Pantheon Report

Generated at 2019-07-29 01:34:33 (UTC).
Tested in mahimahi: `mm-delay 40 mm-link 10mbps.trace 10mbps.trace`
Repeated the test of 21 congestion control schemes once.
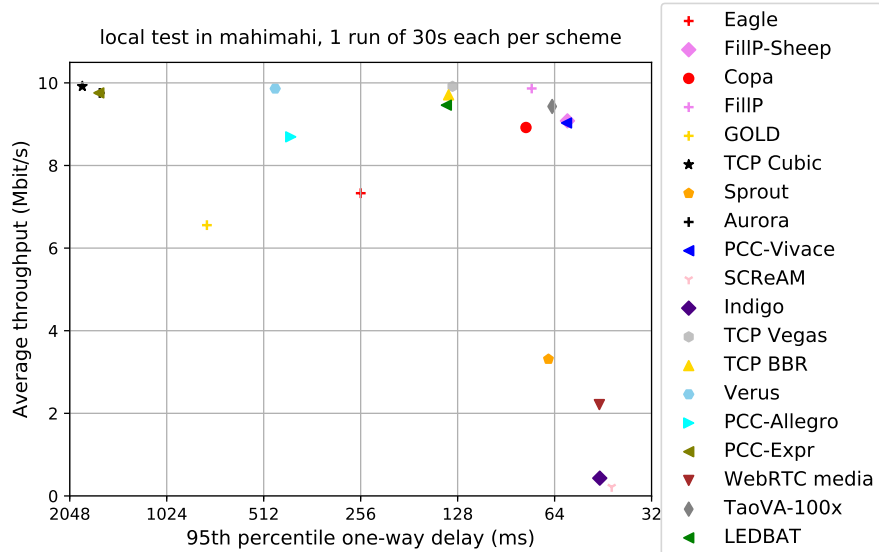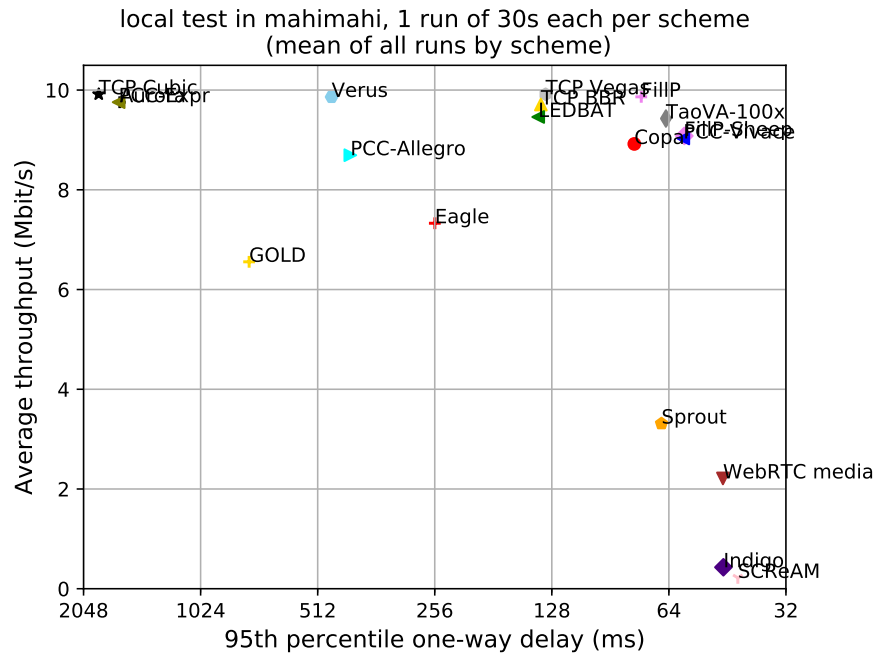Each test lasted for 30 seconds running 1 flow.

```
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 @ ad2a2899723f06e4f7d056af4ea05be3bab4ba4a
third_party/aurora @ f3e943d61015b39960854ba6391797e0c7984d74
third_party/aurora-model @ e292c316c23fb837255c4e142e40590d154bbe95
third_party/eagle @ 8733f53138857a4b4d42064d2aedc4cf935539e3
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	9.76	1652.23	5.72
TCP BBR	1	9.71	136.58	0.39
Copa	1	8.92	78.53	0.16
TCP Cubic	1	9.92	1871.92	5.36
Eagle	1	7.33	255.86	1.72
FillP	1	9.86	75.37	0.20
FillP-Sheep	1	9.08	58.40	0.11
GOLD	1	6.56	768.32	2.67
GoldLSTM	0	N/A	N/A	N/A
Indigo	1	0.43	46.34	0.00
LEDBAT	1	9.46	138.76	0.48
PCC-Allegro	1	8.69	421.97	0.15
PCC-Expr	1	9.76	1663.78	5.50
QUIC Cubic	0	N/A	N/A	N/A
SCReAM	1	0.22	42.55	0.13
Sprout	1	3.31	66.87	0.15
TaoVA-100x	1	9.43	65.13	0.17
TCP Vegas	1	9.92	132.79	0.16
Verus	1	9.86	471.56	1.46
PCC-Vivace	1	9.03	58.77	0.14
WebRTC media	1	2.21	46.47	0.16

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```
Run 1: Statistics of Aurora

Start at: 2019-07-29 01:23:30
End at: 2019-07-29 01:24:00

# Below is generated by plot.py at 2019-07-29 01:34:07
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.76 Mbit/s (97.6% utilization)
95th percentile per-packet one-way delay: 1652.227 ms
Loss rate: 5.72%
-- Flow 1:
Average throughput: 9.76 Mbit/s
95th percentile per-packet one-way delay: 1652.227 ms
Loss rate: 5.72%
```
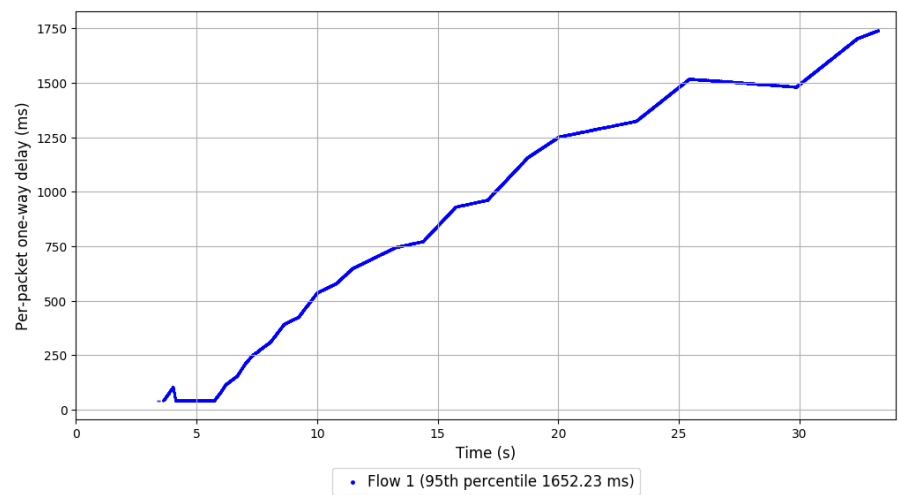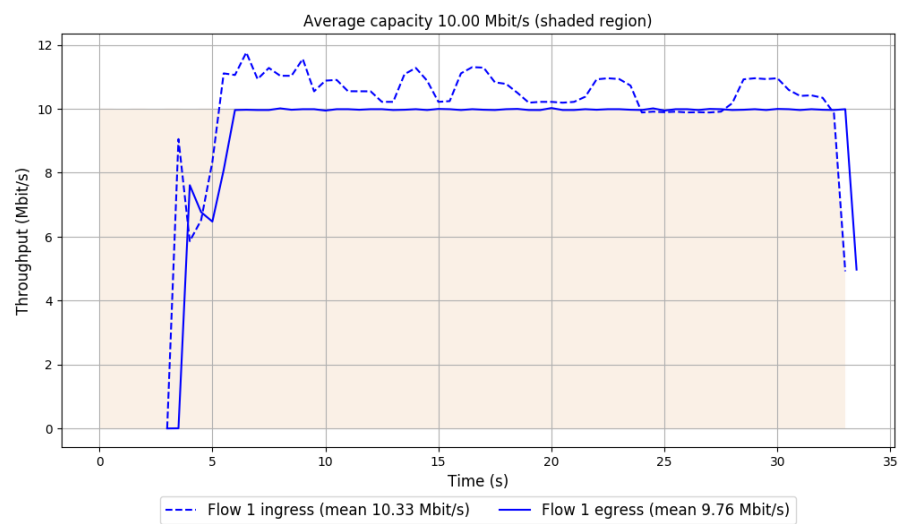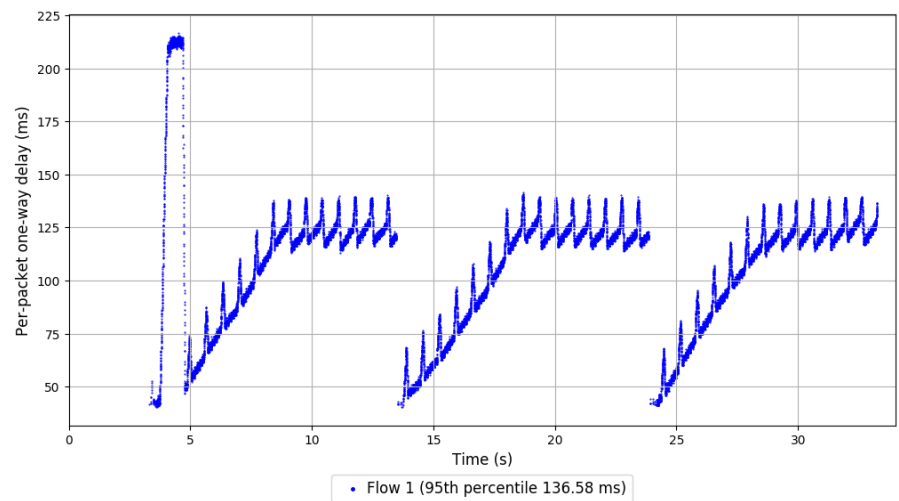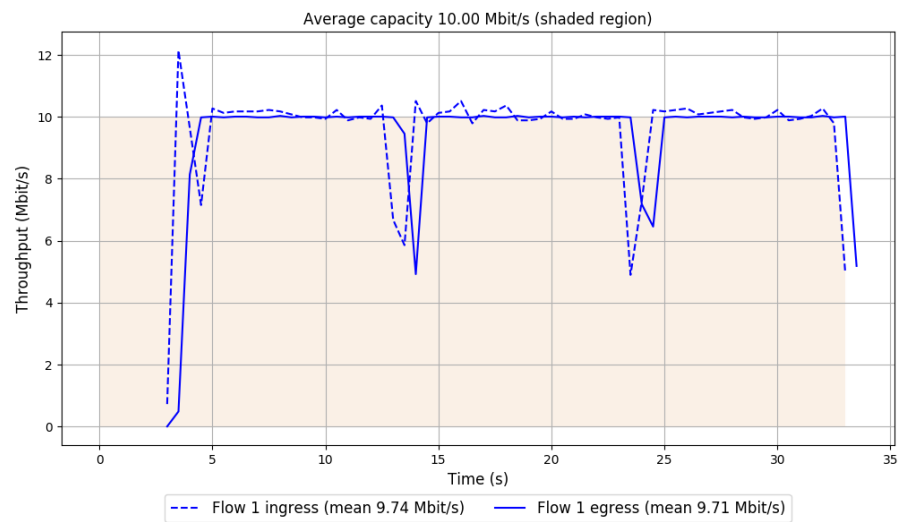
Run 1: Report of Aurora — Data Link

