Pantheon Report

Generated at 2017-09-19 02:25:02 (UTC).

Data path: China ppp0 (*remote*) →AWS Korea Ethernet (*local*).

Repeated the test of 10 congestion control schemes 3 times.

Each test lasted for 30 seconds running 1 flow.

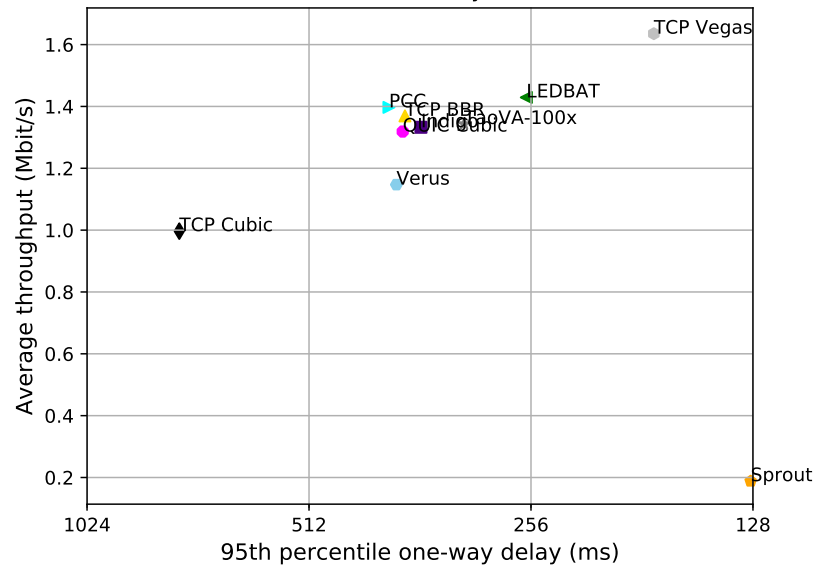Increased UDP receive buffer to 16 MB (default) and 32 MB (max).

Tested BBR with qdisc of Fair Queuing (`fq`), and other schemes with the default Linux qdisc (`pfifo_fast`).

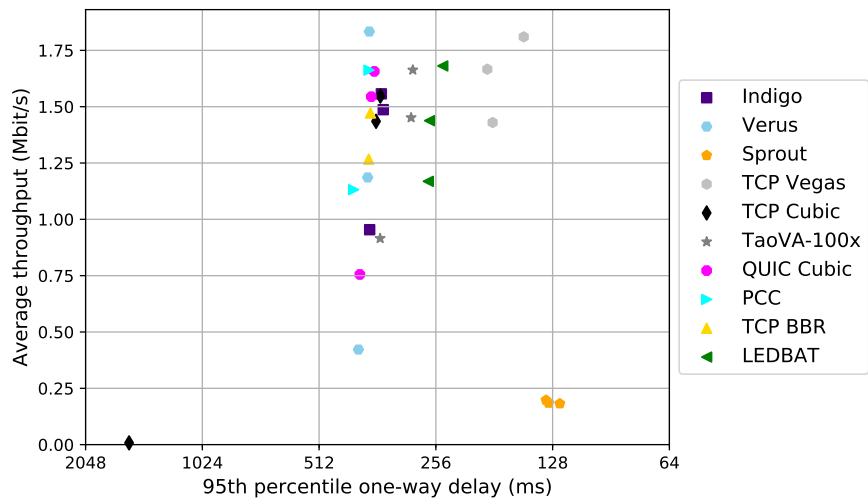NTP offsets were measured against `ntp.nict.jp` and have been applied to correct the timestamps in logs.

```
Git summary:
branch: master @ 57453dc11f8da93a2e03eea75289fea01b816298
third_party/calibrated_koho @ 3cb73c0d1c0322cdfae446ea37a522e53227db50
 M datagrump/sender.cc
third_party/genericCC @ f7ca42f251bf49b432bb71de6d13fa903515c366
third_party/indigo @ b19f3730105f9aa95452552af924e3719b03cc55
third_party/koho_cc @ f0f2e693303aee82ea808e6928eac4f1083a6681
 M datagrump/sender.cc
third_party/libutp @ b3465b942e2826f2b179eaab4a906ce6bb7cf3cf
third_party/pantheon-tunnel @ baf443516dea3eeddeccaf9b916cc313273ca4f4
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/proto-quic @ 77961f1a82733a86b42f1bc8143ebc978f3cff42
third_party/scream @ c3370fd7bd17265a79aeb34e4016ad23f5965885
third_party/sourdough @ f1a14bffe749737437f61b1eaeeb30b267cde681
third_party/sprout @ 6f2efe6e088d91066a9f023df375eee2665089ce
 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/webrtc @ a488197ddd041ace68a42849b2540ad834825f42
```

test from China ppp0 to AWS Korea Ethernet, 3 runs of 30s each per scheme (mean of all runs by scheme)

test from China ppp0 to AWS Korea Ethernet, 3 runs 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
TCP BBR	2	1.37	379.46	8.61
TCP Cubic	3	1.00	767.72	21.45
Indigo	3	1.33	360.98	16.33
LEDBAT	3	1.43	259.78	0.95
PCC	2	1.40	398.90	84.65
QUIC Cubic	3	1.32	382.12	9.11
Sprout	3	0.19	128.93	0.94
TaoVA-100x	3	1.34	315.52	13.87
TCP Vegas	3	1.64	174.44	0.51
Verus	3	1.15	389.74	33.09

```
Run 1: Statistics of TCP BBR

Start at: 2017-09-19 01:18:07
End at: 2017-09-19 01:18:37
Local clock offset: -1.354 ms
Remote clock offset: -2.1 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.47 Mbit/s
95th percentile per-packet one-way delay: 377.478 ms
Loss rate: 8.04%
-- Flow 1:
Average throughput: 1.47 Mbit/s
95th percentile per-packet one-way delay: 377.478 ms
Loss rate: 8.04%
```
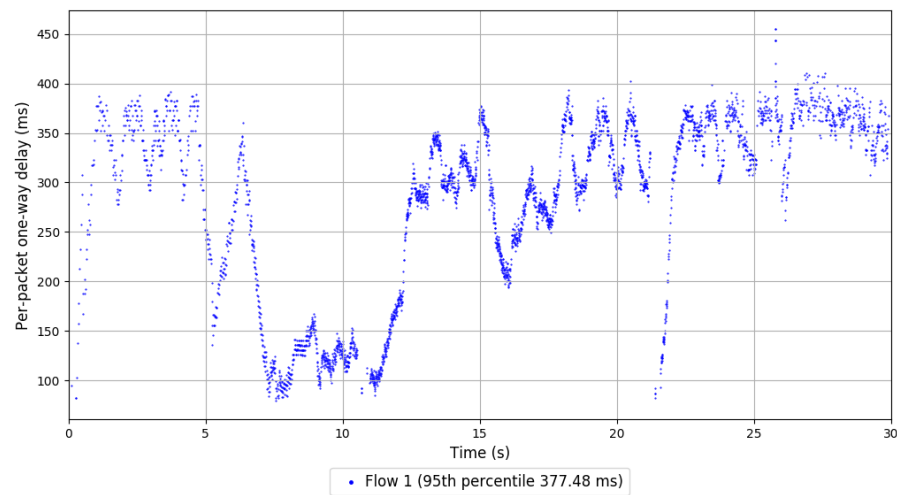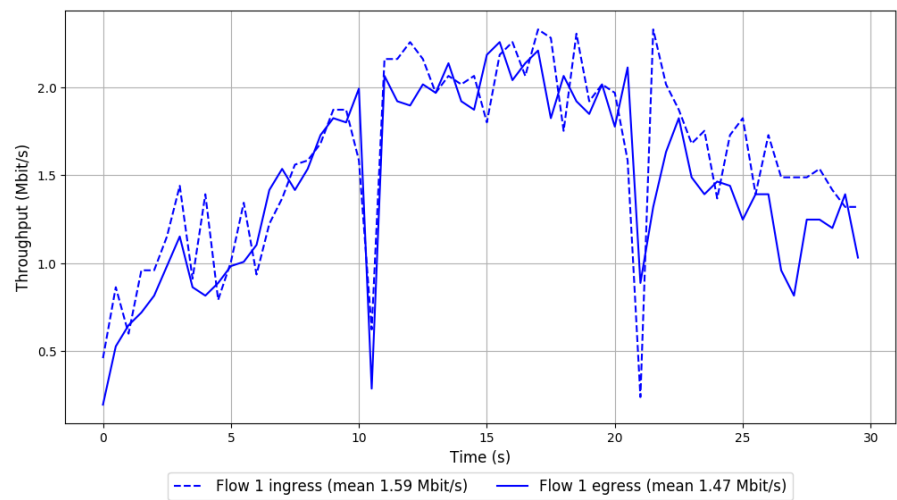
Run 1: Report of TCP BBR — Data Link

```
Run 2: Statistics of TCP BBR

Start at: 2017-09-19 01:29:36
End at: 2017-09-19 01:30:06
Local clock offset: 0.313 ms
Remote clock offset: -1.844 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.27 Mbit/s
95th percentile per-packet one-way delay: 381.432 ms
Loss rate: 9.19%
-- Flow 1:
Average throughput: 1.27 Mbit/s
95th percentile per-packet one-way delay: 381.432 ms
Loss rate: 9.19%
```
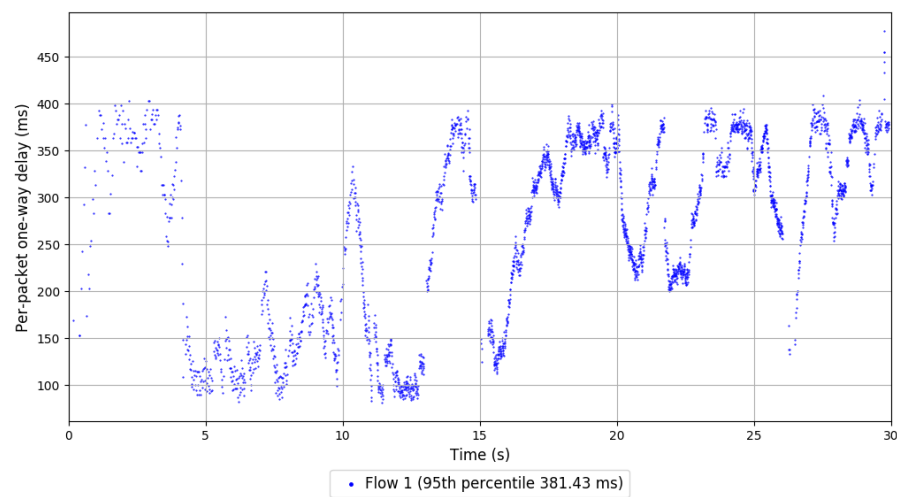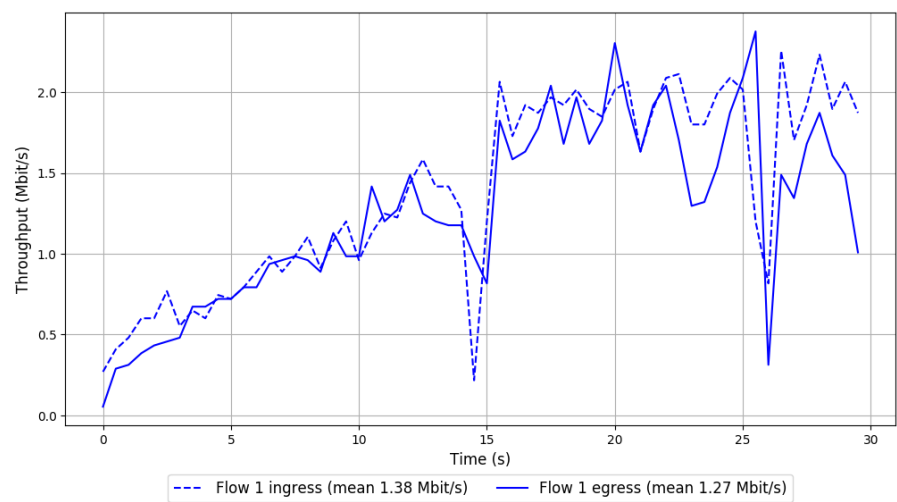
Run 2: Report of TCP BBR — Data Link

```
Run 3: Statistics of TCP BBR

Start at: 2017-09-19 01:41:14
End at: 2017-09-19 01:41:44
Local clock offset: 0.535 ms
Remote clock offset: -1.568 ms
```

