

Измерение производительности для трафика UDP

В [прошлой публикации](#) было рассмотрено измерение производительности сетевых операций для платы HiFive Unleashed с операционной системой Linux на [базе ядра 5.2.9](#) с помощью программы iperf3 и заданного по умолчанию протокола TCP. Измерения показали, что скорость сетевого обмена в значительной мере определяется не возможностями платы и ядра Linux, а параметрами управления потоком данных в реализации протокола TCP. Поскольку для нас основной интерес представляют возможности процессоров Freedom U540, установленных на плате HiFive Unleashed и собранного специально для этой платы ядра Linux 5.2.9, было принято решение провести измерения скорости сетевого обмена по протоколу UDP.

В этом случае активного сетевого обмена между участвующими в тесте хостами не происходит. Хост-клиент генерирует трафик UDP с заданной в командной строке скоростью, а хост-сервер определяет скорость получения пакетов, а также число потерянных пакетов и по завершению каждого теста передает результаты клиенту по протоколу TCP. Трафик TCP невелик и существенного влияния на измерение производительности не оказывает.

В тесте применялась плата HiFive Unleashed с ОС Linux на базе специально собранного ядра версии 5.2.9 и хост x86_64 с двумя процессорами Xeon (суммарно 40 ядер). Сначала измерения проводились с клиентом HiFive и сервером x86_64, затем хосты менялись ролями

Клиент HiFive

Принятая по умолчанию скорость (1 Мбит/с)

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 52003 connected to 192.168.0.10 port 5201
[ ID] Interval          Transfer          Bitrate          Total Datagrams
[ 5] 0.00-1.00 sec      129 KBytes       1.05 Mbits/sec   91
[ 5] 1.00-2.00 sec      127 KBytes       1.04 Mbits/sec   90
[ 5] 2.00-3.00 sec      129 KBytes       1.05 Mbits/sec   91
[ 5] 3.00-4.00 sec      127 KBytes       1.04 Mbits/sec   90
[ 5] 4.00-5.00 sec      129 KBytes       1.05 Mbits/sec   91
[ 5] 5.00-6.00 sec      127 KBytes       1.04 Mbits/sec   90
[ 5] 6.00-7.00 sec      129 KBytes       1.05 Mbits/sec   91
[ 5] 7.00-8.00 sec      127 KBytes       1.04 Mbits/sec   90
[ 5] 8.00-9.00 sec      129 KBytes       1.05 Mbits/sec   91
[ 5] 9.00-10.00 sec     127 KBytes       1.04 Mbits/sec   90
-- -- -- -- --
[ ID] Interval          Transfer          Bitrate          Jitter          Lost/Total Datagrams
[ 5] 0.00-10.00 sec     1.25 MBytes       1.05 Mbits/sec   0.000 ms        0/905 (0%) sender
[ 5] 0.00-10.00 sec     1.25 MBytes       1.05 Mbits/sec   0.014 ms        0/905 (0%) receiver

iperf Done.
```

2 Мбит/с

```
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 45936 connected to 192.168.0.10 port 5201
[ ID] Interval          Transfer          Bitrate          Total Datagrams
[ 5] 0.00-1.00 sec      245 KBytes       2.00 Mbits/sec   173
[ 5] 1.00-2.00 sec      245 KBytes       2.00 Mbits/sec   173
[ 5] 2.00-3.00 sec      243 KBytes       1.99 Mbits/sec   172
[ 5] 3.00-4.00 sec      245 KBytes       2.00 Mbits/sec   173
[ 5] 4.00-5.00 sec      245 KBytes       2.00 Mbits/sec   173
[ 5] 5.00-6.00 sec      243 KBytes       1.99 Mbits/sec   172
[ 5] 6.00-7.00 sec      245 KBytes       2.00 Mbits/sec   173
[ 5] 7.00-8.00 sec      245 KBytes       2.00 Mbits/sec   173
[ 5] 8.00-9.00 sec      243 KBytes       1.99 Mbits/sec   172
[ 5] 9.00-10.00 sec     245 KBytes       2.00 Mbits/sec   173
-- -- -- -- --
[ ID] Interval          Transfer          Bitrate          Jitter          Lost/Total Datagrams
[ 5] 0.00-10.00 sec     2.38 MBytes       2.00 Mbits/sec   0.000 ms        0/1727 (0%) sender
[ 5] 0.00-10.00 sec     2.38 MBytes       2.00 Mbits/sec   0.019 ms        0/1727 (0%) receiver

iperf Done.
```

4 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 4M
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 42367 connected to 192.168.0.10 port 5201
[ ID] Interval          Transfer          Bitrate          Total Datagrams
[ 5] 0.00-1.00 sec      488 KBytes       3.99 Mbits/sec   345
[ 5] 1.00-2.00 sec      489 KBytes       4.01 Mbits/sec   346
[ 5] 2.00-3.00 sec      488 KBytes       4.00 Mbits/sec   345
[ 5] 3.00-4.00 sec      488 KBytes       4.00 Mbits/sec   345
[ 5] 4.00-5.00 sec      489 KBytes       4.01 Mbits/sec   346
[ 5] 5.00-6.00 sec      488 KBytes       4.00 Mbits/sec   345
[ 5] 6.00-7.00 sec      488 KBytes       4.00 Mbits/sec   345
[ 5] 7.00-8.00 sec      489 KBytes       4.01 Mbits/sec   346
[ 5] 8.00-9.00 sec      488 KBytes       4.00 Mbits/sec   345
[ 5] 9.00-10.00 sec     488 KBytes       4.00 Mbits/sec   345
-- -- -- -- --
[ ID] Interval          Transfer          Bitrate          Jitter          Lost/Total Datagrams
[ 5] 0.00-10.00 sec     4.77 MBytes       4.00 Mbits/sec   0.000 ms        0/3453 (0%) sender
[ 5] 0.00-10.00 sec     4.77 MBytes       4.00 Mbits/sec   0.029 ms        0/3453 (0%) receiver
```

iperf Done.