Average capacity 10.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 10.33 Mbit/s) —— Flow 1 egress (mean 9.76 Mbit/s)

• Flow 1 (95th percentile 1652.23 ms)

```
Run 1: Statistics of TCP BBR

Start at: 2019-07-29 01:25:15
End at: 2019-07-29 01:25:45

# Below is generated by plot.py at 2019-07-29 01:34:07
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.71 Mbit/s (97.1% utilization)
95th percentile per-packet one-way delay: 136.576 ms
Loss rate: 0.39%
-- Flow 1:
Average throughput: 9.71 Mbit/s
95th percentile per-packet one-way delay: 136.576 ms
Loss rate: 0.39%
```
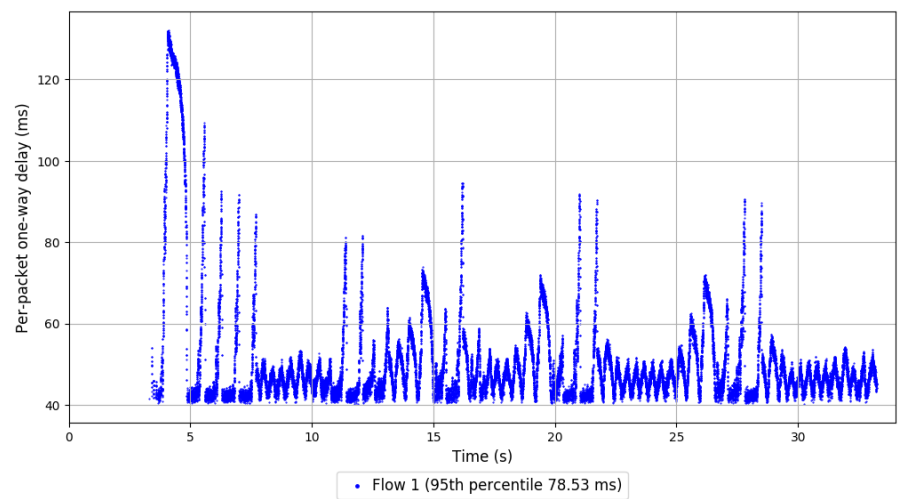
Run 1: Report of TCP BBR — Data Link

Average capacity 10.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 9.74 Mbit/s) —— Flow 1 egress (mean 9.71 Mbit/s)

• Flow 1 (95th percentile 136.58 ms)

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```
Run 1: Statistics of Copa

Start at: 2019-07-29 01:20:03
End at: 2019-07-29 01:20:33

# Below is generated by plot.py at 2019-07-29 01:34:07
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 8.92 Mbit/s (89.2% utilization)
95th percentile per-packet one-way delay: 78.529 ms
Loss rate: 0.16%
-- Flow 1:
Average throughput: 8.92 Mbit/s
95th percentile per-packet one-way delay: 78.529 ms
Loss rate: 0.16%
```
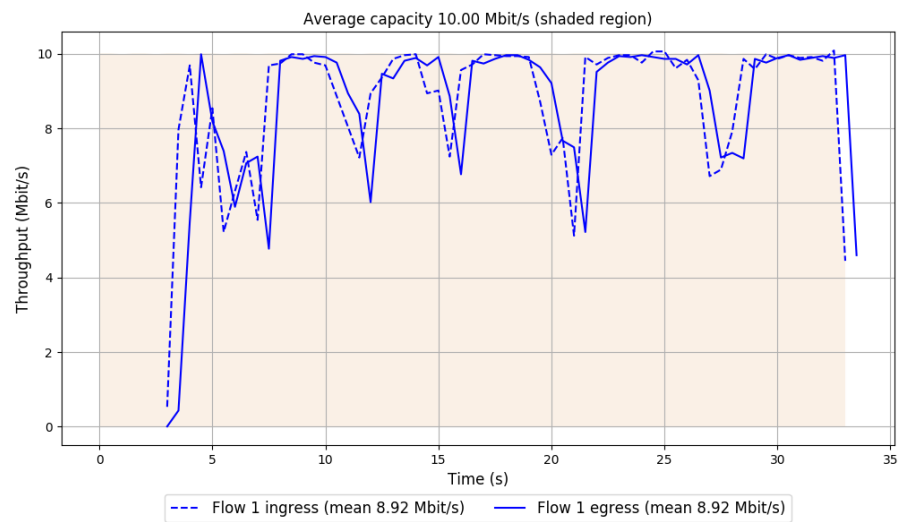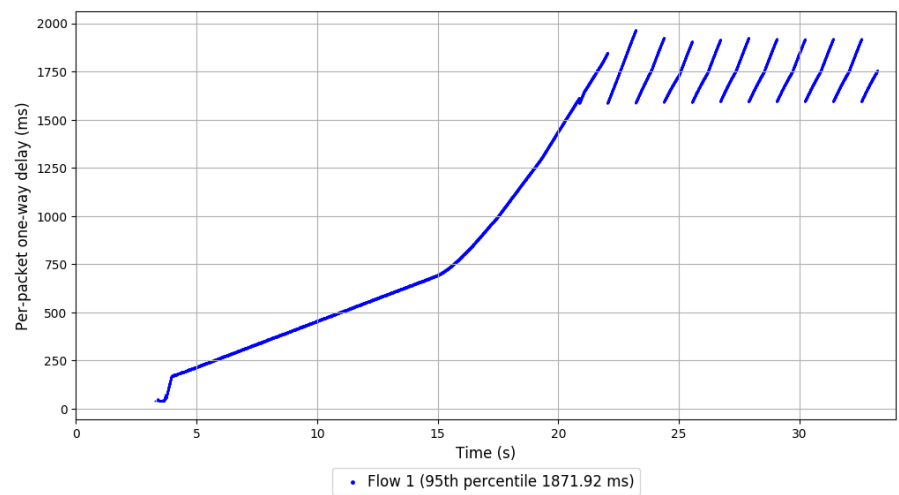
Run 1: Report of Copa — Data Link

Average capacity 10.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 8.92 Mbit/s) ——— Flow 1 egress (mean 8.92 Mbit/s)

• Flow 1 (95th percentile 78.53 ms)

10