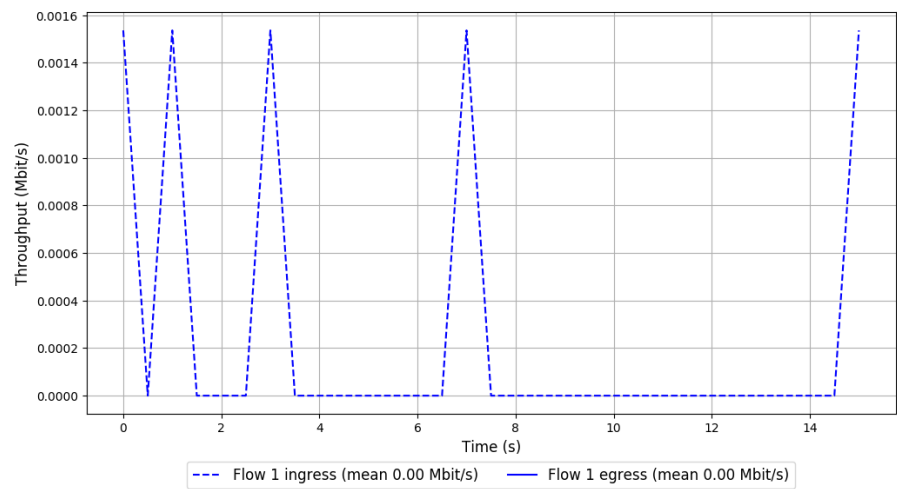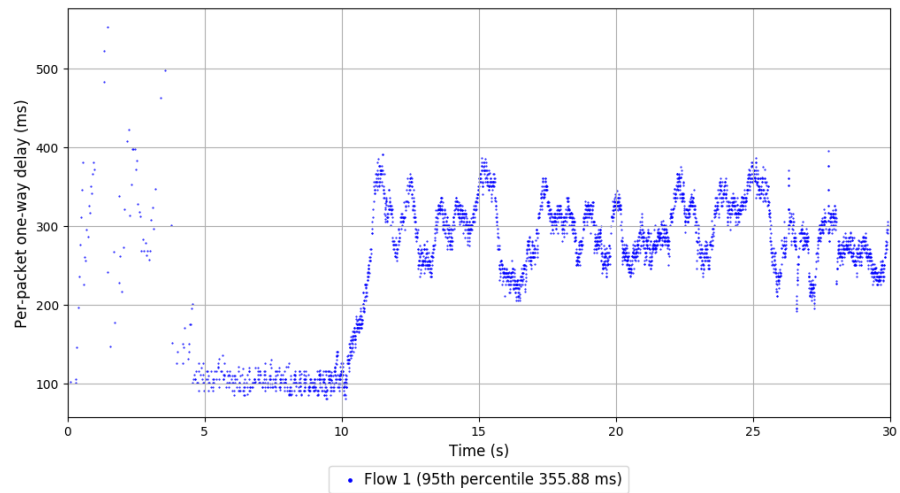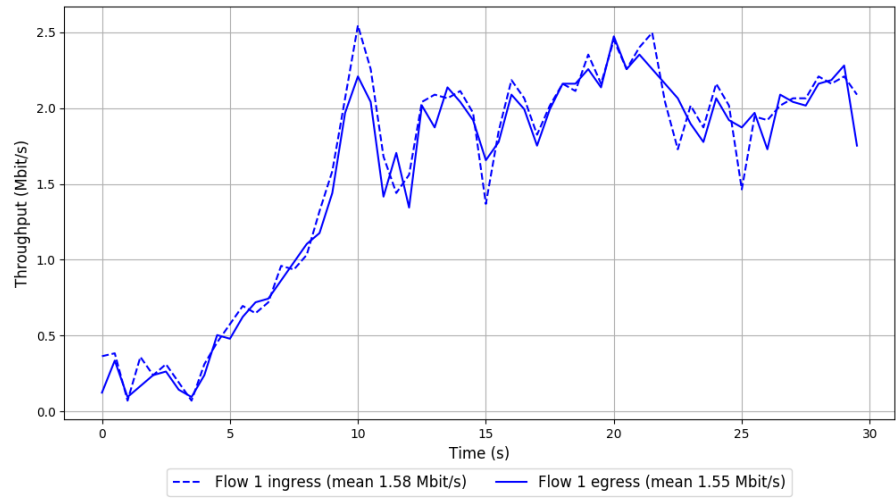## Run 3: Report of TCP BBR — Data Link

Figure is missing

```
Run 1: Statistics of TCP Cubic

Start at: 2017-09-19 01:20:25
End at: 2017-09-19 01:20:55
Local clock offset: 0.03 ms
Remote clock offset: -2.023 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.55 Mbit/s
95th percentile per-packet one-way delay: 355.885 ms
Loss rate: 2.56%
-- Flow 1:
Average throughput: 1.55 Mbit/s
95th percentile per-packet one-way delay: 355.885 ms
Loss rate: 2.56%
```
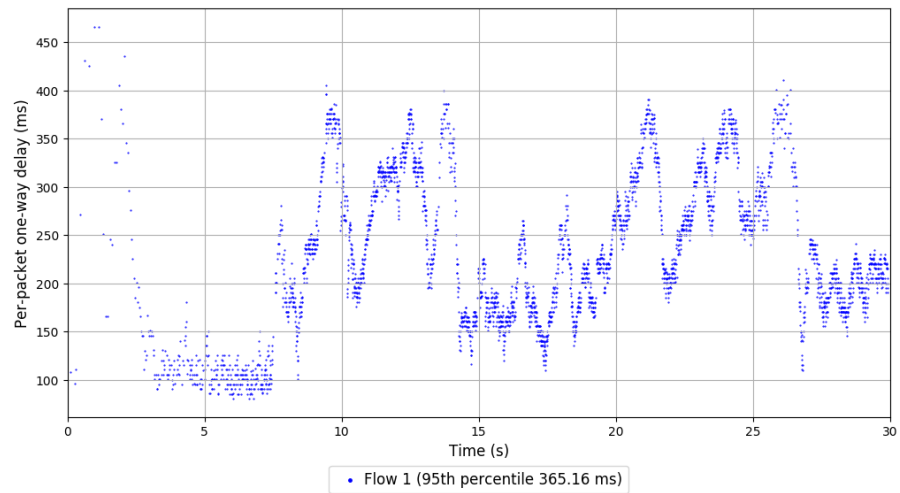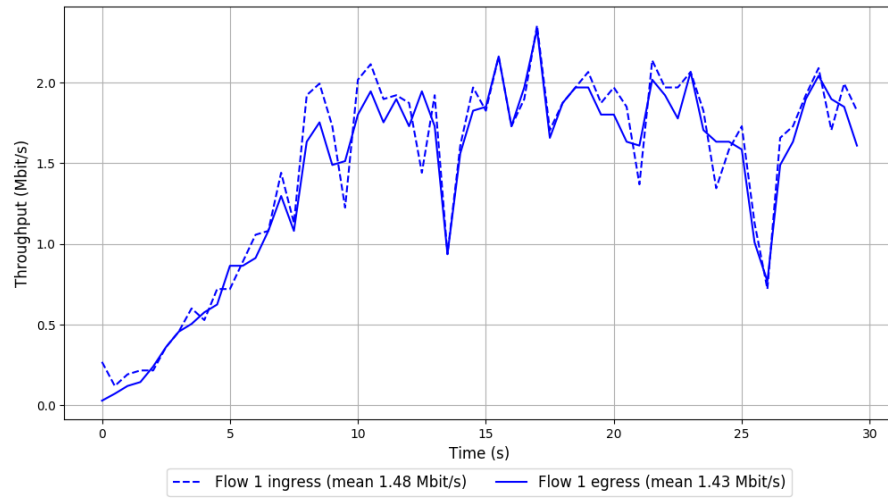
Run 1: Report of TCP Cubic — Data Link

```
Run 2: Statistics of TCP Cubic

Start at: 2017-09-19 01:31:55
End at: 2017-09-19 01:32:25
Local clock offset: 0.238 ms
Remote clock offset: -1.803 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.43 Mbit/s
95th percentile per-packet one-way delay: 365.158 ms
Loss rate: 3.36%
-- Flow 1:
Average throughput: 1.43 Mbit/s
95th percentile per-packet one-way delay: 365.158 ms
Loss rate: 3.36%
```

Run 2: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 1.48 Mbit/s) --- Flow 1 egress (mean 1.43 Mbit/s)

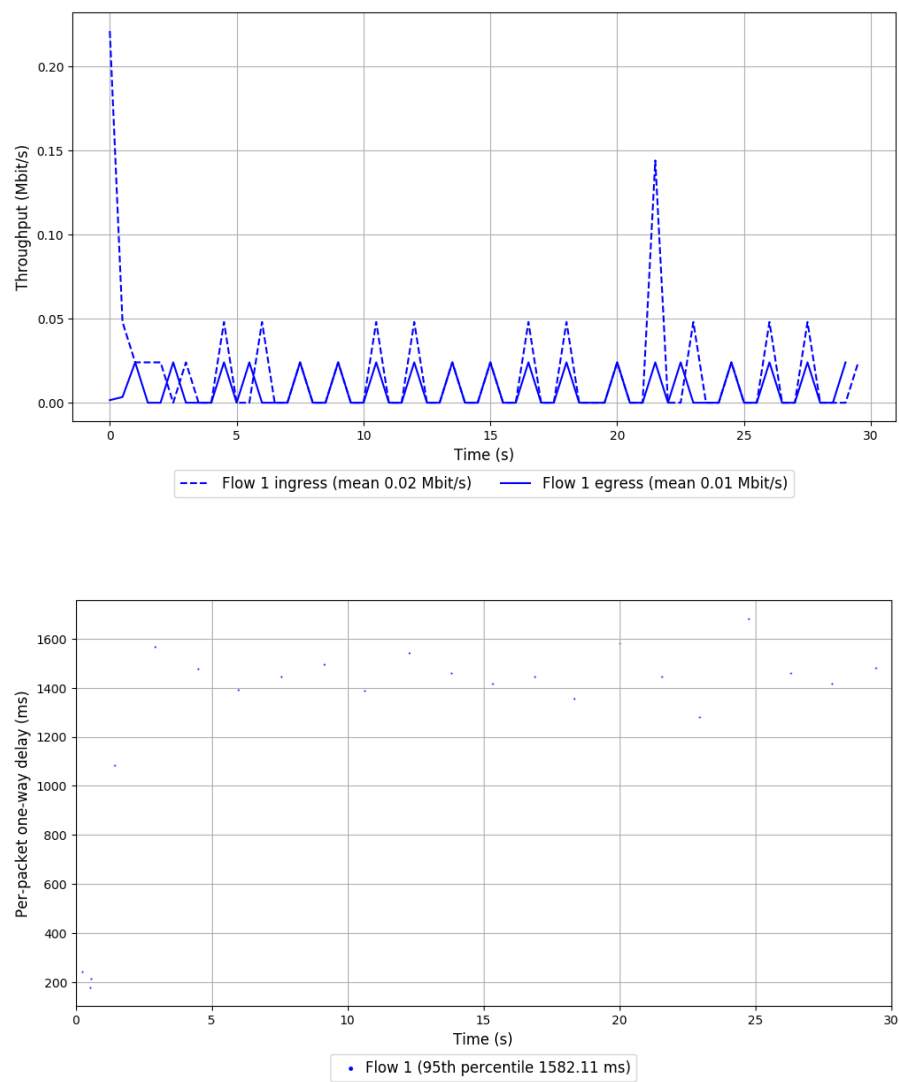• Flow 1 (95th percentile 365.16 ms)

```
Run 3: Statistics of TCP Cubic

Start at: 2017-09-19 01:43:32
End at: 2017-09-19 01:44:02
Local clock offset: 0.536 ms
Remote clock offset: -1.567 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.01 Mbit/s
95th percentile per-packet one-way delay: 1582.111 ms
Loss rate: 58.43%
-- Flow 1:
Average throughput: 0.01 Mbit/s
95th percentile per-packet one-way delay: 1582.111 ms
Loss rate: 58.43%
```

Run 3: Report of TCP Cubic — Data Link

Flow 1 ingress (mean 0.02 Mbit/s)   Flow 1 egress (mean 0.01 Mbit/s)
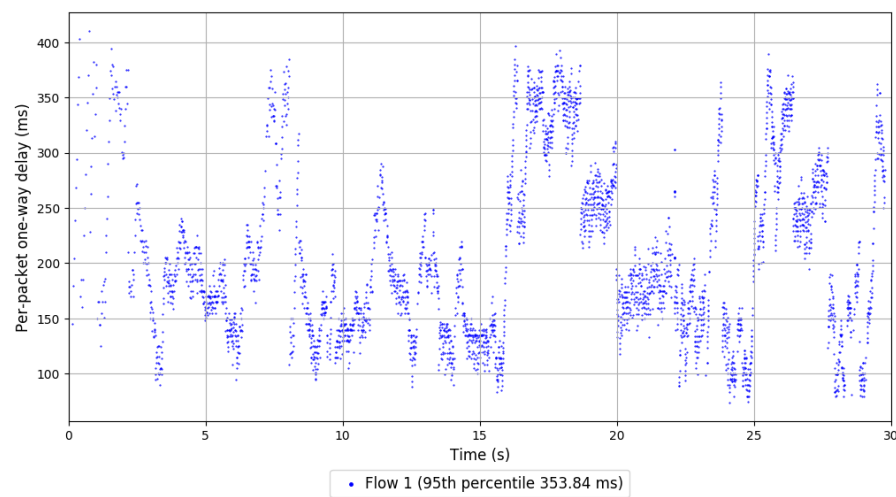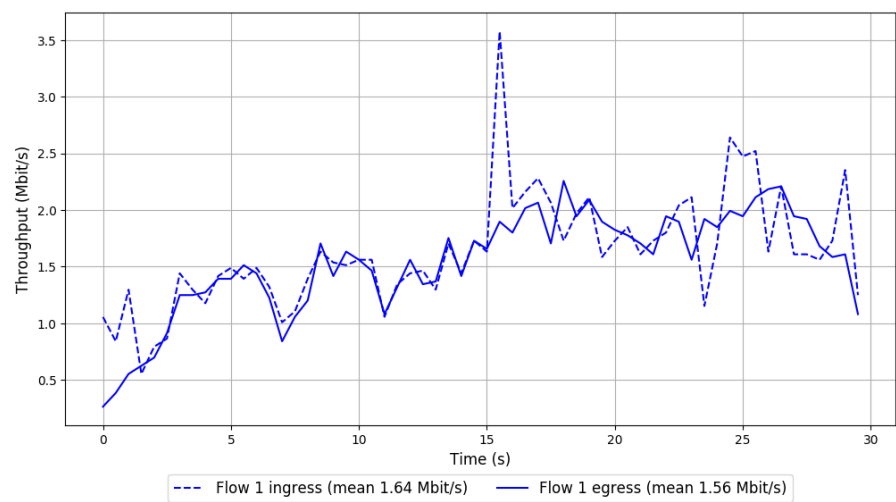