8 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 8M
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 41812 connected to 192.168.0.10 port 5201
[ ID] Interval      Transfer       Bitrate        Total Datagrams
[ 5] 0.00-1.00    sec    976 KBytes    7.98 Mbits/sec    690
[ 5] 1.00-2.00    sec    976 KBytes    7.99 Mbits/sec    690
[ 5] 2.00-3.00    sec    977 KBytes    8.00 Mbits/sec    691
[ 5] 3.00-4.00    sec    976 KBytes    7.99 Mbits/sec    690
[ 5] 4.00-5.00    sec    977 KBytes    8.00 Mbits/sec    691
[ 5] 5.00-6.00    sec    977 KBytes    8.00 Mbits/sec    691
[ 5] 6.00-7.00    sec    976 KBytes    7.99 Mbits/sec    690
[ 5] 7.00-8.00    sec    977 KBytes    8.00 Mbits/sec    691
[ 5] 8.00-9.00    sec    976 KBytes    7.99 Mbits/sec    690
[ 5] 9.00-10.00   sec    977 KBytes    8.00 Mbits/sec    691
-----
[ ID] Interval      Transfer       Bitrate        Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00   sec    9.54 MBytes    8.00 Mbits/sec  0.000 ms   0/6905 (0%)  sender
[ 5] 0.00-10.00   sec    9.54 MBytes    8.00 Mbits/sec  0.063 ms   0/6905 (0%)  receiver
```

iperf Done.

16 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 16M
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 52891 connected to 192.168.0.10 port 5201
[ ID] Interval      Transfer       Bitrate        Total Datagrams
[ 5] 0.00-1.00    sec    1.90 MBytes    15.9 Mbits/sec    1377
[ 5] 1.00-2.00    sec    1.91 MBytes    16.0 Mbits/sec    1381
[ 5] 2.00-3.00    sec    1.91 MBytes    16.0 Mbits/sec    1382
[ 5] 3.00-4.00    sec    1.91 MBytes    16.0 Mbits/sec    1381
[ 5] 4.00-5.00    sec    1.91 MBytes    16.0 Mbits/sec    1381
[ 5] 5.00-6.00    sec    1.91 MBytes    16.0 Mbits/sec    1381
[ 5] 6.00-7.00    sec    1.91 MBytes    16.0 Mbits/sec    1381
[ 5] 7.00-8.00    sec    1.91 MBytes    16.0 Mbits/sec    1382
[ 5] 8.00-9.00    sec    1.91 MBytes    16.0 Mbits/sec    1381
[ 5] 9.00-10.00   sec    1.91 MBytes    16.0 Mbits/sec    1381
-----
[ ID] Interval      Transfer       Bitrate        Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00   sec    19.1 MBytes    16.0 Mbits/sec  0.000 ms   0/13808 (0%) sender
[ 5] 0.00-10.00   sec    19.1 MBytes    16.0 Mbits/sec  0.074 ms   0/13808 (0%) receiver
```

iperf Done.

32 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 32M
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 34927 connected to 192.168.0.10 port 5201
[ ID] Interval      Transfer       Bitrate        Total Datagrams
[ 5] 0.00-1.00    sec    3.81 MBytes    31.9 Mbits/sec    2760
[ 5] 1.00-2.00    sec    3.81 MBytes    32.0 Mbits/sec    2762
[ 5] 2.00-3.00    sec    3.82 MBytes    32.0 Mbits/sec    2763
[ 5] 3.00-4.00    sec    3.81 MBytes    32.0 Mbits/sec    2762
[ 5] 4.00-5.00    sec    3.82 MBytes    32.0 Mbits/sec    2763
[ 5] 5.00-6.00    sec    3.82 MBytes    32.0 Mbits/sec    2763
[ 5] 6.00-7.00    sec    3.81 MBytes    32.0 Mbits/sec    2762
[ 5] 7.00-8.00    sec    3.81 MBytes    32.0 Mbits/sec    2762
[ 5] 8.00-9.00    sec    3.82 MBytes    32.0 Mbits/sec    2763
[ 5] 9.00-10.00   sec    3.81 MBytes    32.0 Mbits/sec    2761
-----
[ ID] Interval      Transfer       Bitrate        Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00   sec    38.1 MBytes    32.0 Mbits/sec  0.000 ms   0/27621 (0%) sender
[ 5] 0.00-10.00   sec    38.1 MBytes    32.0 Mbits/sec  0.060 ms   0/27621 (0%) receiver
```

iperf Done.

64 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 64M
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 39289 connected to 192.168.0.10 port 5201
[ ID] Interval      Transfer       Bitrate        Total Datagrams
[ 5] 0.00-1.00    sec    7.62 MBytes    63.9 Mbits/sec    5516
[ 5] 1.00-2.00    sec    7.62 MBytes    64.0 Mbits/sec    5521
[ 5] 2.00-3.00    sec    7.62 MBytes    63.9 Mbits/sec    5516
[ 5] 3.00-4.00    sec    7.65 MBytes    64.1 Mbits/sec    5538
[ 5] 4.00-5.00    sec    7.64 MBytes    64.1 Mbits/sec    5531
[ 5] 5.00-6.00    sec    7.63 MBytes    64.0 Mbits/sec    5522
[ 5] 6.00-7.00    sec    7.62 MBytes    64.0 Mbits/sec    5521
[ 5] 7.00-8.00    sec    7.64 MBytes    64.1 Mbits/sec    5532
[ 5] 8.00-9.00    sec    7.61 MBytes    63.8 Mbits/sec    5509
[ 5] 9.00-10.00   sec    7.65 MBytes    63.9 Mbits/sec    5539
-----
[ ID] Interval      Transfer       Bitrate        Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00   sec    76.3 MBytes    64.0 Mbits/sec  0.000 ms   0/55245 (0%) sender
```

```
[ 5] 0.00-10.00 sec 76.3 MBytes 64.0 Mbits/sec 0.073 ms 0/55245 (0%) receiver
```

iperf Done.