```
Run 1: Statistics of TCP Cubic

Start at: 2019-07-29 01:22:21
End at: 2019-07-29 01:22:51

# Below is generated by plot.py at 2019-07-29 01:34:07
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.92 Mbit/s (99.2% utilization)
95th percentile per-packet one-way delay: 1871.925 ms
Loss rate: 5.36%
-- Flow 1:
Average throughput: 9.92 Mbit/s
95th percentile per-packet one-way delay: 1871.925 ms
Loss rate: 5.36%
```
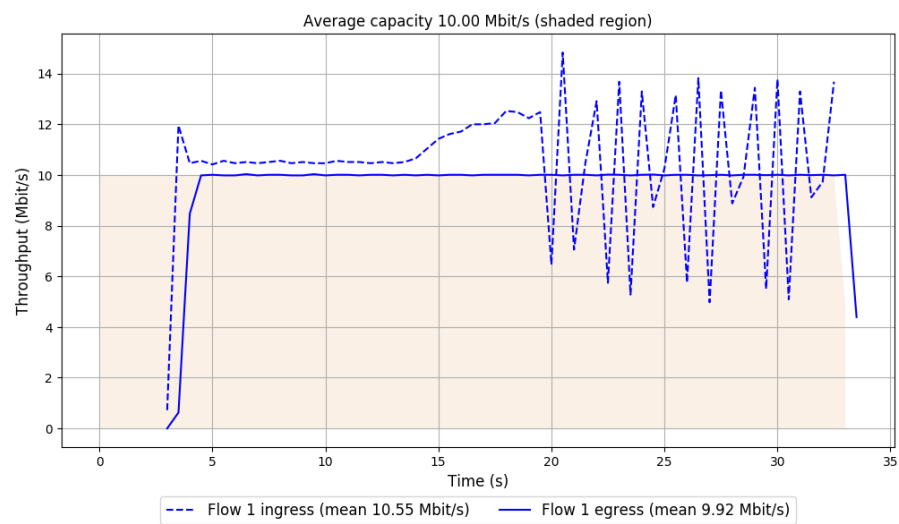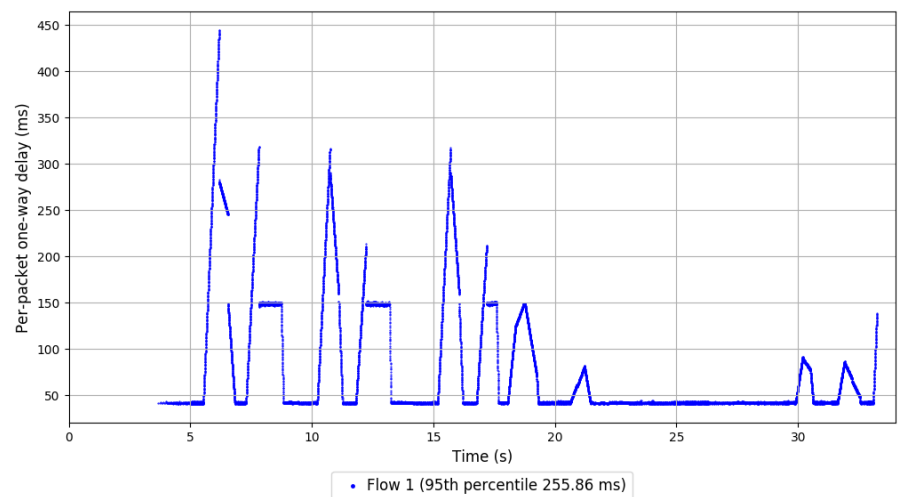
Run 1: Report of TCP Cubic — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Throughput (Mbit/s) vs Time (s)

- - - Flow 1 ingress (mean 10.55 Mbit/s) —— Flow 1 egress (mean 9.92 Mbit/s)

Per-packet one-way delay (ms) vs Time (s)

· Flow 1 (95th percentile 1871.92 ms)

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```
Run 1: Statistics of Eagle

Start at: 2019-07-29 01:18:53
End at: 2019-07-29 01:19:23

# Below is generated by plot.py at 2019-07-29 01:34:07
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 7.33 Mbit/s (73.3% utilization)
95th percentile per-packet one-way delay: 255.860 ms
Loss rate: 1.72%
-- Flow 1:
Average throughput: 7.33 Mbit/s
95th percentile per-packet one-way delay: 255.860 ms
Loss rate: 1.72%
```
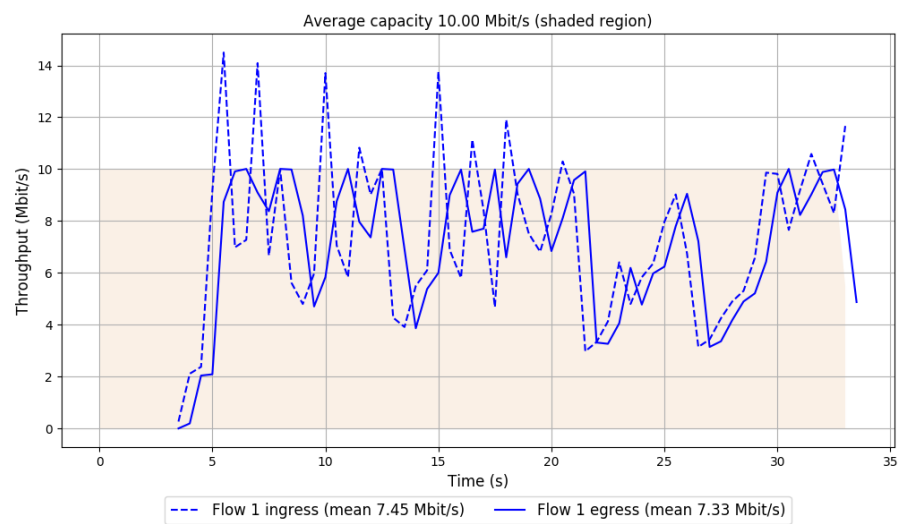
Run 1: Report of Eagle — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 7.45 Mbit/s)   Flow 1 egress (mean 7.33 Mbit/s)

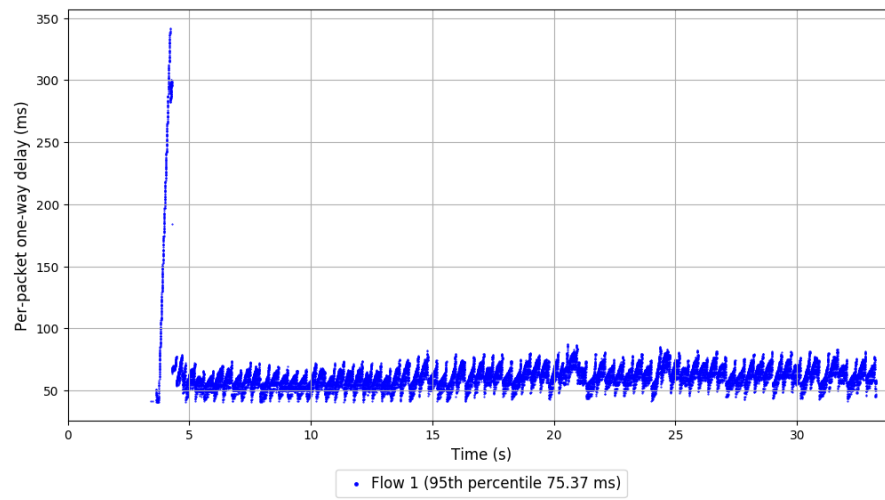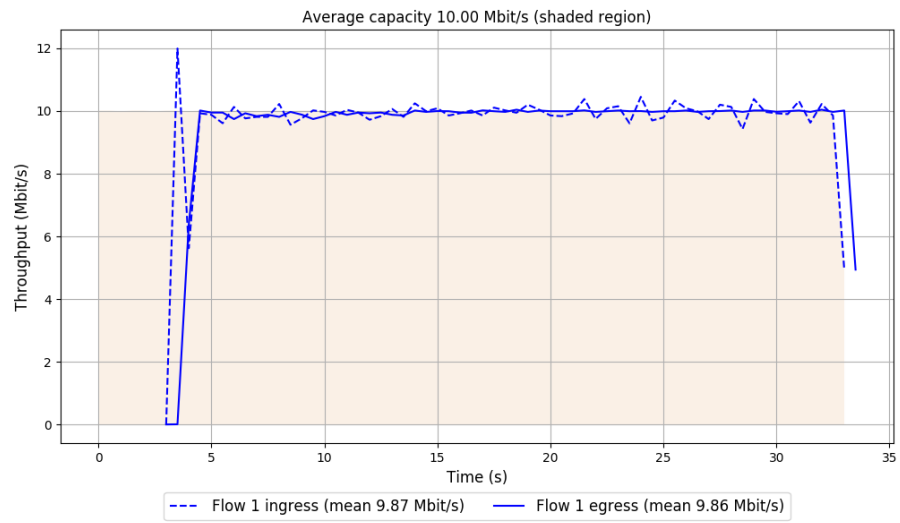Flow 1 (95th percentile 255.86 ms)

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```
Run 1: Statistics of FillP

Start at: 2019-07-29 01:26:59
End at: 2019-07-29 01:27:29

# Below is generated by plot.py at 2019-07-29 01:34:07
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.86 Mbit/s (98.6% utilization)
95th percentile per-packet one-way delay: 75.372 ms
Loss rate: 0.20%
-- Flow 1:
Average throughput: 9.86 Mbit/s
95th percentile per-packet one-way delay: 75.372 ms
Loss rate: 0.20%
```

Run 1: Report of FillP — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 9.87 Mbit/s) — Flow 1 egress (mean 9.86 Mbit/s)

• Flow 1 (95th percentile 75.37 ms)

