Pantheon Report

Generated at 2019-07-30 07:14:25 (UTC).
Tested in mahimahi: `mm-delay 40 mm-link 120mbps.trace 120mbps.trace`
Repeated the test of 21 congestion control schemes once.
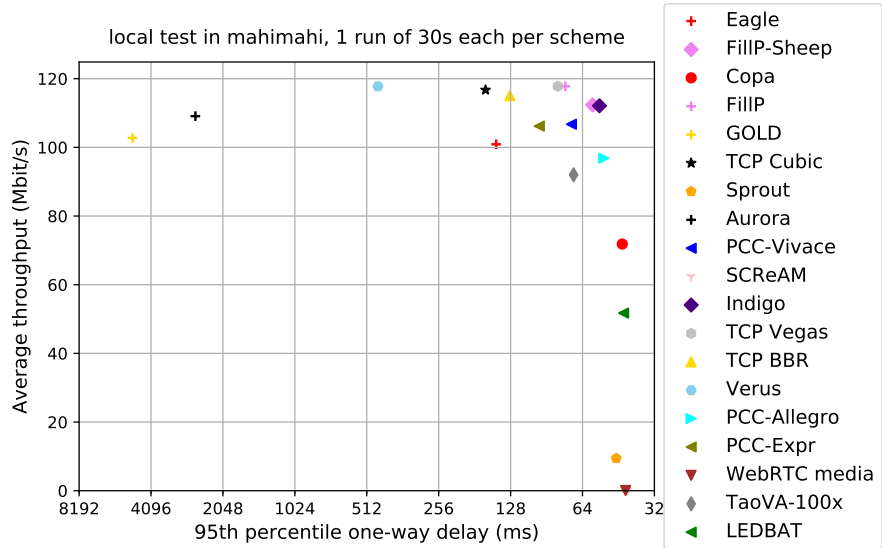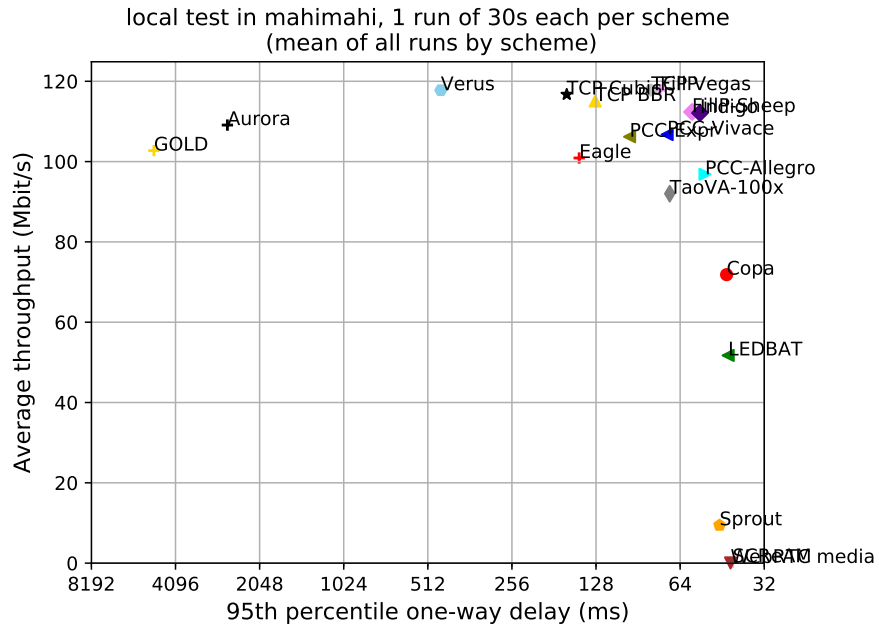Each test lasted for 30 seconds running 1 flow.

```
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 @ 1cd76c3fa289ac6a3352a582274d3b9d6a2bd4e8
third_party/aurora @ f3e943d61015b39960854ba6391797e0c7984d74
third_party/aurora-model @ e292c316c23fb837255c4e142e40590d154bbe95
third_party/eagle @ ce4c8d9511b8dfde83c08384f81b2617bfb10438
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	109.09	2670.89	9.81
TCP BBR	1	115.09	128.86	0.37
Copa	1	71.84	43.63	0.20
TCP Cubic	1	116.72	162.95	0.15
Eagle	1	100.89	147.08	0.07
FillP	1	117.80	75.52	0.22
FillP-Sheep	1	112.37	58.03	0.15
GOLD	1	102.74	4894.26	33.77
GoldLSTM	0	N/A	N/A	N/A
Indigo	1	112.12	54.35	0.13
LEDBAT	1	51.73	43.09	0.29
PCC-Allegro	1	96.84	52.13	0.16
PCC-Expr	1	106.19	97.09	0.33
QUIC Cubic	0	N/A	N/A	N/A
SCReAM	1	0.22	41.52	0.13
Sprout	1	9.43	46.25	0.35
TaoVA-100x	1	92.01	69.74	0.28
TCP Vegas	1	117.80	81.24	0.19
Verus	1	117.77	460.06	1.14
PCC-Vivace	1	106.74	71.25	0.15
WebRTC media	1	0.05	42.25	0.00

```
Run 1: Statistics of Aurora

Start at: 2019-07-30 06:58:16
End at: 2019-07-30 06:58:46

# Below is generated by plot.py at 2019-07-30 07:11:55
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 109.09 Mbit/s (90.9% utilization)
95th percentile per-packet one-way delay: 2670.886 ms
Loss rate: 9.81%
-- Flow 1:
Average throughput: 109.09 Mbit/s
95th percentile per-packet one-way delay: 2670.886 ms
Loss rate: 9.81%
```
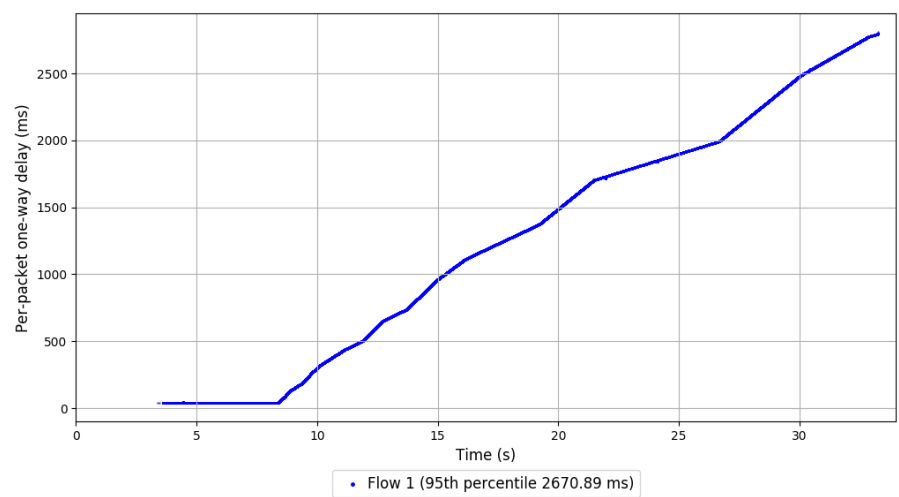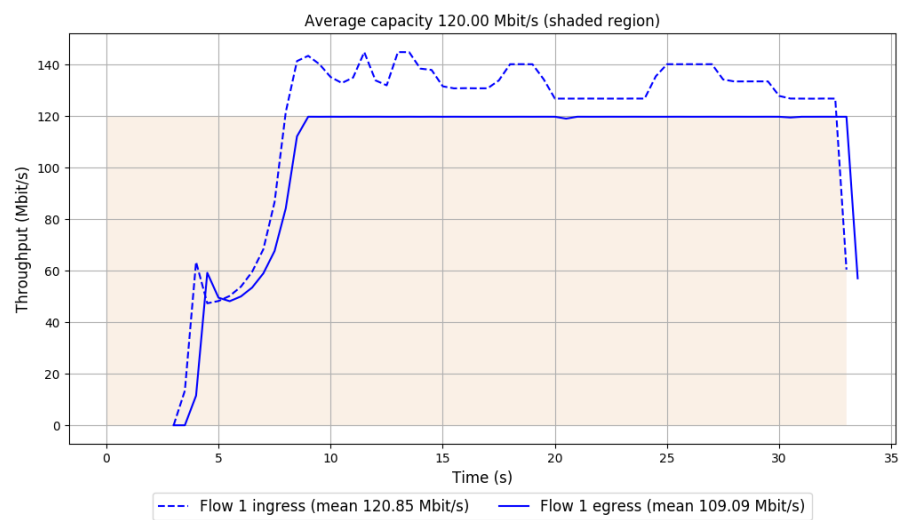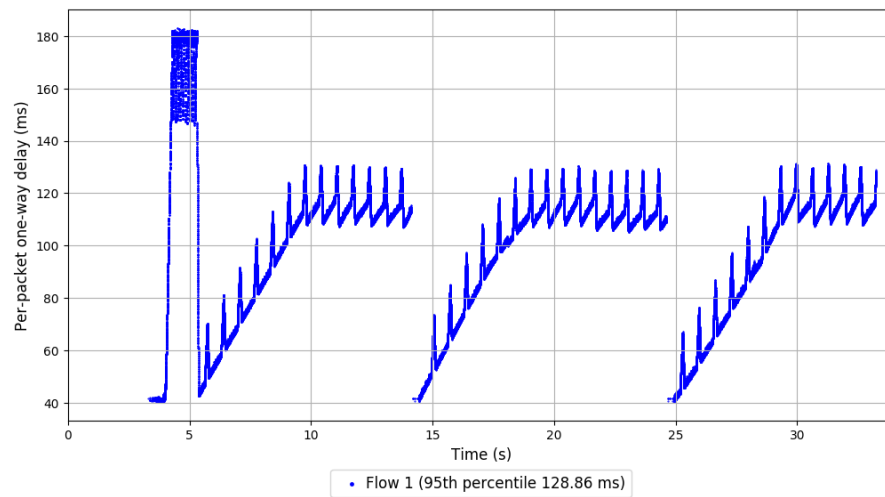
Run 1: Report of Aurora — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 120.85 Mbit/s)   Flow 1 egress (mean 109.09 Mbit/s)

Flow 1 (95th percentile 2670.89 ms)