128 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 128M
```

```
Connecting to host 192.168.0.10, port 5201
```

```
[ 5] local 192.168.0.3 port 49324 connected to 192.168.0.10 port 5201
```

[ID]	Interval		Transfer	Bitrate	Total Datagrams
[5]	0.00-1.00	sec	10.6 MBytes	88.6 Mbits/sec	7650
[5]	1.00-2.00	sec	10.6 MBytes	88.7 Mbits/sec	7658
[5]	2.00-3.00	sec	10.6 MBytes	89.1 Mbits/sec	7689
[5]	3.00-4.00	sec	10.6 MBytes	88.6 Mbits/sec	7645
[5]	4.00-5.00	sec	10.5 MBytes	88.3 Mbits/sec	7623
[5]	5.00-6.00	sec	10.5 MBytes	87.9 Mbits/sec	7590
[5]	6.00-7.00	sec	10.4 MBytes	87.6 Mbits/sec	7563
[5]	7.00-8.00	sec	10.4 MBytes	87.4 Mbits/sec	7549
[5]	8.00-9.00	sec	10.7 MBytes	90.0 Mbits/sec	7766
[5]	9.00-10.00	sec	10.7 MBytes	90.0 Mbits/sec	7771

[ID]	Interval		Transfer	Bitrate	Jitter	Lost/Total Datagrams
[5]	0.00-10.00	sec	106 MBytes	88.6 Mbits/sec	0.000 ms	0/76504 (0%) sender
[5]	0.00-10.00	sec	106 MBytes	88.6 Mbits/sec	0.077 ms	0/76504 (0%) receiver

iperf Done.

256 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 256M
```

```
Connecting to host 192.168.0.10, port 5201
```

```
[ 5] local 192.168.0.3 port 50317 connected to 192.168.0.10 port 5201
```

[ID]	Interval		Transfer	Bitrate	Total Datagrams
[5]	0.00-1.00	sec	10.6 MBytes	88.6 Mbits/sec	7650
[5]	1.00-2.00	sec	10.6 MBytes	88.7 Mbits/sec	7660
[5]	2.00-3.00	sec	10.6 MBytes	88.9 Mbits/sec	7676
[5]	3.00-4.00	sec	10.7 MBytes	89.4 Mbits/sec	7718
[5]	4.00-5.00	sec	10.6 MBytes	89.0 Mbits/sec	7687
[5]	5.00-6.00	sec	10.6 MBytes	88.9 Mbits/sec	7673
[5]	6.00-7.00	sec	10.6 MBytes	88.9 Mbits/sec	7678
[5]	7.00-8.00	sec	10.7 MBytes	89.8 Mbits/sec	7752
[5]	8.00-9.00	sec	10.7 MBytes	89.7 Mbits/sec	7741
[5]	9.00-10.00	sec	10.7 MBytes	89.5 Mbits/sec	7725

[ID]	Interval		Transfer	Bitrate	Jitter	Lost/Total Datagrams
[5]	0.00-10.00	sec	106 MBytes	89.1 Mbits/sec	0.000 ms	0/76960 (0%) sender
[5]	0.00-10.00	sec	106 MBytes	89.1 Mbits/sec	0.083 ms	0/76960 (0%) receiver

iperf Done.

512 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 512M
```

```
Connecting to host 192.168.0.10, port 5201
```

```
[ 5] local 192.168.0.3 port 44858 connected to 192.168.0.10 port 5201
```

[ID]	Interval		Transfer	Bitrate	Total Datagrams
[5]	0.00-1.00	sec	8.35 MBytes	70.0 Mbits/sec	6046
[5]	1.00-2.00	sec	8.50 MBytes	71.3 Mbits/sec	6152
[5]	2.00-3.00	sec	8.45 MBytes	70.9 Mbits/sec	6122
[5]	3.00-4.00	sec	7.75 MBytes	65.0 Mbits/sec	5615
[5]	4.00-5.00	sec	7.66 MBytes	64.3 Mbits/sec	5548
[5]	5.00-6.00	sec	7.64 MBytes	64.1 Mbits/sec	5530
[5]	6.00-7.00	sec	7.62 MBytes	63.9 Mbits/sec	5517
[5]	7.00-8.00	sec	7.77 MBytes	65.2 Mbits/sec	5627
[5]	8.00-9.00	sec	7.77 MBytes	65.1 Mbits/sec	5624
[5]	9.00-10.00	sec	7.72 MBytes	64.8 Mbits/sec	5594

[ID]	Interval		Transfer	Bitrate	Jitter	Lost/Total Datagrams
[5]	0.00-10.00	sec	79.2 MBytes	66.5 Mbits/sec	0.000 ms	0/57375 (0%) sender
[5]	0.00-10.00	sec	79.2 MBytes	66.5 Mbits/sec	0.021 ms	0/57375 (0%) receiver

iperf Done.

1000 Мбит/с

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 1000M
```

```
Connecting to host 192.168.0.10, port 5201
```

```
[ 5] local 192.168.0.3 port 56734 connected to 192.168.0.10 port 5201
```

[ID]	Interval		Transfer	Bitrate	Total Datagrams
[5]	0.00-1.00	sec	7.69 MBytes	64.5 Mbits/sec	5571
[5]	1.00-2.00	sec	7.69 MBytes	64.5 Mbits/sec	5570
[5]	2.00-3.00	sec	7.69 MBytes	64.6 Mbits/sec	5572
[5]	3.00-4.00	sec	7.67 MBytes	64.3 Mbits/sec	5554
[5]	4.00-5.00	sec	7.67 MBytes	64.3 Mbits/sec	5555
[5]	5.00-6.00	sec	7.63 MBytes	64.0 Mbits/sec	5527
[5]	6.00-7.00	sec	7.62 MBytes	63.9 Mbits/sec	5520
[5]	7.00-8.00	sec	7.68 MBytes	64.5 Mbits/sec	5565
[5]	8.00-9.00	sec	7.65 MBytes	64.2 Mbits/sec	5540
[5]	9.00-10.00	sec	7.63 MBytes	64.0 Mbits/sec	5522