Flow 1 (95th percentile 1582.11 ms)

```
Run 1: Statistics of Indigo

Start at: 2017-09-19 01:14:40
End at: 2017-09-19 01:15:10
Local clock offset: -1.335 ms
Remote clock offset: -2.179 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.56 Mbit/s
95th percentile per-packet one-way delay: 353.844 ms
Loss rate: 5.48%
-- Flow 1:
Average throughput: 1.56 Mbit/s
95th percentile per-packet one-way delay: 353.844 ms
Loss rate: 5.48%
```

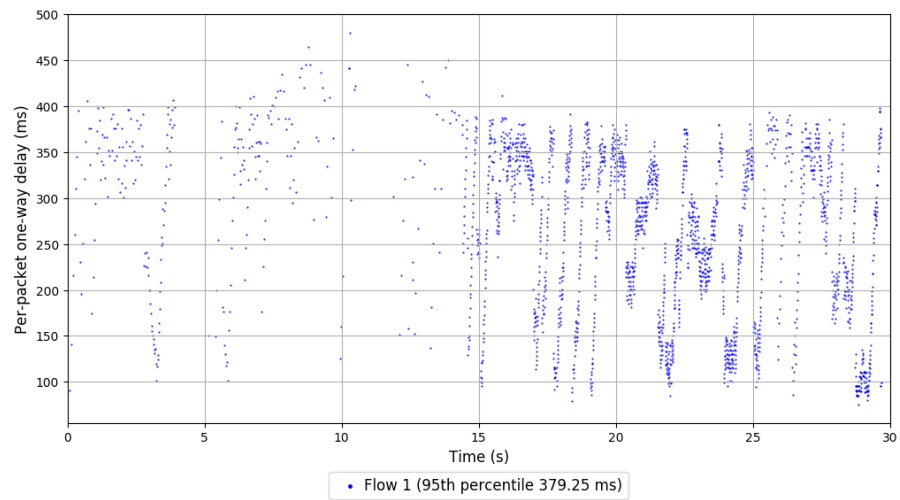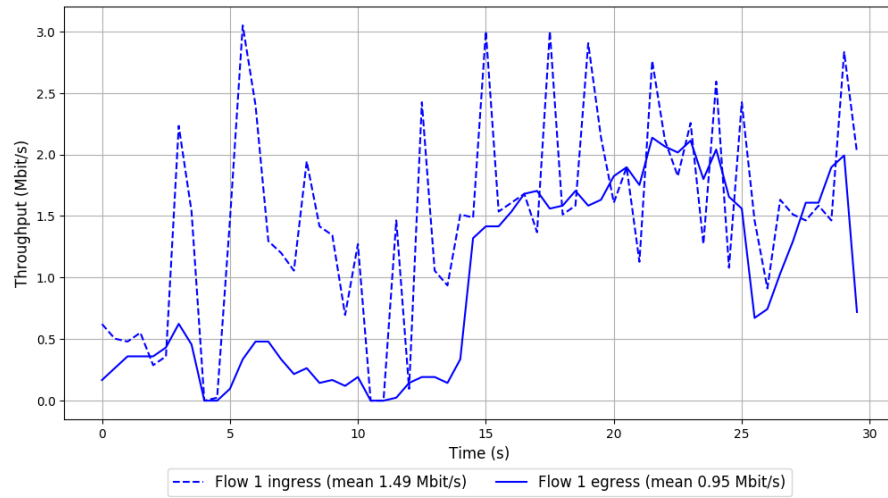Run 1: Report of Indigo — Data Link

```
Run 2: Statistics of Indigo

Start at: 2017-09-19 01:26:09
End at: 2017-09-19 01:26:39
Local clock offset: -0.971 ms
Remote clock offset: -1.948 ms


# Below is generated by plot.py at 2017-09-19 02:24:44
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.95 Mbit/s
95th percentile per-packet one-way delay: 379.255 ms
Loss rate: 36.48%
-- Flow 1:
Average throughput: 0.95 Mbit/s
95th percentile per-packet one-way delay: 379.255 ms
Loss rate: 36.48%
```
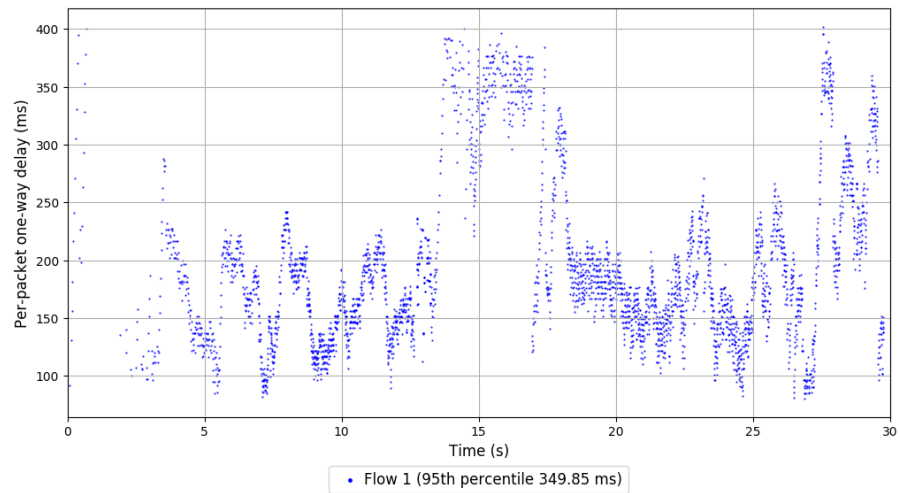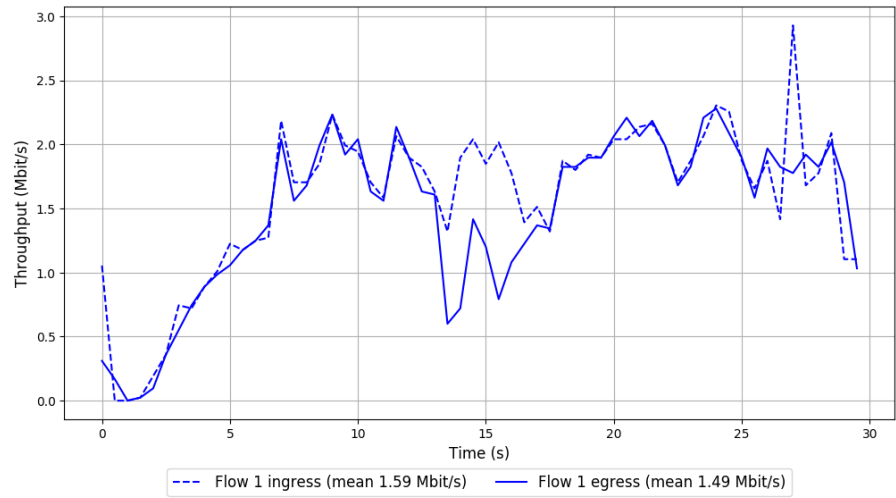
Run 2: Report of Indigo — Data Link

```
Run 3: Statistics of Indigo

Start at: 2017-09-19 01:37:46
End at: 2017-09-19 01:38:16
Local clock offset: 0.389 ms
Remote clock offset: -1.619 ms


# Below is generated by plot.py at 2017-09-19 02:24:45
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.49 Mbit/s
95th percentile per-packet one-way delay: 349.846 ms
Loss rate: 7.03%
-- Flow 1:
Average throughput: 1.49 Mbit/s
95th percentile per-packet one-way delay: 349.846 ms
Loss rate: 7.03%
```

Run 3: Report of Indigo — Data Link

Flow 1 ingress (mean 1.59 Mbit/s) Flow 1 egress (mean 1.49 Mbit/s)

