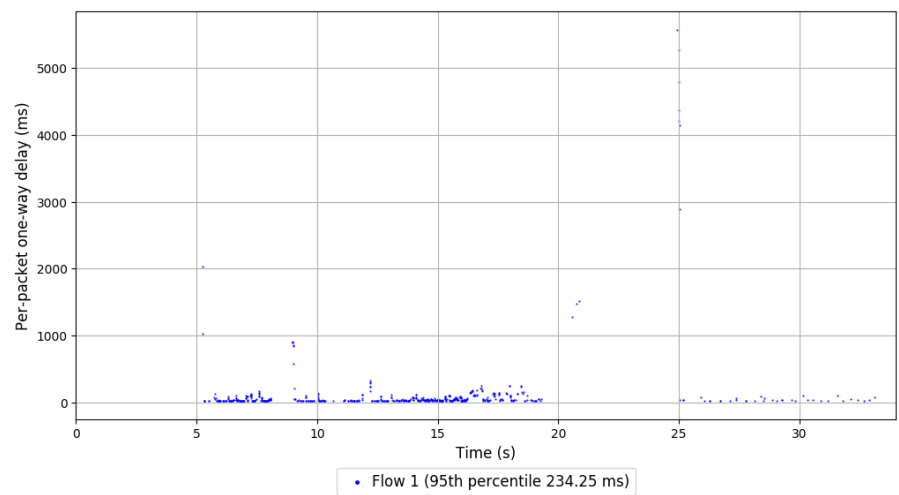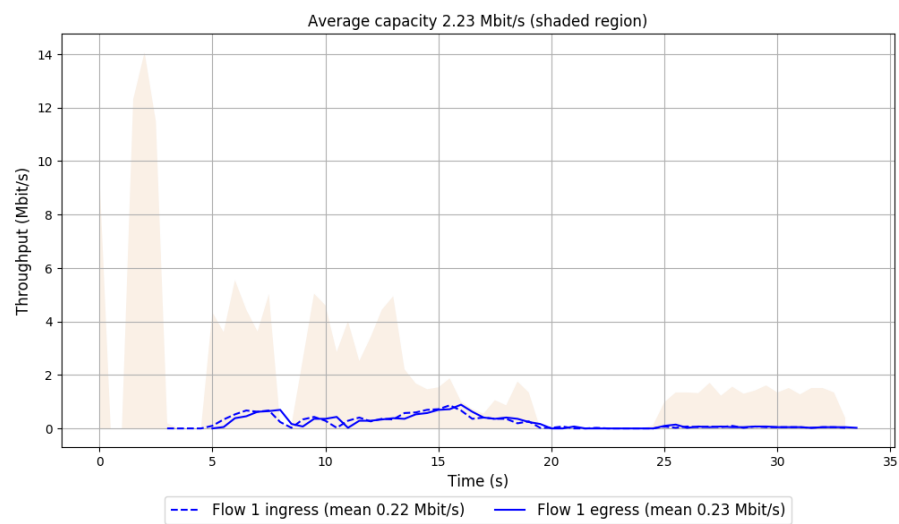
Run 1: Report of TCP Vegas — Data Link

Average capacity 2.23 Mbit/s (shaded region)

--- Flow 1 ingress (mean 0.22 Mbit/s)   —— Flow 1 egress (mean 0.23 Mbit/s)