[ID]	Interval		Transfer	Bitrate	Jitter	Lost/Total Datagrams
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```
[ 5] 0.00-10.00 sec 76.6 MBytes 64.3 Mbits/sec 0.000 ms 0/55496 (0%) sender
[ 5] 0.00-10.00 sec 76.6 MBytes 64.3 Mbits/sec 0.033 ms 0/55496 (0%) receiver
```

iperf Done.

Вывод на стороне клиента (и сервера тоже) потери пакетов не показывал, поскольку скоростные ограничения возникали на стороне генерирующего трафик клиента, а сеть между клиентом и сервером не была загружена и в ней пакеты не терялись. Производительности сервера в этом тесте было достаточно для обработки пакетов со скоростью среды.

Из приведенных результатов и графика (Рисунок 1) видно, что в диапазоне скоростей передачи трафика клиентом HiFive между 64 и 128 Мбит/с наступает насыщение, а затем даже некоторое снижение определяемой iperf3 скорости и числа переданных дейтаграмм. Исследуем интервал скоростей 64-256 Мбит/с более подробно.

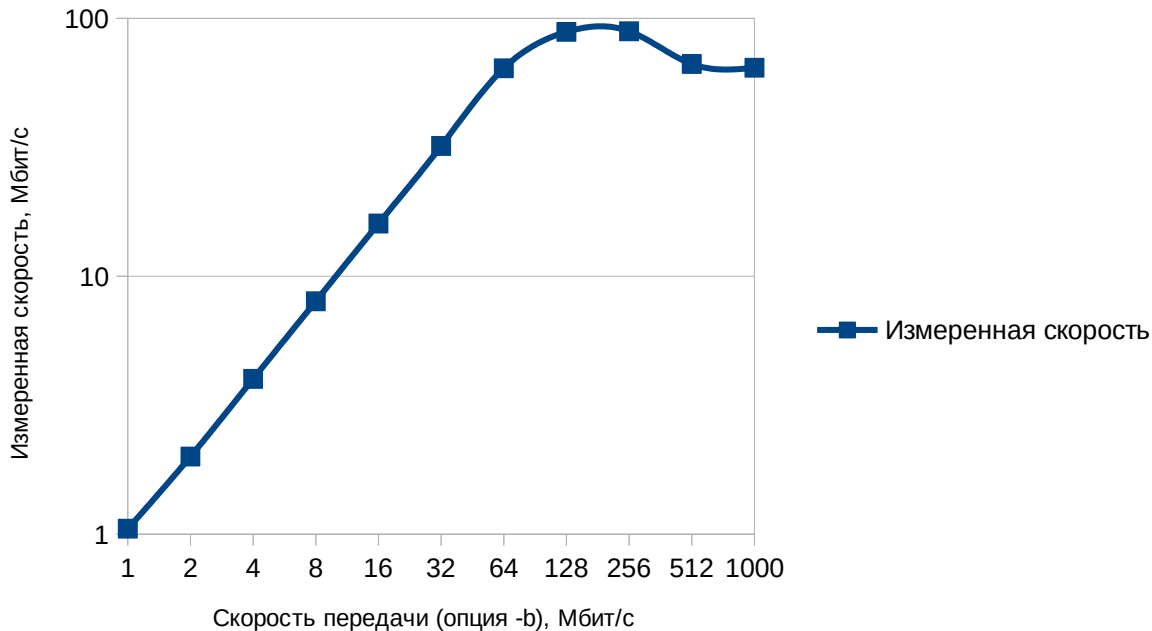


Рисунок 1. Зависимость измеренной скорости от значения опции iperf3 -b.

Поведение в интервале скоростей 64 — 128 Мбит/с

При скорости 70 Мбит/с скорость передачи, заданная в iperf3 еще совпадает с измеренной скоростью, как можно видеть из приведенного ниже вывода