Flow 1 (95th percentile 349.85 ms)

```
Run 1: Statistics of LEDBAT

Start at: 2017-09-19 01:19:15
End at: 2017-09-19 01:19:45
Local clock offset: -1.316 ms
Remote clock offset: -2.067 ms


# Below is generated by plot.py at 2017-09-19 02:24:45
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.17 Mbit/s
95th percentile per-packet one-way delay: 267.806 ms
Loss rate: 1.06%
-- Flow 1:
Average throughput: 1.17 Mbit/s
95th percentile per-packet one-way delay: 267.806 ms
Loss rate: 1.06%
```
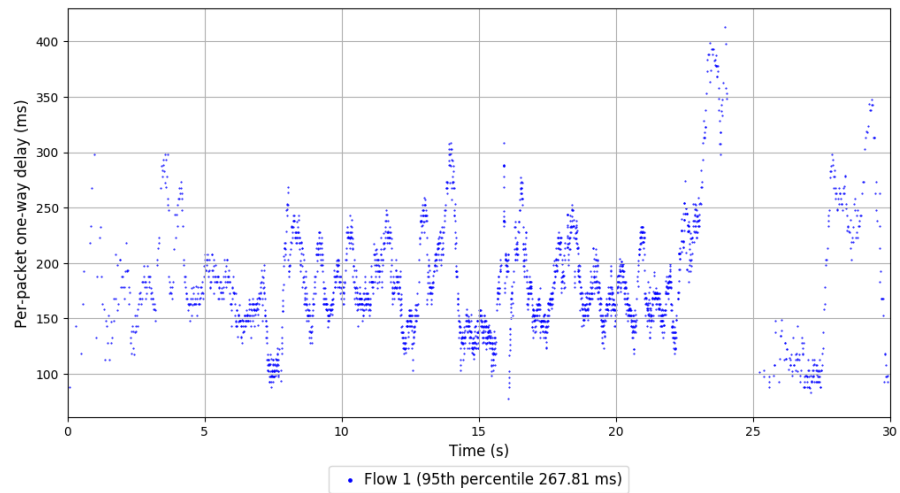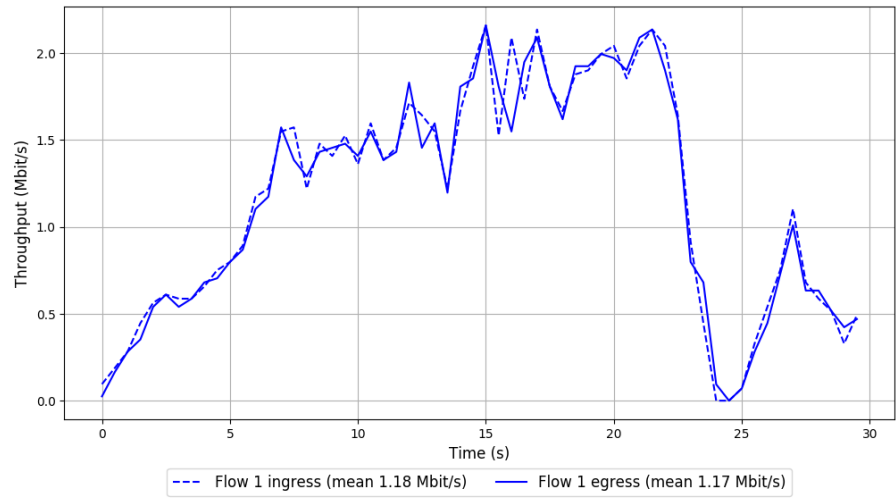
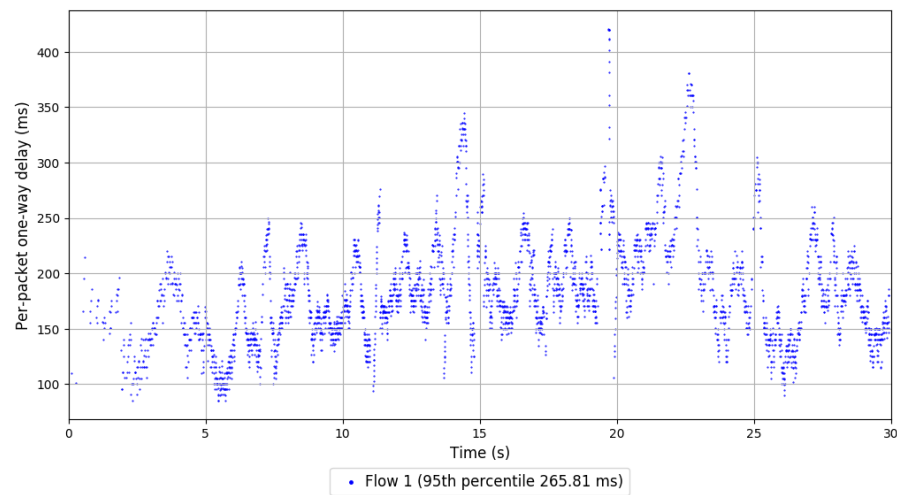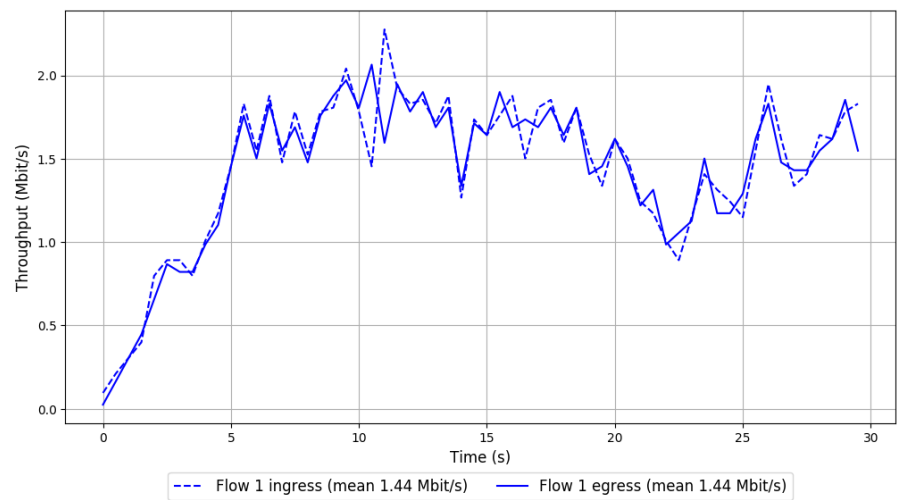Run 1: Report of LEDBAT — Data Link

```
Run 2: Statistics of LEDBAT

Start at: 2017-09-19 01:30:46
End at: 2017-09-19 01:31:16
Local clock offset: -1.0 ms
Remote clock offset: -1.835 ms

# Below is generated by plot.py at 2017-09-19 02:24:47
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.44 Mbit/s
95th percentile per-packet one-way delay: 265.806 ms
Loss rate: 0.92%
-- Flow 1:
Average throughput: 1.44 Mbit/s
95th percentile per-packet one-way delay: 265.806 ms
Loss rate: 0.92%
```
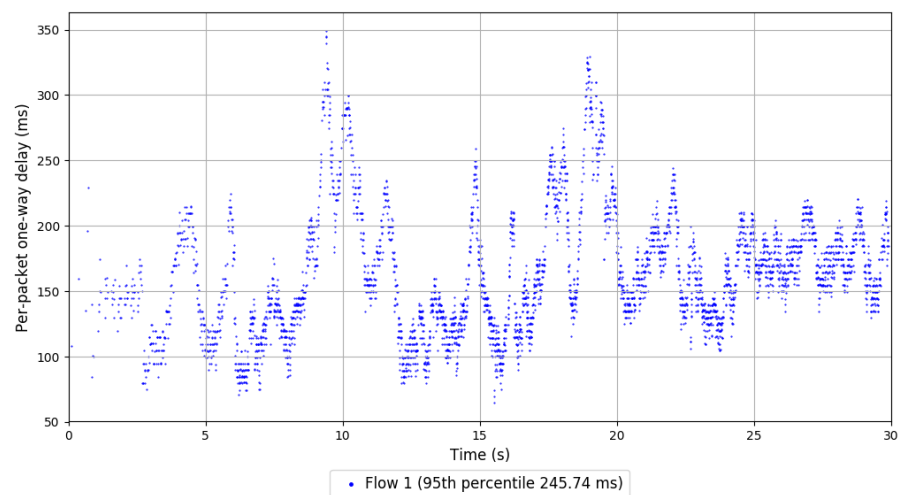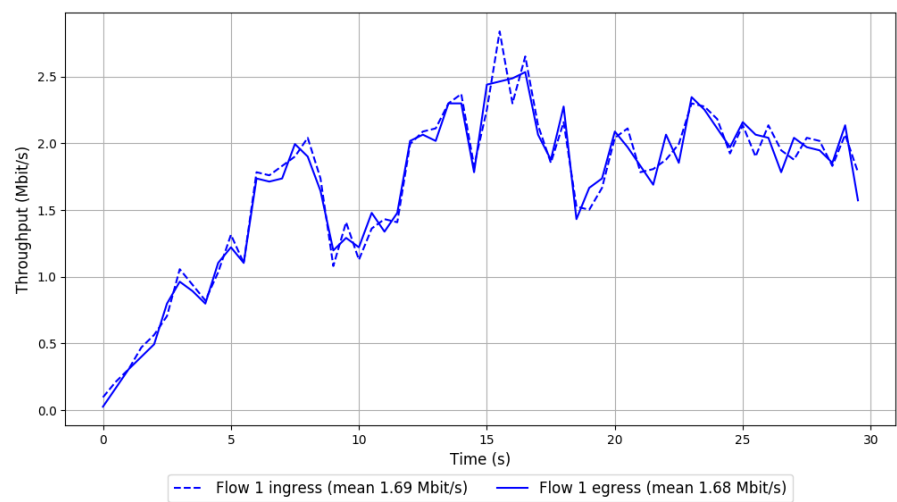
Run 2: Report of LEDBAT — Data Link

```
Run 3: Statistics of LEDBAT

Start at: 2017-09-19 01:42:23
End at: 2017-09-19 01:42:53
Local clock offset: -13.907 ms
Remote clock offset: -1.592 ms


# Below is generated by plot.py at 2017-09-19 02:24:48
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.68 Mbit/s
95th percentile per-packet one-way delay: 245.742 ms
Loss rate: 0.88%
-- Flow 1:
Average throughput: 1.68 Mbit/s
95th percentile per-packet one-way delay: 245.742 ms
Loss rate: 0.88%
```

Run 3: Report of LEDBAT — Data Link

Flow 1 ingress (mean 1.69 Mbit/s)   Flow 1 egress (mean 1.68 Mbit/s)

Flow 1 (95th percentile 245.74 ms)

```
Run 1: Statistics of PCC

Start at: 2017-09-19 01:21:33
End at: 2017-09-19 01:22:03
Local clock offset: -1.151 ms
Remote clock offset: -2.044 ms
```
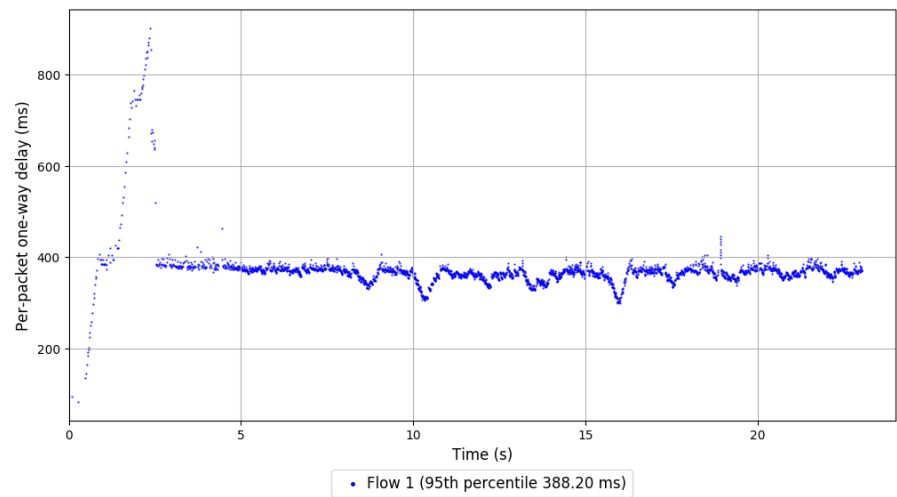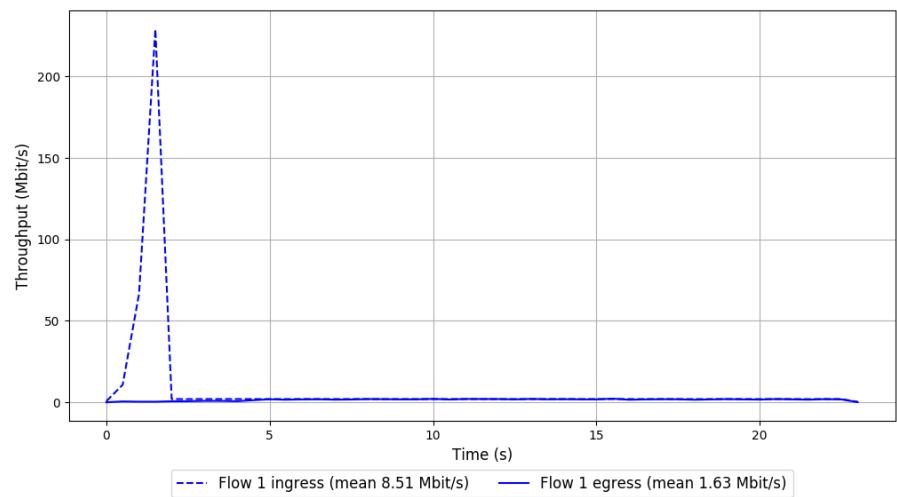
Run 1: Report of PCC — Data Link

Flow 1 ingress (mean 8.51 Mbit/s)   Flow 1 egress (mean 1.63 Mbit/s)
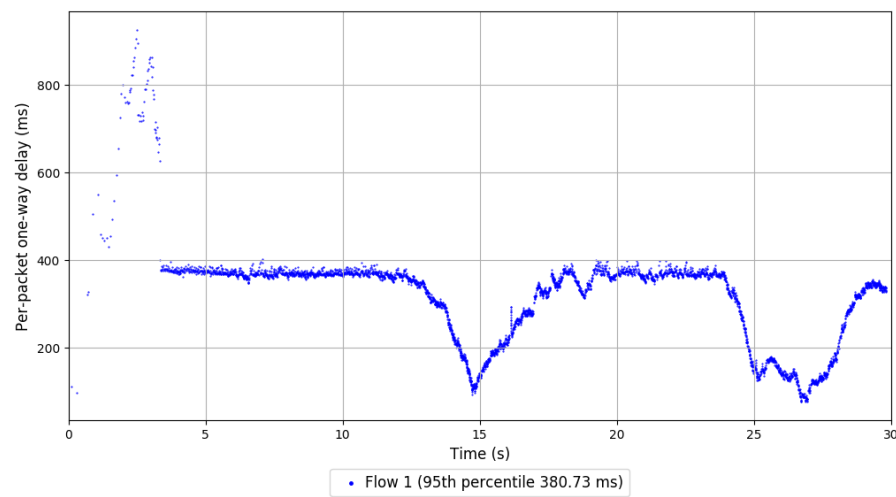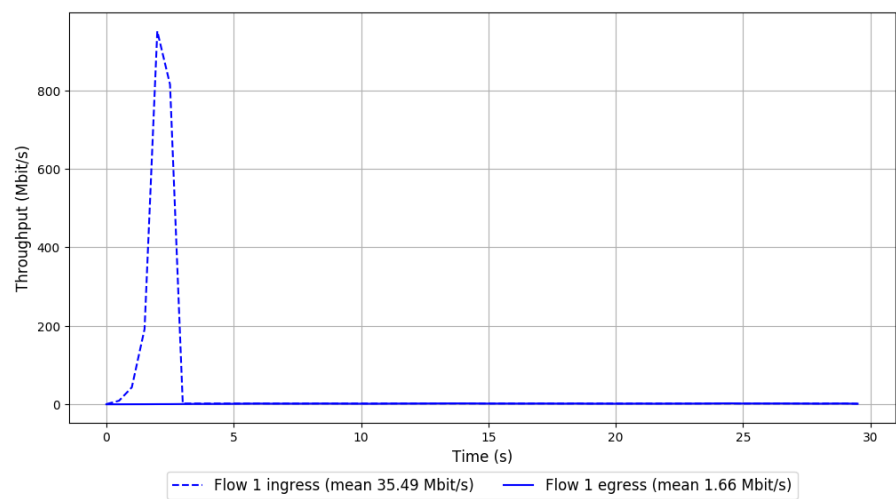

Flow 1 (95th percentile 388.20 ms)

```
Run 2: Statistics of PCC

Start at: 2017-09-19 01:33:04
End at: 2017-09-19 01:33:34
Local clock offset: -0.812 ms
Remote clock offset: -1.779 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 380.726 ms
Loss rate: 95.34%
-- Flow 1:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 380.726 ms
Loss rate: 95.34%
```