```
Run 1: Statistics of TCP BBR

Start at: 2019-07-30 07:00:32
End at: 2019-07-30 07:01:02

# Below is generated by plot.py at 2019-07-30 07:11:55
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 115.09 Mbit/s (95.9% utilization)
95th percentile per-packet one-way delay: 128.862 ms
Loss rate: 0.37%
-- Flow 1:
Average throughput: 115.09 Mbit/s
95th percentile per-packet one-way delay: 128.862 ms
Loss rate: 0.37%
```
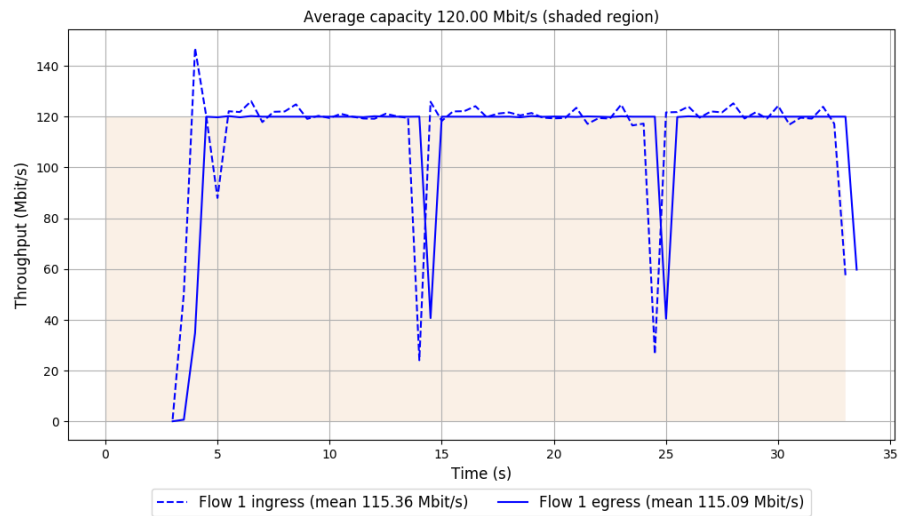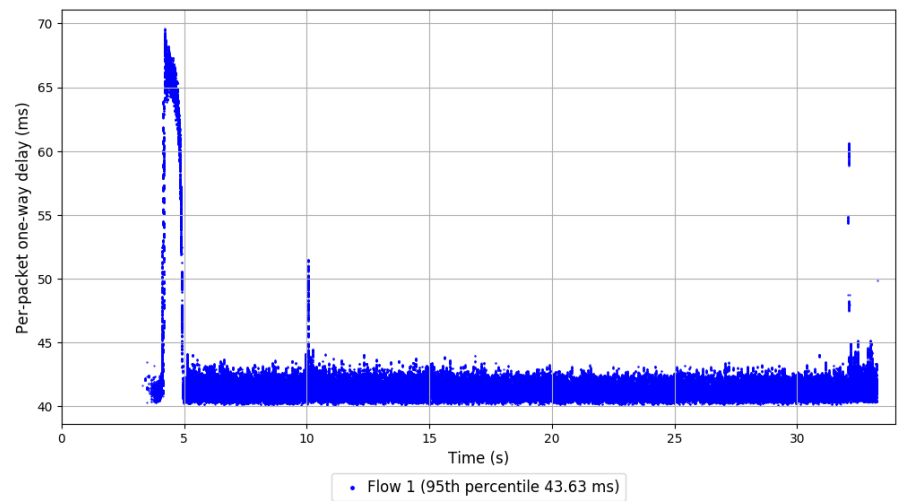
Run 1: Report of TCP BBR — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 115.36 Mbit/s) --- Flow 1 egress (mean 115.09 Mbit/s)

Flow 1 (95th percentile 128.86 ms)

```
Run 1: Statistics of Copa

Start at: 2019-07-30 06:53:59
End at: 2019-07-30 06:54:29

# Below is generated by plot.py at 2019-07-30 07:11:55
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 71.84 Mbit/s (59.9% utilization)
95th percentile per-packet one-way delay: 43.632 ms
Loss rate: 0.20%
-- Flow 1:
Average throughput: 71.84 Mbit/s
95th percentile per-packet one-way delay: 43.632 ms
Loss rate: 0.20%
```
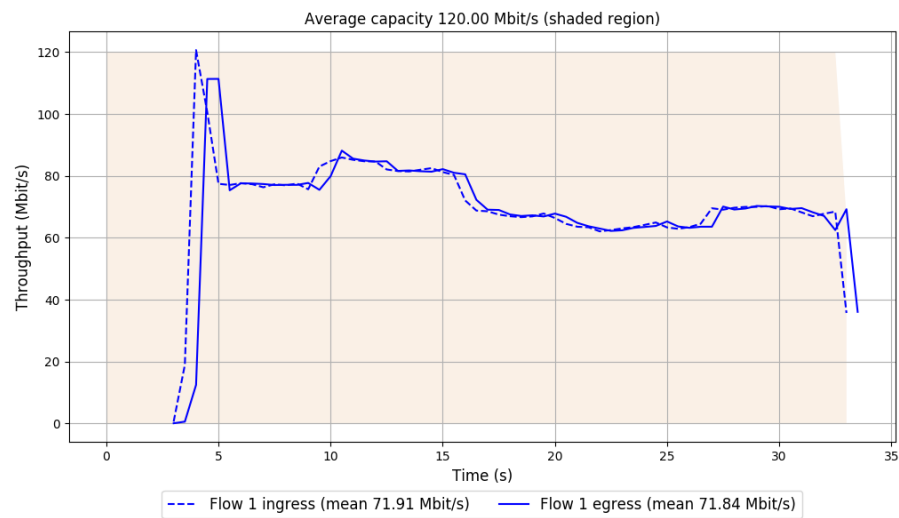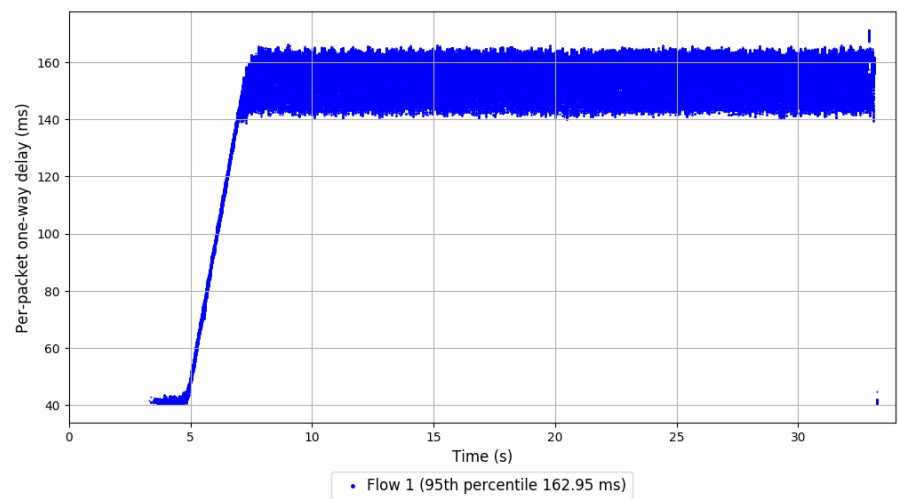
Run 1: Report of Copa — Data Link

Average capacity 120.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 71.91 Mbit/s) — Flow 1 egress (mean 71.84 Mbit/s)

• Flow 1 (95th percentile 43.63 ms)

```
Run 1: Statistics of TCP Cubic

Start at: 2019-07-30 06:56:57
End at: 2019-07-30 06:57:27

# Below is generated by plot.py at 2019-07-30 07:11:55
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 116.72 Mbit/s (97.3% utilization)
95th percentile per-packet one-way delay: 162.946 ms
Loss rate: 0.15%
-- Flow 1:
Average throughput: 116.72 Mbit/s
95th percentile per-packet one-way delay: 162.946 ms
Loss rate: 0.15%
```
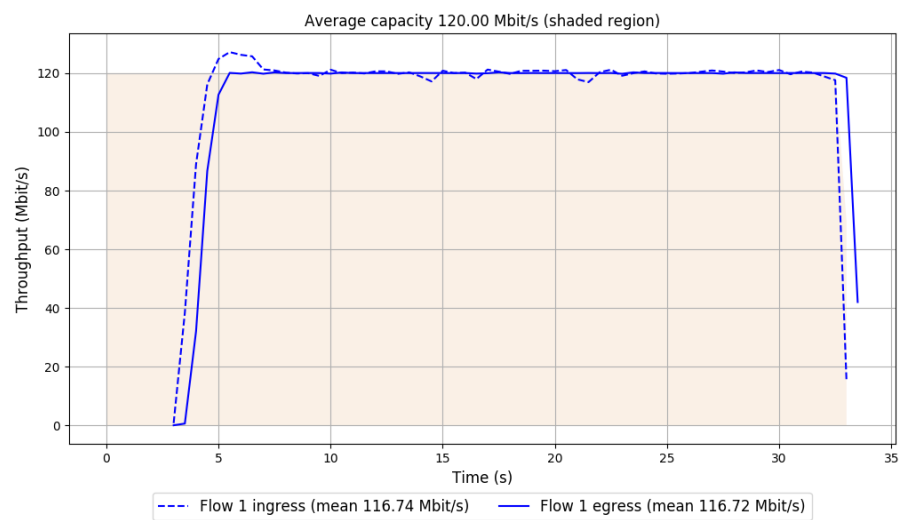
Run 1: Report of TCP Cubic — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 116.74 Mbit/s)   Flow 1 egress (mean 116.72 Mbit/s)

Flow 1 (95th percentile 162.95 ms)