```
root@freedom-u540:~# iperf3 -c 192.168.0.10 -u -b 70M
Connecting to host 192.168.0.10, port 5201
[ 5] local 192.168.0.3 port 39737 connected to 192.168.0.10 port 5201
[ ID] Interval      Transfer    Bitrate    Total Datagrams
[ 5] 0.00-1.00    sec 8.33 MBytes 69.8 Mbits/sec 6030
[ 5] 1.00-2.00    sec 8.33 MBytes 69.9 Mbits/sec 6032
[ 5] 2.00-3.00    sec 8.34 MBytes 70.0 Mbits/sec 6043
[ 5] 3.00-4.00    sec 8.36 MBytes 70.2 Mbits/sec 6055
[ 5] 4.00-5.00    sec 8.35 MBytes 70.0 Mbits/sec 6049
[ 5] 5.00-6.00    sec 8.34 MBytes 70.0 Mbits/sec 6040
[ 5] 6.00-7.00    sec 8.32 MBytes 69.8 Mbits/sec 6027
[ 5] 7.00-8.00    sec 8.35 MBytes 70.0 Mbits/sec 6044
[ 5] 8.00-9.00    sec 8.37 MBytes 70.2 Mbits/sec 6059
[ 5] 9.00-10.00   sec 8.35 MBytes 70.1 Mbits/sec 6048
-----
[ ID] Interval      Transfer    Bitrate    Jitter    Lost/Total Datagrams
[ 5] 0.00-10.00   sec 83.4 MBytes 70.0 Mbits/sec 0.000 ms 0/60427 (0%) sender
[ 5] 0.00-10.00   sec 83.4 MBytes 70.0 Mbits/sec 0.072 ms 0/60427 (0%) receiver
```

iperf Done.

Заметное насыщение начинается в интервале скоростей 71 - 72 Мбит/с. Не будем загромождать текст подробным выводом измерений в диапазоне и покажем лишь график усредненных по нескольким измерениям значений скорости в зависимости параметра -b в команде iperf3. Отметим, что при скорости передачи выше 70 Мбит/с утилита top показывала близкую к 100% загрузку процессора, поэтому результаты iperf3 отличались от измерения к измерению и на графике (Рисунок 2) приведены усредненные значения.

С момента насыщения, как можно видеть из приведенного выше вывода для скоростей выше 64 Мбит/с измеренная скорость в каждом интервале iperf3 колеблется в значительных пределах. Это обусловлено тем, что генерация пакетов iperf3 практически полностью загружает процессоры, поэтому реальная скорость генерации зависит от текущей загрузки процессоров фоновыми задачами с высоким приоритетом (системные процессы).

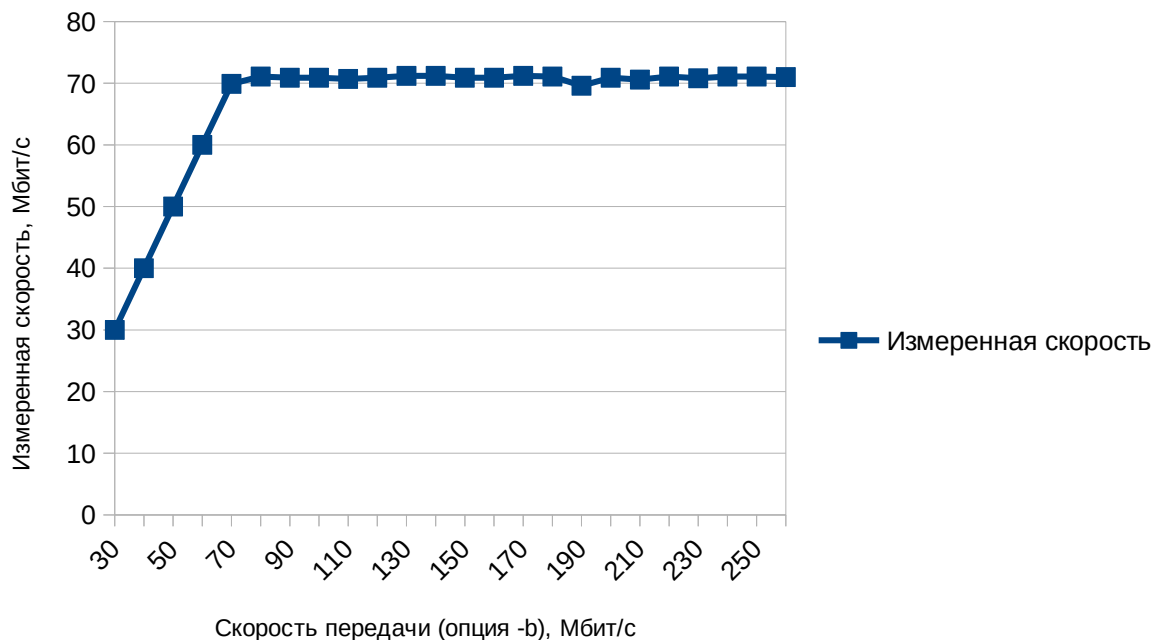


Рисунок 2. Насыщение скорости передачи трафика UDP.

Сервер HiFive

Принятая по умолчанию скорость (1 Мбит/с)

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u
Connecting to host 192.168.0.3, port 5201
[ 5] local 192.168.0.10 port 42358 connected to 192.168.0.3 port 5201
[ ID] Interval           Transfer     Bitrate      Total Datagrams
[ 5] 0.00-1.00   sec      129 KBytes   1.05 Mbits/sec   91
[ 5] 1.00-2.00   sec      127 KBytes   1.04 Mbits/sec   90
[ 5] 2.00-3.00   sec      129 KBytes   1.05 Mbits/sec   91
[ 5] 3.00-4.00   sec      127 KBytes   1.04 Mbits/sec   90
[ 5] 4.00-5.00   sec      129 KBytes   1.05 Mbits/sec   91
[ 5] 5.00-6.00   sec      129 KBytes   1.05 Mbits/sec   91
[ 5] 6.00-7.00   sec      127 KBytes   1.04 Mbits/sec   90
[ 5] 7.00-8.00   sec      129 KBytes   1.05 Mbits/sec   91
[ 5] 8.00-9.00   sec      127 KBytes   1.04 Mbits/sec   90
[ 5] 9.00-10.00  sec      129 KBytes   1.05 Mbits/sec   91
-----
[ ID] Interval           Transfer     Bitrate      Jitter        Lost/Total Datagrams
[ 5] 0.00-10.00  sec      1.25 MBytes   1.05 Mbits/sec  0.000 ms    0/906 (0%)  sender
[ 5] 0.00-10.00  sec      1.25 MBytes   1.05 Mbits/sec  0.005 ms    0/906 (0%)  receiver
```

iperf Done.