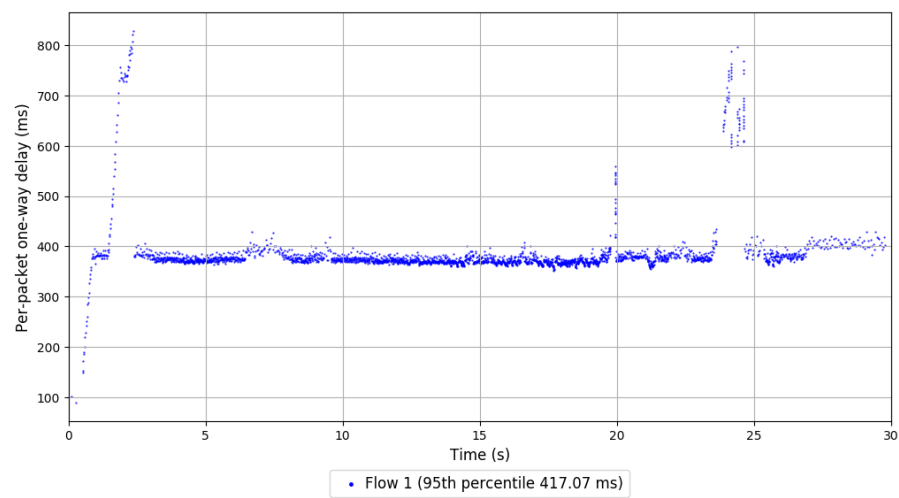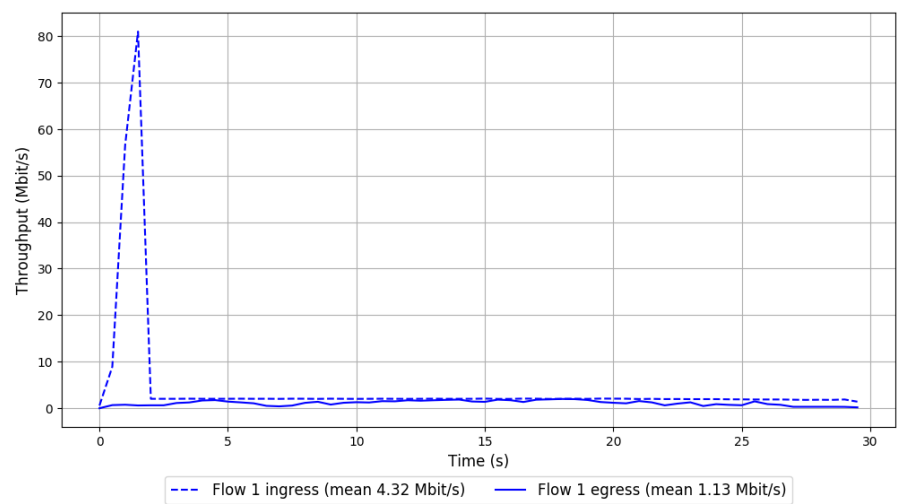# Run 2: Report of PCC — Data Link

```
Run 3: Statistics of PCC

Start at: 2017-09-19 01:44:41
End at: 2017-09-19 01:45:11
Local clock offset: -0.61 ms
Remote clock offset: -1.534 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.13 Mbit/s
95th percentile per-packet one-way delay: 417.073 ms
Loss rate: 73.96%
-- Flow 1:
Average throughput: 1.13 Mbit/s
95th percentile per-packet one-way delay: 417.073 ms
Loss rate: 73.96%
```

Run 3: Report of PCC — Data Link

Flow 1 ingress (mean 4.32 Mbit/s)   Flow 1 egress (mean 1.13 Mbit/s)

Flow 1 (95th percentile 417.07 ms)

```
Run 1: Statistics of QUIC Cubic

Start at: 2017-09-19 01:16:58
End at: 2017-09-19 01:17:28
Local clock offset: -0.14 ms
Remote clock offset: -2.134 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.54 Mbit/s
95th percentile per-packet one-way delay: 375.459 ms
Loss rate: 5.30%
-- Flow 1:
Average throughput: 1.54 Mbit/s
95th percentile per-packet one-way delay: 375.459 ms
Loss rate: 5.30%
```
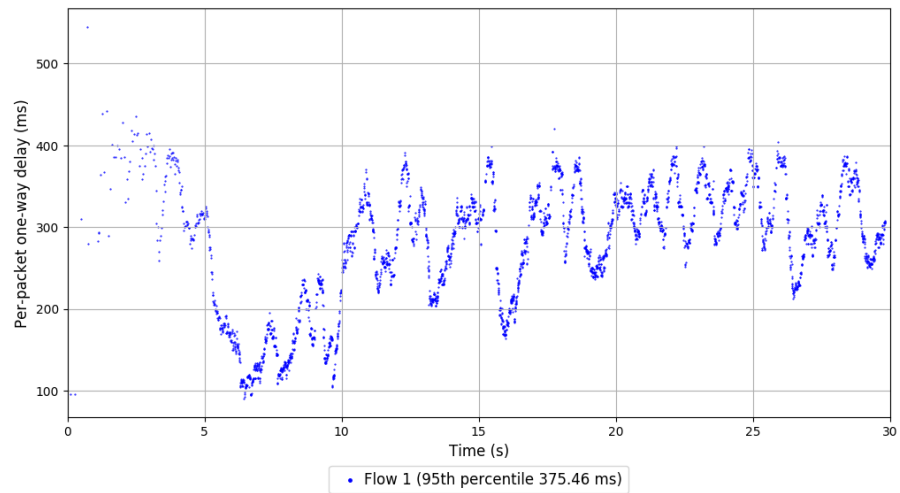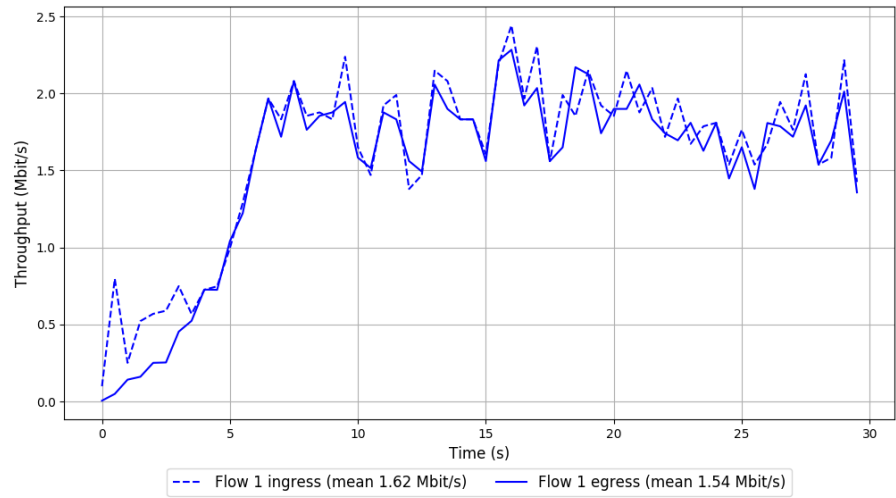
Run 1: Report of QUIC Cubic — Data Link

```
Run 2: Statistics of QUIC Cubic

Start at: 2017-09-19 01:28:27
End at: 2017-09-19 01:28:57
Local clock offset: 0.338 ms
Remote clock offset: -1.888 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.76 Mbit/s
95th percentile per-packet one-way delay: 401.984 ms
Loss rate: 17.06%
-- Flow 1:
Average throughput: 0.76 Mbit/s
95th percentile per-packet one-way delay: 401.984 ms
Loss rate: 17.06%
```
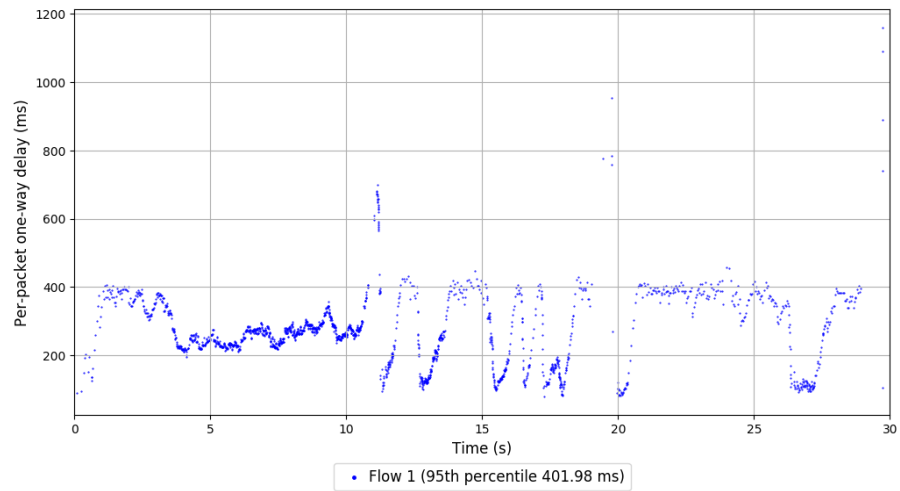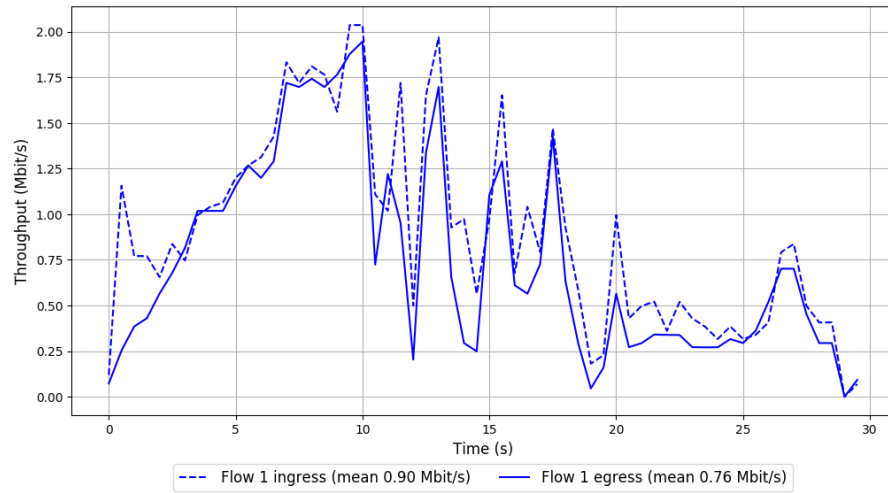
Run 2: Report of QUIC Cubic — Data Link

```
Run 3: Statistics of QUIC Cubic

Start at: 2017-09-19 01:40:05
End at: 2017-09-19 01:40:35
Local clock offset: 0.475 ms
Remote clock offset: -1.684 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 368.927 ms
Loss rate: 4.98%
-- Flow 1:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 368.927 ms
Loss rate: 4.98%
```
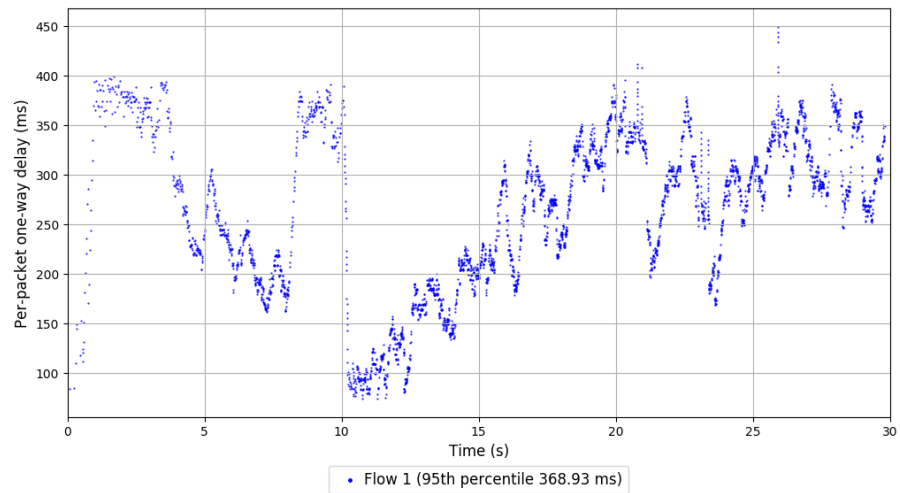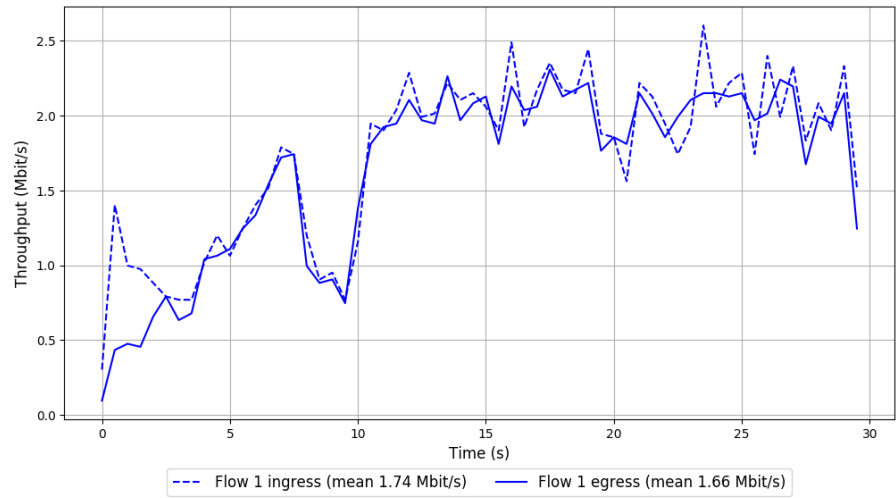
Run 3: Report of QUIC Cubic — Data Link