```
Run 1: Statistics of FillP-Sheep

Start at: 2019-07-29 01:19:28
End at: 2019-07-29 01:19:58

# Below is generated by plot.py at 2019-07-29 01:34:11
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.08 Mbit/s (90.8% utilization)
95th percentile per-packet one-way delay: 58.398 ms
Loss rate: 0.11%
-- Flow 1:
Average throughput: 9.08 Mbit/s
95th percentile per-packet one-way delay: 58.398 ms
Loss rate: 0.11%
```
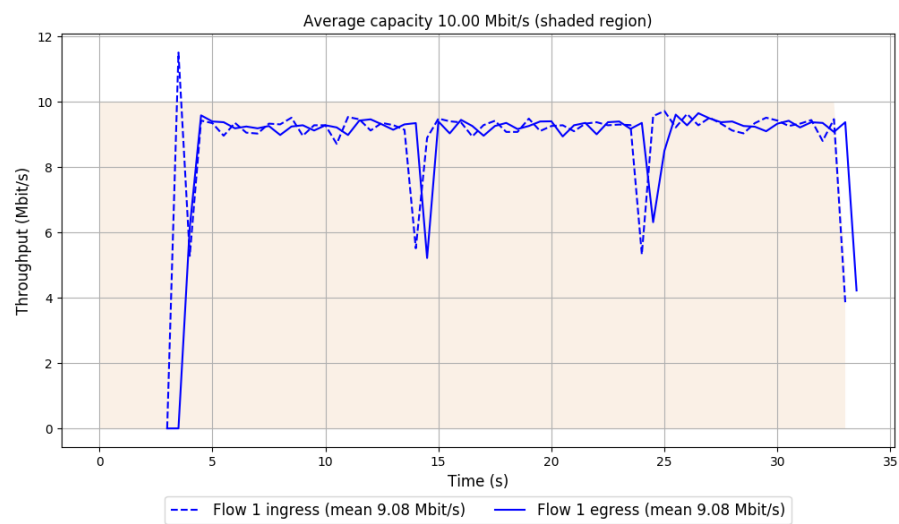
Run 1: Report of FillP-Sheep — Data Link

Average capacity 10.00 Mbit/s (shaded region)
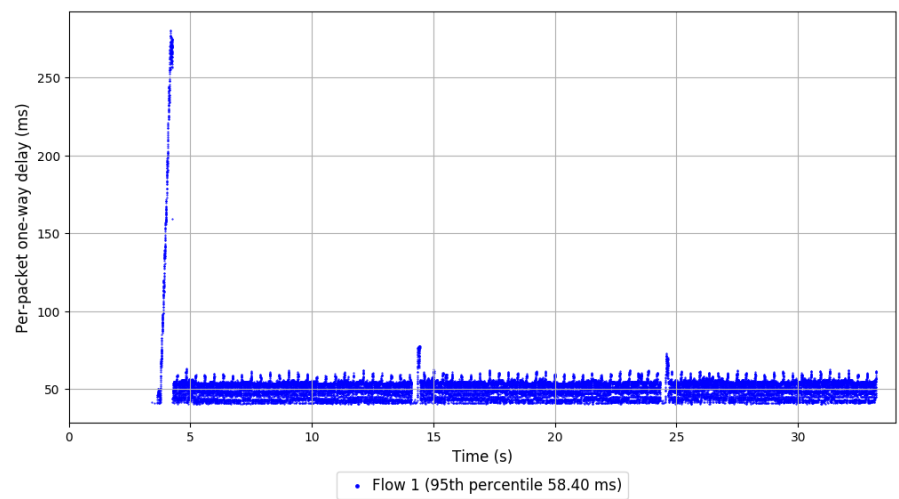
```
Run 1: Statistics of GOLD

Start at: 2019-07-29 01:21:47
End at: 2019-07-29 01:22:17

# Below is generated by plot.py at 2019-07-29 01:34:11
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 6.56 Mbit/s (65.6% utilization)
95th percentile per-packet one-way delay: 768.322 ms
Loss rate: 2.67%
-- Flow 1:
Average throughput: 6.56 Mbit/s
95th percentile per-packet one-way delay: 768.322 ms
Loss rate: 2.67%
```
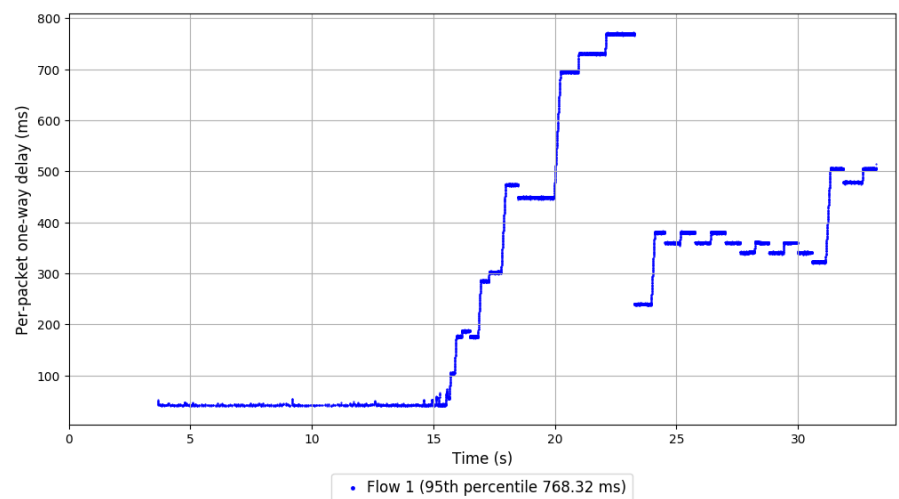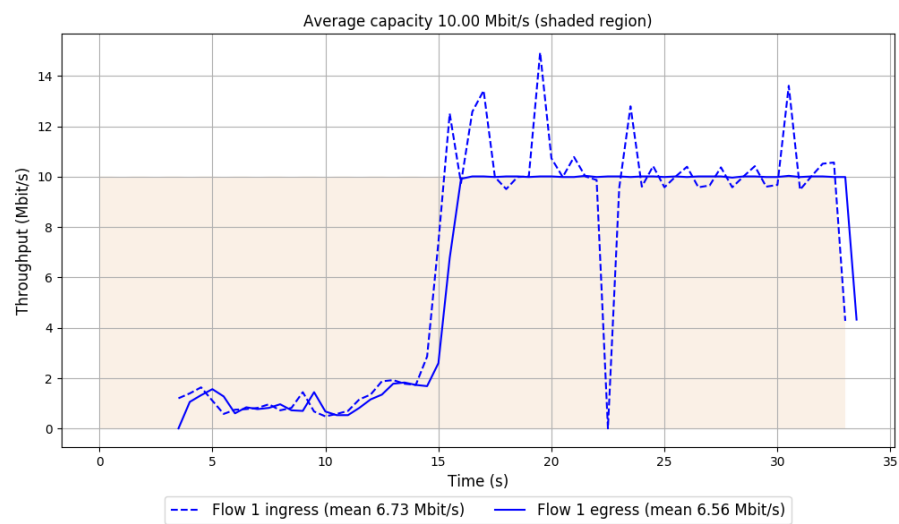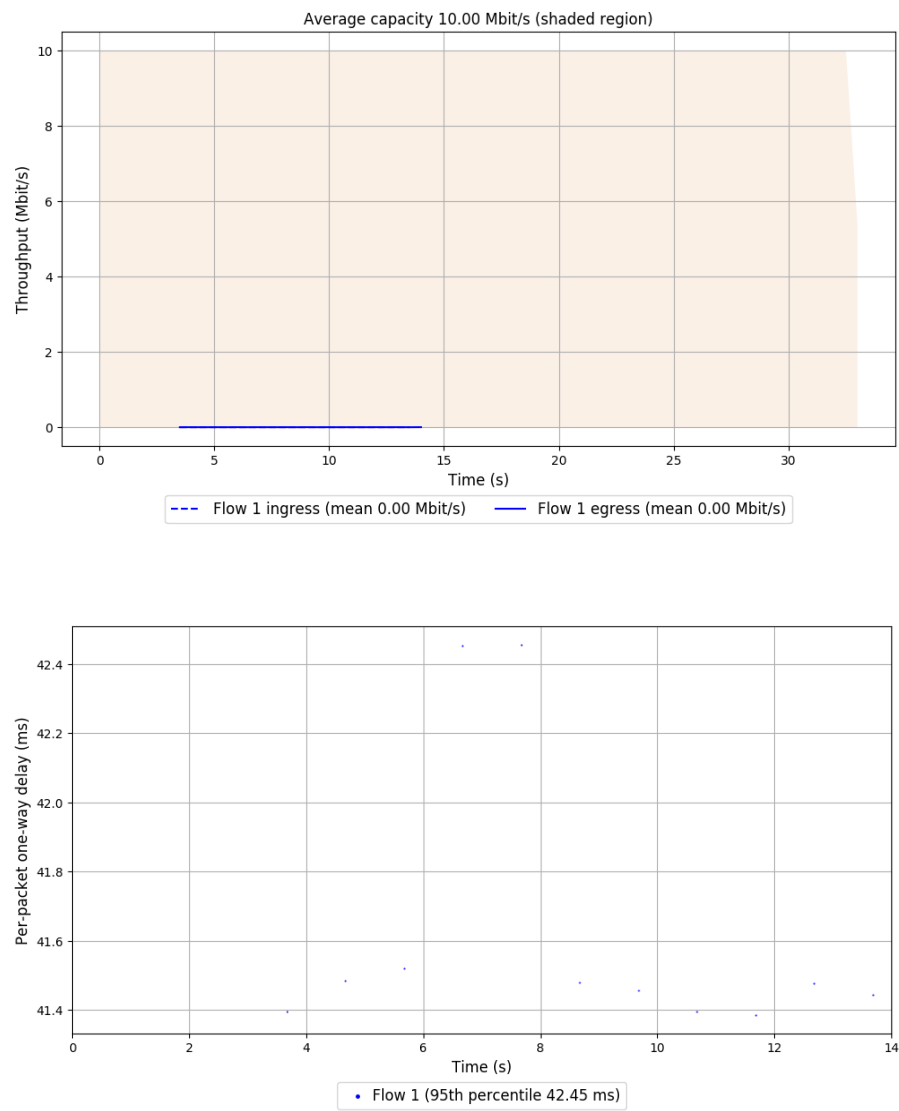
Run 1: Report of GOLD — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 6.73 Mbit/s) ----- Flow 1 egress (mean 6.56 Mbit/s) ——

• Flow 1 (95th percentile 768.32 ms)

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Run 1: Statistics of GoldLSTM

Start at: 2019-07-29 01:25:50
End at: 2019-07-29 01:26:20

Run 1: Report of GoldLSTM — Data Link

Average capacity 10.00 Mbit/s (shaded region)

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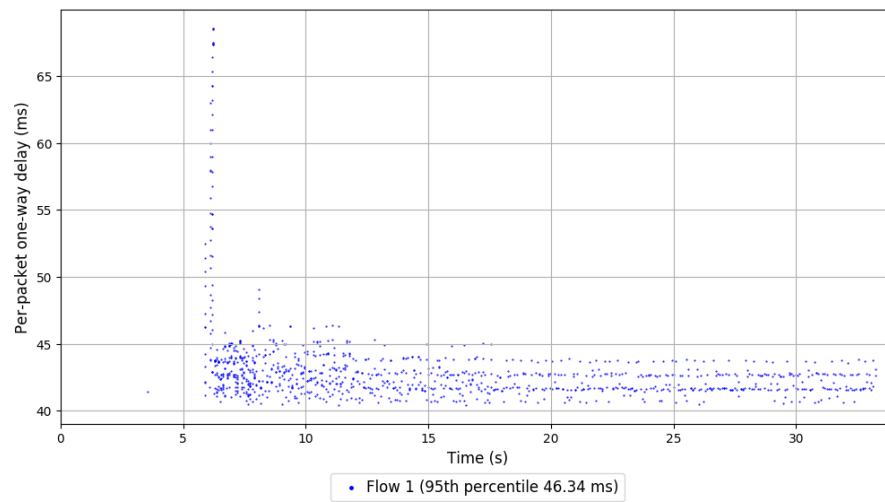

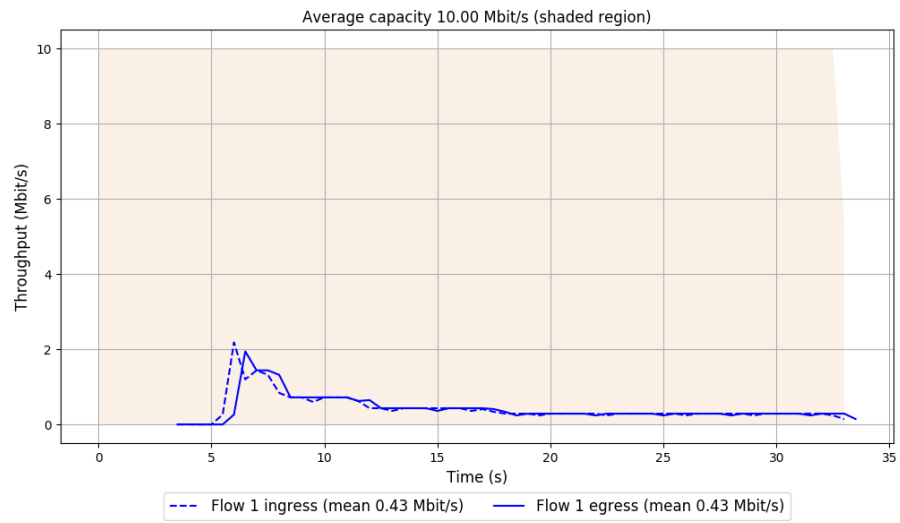
• Flow 1 (95th percentile 42.45 ms)