2 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 2M
Connecting to host 192.168.0.3, port 5201
[ 5] local 192.168.0.10 port 37942 connected to 192.168.0.3 port 5201
[ ID] Interval           Transfer     Bitrate      Total Datagrams
[ 5] 0.00-1.00   sec      245 KBytes   2.00 Mbits/sec   173
[ 5] 1.00-2.00   sec      245 KBytes   2.00 Mbits/sec   173
[ 5] 2.00-3.00   sec      243 KBytes   1.99 Mbits/sec   172
[ 5] 3.00-4.00   sec      245 KBytes   2.00 Mbits/sec   173
[ 5] 4.00-5.00   sec      245 KBytes   2.00 Mbits/sec   173
[ 5] 5.00-6.00   sec      243 KBytes   1.99 Mbits/sec   172
[ 5] 6.00-7.00   sec      245 KBytes   2.00 Mbits/sec   173
[ 5] 7.00-8.00   sec      245 KBytes   2.00 Mbits/sec   173
[ 5] 8.00-9.00   sec      243 KBytes   1.99 Mbits/sec   172
[ 5] 9.00-10.00  sec      245 KBytes   2.00 Mbits/sec   173
-----
[ ID] Interval           Transfer     Bitrate      Jitter        Lost/Total Datagrams
[ 5] 0.00-10.00  sec      2.38 MBytes   2.00 Mbits/sec  0.000 ms    0/1727 (0%)  sender
[ 5] 0.00-10.00  sec      2.38 MBytes   2.00 Mbits/sec  0.006 ms    0/1727 (0%)  receiver
```

iperf Done.

4 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 4M
Connecting to host 192.168.0.3, port 5201
[ 5] local 192.168.0.10 port 54584 connected to 192.168.0.3 port 5201
[ ID] Interval           Transfer     Bitrate      Total Datagrams
[ 5] 0.00-1.00   sec      488 KBytes   4.00 Mbits/sec   345
[ 5] 1.00-2.00   sec      489 KBytes   4.01 Mbits/sec   346
[ 5] 2.00-3.00   sec      488 KBytes   4.00 Mbits/sec   345
```

```
[ 5] 3.00-4.00 sec 488 KBytes 4.00 Mbits/sec 345
[ 5] 4.00-5.00 sec 489 KBytes 4.01 Mbits/sec 346
[ 5] 5.00-6.00 sec 488 KBytes 4.00 Mbits/sec 345
[ 5] 6.00-7.00 sec 488 KBytes 4.00 Mbits/sec 345
[ 5] 7.00-8.00 sec 489 KBytes 4.01 Mbits/sec 346
[ 5] 8.00-9.00 sec 488 KBytes 4.00 Mbits/sec 345
[ 5] 9.00-10.00 sec 488 KBytes 4.00 Mbits/sec 345
```

```
[ ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[ 5] 0.00-10.00 sec 4.77 MBytes 4.00 Mbits/sec 0.000 ms 0/3453 (0%) sender
[ 5] 0.00-10.00 sec 4.77 MBytes 4.00 Mbits/sec 0.023 ms 0/3453 (0%) receiver
```

iperf Done.

8 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 8M
```

```
Connecting to host 192.168.0.3, port 5201
```

```
[ 5] local 192.168.0.10 port 42485 connected to 192.168.0.3 port 5201
```

```
[ ID] Interval Transfer Bitrate Total Datagrams
[ 5] 0.00-1.00 sec 976 KBytes 7.99 Mbits/sec 690
[ 5] 1.00-2.00 sec 977 KBytes 8.00 Mbits/sec 691
[ 5] 2.00-3.00 sec 977 KBytes 8.00 Mbits/sec 691
[ 5] 3.00-4.00 sec 976 KBytes 7.99 Mbits/sec 690
[ 5] 4.00-5.00 sec 977 KBytes 8.00 Mbits/sec 691
[ 5] 5.00-6.00 sec 977 KBytes 8.00 Mbits/sec 691
[ 5] 6.00-7.00 sec 976 KBytes 7.99 Mbits/sec 690
[ 5] 7.00-8.00 sec 977 KBytes 8.00 Mbits/sec 691
[ 5] 8.00-9.00 sec 976 KBytes 7.99 Mbits/sec 690
[ 5] 9.00-10.00 sec 977 KBytes 8.00 Mbits/sec 691
```

```
[ ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[ 5] 0.00-10.00 sec 9.54 MBytes 8.00 Mbits/sec 0.000 ms 0/6906 (0%) sender
[ 5] 0.00-10.00 sec 9.54 MBytes 8.00 Mbits/sec 0.005 ms 0/6906 (0%) receiver
```

iperf Done.

16 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 16M
```

```
Connecting to host 192.168.0.3, port 5201
```

```
[ 5] local 192.168.0.10 port 51701 connected to 192.168.0.3 port 5201
```

```
[ ID] Interval Transfer Bitrate Total Datagrams
[ 5] 0.00-1.00 sec 1.91 MBytes 16.0 Mbits/sec 1380
[ 5] 1.00-2.00 sec 1.91 MBytes 16.0 Mbits/sec 1382
[ 5] 2.00-3.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
[ 5] 3.00-4.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
[ 5] 4.00-5.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
[ 5] 5.00-6.00 sec 1.91 MBytes 16.0 Mbits/sec 1382
[ 5] 6.00-7.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
[ 5] 7.00-8.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
[ 5] 8.00-9.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
[ 5] 9.00-10.00 sec 1.91 MBytes 16.0 Mbits/sec 1381
```

```
[ ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[ 5] 0.00-10.00 sec 19.1 MBytes 16.0 Mbits/sec 0.000 ms 0/13811 (0%) sender
[ 5] 0.00-10.00 sec 19.1 MBytes 16.0 Mbits/sec 0.027 ms 0/13811 (0%) receiver
```

iperf Done.

32 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 32M
```

```
Connecting to host 192.168.0.3, port 5201
```

```
[ 5] local 192.168.0.10 port 59259 connected to 192.168.0.3 port 5201
```

```
[ ID] Interval Transfer Bitrate Total Datagrams
[ 5] 0.00-1.00 sec 3.81 MBytes 32.0 Mbits/sec 2761
[ 5] 1.00-2.00 sec 3.81 MBytes 32.0 Mbits/sec 2762
[ 5] 2.00-3.00 sec 3.81 MBytes 32.0 Mbits/sec 2762
[ 5] 3.00-4.00 sec 3.82 MBytes 32.0 Mbits/sec 2763
[ 5] 4.00-5.00 sec 3.81 MBytes 32.0 Mbits/sec 2762
[ 5] 5.00-6.00 sec 3.82 MBytes 32.0 Mbits/sec 2763
[ 5] 6.00-7.00 sec 3.81 MBytes 32.0 Mbits/sec 2762
[ 5] 7.00-8.00 sec 3.82 MBytes 32.0 Mbits/sec 2763
[ 5] 8.00-9.00 sec 3.81 MBytes 32.0 Mbits/sec 2762
[ 5] 9.00-10.00 sec 3.81 MBytes 32.0 Mbits/sec 2762
```