Flow 1 ingress (mean 1.74 Mbit/s)   Flow 1 egress (mean 1.66 Mbit/s)
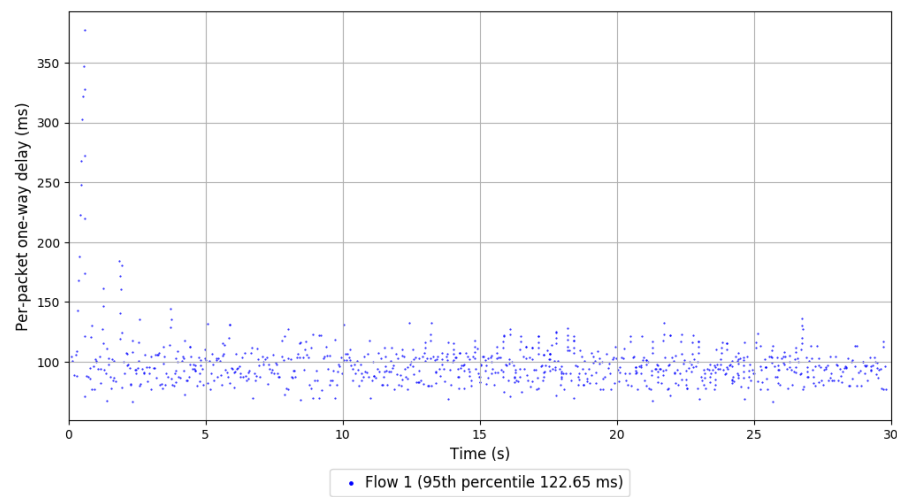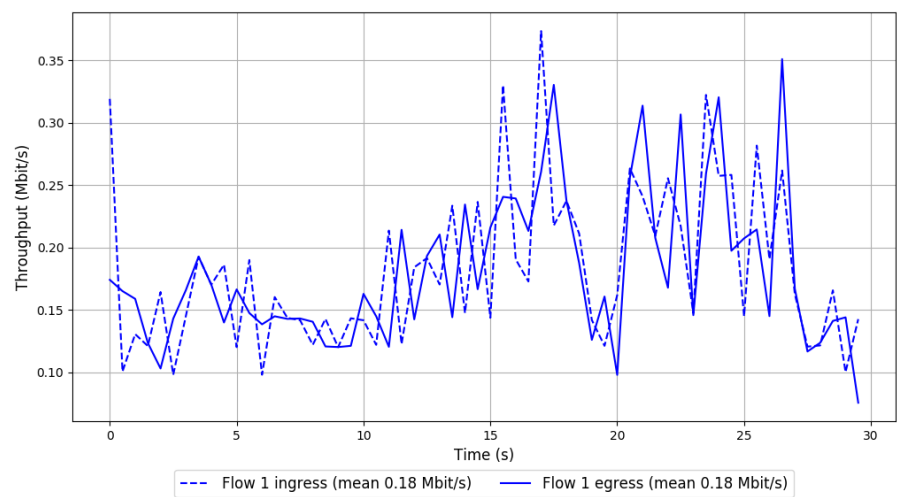

Flow 1 (95th percentile 368.93 ms)

```
Run 1: Statistics of Sprout

Start at: 2017-09-19 01:22:42
End at: 2017-09-19 01:23:12
Local clock offset: -1.199 ms
Remote clock offset: -1.981 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.18 Mbit/s
95th percentile per-packet one-way delay: 122.647 ms
Loss rate: 1.03%
-- Flow 1:
Average throughput: 0.18 Mbit/s
95th percentile per-packet one-way delay: 122.647 ms
Loss rate: 1.03%
```

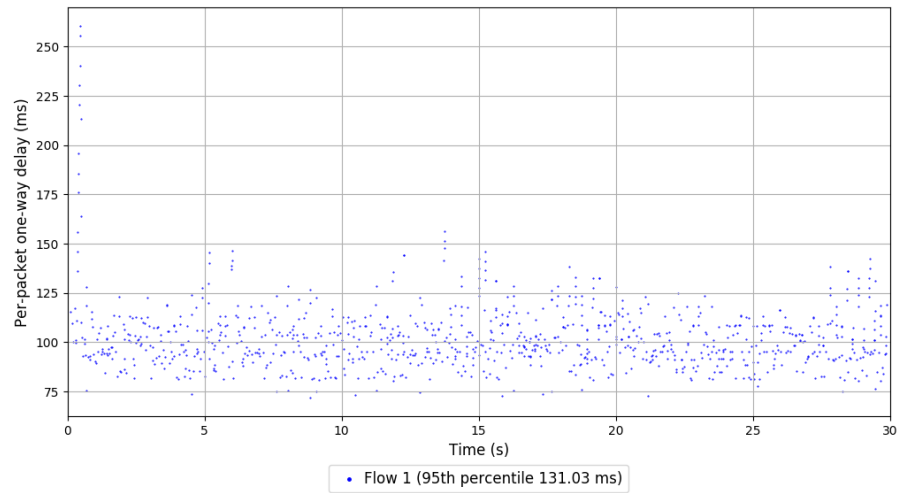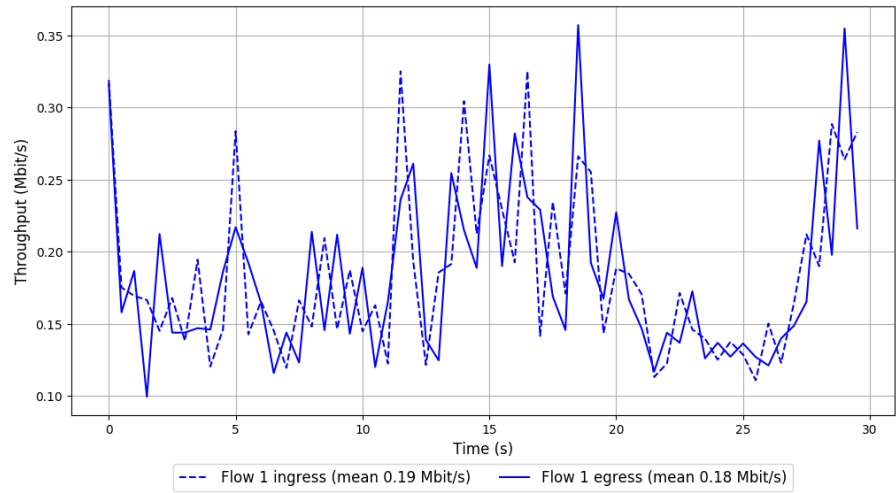Run 1: Report of Sprout — Data Link

```
Run 2: Statistics of Sprout

Start at: 2017-09-19 01:34:19
End at: 2017-09-19 01:34:49
Local clock offset: 0.478 ms
Remote clock offset: -1.674 ms

# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.18 Mbit/s
95th percentile per-packet one-way delay: 131.035 ms
Loss rate: 0.63%
-- Flow 1:
Average throughput: 0.18 Mbit/s
95th percentile per-packet one-way delay: 131.035 ms
Loss rate: 0.63%
```
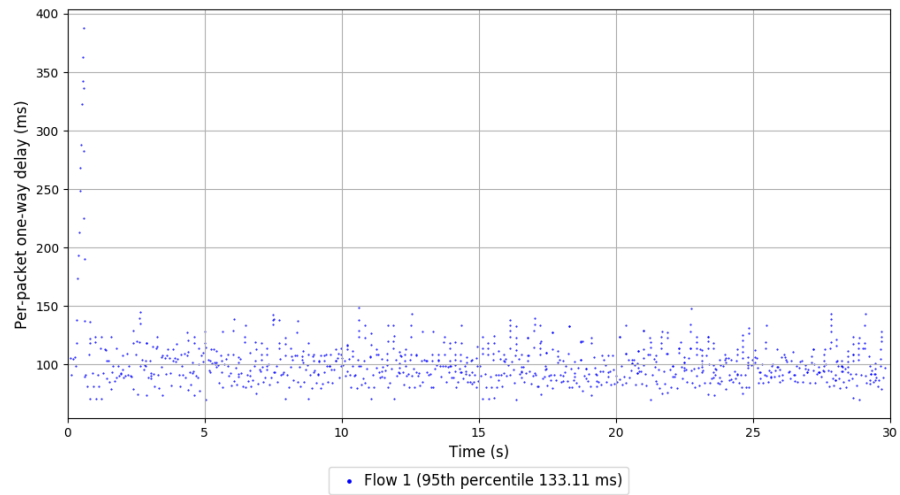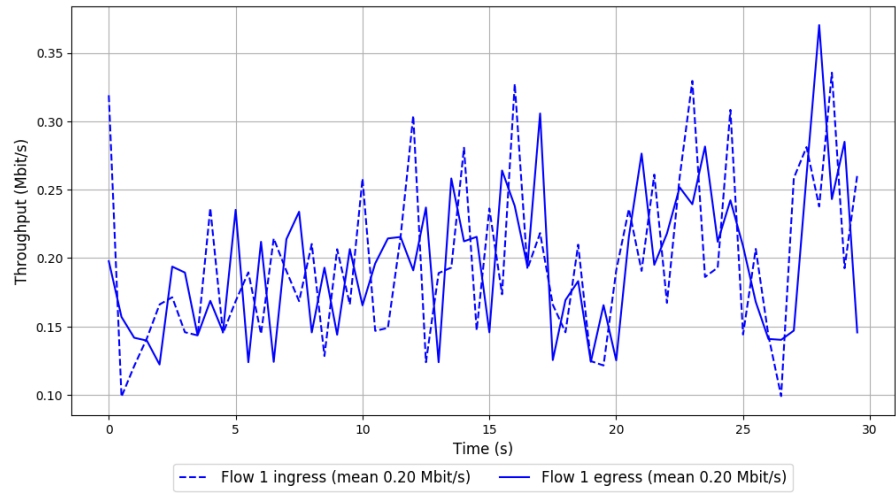
Run 2: Report of Sprout — Data Link

```
Run 3: Statistics of Sprout

Start at: 2017-09-19 01:45:50
End at: 2017-09-19 01:46:20
Local clock offset: -0.577 ms
Remote clock offset: -1.499 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.20 Mbit/s
95th percentile per-packet one-way delay: 133.113 ms
Loss rate: 1.15%
-- Flow 1:
Average throughput: 0.20 Mbit/s
95th percentile per-packet one-way delay: 133.113 ms
Loss rate: 1.15%
```

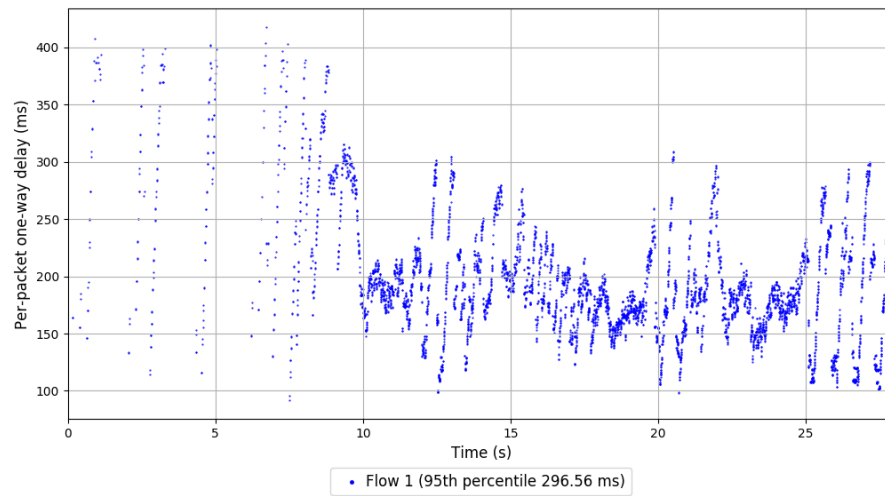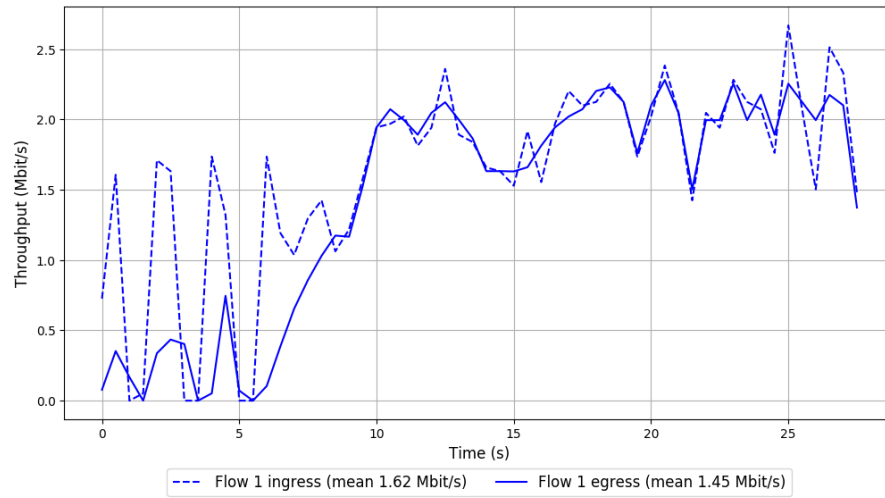# Run 3: Report of Sprout — Data Link