```
Run 1: Statistics of Indigo

Start at: 2019-07-29 01:20:38
End at: 2019-07-29 01:21:08

# Below is generated by plot.py at 2019-07-29 01:34:11
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 0.43 Mbit/s (4.3% utilization)
95th percentile per-packet one-way delay: 46.343 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.43 Mbit/s
95th percentile per-packet one-way delay: 46.343 ms
Loss rate: 0.00%
```

Run 1: Report of Indigo — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 0.43 Mbit/s) —— Flow 1 egress (mean 0.43 Mbit/s)

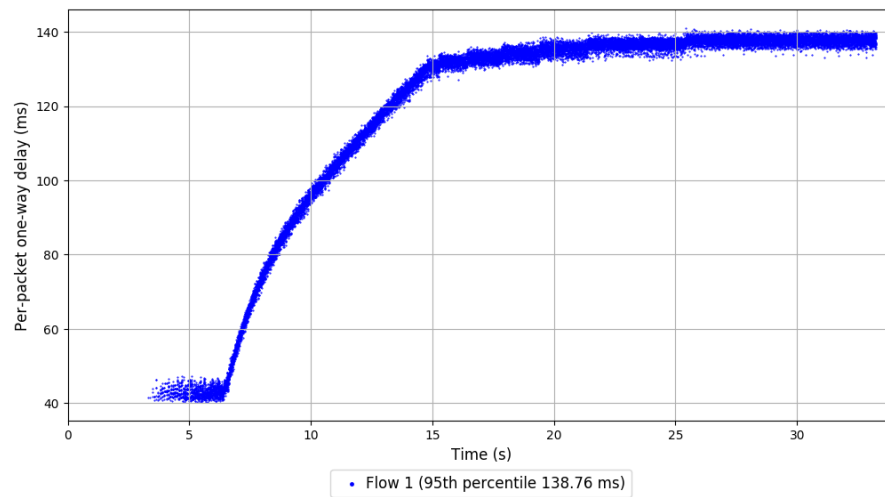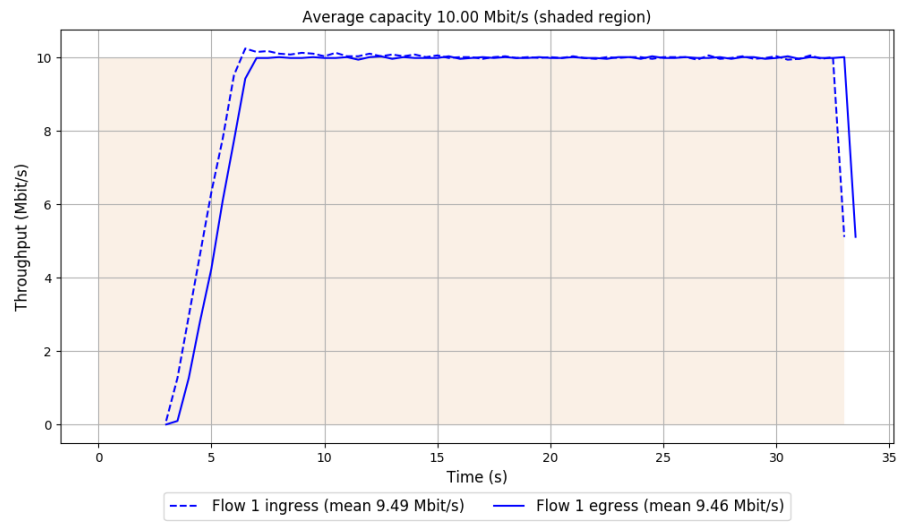• Flow 1 (95th percentile 46.34 ms)

```
Run 1: Statistics of LEDBAT

Start at: 2019-07-29 01:29:51
End at: 2019-07-29 01:30:21

# Below is generated by plot.py at 2019-07-29 01:34:17
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.46 Mbit/s (94.6% utilization)
95th percentile per-packet one-way delay: 138.758 ms
Loss rate: 0.48%
-- Flow 1:
Average throughput: 9.46 Mbit/s
95th percentile per-packet one-way delay: 138.758 ms
Loss rate: 0.48%
```

Run 1: Report of LEDBAT — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 9.49 Mbit/s)   Flow 1 egress (mean 9.46 Mbit/s)

Flow 1 (95th percentile 138.76 ms)