• Flow 1 (95th percentile 234.25 ms)

```
Run 1: Statistics of Verus

Start at: 2019-07-31 14:15:08
End at: 2019-07-31 14:15:38


# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 1.19 Mbit/s (53.3% utilization)
95th percentile per-packet one-way delay: 1073.579 ms
Loss rate: 1.51%
-- Flow 1:
Average throughput: 1.19 Mbit/s
95th percentile per-packet one-way delay: 1073.579 ms
Loss rate: 1.51%
```
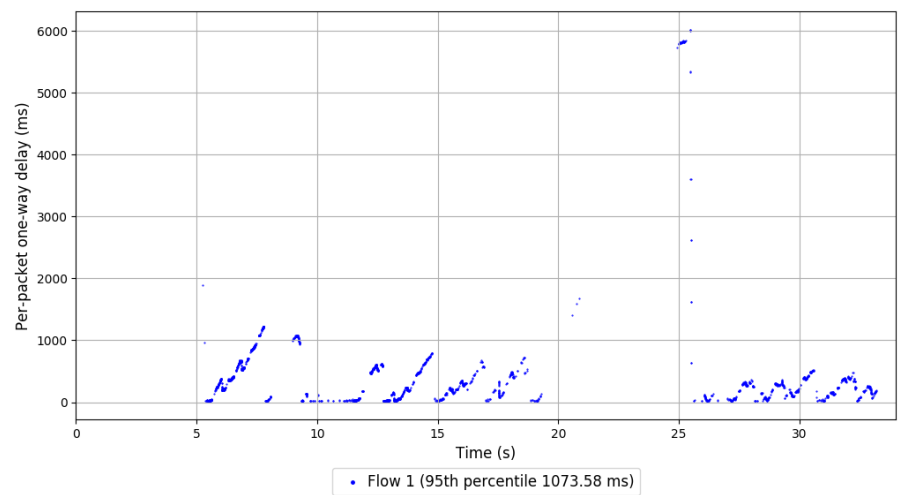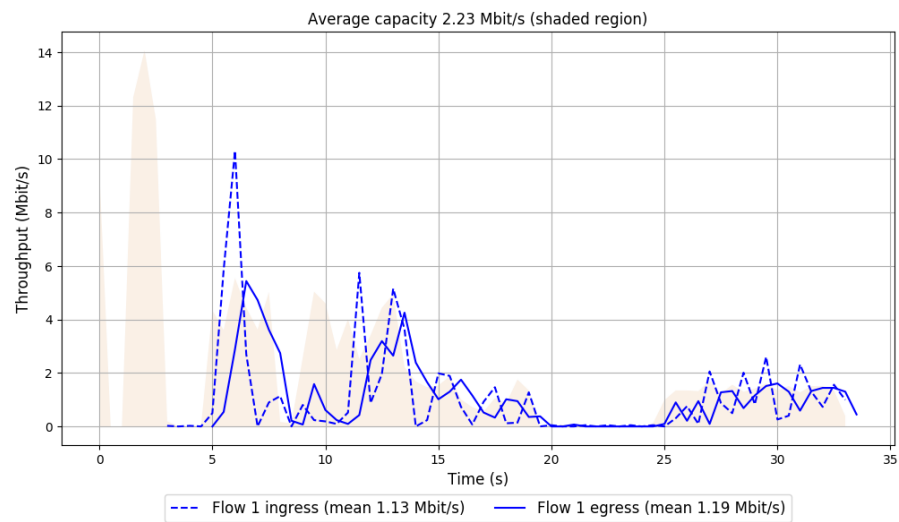
Run 1: Report of Verus — Data Link

```
Run 1: Statistics of PCC-Vivace

Start at: 2019-07-31 14:17:58
End at: 2019-07-31 14:18:28

# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.22 Mbit/s
Average throughput: 1.63 Mbit/s (73.5% utilization)
95th percentile per-packet one-way delay: 9226.263 ms
Loss rate: 30.49%
-- Flow 1:
Average throughput: 1.63 Mbit/s
95th percentile per-packet one-way delay: 9226.263 ms
Loss rate: 30.49%
```
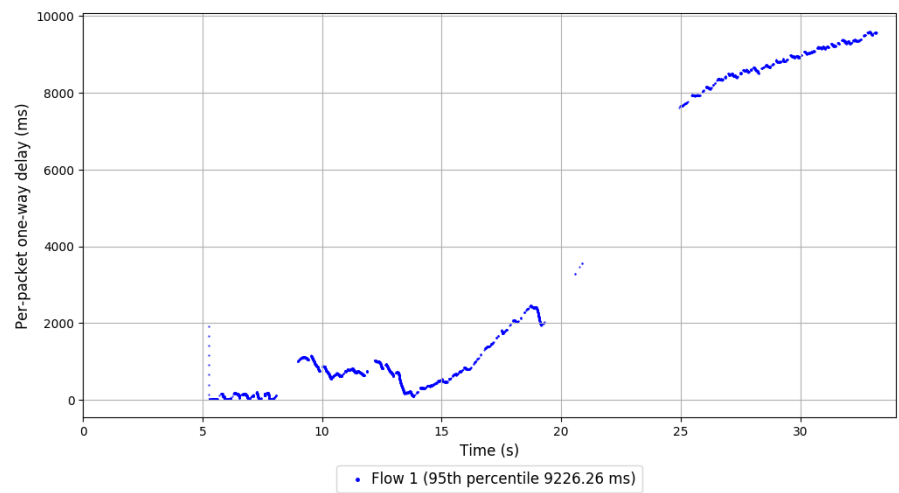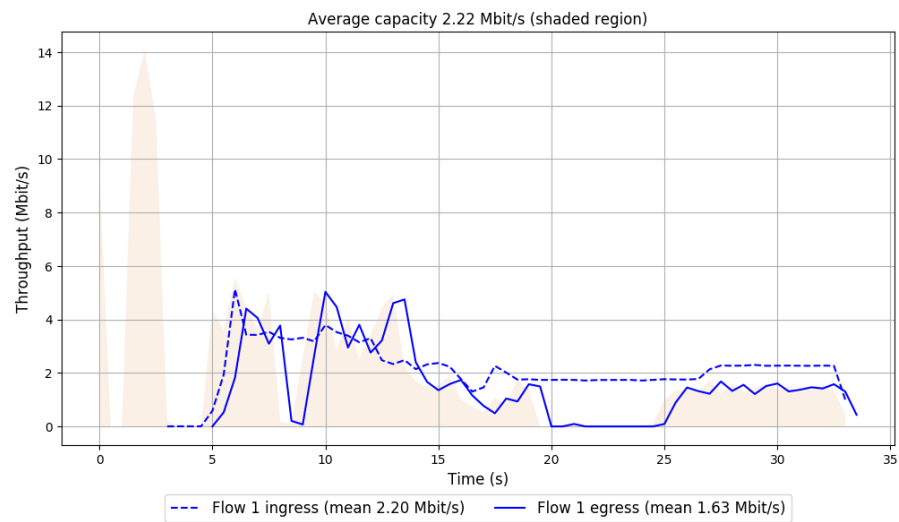
Run 1: Report of PCC-Vivace — Data Link

Average capacity 2.22 Mbit/s (shaded region)

```
Run 1: Statistics of WebRTC media

Start at: 2019-07-31 14:23:05
End at: 2019-07-31 14:23:35

# Below is generated by plot.py at 2019-07-31 14:25:40
# Datalink statistics
-- Total of 1 flow:
Average capacity: 2.23 Mbit/s
Average throughput: 0.05 Mbit/s (2.1% utilization)
95th percentile per-packet one-way delay: 496.186 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.05 Mbit/s
95th percentile per-packet one-way delay: 496.186 ms
Loss rate: 0.00%
```

Run 1: Report of WebRTC media — Data Link

Average capacity 2.23 Mbit/s (shaded region)

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

• Flow 1 (95th percentile 496.19 ms)