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

Start at: 2017-09-19 01:15:49
End at: 2017-09-19 01:16:19
Local clock offset: -0.195 ms
Remote clock offset: -2.104 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.45 Mbit/s
95th percentile per-packet one-way delay: 296.564 ms
Loss rate: 11.18%
-- Flow 1:
Average throughput: 1.45 Mbit/s
95th percentile per-packet one-way delay: 296.564 ms
Loss rate: 11.18%
```

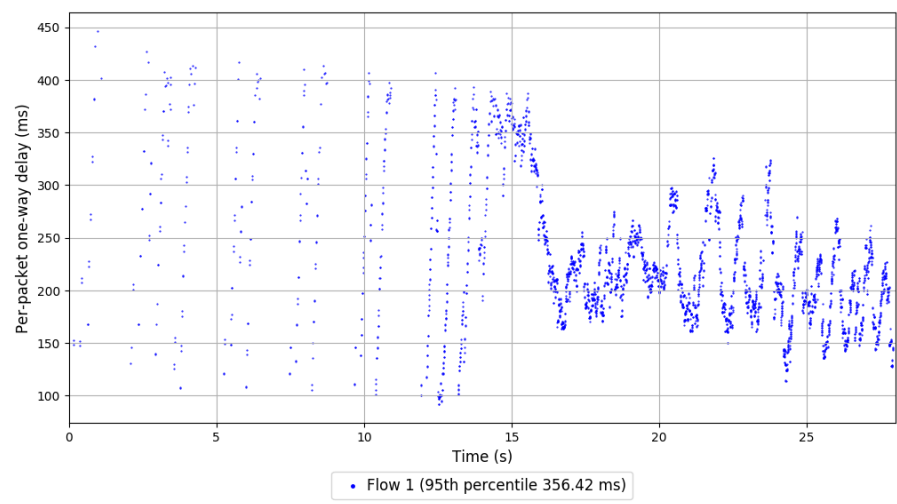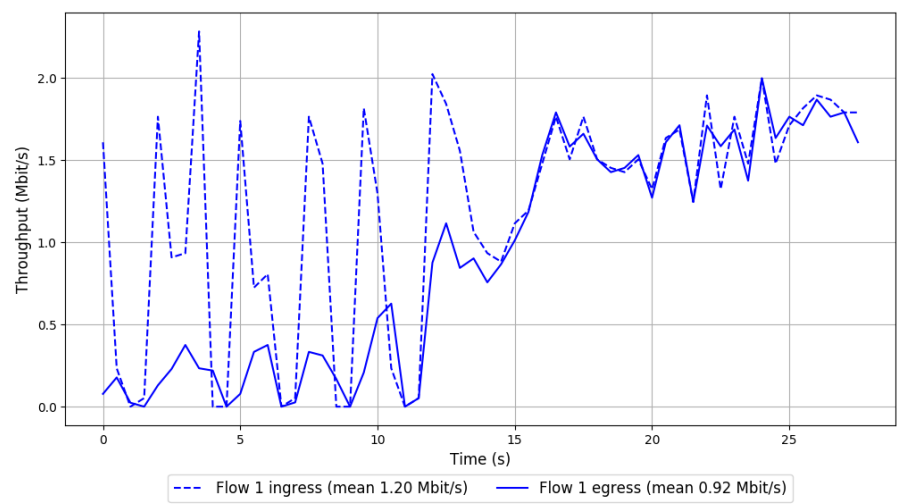Run 1: Report of TaoVA-100x — Data Link

```
Run 2: Statistics of TaoVA-100x

Start at: 2017-09-19 01:27:18
End at: 2017-09-19 01:27:48
Local clock offset: -1.047 ms
Remote clock offset: -1.899 ms

# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.92 Mbit/s
95th percentile per-packet one-way delay: 356.423 ms
Loss rate: 24.56%
-- Flow 1:
Average throughput: 0.92 Mbit/s
95th percentile per-packet one-way delay: 356.423 ms
Loss rate: 24.56%
```

Run 2: Report of TaoVA-100x — Data Link

Flow 1 ingress (mean 1.20 Mbit/s)   Flow 1 egress (mean 0.92 Mbit/s)

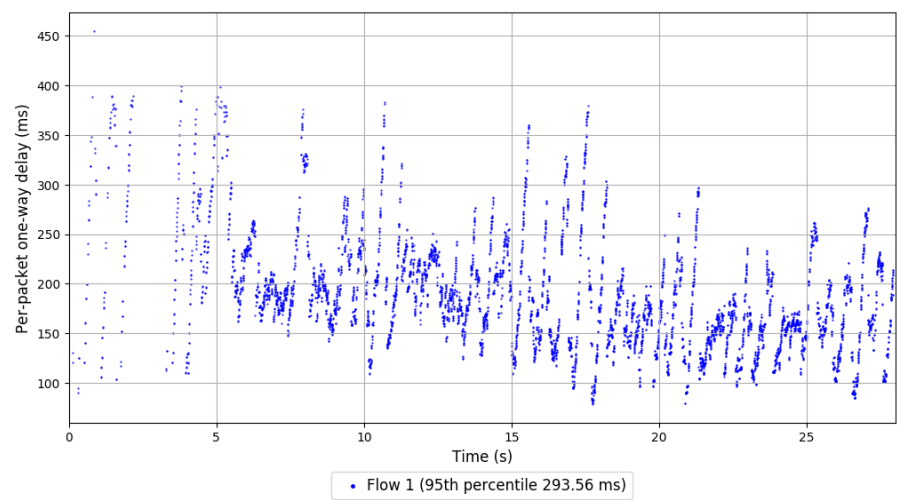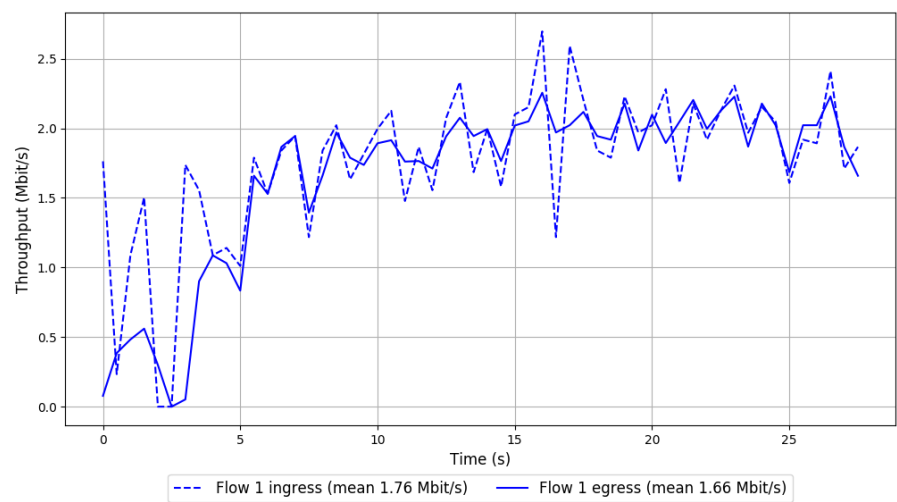Flow 1 (95th percentile 356.42 ms)

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```
Run 3: Statistics of TaoVA-100x

Start at: 2017-09-19 01:38:55
End at: 2017-09-19 01:39:25
Local clock offset: -0.824 ms
Remote clock offset: -1.627 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 293.563 ms
Loss rate: 5.87%
-- Flow 1:
Average throughput: 1.66 Mbit/s
95th percentile per-packet one-way delay: 293.563 ms
Loss rate: 5.87%
```

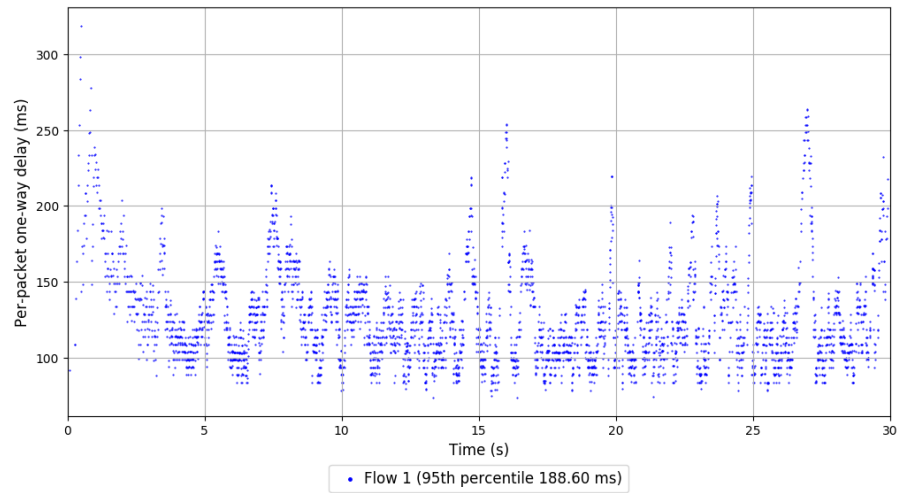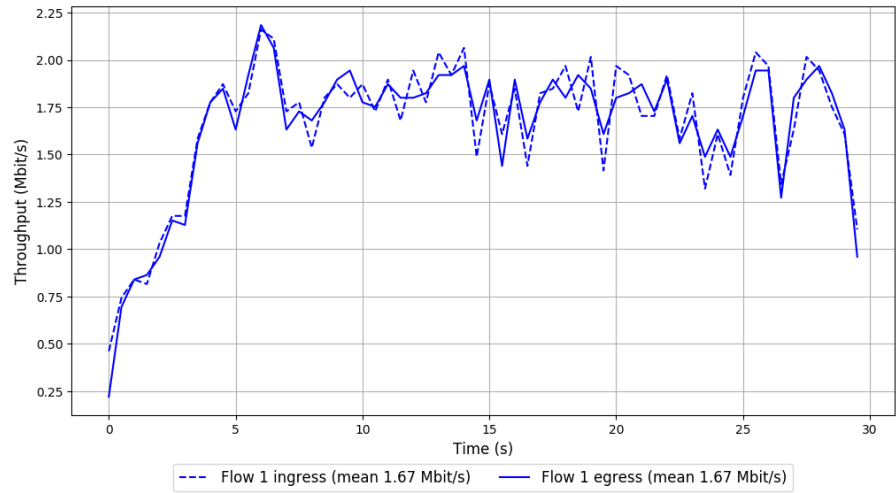Run 3: Report of TaoVA-100x — Data Link

```
Run 1: Statistics of TCP Vegas

Start at: 2017-09-19 01:23:51
End at: 2017-09-19 01:24:21
Local clock offset: -1.199 ms
Remote clock offset: -1.923 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.67 Mbit/s
95th percentile per-packet one-way delay: 188.602 ms
Loss rate: 0.53%
-- Flow 1:
Average throughput: 1.67 Mbit/s
95th percentile per-packet one-way delay: 188.602 ms
Loss rate: 0.53%
```

Run 1: Report of TCP Vegas — Data Link

Flow 1 ingress (mean 1.67 Mbit/s) — — —   Flow 1 egress (mean 1.67 Mbit/s) ———
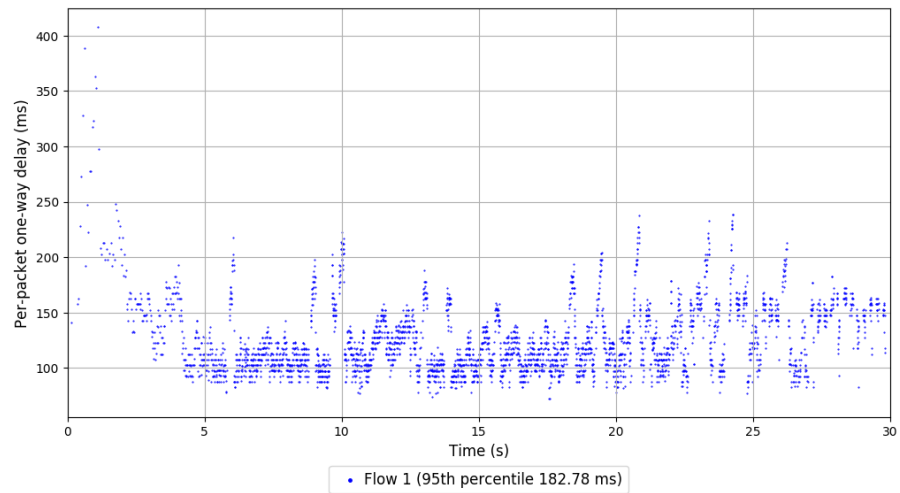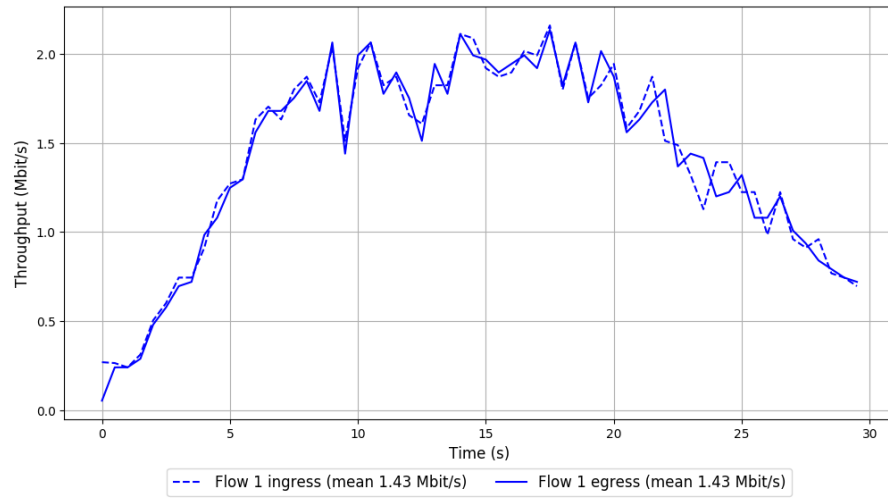