```
Run 1: Statistics of PCC-Allegro

Start at: 2019-07-29 01:28:42
End at: 2019-07-29 01:29:12

# Below is generated by plot.py at 2019-07-29 01:34:17
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 8.69 Mbit/s (86.9% utilization)
95th percentile per-packet one-way delay: 421.967 ms
Loss rate: 0.15%
-- Flow 1:
Average throughput: 8.69 Mbit/s
95th percentile per-packet one-way delay: 421.967 ms
Loss rate: 0.15%
```
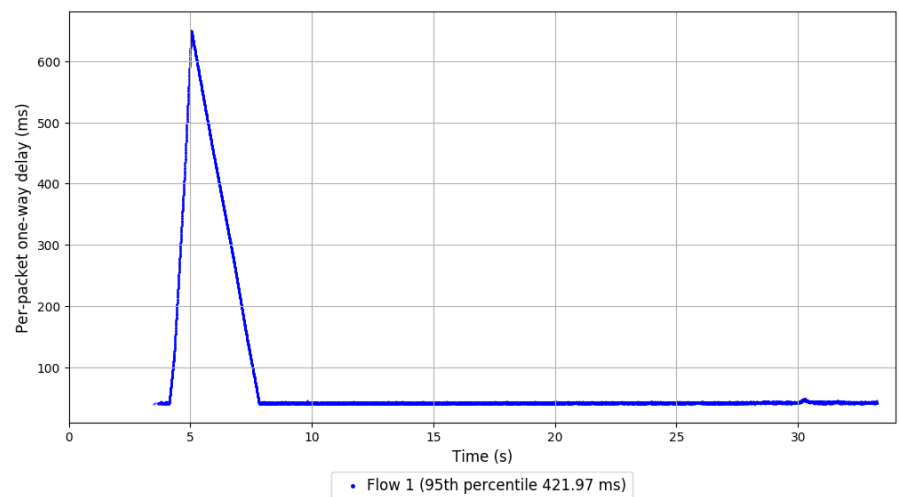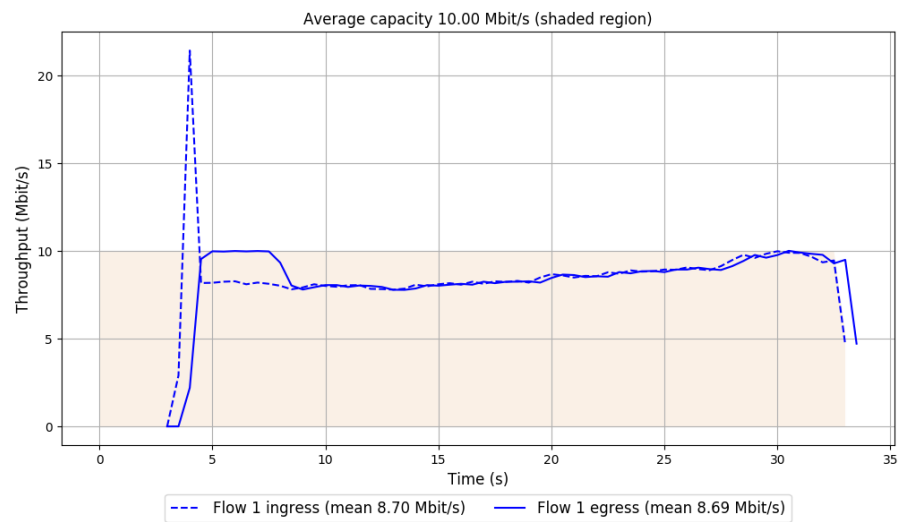
Run 1: Report of PCC-Allegro — Data Link

Average capacity 10.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 8.70 Mbit/s) ⸺ Flow 1 egress (mean 8.69 Mbit/s)
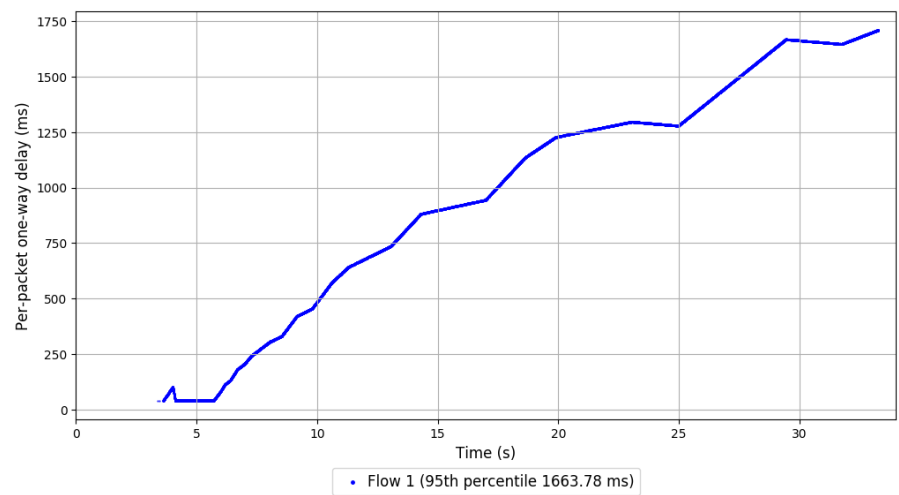

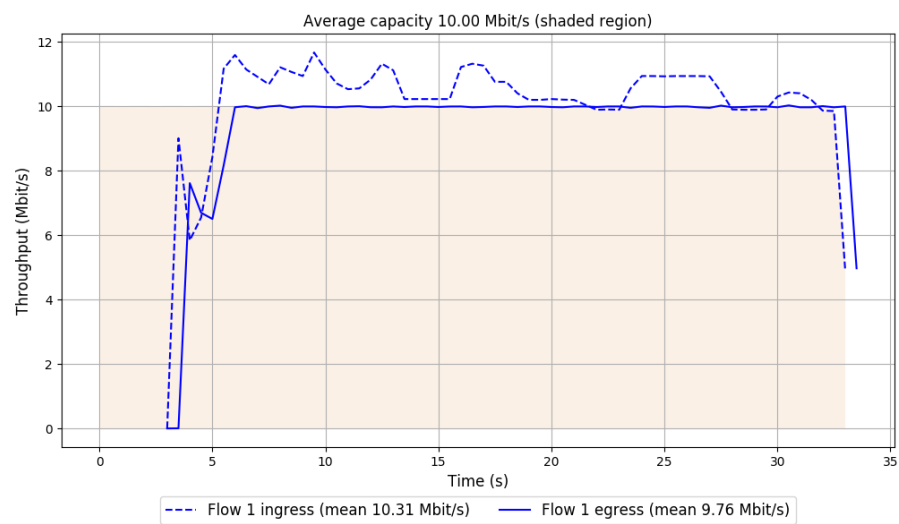• Flow 1 (95th percentile 421.97 ms)

```
Run 1: Statistics of PCC-Expr

Start at: 2019-07-29 01:30:26
End at: 2019-07-29 01:30:56

# Below is generated by plot.py at 2019-07-29 01:34:26
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.76 Mbit/s (97.6% utilization)
95th percentile per-packet one-way delay: 1663.780 ms
Loss rate: 5.50%
-- Flow 1:
Average throughput: 9.76 Mbit/s
95th percentile per-packet one-way delay: 1663.780 ms
Loss rate: 5.50%
```

Run 1: Report of PCC-Expr — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 10.31 Mbit/s) Flow 1 egress (mean 9.76 Mbit/s)

Flow 1 (95th percentile 1663.78 ms)

Run 1: Statistics of QUIC Cubic

Start at: 2019-07-29 01:28:08
End at: 2019-07-29 01:28:38

Run 1: Report of QUIC Cubic — Data Link
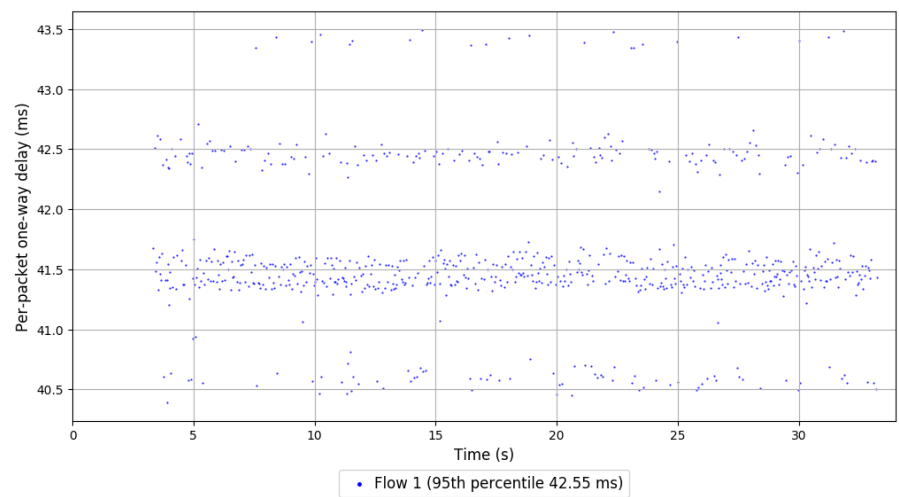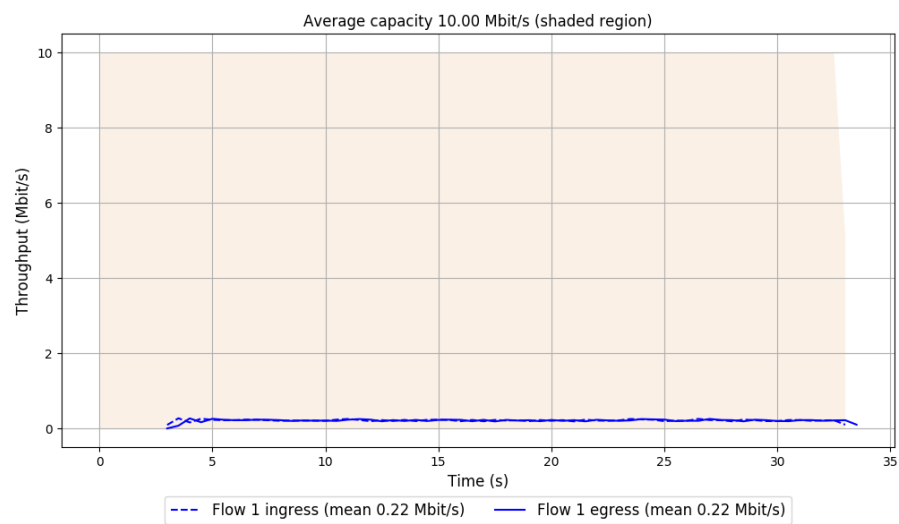
Figure is missing

Figure is missing

```
Run 1: Statistics of SCReAM

Start at: 2019-07-29 01:27:34
End at: 2019-07-29 01:28:04

# Below is generated by plot.py at 2019-07-29 01:34:26
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 0.22 Mbit/s (2.2% utilization)
95th percentile per-packet one-way delay: 42.550 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 42.550 ms
Loss rate: 0.13%
```

Run 1: Report of SCReAM — Data Link

Average capacity 10.00 Mbit/s (shaded region)

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

• Flow 1 (95th percentile 42.55 ms)

34