```
Run 1: Statistics of Eagle

Start at: 2019-07-30 06:52:34
End at: 2019-07-30 06:53:04

# Below is generated by plot.py at 2019-07-30 07:11:55
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 100.89 Mbit/s (84.1% utilization)
95th percentile per-packet one-way delay: 147.076 ms
Loss rate: 0.07%
-- Flow 1:
Average throughput: 100.89 Mbit/s
95th percentile per-packet one-way delay: 147.076 ms
Loss rate: 0.07%
```
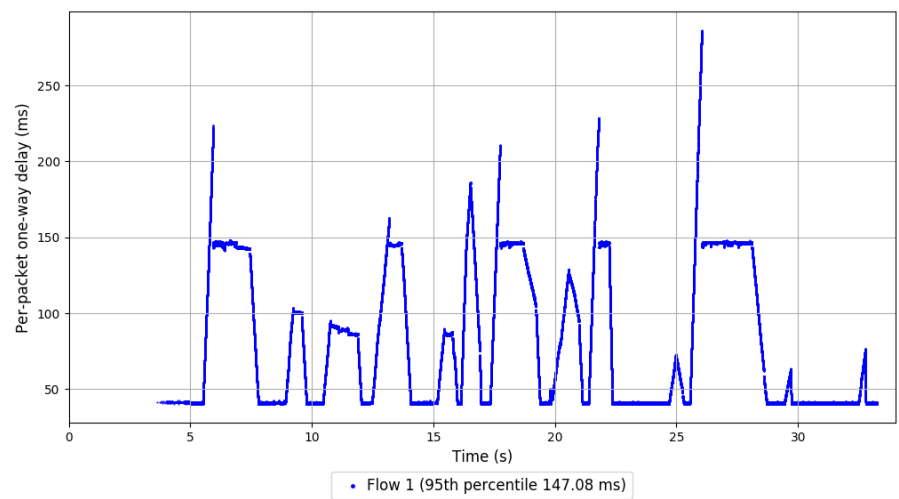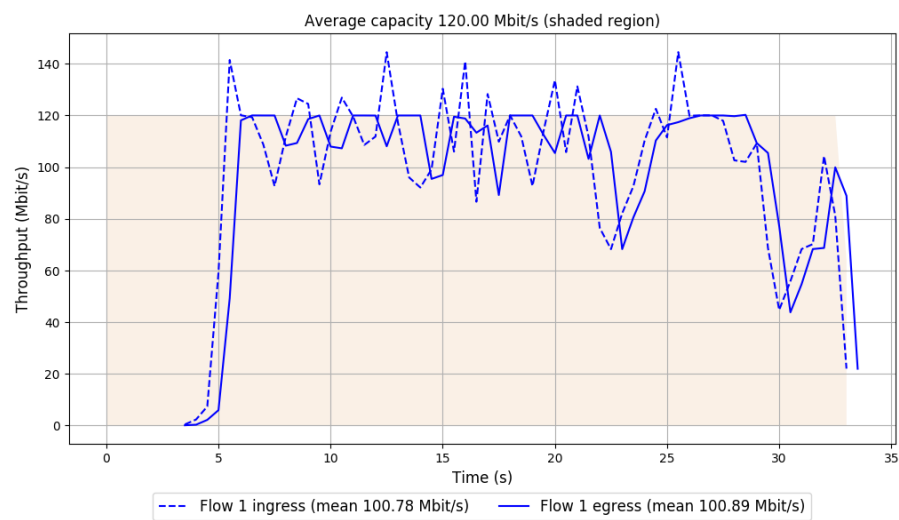
Run 1: Report of Eagle — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 100.78 Mbit/s)   Flow 1 egress (mean 100.89 Mbit/s)
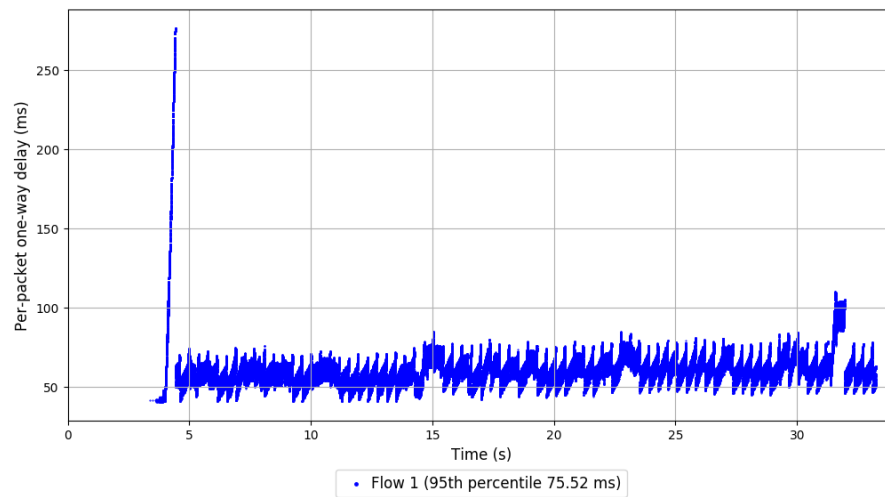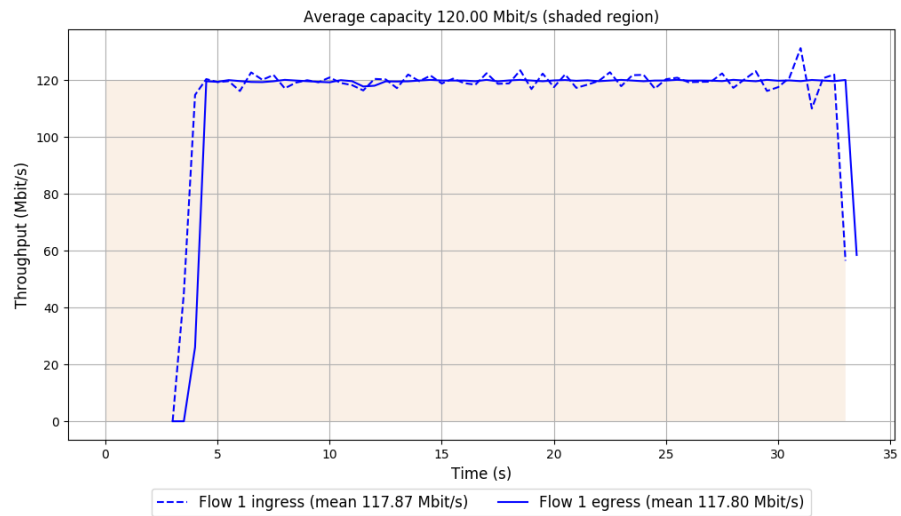

Flow 1 (95th percentile 147.08 ms)

```
Run 1: Statistics of FillP

Start at: 2019-07-30 07:02:37
End at: 2019-07-30 07:03:07

# Below is generated by plot.py at 2019-07-30 07:11:55
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 117.80 Mbit/s (98.2% utilization)
95th percentile per-packet one-way delay: 75.519 ms
Loss rate: 0.22%
-- Flow 1:
Average throughput: 117.80 Mbit/s
95th percentile per-packet one-way delay: 75.519 ms
Loss rate: 0.22%
```

Run 1: Report of FillP — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 117.87 Mbit/s)   Flow 1 egress (mean 117.80 Mbit/s)

Flow 1 (95th percentile 75.52 ms)