Flow 1 (95th percentile 188.60 ms)

```
Run 2: Statistics of TCP Vegas

Start at: 2017-09-19 01:35:27
End at: 2017-09-19 01:35:57
Local clock offset: -0.693 ms
Remote clock offset: -1.723 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.43 Mbit/s
95th percentile per-packet one-way delay: 182.778 ms
Loss rate: 0.56%
-- Flow 1:
Average throughput: 1.43 Mbit/s
95th percentile per-packet one-way delay: 182.778 ms
Loss rate: 0.56%
```

Run 2: Report of TCP Vegas — Data Link

Flow 1 ingress (mean 1.43 Mbit/s)   Flow 1 egress (mean 1.43 Mbit/s)
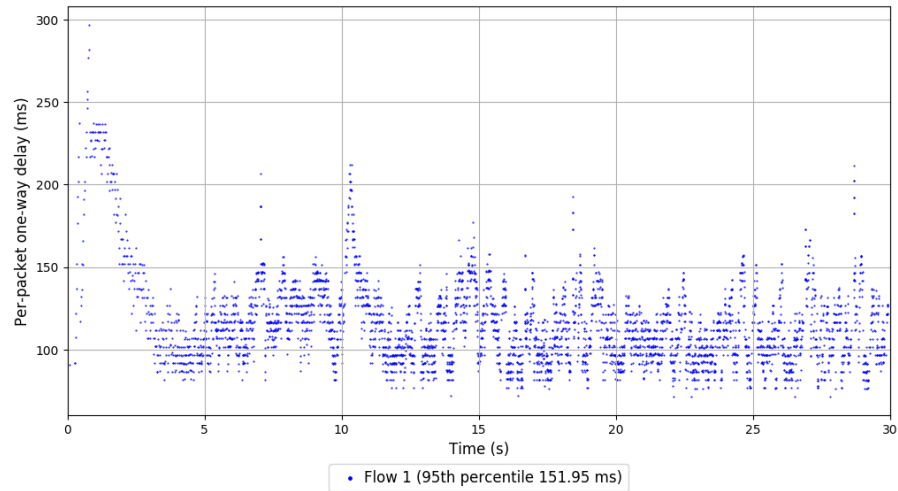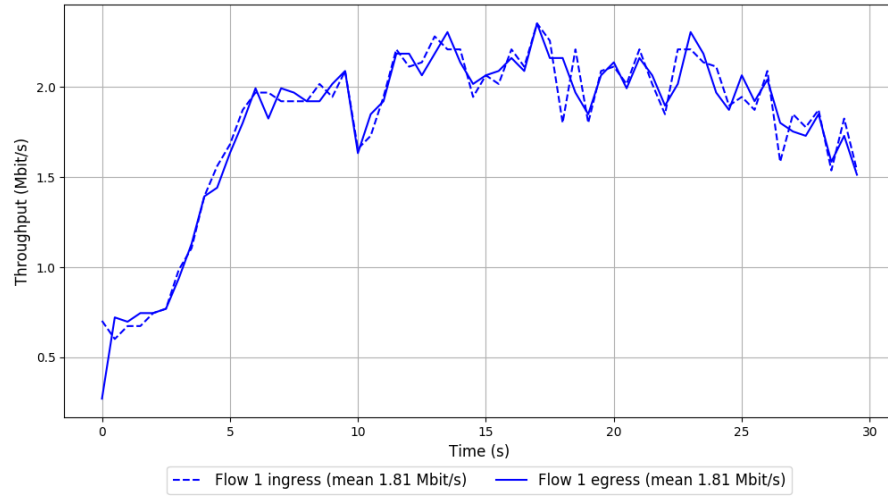

Flow 1 (95th percentile 182.78 ms)

```
Run 3: Statistics of TCP Vegas

Start at: 2017-09-19 01:46:59
End at: 2017-09-19 01:47:29
Local clock offset: 0.524 ms
Remote clock offset: -1.501 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.81 Mbit/s
95th percentile per-packet one-way delay: 151.954 ms
Loss rate: 0.44%
-- Flow 1:
Average throughput: 1.81 Mbit/s
95th percentile per-packet one-way delay: 151.954 ms
Loss rate: 0.44%
```

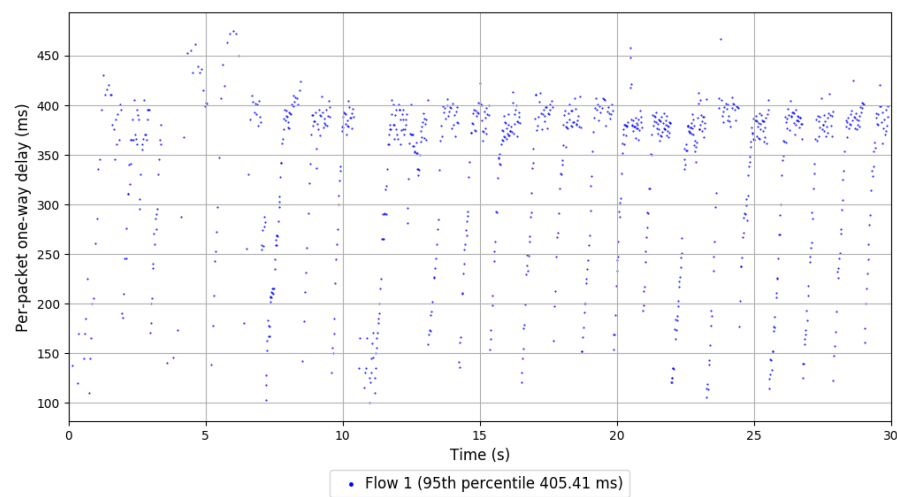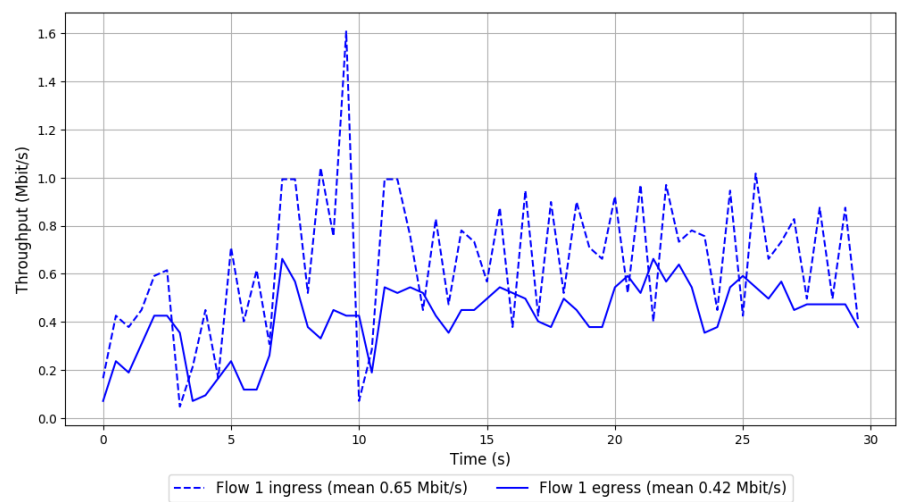Run 3: Report of TCP Vegas — Data Link

```
Run 1: Statistics of Verus

Start at: 2017-09-19 01:25:00
End at: 2017-09-19 01:25:30
Local clock offset: -1.058 ms
Remote clock offset: -1.932 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 0.42 Mbit/s
95th percentile per-packet one-way delay: 405.414 ms
Loss rate: 35.52%
-- Flow 1:
Average throughput: 0.42 Mbit/s
95th percentile per-packet one-way delay: 405.414 ms
Loss rate: 35.52%
```

Run 1: Report of Verus — Data Link

```
Run 2: Statistics of Verus

Start at: 2017-09-19 01:36:37
End at: 2017-09-19 01:37:07
Local clock offset: -0.725 ms
Remote clock offset: -1.73 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.19 Mbit/s
95th percentile per-packet one-way delay: 383.777 ms
Loss rate: 40.17%
-- Flow 1:
Average throughput: 1.19 Mbit/s
95th percentile per-packet one-way delay: 383.777 ms
Loss rate: 40.17%
```
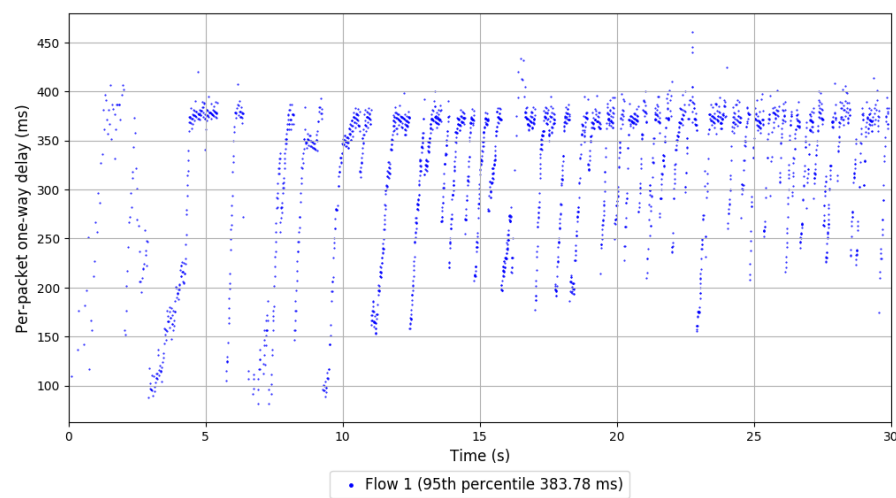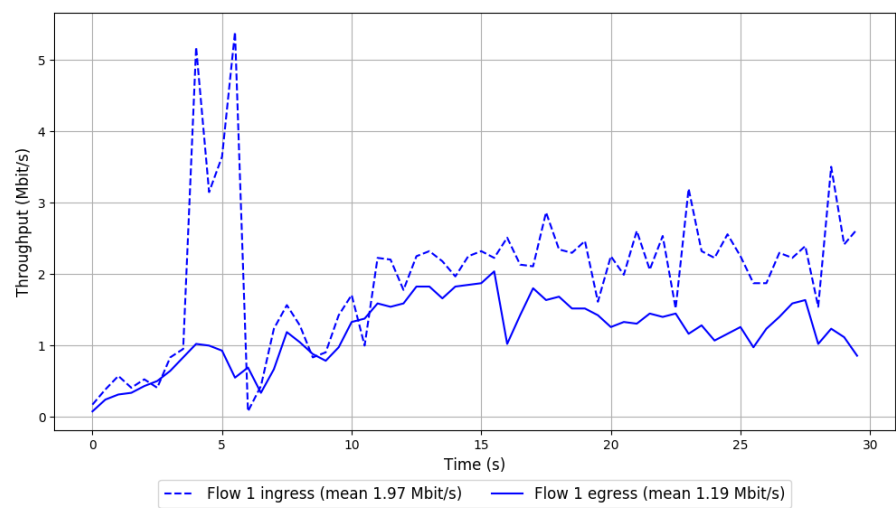
Run 2: Report of Verus — Data Link

Flow 1 ingress (mean 1.97 Mbit/s)   Flow 1 egress (mean 1.19 Mbit/s)

• Flow 1 (95th percentile 383.78 ms)

```
Run 3: Statistics of Verus

Start at: 2017-09-19 01:48:08
End at: 2017-09-19 01:48:38
Local clock offset: -0.557 ms
Remote clock offset: -1.484 ms


# Below is generated by plot.py at 2017-09-19 02:25:00
# Datalink statistics
-- Total of 1 flow:
Average throughput: 1.83 Mbit/s
95th percentile per-packet one-way delay: 380.024 ms
Loss rate: 23.59%
-- Flow 1:
Average throughput: 1.83 Mbit/s
95th percentile per-packet one-way delay: 380.024 ms
Loss rate: 23.59%
```

Run 3: Report of Verus — Data Link