```
Run 1: Statistics of Sprout

Start at: 2019-07-29 01:22:56
End at: 2019-07-29 01:23:26

# Below is generated by plot.py at 2019-07-29 01:34:26
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 3.31 Mbit/s (33.1% utilization)
95th percentile per-packet one-way delay: 66.869 ms
Loss rate: 0.15%
-- Flow 1:
Average throughput: 3.31 Mbit/s
95th percentile per-packet one-way delay: 66.869 ms
Loss rate: 0.15%
```
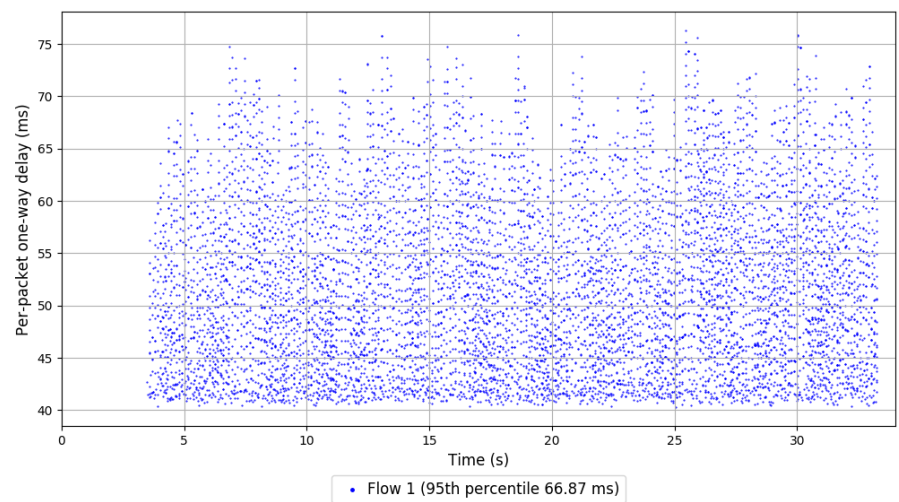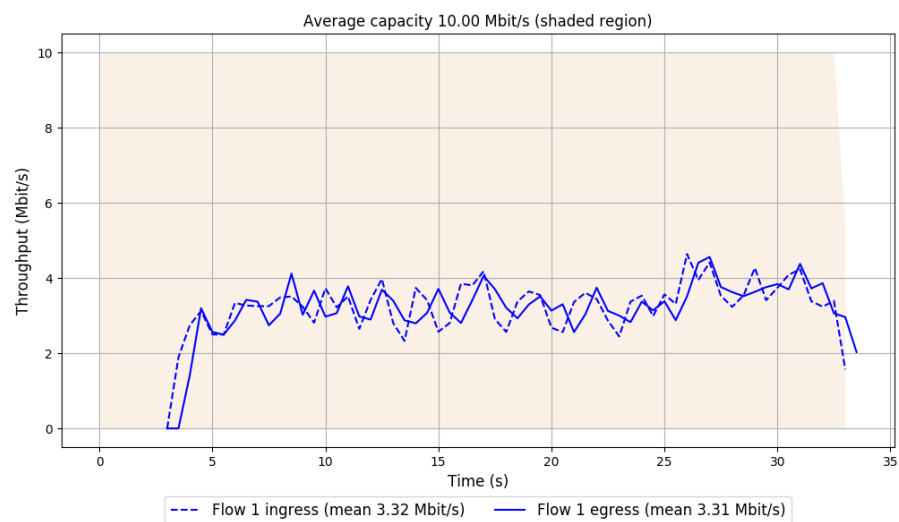
Run 1: Report of Sprout — Data Link

Average capacity 10.00 Mbit/s (shaded region)

Flow 1 ingress (mean 3.32 Mbit/s)   Flow 1 egress (mean 3.31 Mbit/s)

Flow 1 (95th percentile 66.87 ms)

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

Start at: 2019-07-29 01:26:24
End at: 2019-07-29 01:26:54


# Below is generated by plot.py at 2019-07-29 01:34:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.43 Mbit/s (94.3% utilization)
95th percentile per-packet one-way delay: 65.128 ms
Loss rate: 0.17%
-- Flow 1:
Average throughput: 9.43 Mbit/s
95th percentile per-packet one-way delay: 65.128 ms
Loss rate: 0.17%
```
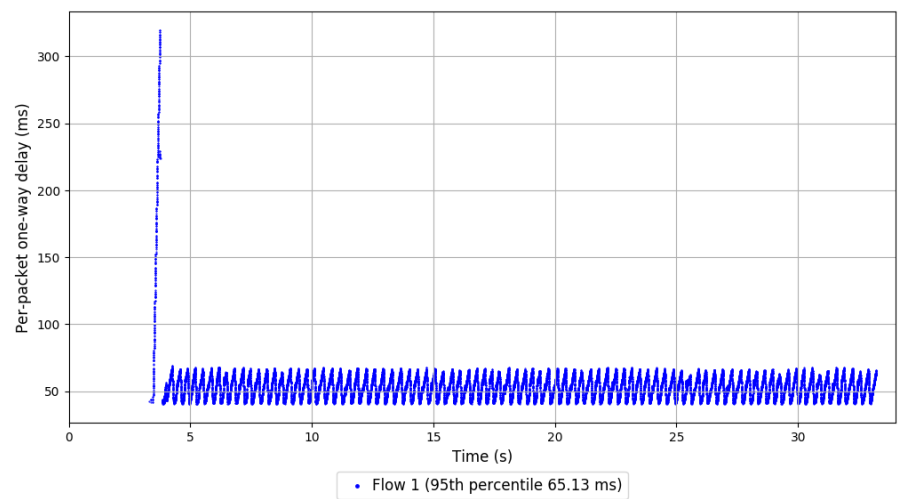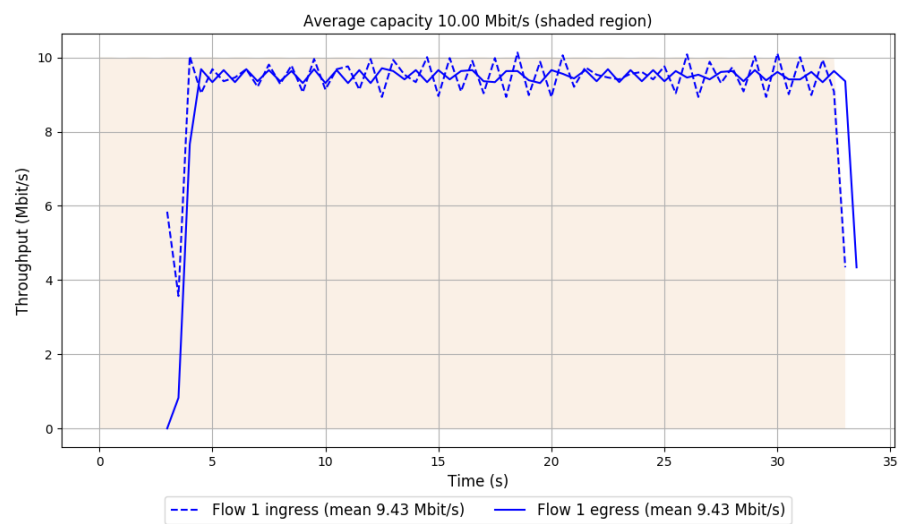
Run 1: Report of TaoVA-100x — Data Link

Average capacity 10.00 Mbit/s (shaded region)

```
Run 1: Statistics of TCP Vegas

Start at: 2019-07-29 01:24:41
End at: 2019-07-29 01:25:11

# Below is generated by plot.py at 2019-07-29 01:34:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.92 Mbit/s (99.2% utilization)
95th percentile per-packet one-way delay: 132.786 ms
Loss rate: 0.16%
-- Flow 1:
Average throughput: 9.92 Mbit/s
95th percentile per-packet one-way delay: 132.786 ms
Loss rate: 0.16%
```
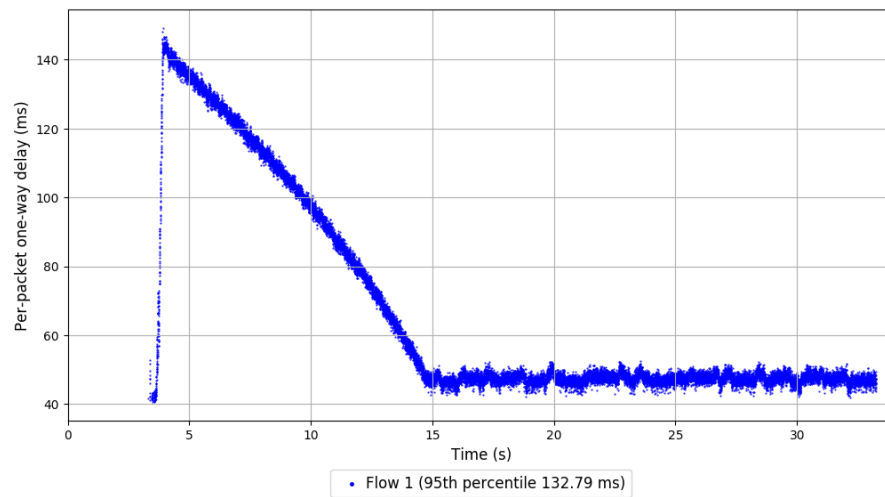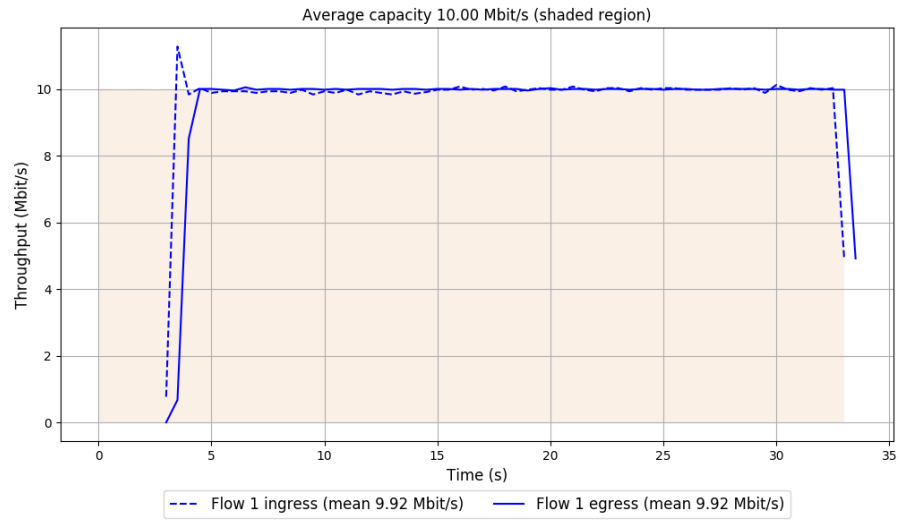
Run 1: Report of TCP Vegas — Data Link