```
Run 1: Statistics of FillP-Sheep

Start at: 2019-07-30 06:53:17
End at: 2019-07-30 06:53:47

# Below is generated by plot.py at 2019-07-30 07:12:45
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 112.37 Mbit/s (93.6% utilization)
95th percentile per-packet one-way delay: 58.033 ms
Loss rate: 0.15%
-- Flow 1:
Average throughput: 112.37 Mbit/s
95th percentile per-packet one-way delay: 58.033 ms
Loss rate: 0.15%
```
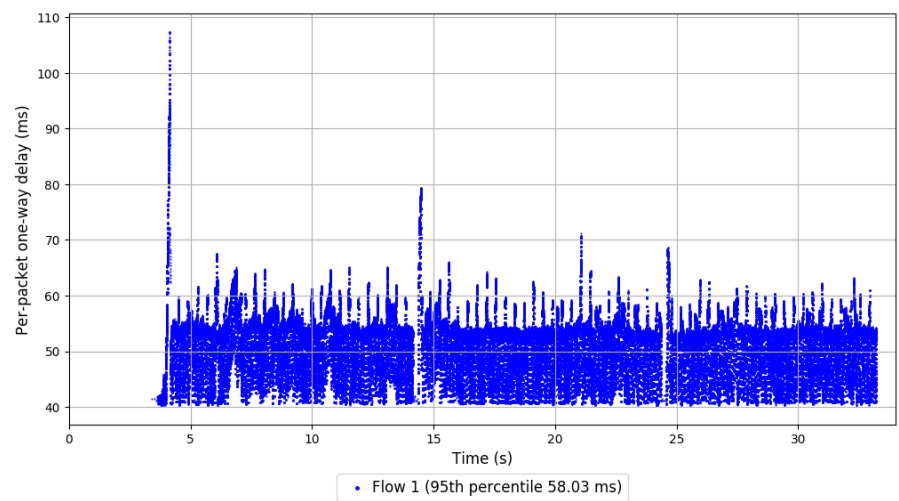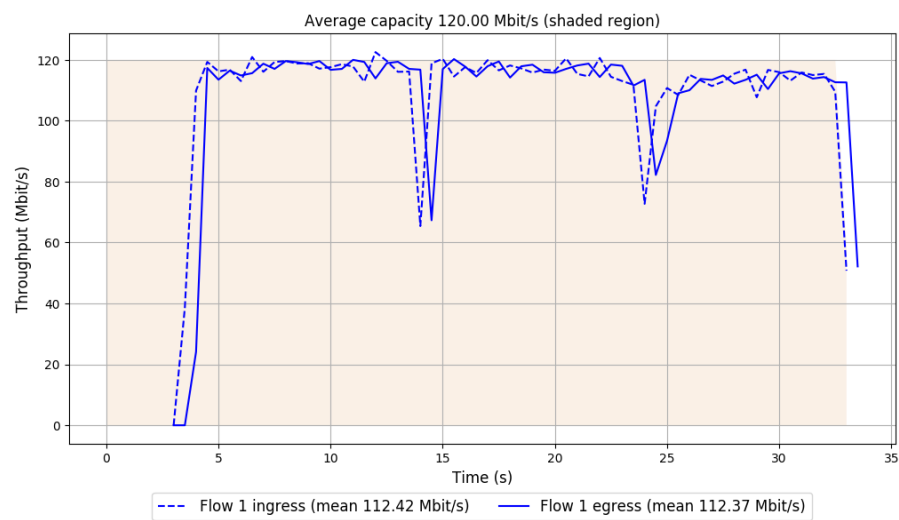
Run 1: Report of FillP-Sheep — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 112.42 Mbit/s) —— Flow 1 egress (mean 112.37 Mbit/s)

• Flow 1 (95th percentile 58.03 ms)

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```
Run 1: Statistics of GOLD

Start at: 2019-07-30 06:56:12
End at: 2019-07-30 06:56:42

# Below is generated by plot.py at 2019-07-30 07:12:45
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 102.74 Mbit/s (85.6% utilization)
95th percentile per-packet one-way delay: 4894.257 ms
Loss rate: 33.77%
-- Flow 1:
Average throughput: 102.74 Mbit/s
95th percentile per-packet one-way delay: 4894.257 ms
Loss rate: 33.77%
```
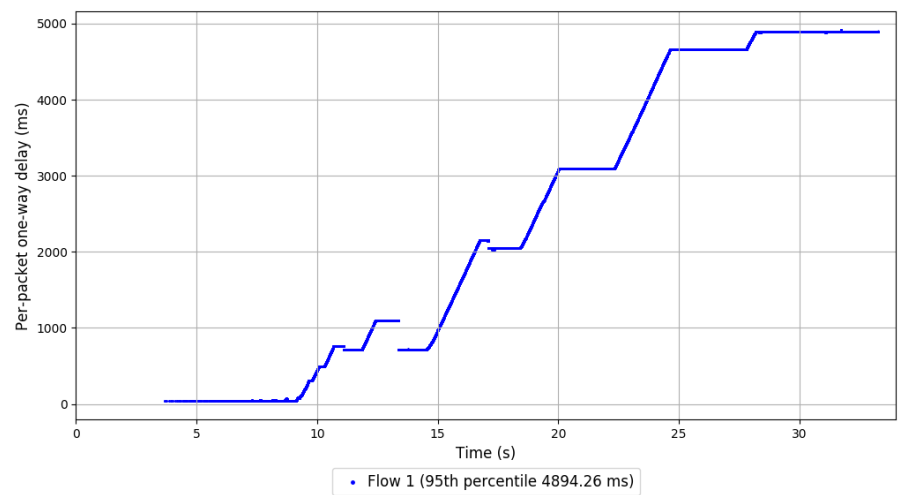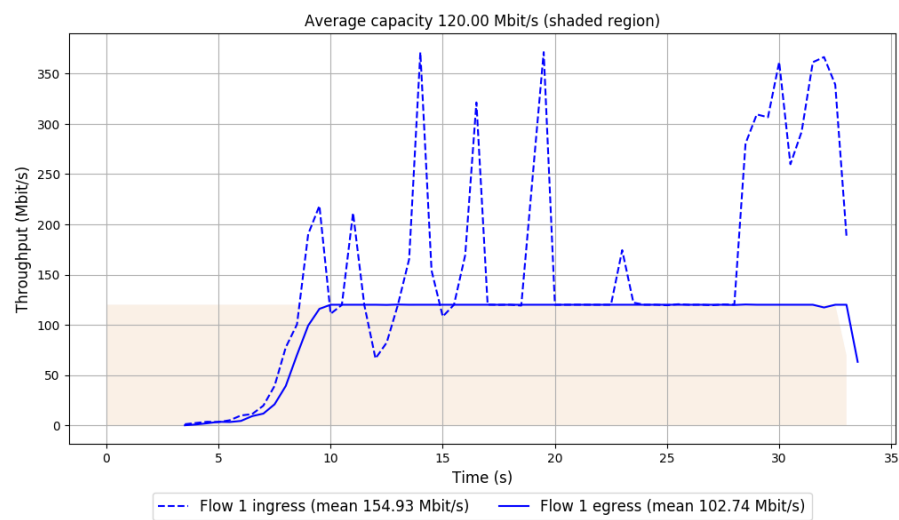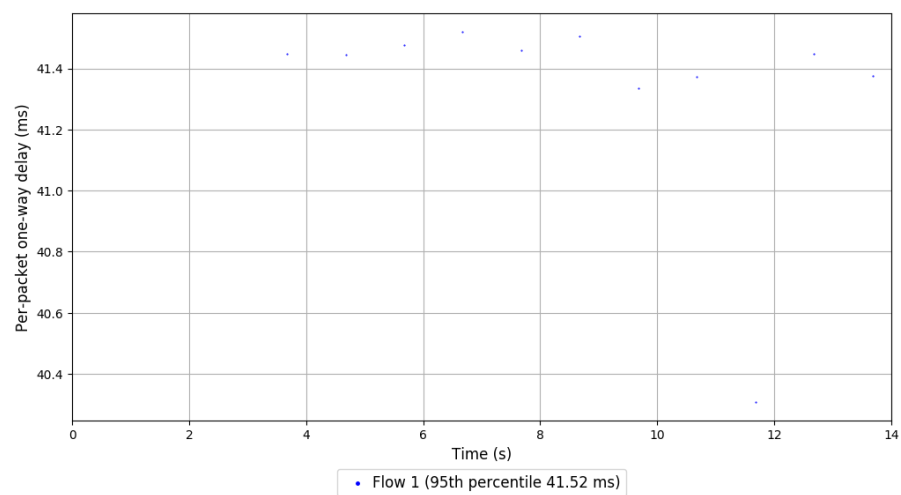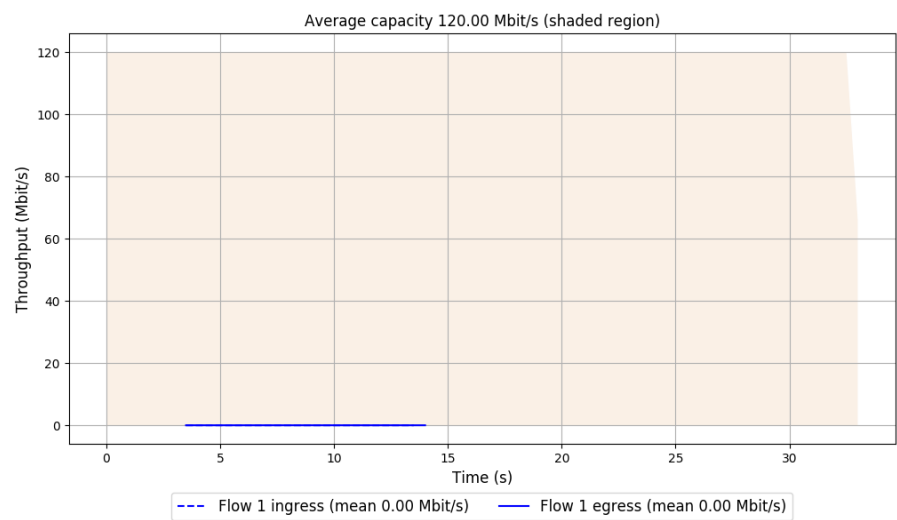
Run 1: Report of GOLD — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 154.93 Mbit/s) — Flow 1 egress (mean 102.74 Mbit/s)

· Flow 1 (95th percentile 4894.26 ms)

Run 1: Statistics of GoldLSTM

Start at: 2019-07-30 07:01:14
End at: 2019-07-30 07:01:44

Run 1: Report of GoldLSTM — Data Link

Average capacity 120.00 Mbit/s (shaded region)