```
[ ID] Interval Transfer Bitrate Jitter Lost/Total Datagrams
[ 5] 0.00-10.00 sec 38.1 MBytes 32.0 Mbits/sec 0.000 ms 0/27622 (0%) sender
[ 5] 0.00-10.00 sec 38.1 MBytes 32.0 Mbits/sec 0.058 ms 0/27622 (0%) receiver
```

iperf Done.

64 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 64M
```

```
Connecting to host 192.168.0.3, port 5201
```

```
[ 5] local 192.168.0.10 port 54983 connected to 192.168.0.3 port 5201
```

```
[ ID] Interval Transfer Bitrate Total Datagrams
[ 5] 0.00-1.00 sec 7.62 MBytes 63.9 Mbits/sec 5521
[ 5] 1.00-2.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
```

```

[ 5] 2.00-3.00 sec 7.63 MBytes 64.0 Mbits/sec 5524
[ 5] 3.00-4.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
[ 5] 4.00-5.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
[ 5] 5.00-6.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
[ 5] 6.00-7.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
[ 5] 7.00-8.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
[ 5] 8.00-9.00 sec 7.63 MBytes 64.0 Mbits/sec 5524
[ 5] 9.00-10.00 sec 7.63 MBytes 64.0 Mbits/sec 5525
-----
[ ID] Interval          Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00 sec 76.3 MBytes 64.0 Mbits/sec 0.000 ms 0/55244 (0%) sender
[ 5] 0.00-10.00 sec 76.3 MBytes 64.0 Mbits/sec 0.066 ms 0/55244 (0%) receiver

```

iperf Done.

128 Мбит/с

```

[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 128M
Connecting to host 192.168.0.3, port 5201
[ 5] local 192.168.0.10 port 47960 connected to 192.168.0.3 port 5201
[ ID] Interval          Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.00 sec 15.2 MBytes 128 Mbits/sec 11041
[ 5] 1.00-2.00 sec 15.3 MBytes 128 Mbits/sec 11049
[ 5] 2.00-3.00 sec 15.3 MBytes 128 Mbits/sec 11050
[ 5] 3.00-4.00 sec 15.3 MBytes 128 Mbits/sec 11051
[ 5] 4.00-5.00 sec 15.3 MBytes 128 Mbits/sec 11049
[ 5] 5.00-6.00 sec 15.3 MBytes 128 Mbits/sec 11050
[ 5] 6.00-7.00 sec 15.3 MBytes 128 Mbits/sec 11049
[ 5] 7.00-8.00 sec 15.3 MBytes 128 Mbits/sec 11050
[ 5] 8.00-9.00 sec 15.3 MBytes 128 Mbits/sec 11049
[ 5] 9.00-10.00 sec 15.3 MBytes 128 Mbits/sec 11051
-----
[ ID] Interval          Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00 sec 153 MBytes 128 Mbits/sec 0.000 ms 0/110489 (0%) sender
[ 5] 0.00-10.00 sec 153 MBytes 128 Mbits/sec 0.080 ms 0/110489 (0%) receiver

```

iperf Done.

256 Мбит/с

```

[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 256M
Connecting to host 192.168.0.3, port 5201
[ 5] local 192.168.0.10 port 48766 connected to 192.168.0.3 port 5201
[ ID] Interval          Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.00 sec 30.5 MBytes 256 Mbits/sec 22084
[ 5] 1.00-2.00 sec 30.5 MBytes 256 Mbits/sec 22100
[ 5] 2.00-3.00 sec 30.5 MBytes 256 Mbits/sec 22099
[ 5] 3.00-4.00 sec 30.5 MBytes 256 Mbits/sec 22099
[ 5] 4.00-5.00 sec 30.5 MBytes 256 Mbits/sec 22098
[ 5] 5.00-6.00 sec 30.5 MBytes 256 Mbits/sec 22100
[ 5] 6.00-7.00 sec 30.5 MBytes 256 Mbits/sec 22098
[ 5] 7.00-8.00 sec 30.5 MBytes 256 Mbits/sec 22100
[ 5] 8.00-9.00 sec 30.5 MBytes 256 Mbits/sec 22101
[ 5] 9.00-10.00 sec 30.5 MBytes 256 Mbits/sec 22101
-----
[ ID] Interval          Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00 sec 305 MBytes 256 Mbits/sec 0.000 ms 0/220980 (0%) sender
[ 5] 0.00-10.00 sec 219 MBytes 183 Mbits/sec 0.127 ms 62608/220852 (28%) receiver

```

iperf Done.

Вывод сервера

```

-----
Server listening on 5201
-----
Accepted connection from 192.168.0.10, port 60266
[ 5] local 192.168.0.3 port 5201 connected to 192.168.0.10 port 48766
[ ID] Interval          Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-1.00 sec 21.9 MBytes 183 Mbits/sec 0.104 ms 6152/21982 (28%)
[ 5] 1.00-2.00 sec 21.9 MBytes 184 Mbits/sec 0.094 ms 6237/22078 (28%)
[ 5] 2.00-3.00 sec 21.9 MBytes 183 Mbits/sec 0.101 ms 6293/22117 (28%)
[ 5] 3.00-4.00 sec 21.8 MBytes 183 Mbits/sec 0.083 ms 6273/22092 (28%)
[ 5] 4.00-5.00 sec 21.8 MBytes 183 Mbits/sec 0.090 ms 6298/22099 (28%)
[ 5] 5.00-6.00 sec 21.9 MBytes 184 Mbits/sec 0.099 ms 6269/22110 (28%)
[ 5] 6.00-7.00 sec 21.9 MBytes 183 Mbits/sec 0.114 ms 6274/22098 (28%)
[ 5] 7.00-8.00 sec 21.9 MBytes 183 Mbits/sec 0.093 ms 6259/22100 (28%)
[ 5] 8.00-9.00 sec 21.8 MBytes 183 Mbits/sec 0.114 ms 6288/22099 (28%)
[ 5] 9.00-10.00 sec 21.8 MBytes 183 Mbits/sec 0.109 ms 6265/22076 (28%)
[ 5] 10.00-10.00 sec 1.41 KBytes 17.8 Mbits/sec 0.127 ms 0/1 (0%)
-----
[ ID] Interval          Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00 sec 219 MBytes 183 Mbits/sec 0.127 ms 62608/220852 (28%) receiver