Average capacity 10.00 Mbit/s (shaded region)

```
Run 1: Statistics of Verus

Start at: 2019-07-29 01:21:12
End at: 2019-07-29 01:21:42

# Below is generated by plot.py at 2019-07-29 01:34:29
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.86 Mbit/s (98.6% utilization)
95th percentile per-packet one-way delay: 471.555 ms
Loss rate: 1.46%
-- Flow 1:
Average throughput: 9.86 Mbit/s
95th percentile per-packet one-way delay: 471.555 ms
Loss rate: 1.46%
```
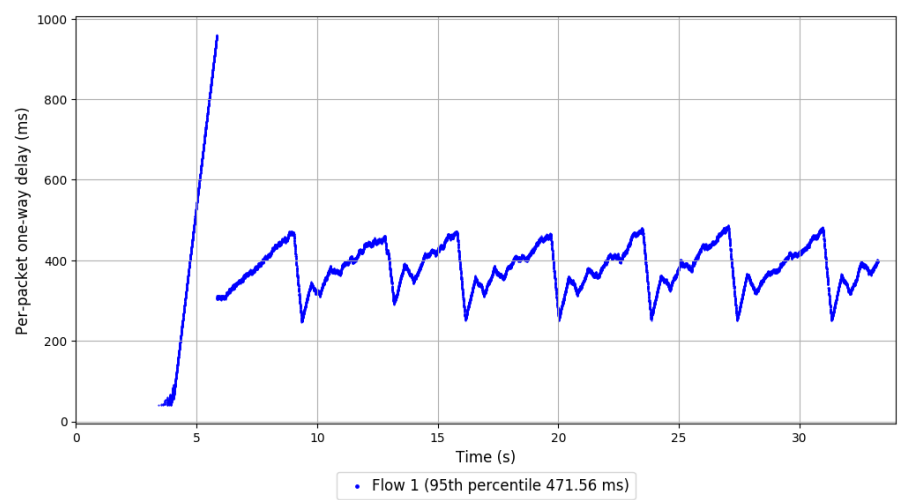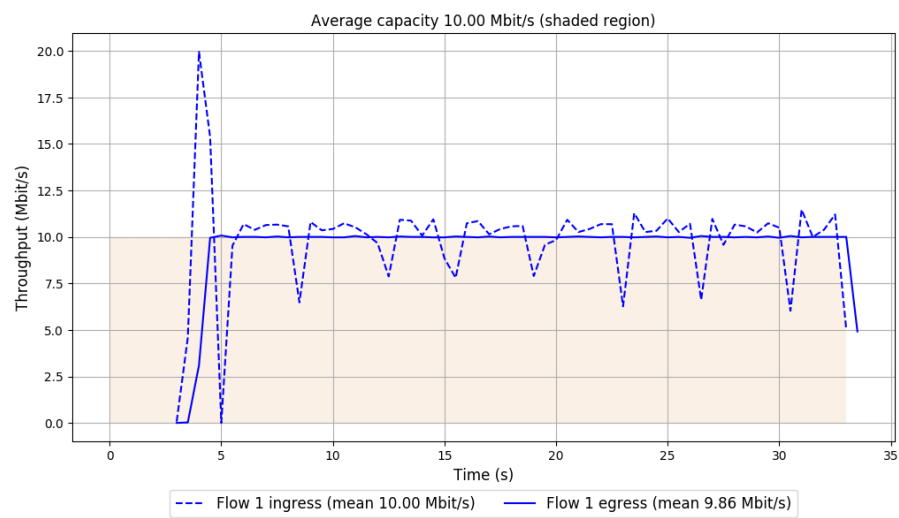
Run 1: Report of Verus — Data Link

Average capacity 10.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 10.00 Mbit/s) —— Flow 1 egress (mean 9.86 Mbit/s)

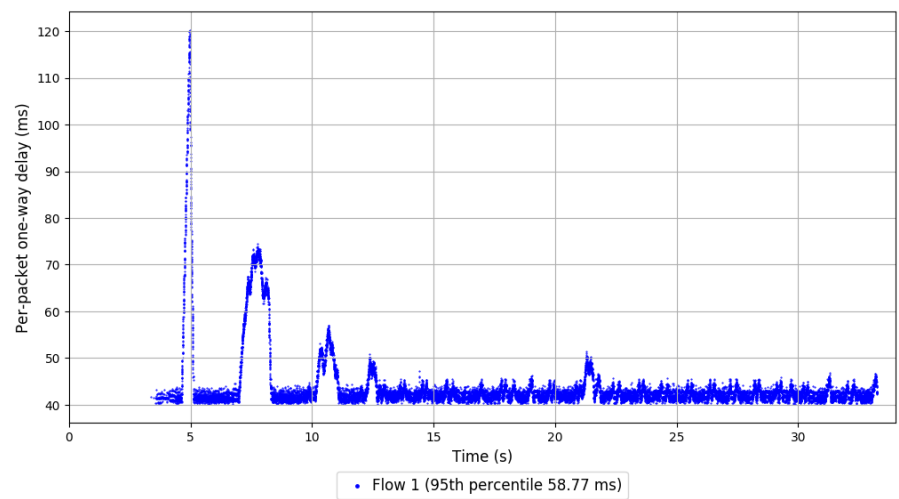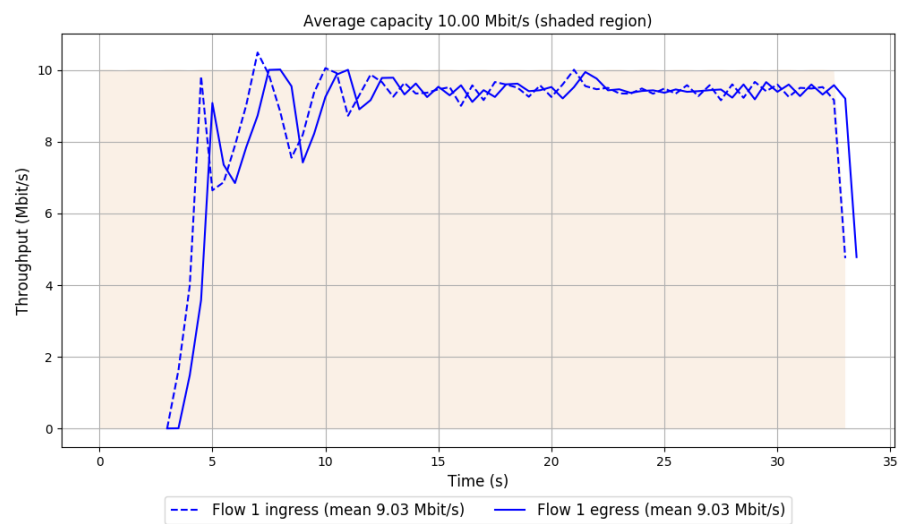
• Flow 1 (95th percentile 471.56 ms)

```
Run 1: Statistics of PCC-Vivace

Start at: 2019-07-29 01:24:06
End at: 2019-07-29 01:24:36

# Below is generated by plot.py at 2019-07-29 01:34:30
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 9.03 Mbit/s (90.3% utilization)
95th percentile per-packet one-way delay: 58.771 ms
Loss rate: 0.14%
-- Flow 1:
Average throughput: 9.03 Mbit/s
95th percentile per-packet one-way delay: 58.771 ms
Loss rate: 0.14%
```

Run 1: Report of PCC-Vivace — Data Link

Average capacity 10.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 9.03 Mbit/s)   —— Flow 1 egress (mean 9.03 Mbit/s)

• Flow 1 (95th percentile 58.77 ms)

```
Run 1: Statistics of WebRTC media

Start at: 2019-07-29 01:29:17
End at: 2019-07-29 01:29:47


# Below is generated by plot.py at 2019-07-29 01:34:30
# Datalink statistics
-- Total of 1 flow:
Average capacity: 10.00 Mbit/s
Average throughput: 2.21 Mbit/s (22.1% utilization)
95th percentile per-packet one-way delay: 46.473 ms
Loss rate: 0.16%
-- Flow 1:
Average throughput: 2.21 Mbit/s
95th percentile per-packet one-way delay: 46.473 ms
Loss rate: 0.16%
```

Run 1: Report of WebRTC media — Data Link

Average capacity 10.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 2.21 Mbit/s) —— Flow 1 egress (mean 2.21 Mbit/s)

• Flow 1 (95th percentile 46.47 ms)