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

Flow 1 (95th percentile 41.52 ms)

```
Run 1: Statistics of Indigo

Start at: 2019-07-30 06:54:42
End at: 2019-07-30 06:55:12

# Below is generated by plot.py at 2019-07-30 07:12:45
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 112.12 Mbit/s (93.4% utilization)
95th percentile per-packet one-way delay: 54.354 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 112.12 Mbit/s
95th percentile per-packet one-way delay: 54.354 ms
Loss rate: 0.13%
```
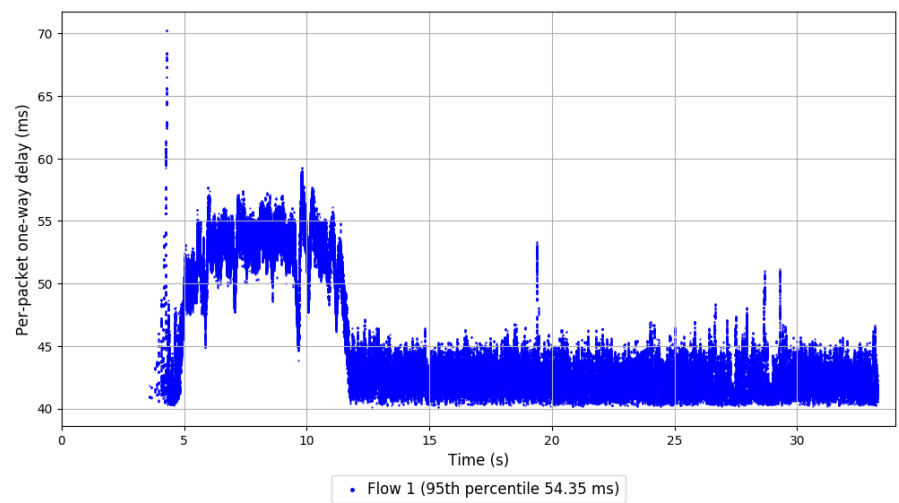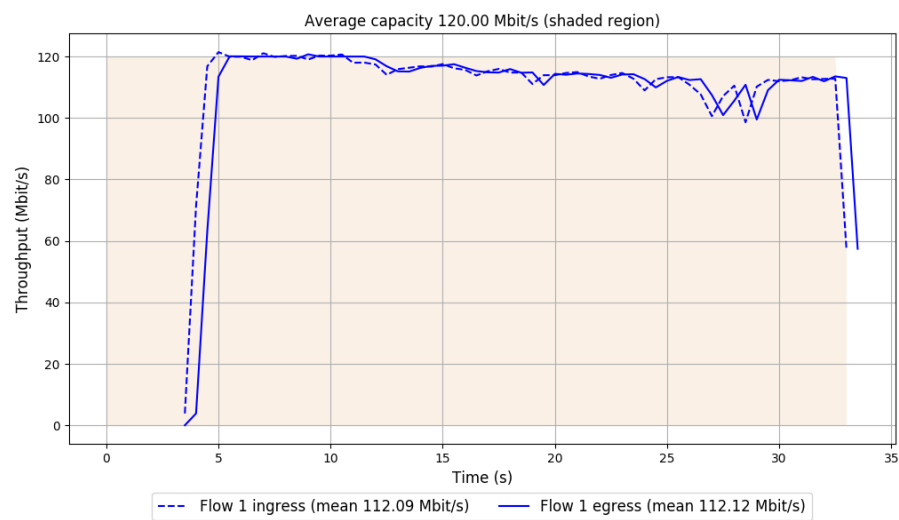
Run 1: Report of Indigo — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 112.09 Mbit/s)   Flow 1 egress (mean 112.12 Mbit/s)

Flow 1 (95th percentile 54.35 ms)

```
Run 1: Statistics of LEDBAT

Start at: 2019-07-30 07:05:45
End at: 2019-07-30 07:06:15

# Below is generated by plot.py at 2019-07-30 07:12:45
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 51.73 Mbit/s (43.1% utilization)
95th percentile per-packet one-way delay: 43.091 ms
Loss rate: 0.29%
-- Flow 1:
Average throughput: 51.73 Mbit/s
95th percentile per-packet one-way delay: 43.091 ms
Loss rate: 0.29%
```
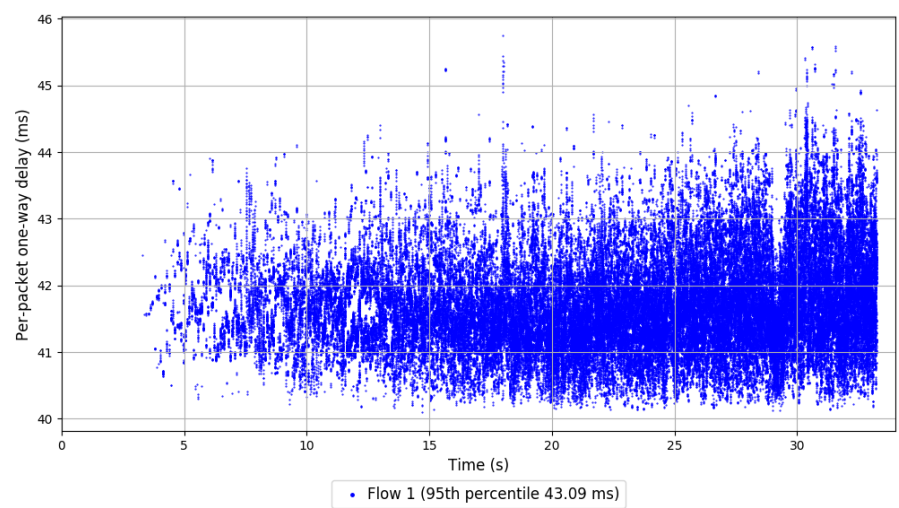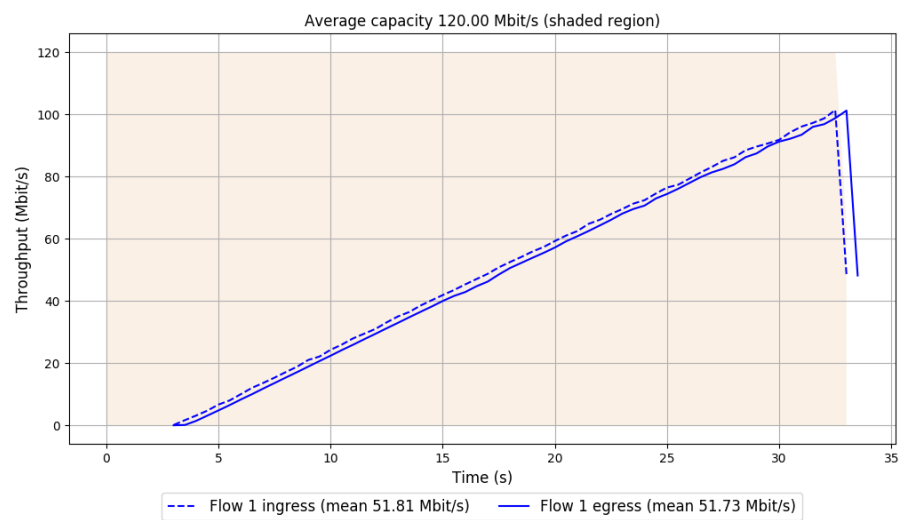
Run 1: Report of LEDBAT — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 51.81 Mbit/s) —— Flow 1 egress (mean 51.73 Mbit/s)

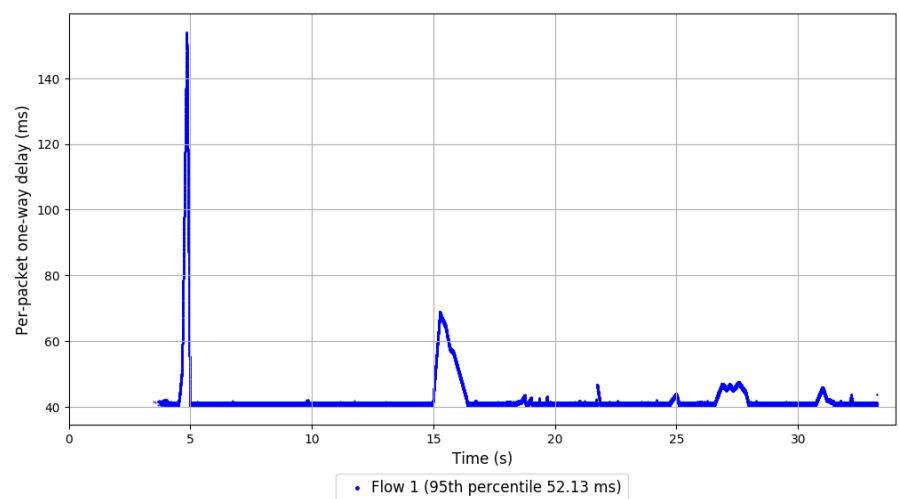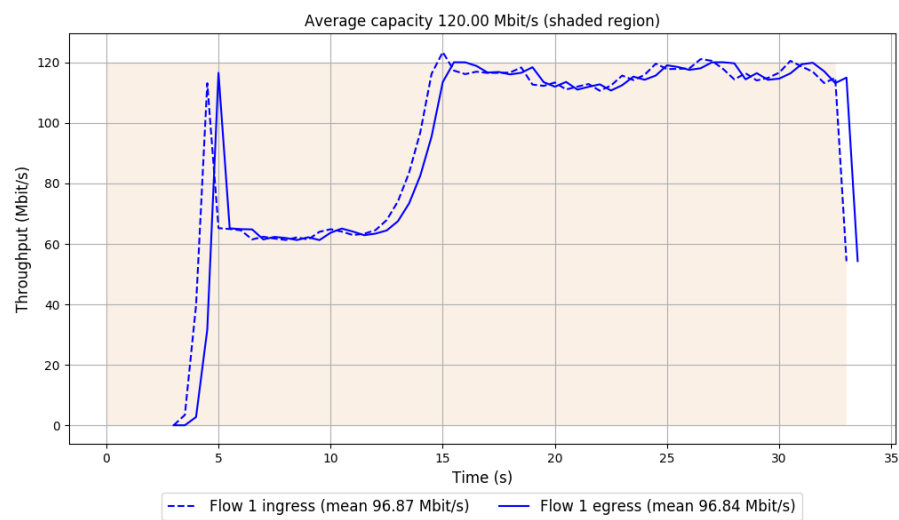• Flow 1 (95th percentile 43.09 ms)

```
Run 1: Statistics of PCC-Allegro

Start at: 2019-07-30 07:04:28
End at: 2019-07-30 07:04:58

# Below is generated by plot.py at 2019-07-30 07:12:52
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 96.84 Mbit/s (80.7% utilization)
95th percentile per-packet one-way delay: 52.126 ms
Loss rate: 0.16%
-- Flow 1:
Average throughput: 96.84 Mbit/s
95th percentile per-packet one-way delay: 52.126 ms
Loss rate: 0.16%
```

Run 1: Report of PCC-Allegro — Data Link

Average capacity 120.00 Mbit/s (shaded region)

--- Flow 1 ingress (mean 96.87 Mbit/s) —— Flow 1 egress (mean 96.84 Mbit/s)

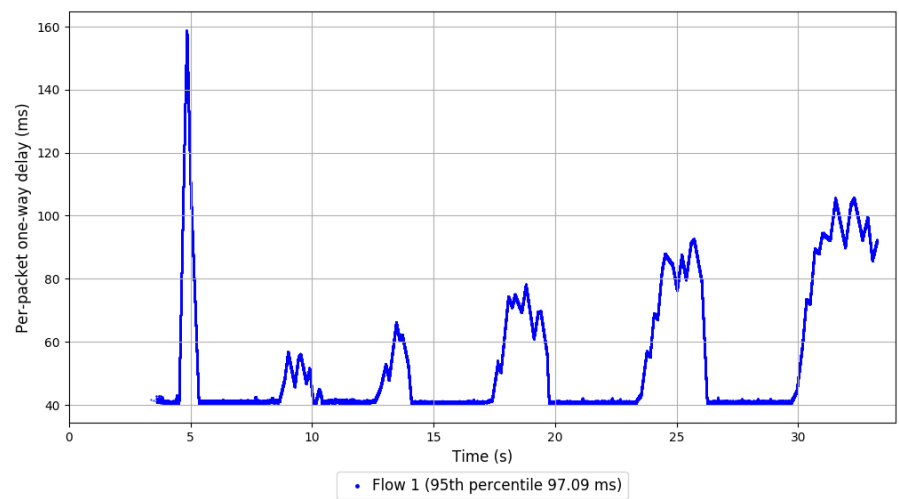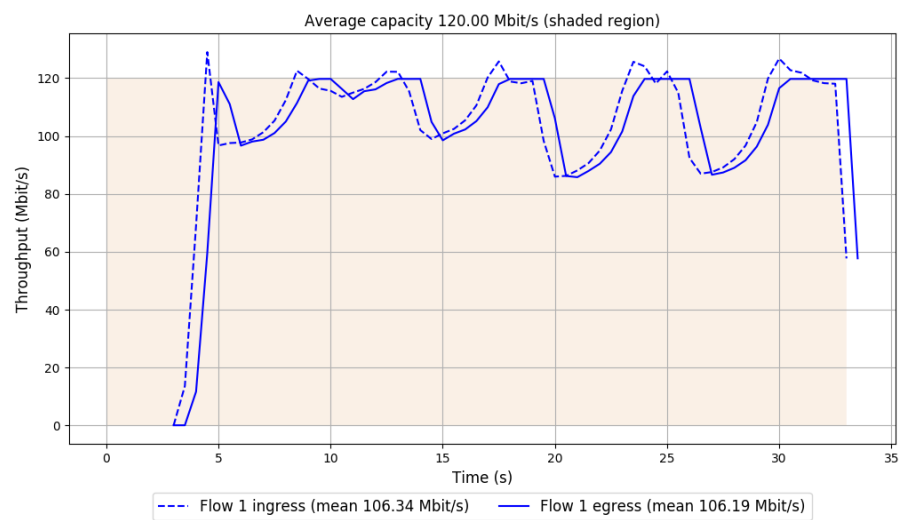• Flow 1 (95th percentile 52.13 ms)

```
Run 1: Statistics of PCC-Expr

Start at: 2019-07-30 07:06:24
End at: 2019-07-30 07:06:54

# Below is generated by plot.py at 2019-07-30 07:14:20
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 106.19 Mbit/s (88.5% utilization)
95th percentile per-packet one-way delay: 97.090 ms
Loss rate: 0.33%
-- Flow 1:
Average throughput: 106.19 Mbit/s
95th percentile per-packet one-way delay: 97.090 ms
Loss rate: 0.33%
```

Run 1: Report of PCC-Expr — Data Link

Average capacity 120.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 106.34 Mbit/s) —— Flow 1 egress (mean 106.19 Mbit/s)

• Flow 1 (95th percentile 97.09 ms)

Run 1: Statistics of QUIC Cubic

Start at: 2019-07-30 07:03:54
End at: 2019-07-30 07:04:24

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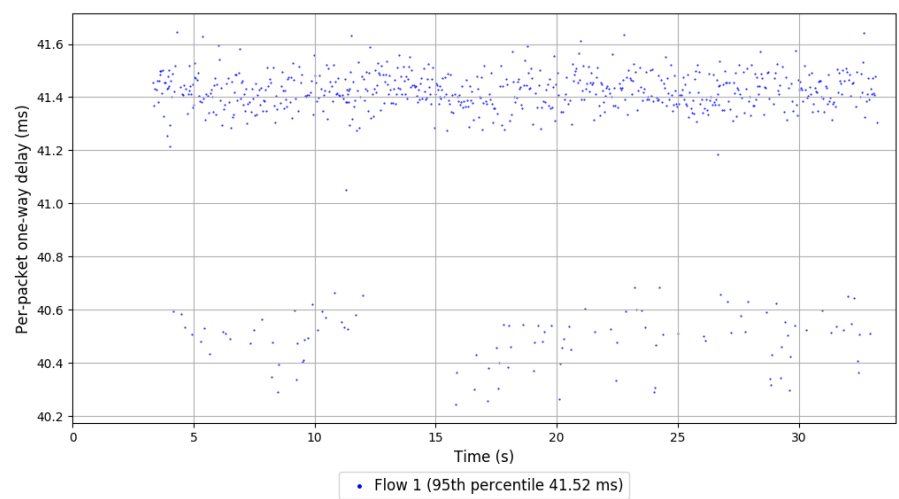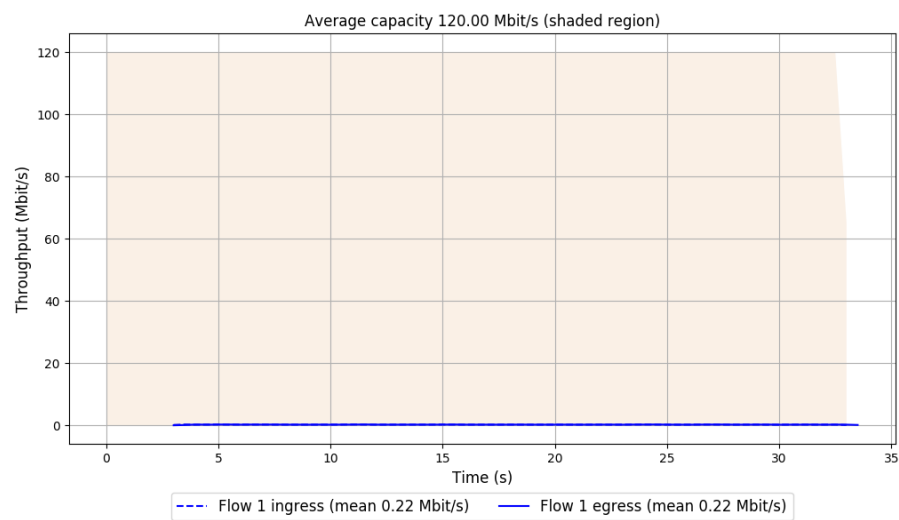
Figure is missing

Figure is missing

```
Run 1: Statistics of SCReAM

Start at: 2019-07-30 07:03:18
End at: 2019-07-30 07:03:48

# Below is generated by plot.py at 2019-07-30 07:14:20
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 0.22 Mbit/s (0.2% utilization)
95th percentile per-packet one-way delay: 41.520 ms
Loss rate: 0.13%
-- Flow 1:
Average throughput: 0.22 Mbit/s
95th percentile per-packet one-way delay: 41.520 ms
Loss rate: 0.13%
```

Run 1: Report of SCReAM — Data Link

Average capacity 120.00 Mbit/s (shaded region)

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

• Flow 1 (95th percentile 41.52 ms)

```
Run 1: Statistics of Sprout

Start at: 2019-07-30 06:57:40
End at: 2019-07-30 06:58:10


# Below is generated by plot.py at 2019-07-30 07:14:20
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 9.43 Mbit/s (7.9% utilization)
95th percentile per-packet one-way delay: 46.254 ms
Loss rate: 0.35%
-- Flow 1:
Average throughput: 9.43 Mbit/s
95th percentile per-packet one-way delay: 46.254 ms
Loss rate: 0.35%
```
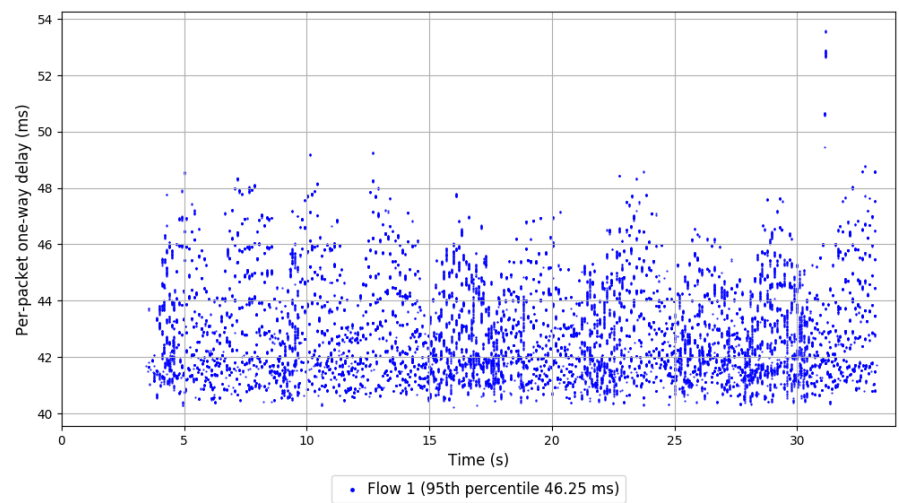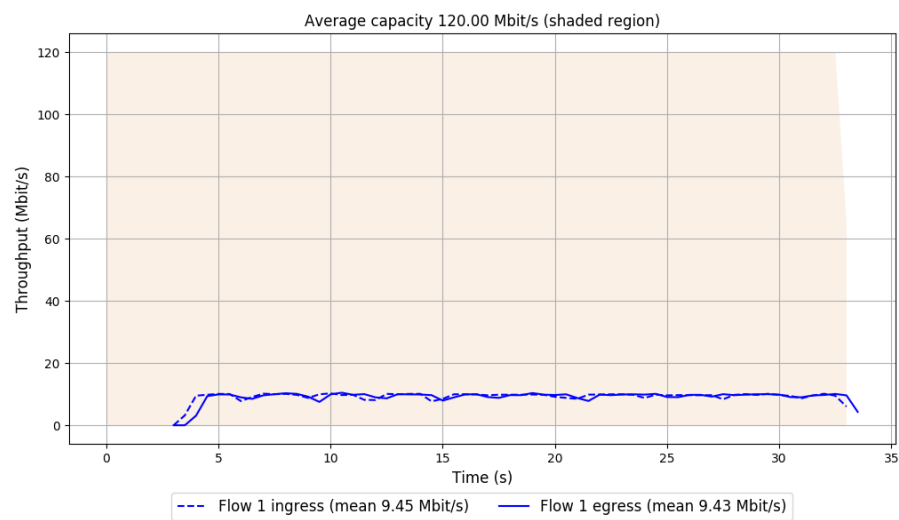
Run 1: Report of Sprout — Data Link

Average capacity 120.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 9.45 Mbit/s) ——— Flow 1 egress (mean 9.43 Mbit/s)

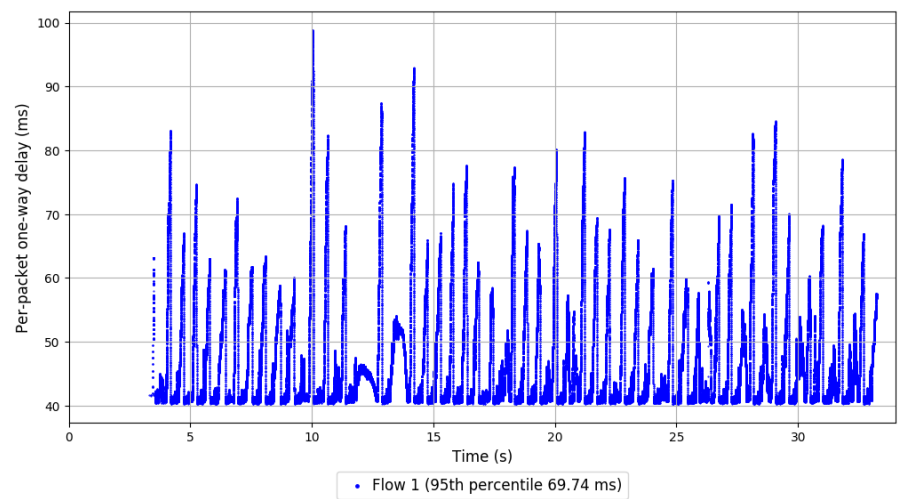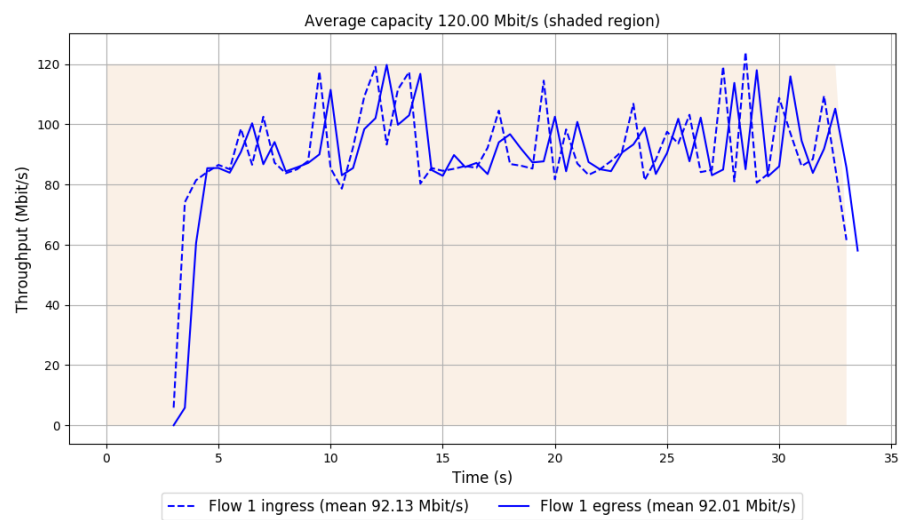

• Flow 1 (95th percentile 46.25 ms)

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

Start at: 2019-07-30 07:01:50
End at: 2019-07-30 07:02:20

# Below is generated by plot.py at 2019-07-30 07:14:22
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 92.01 Mbit/s (76.7% utilization)
95th percentile per-packet one-way delay: 69.742 ms
Loss rate: 0.28%
-- Flow 1:
Average throughput: 92.01 Mbit/s
95th percentile per-packet one-way delay: 69.742 ms
Loss rate: 0.28%
```

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

Average capacity 120.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 92.13 Mbit/s)   —— Flow 1 egress (mean 92.01 Mbit/s)

• Flow 1 (95th percentile 69.74 ms)

```
Run 1: Statistics of TCP Vegas

Start at: 2019-07-30 06:59:49
End at: 2019-07-30 07:00:19

# Below is generated by plot.py at 2019-07-30 07:14:22
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 117.80 Mbit/s (98.2% utilization)
95th percentile per-packet one-way delay: 81.238 ms
Loss rate: 0.19%
-- Flow 1:
Average throughput: 117.80 Mbit/s
95th percentile per-packet one-way delay: 81.238 ms
Loss rate: 0.19%
```
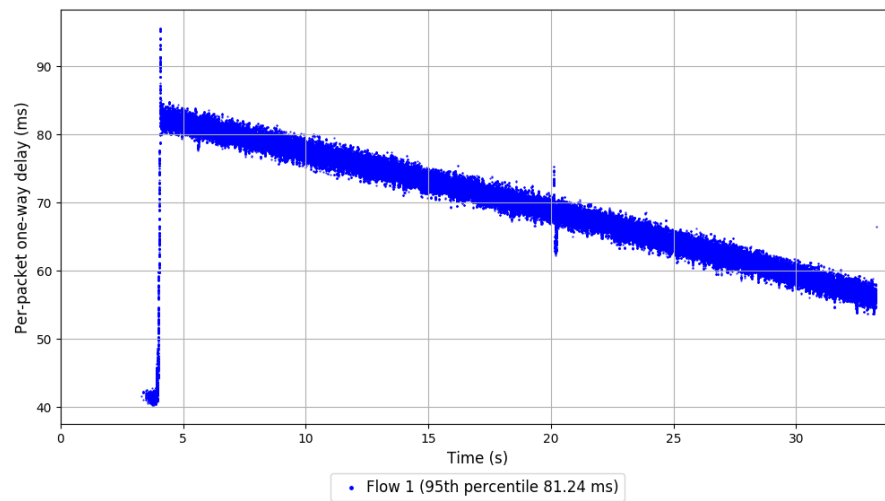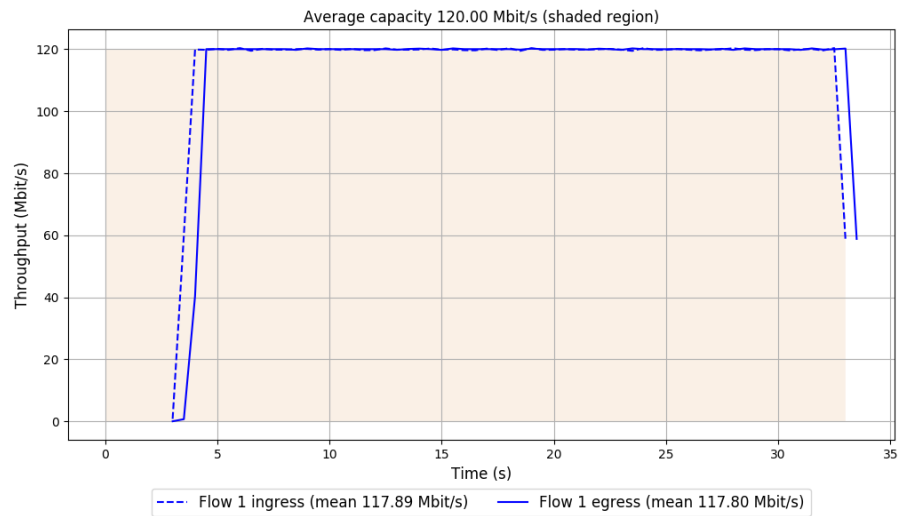
Run 1: Report of TCP Vegas — Data Link

Average capacity 120.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 117.89 Mbit/s) ——— Flow 1 egress (mean 117.80 Mbit/s)

• Flow 1 (95th percentile 81.24 ms)

```
Run 1: Statistics of Verus

Start at: 2019-07-30 06:55:27
End at: 2019-07-30 06:55:57

# Below is generated by plot.py at 2019-07-30 07:14:22
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 117.77 Mbit/s (98.1% utilization)
95th percentile per-packet one-way delay: 460.059 ms
Loss rate: 1.14%
-- Flow 1:
Average throughput: 117.77 Mbit/s
95th percentile per-packet one-way delay: 460.059 ms
Loss rate: 1.14%
```
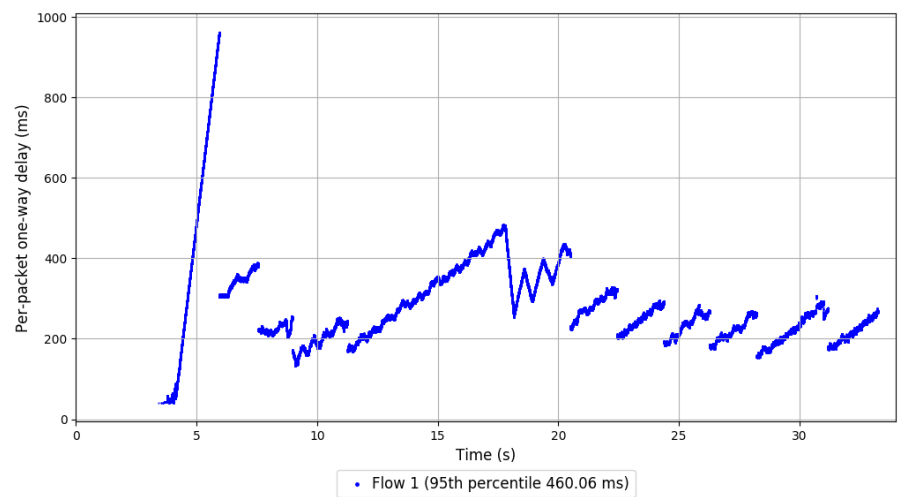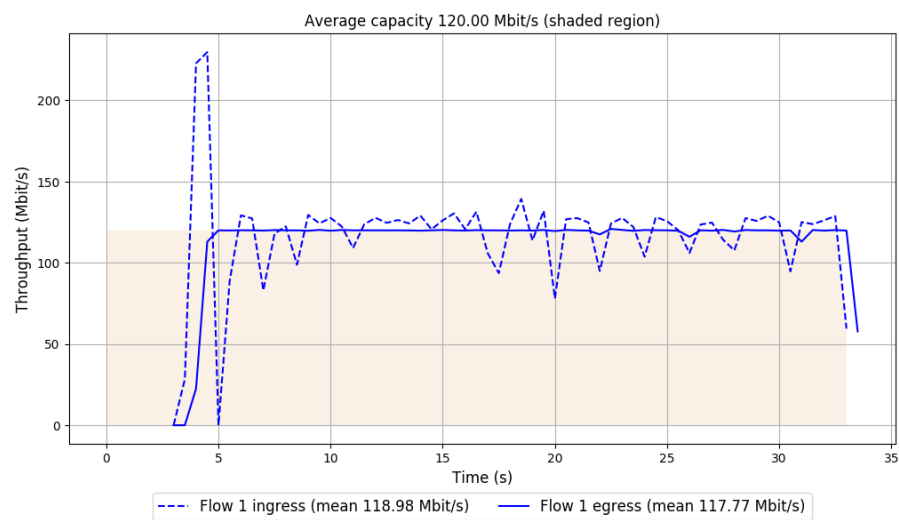
Run 1: Report of Verus — Data Link

Average capacity 120.00 Mbit/s (shaded region)

Flow 1 ingress (mean 118.98 Mbit/s)   Flow 1 egress (mean 117.77 Mbit/s)

Flow 1 (95th percentile 460.06 ms)

```
Run 1: Statistics of PCC-Vivace

Start at: 2019-07-30 06:59:04
End at: 2019-07-30 06:59:34

# Below is generated by plot.py at 2019-07-30 07:14:22
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 106.74 Mbit/s (88.9% utilization)
95th percentile per-packet one-way delay: 71.249 ms
Loss rate: 0.15%
-- Flow 1:
Average throughput: 106.74 Mbit/s
95th percentile per-packet one-way delay: 71.249 ms
Loss rate: 0.15%
```
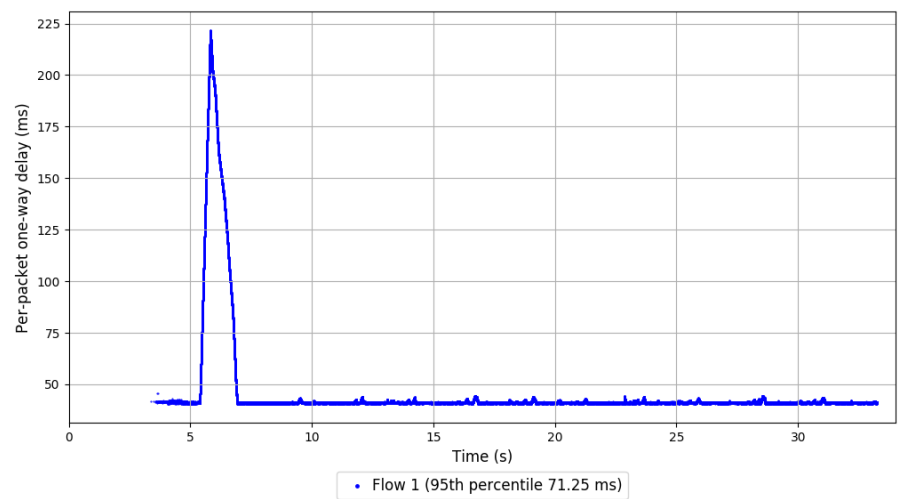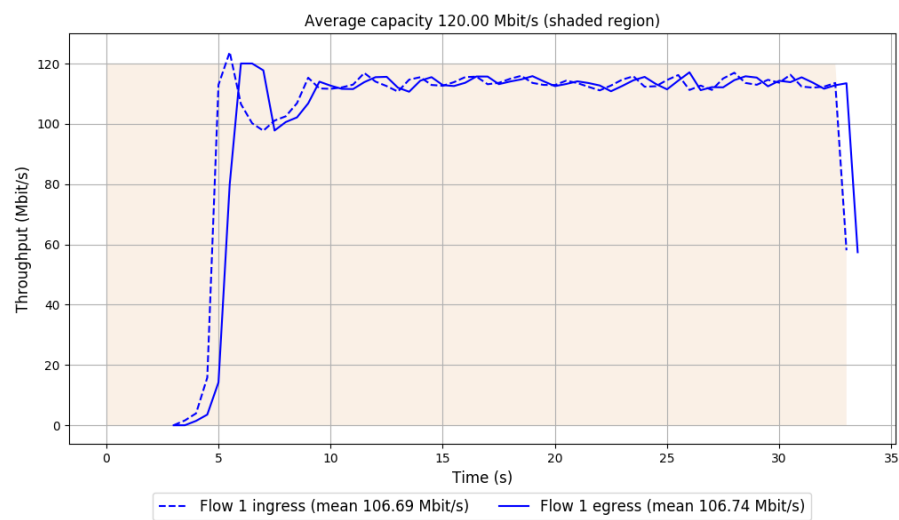
Run 1: Report of PCC-Vivace — Data Link

Average capacity 120.00 Mbit/s (shaded region)

- - - Flow 1 ingress (mean 106.69 Mbit/s) —— Flow 1 egress (mean 106.74 Mbit/s)

• Flow 1 (95th percentile 71.25 ms)

```
Run 1: Statistics of WebRTC media

Start at: 2019-07-30 07:05:09
End at: 2019-07-30 07:05:39

# Below is generated by plot.py at 2019-07-30 07:14:22
# Datalink statistics
-- Total of 1 flow:
Average capacity: 120.00 Mbit/s
Average throughput: 0.05 Mbit/s (0.0% utilization)
95th percentile per-packet one-way delay: 42.249 ms
Loss rate: 0.00%
-- Flow 1:
Average throughput: 0.05 Mbit/s
95th percentile per-packet one-way delay: 42.249 ms
Loss rate: 0.00%
```

Run 1: Report of WebRTC media — Data Link

Average capacity 120.00 Mbit/s (shaded region)

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

• Flow 1 (95th percentile 42.25 ms)