```

512 Мбит/с

```

[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 512M
Connecting to host 192.168.0.3, port 5201
[ 5] local 192.168.0.10 port 40006 connected to 192.168.0.3 port 5201
[ ID] Interval          Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.00 sec 61.0 MBytes 512 Mbits/sec 44179
[ 5] 1.00-2.00 sec 61.0 MBytes 512 Mbits/sec 44195
[ 5] 2.00-3.00 sec 61.0 MBytes 512 Mbits/sec 44192

```

```
[ 5] 3.00-4.00 sec 61.0 MBytes 512 Mbits/sec 44197
[ 5] 4.00-5.00 sec 61.0 MBytes 512 Mbits/sec 44198
[ 5] 5.00-6.00 sec 61.0 MBytes 512 Mbits/sec 44207
[ 5] 6.00-7.00 sec 61.0 MBytes 512 Mbits/sec 44205
[ 5] 7.00-8.00 sec 61.0 MBytes 512 Mbits/sec 44194
[ 5] 8.00-9.00 sec 61.0 MBytes 512 Mbits/sec 44198
[ 5] 9.00-10.00 sec 61.0 MBytes 512 Mbits/sec 44194
```

```
-----
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00 sec 610 MBytes   512 Mbits/sec 0.000 ms   0/441959 (0%) sender
[ 5] 0.00-10.02 sec 209 MBytes   175 Mbits/sec 0.075 ms  290265/441703 (66%) receiver
```

iperf Done.

Вывод сервера

```
-----
Server listening on 5201
```

```
-----
Accepted connection from 192.168.0.10, port 60312
```

```
[ 5] local 192.168.0.3 port 5201 connected to 192.168.0.10 port 40006
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-1.00 sec 20.9 MBytes   175 Mbits/sec 0.131 ms   28013/43126 (65%)
[ 5] 1.00-2.00 sec 20.9 MBytes   175 Mbits/sec 0.068 ms   29032/44139 (66%)
[ 5] 2.00-3.00 sec 20.9 MBytes   175 Mbits/sec 0.077 ms   29134/44249 (66%)
[ 5] 3.00-4.00 sec 20.9 MBytes   175 Mbits/sec 0.123 ms   29107/44240 (66%)
[ 5] 4.00-5.00 sec 20.9 MBytes   175 Mbits/sec 0.100 ms   29067/44191 (66%)
[ 5] 5.00-6.00 sec 20.9 MBytes   175 Mbits/sec 0.085 ms   29008/44141 (66%)
[ 5] 6.00-7.00 sec 20.9 MBytes   175 Mbits/sec 0.129 ms   29117/44232 (66%)
[ 5] 7.00-8.00 sec 20.9 MBytes   175 Mbits/sec 0.129 ms   29130/44240 (66%)
[ 5] 8.00-9.00 sec 20.9 MBytes   175 Mbits/sec 0.119 ms   29083/44196 (66%)
[ 5] 9.00-10.00 sec 20.9 MBytes   175 Mbits/sec 0.077 ms   29024/44133 (66%)
[ 5] 10.00-10.02 sec 376 KBytes    172 Mbits/sec 0.075 ms   550/816 (67%)
```

```
-----
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.02 sec 209 MBytes   175 Mbits/sec 0.075 ms  290265/441703 (66%) receiver
```

1000 Мбит/с

```
[root@Lhotze ~]# iperf3 -c 192.168.0.3 -u -b 1000M
```

```
Connecting to host 192.168.0.3, port 5201
```

```
[ 5] local 192.168.0.10 port 50966 connected to 192.168.0.3 port 5201
[ ID] Interval      Transfer      Bitrate      Total Datagrams
[ 5] 0.00-1.00 sec 114 MBytes    956 Mbits/sec 82540
[ 5] 1.00-2.00 sec 114 MBytes    956 Mbits/sec 82564
[ 5] 2.00-3.00 sec 114 MBytes    956 Mbits/sec 82560
[ 5] 3.00-4.00 sec 114 MBytes    956 Mbits/sec 82564
[ 5] 4.00-5.00 sec 114 MBytes    956 Mbits/sec 82564
[ 5] 5.00-6.00 sec 114 MBytes    956 Mbits/sec 82564
[ 5] 6.00-7.00 sec 114 MBytes    956 Mbits/sec 82560
[ 5] 7.00-8.00 sec 114 MBytes    956 Mbits/sec 82571
[ 5] 8.00-9.00 sec 114 MBytes    956 Mbits/sec 82567
[ 5] 9.00-10.00 sec 114 MBytes    956 Mbits/sec 82563
```

```
-----
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.00 sec 1.11 GBytes   956 Mbits/sec 0.000 ms   0/825617 (0%) sender
[ 5] 0.00-10.02 sec 209 MBytes    175 Mbits/sec 0.097 ms  673764/825232 (82%) receiver
```

iperf Done.

Вывод сервера

```
-----
Server listening on 5201
```

```
-----
Accepted connection from 192.168.0.10, port 60354
```

```
[ 5] local 192.168.0.3 port 5201 connected to 192.168.0.10 port 50966
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-1.00 sec 20.9 MBytes   175 Mbits/sec 0.172 ms   65460/80582 (81%)
[ 5] 1.00-2.00 sec 20.9 MBytes   175 Mbits/sec 0.085 ms   67393/82502 (82%)
[ 5] 2.00-3.00 sec 20.9 MBytes   175 Mbits/sec 0.104 ms   67515/82633 (82%)
[ 5] 3.00-4.00 sec 20.9 MBytes   175 Mbits/sec 0.074 ms   67355/82470 (82%)
[ 5] 4.00-5.00 sec 20.9 MBytes   175 Mbits/sec 0.116 ms   67487/82594 (82%)
[ 5] 5.00-6.00 sec 20.9 MBytes   175 Mbits/sec 0.156 ms   67488/82601 (82%)
[ 5] 6.00-7.00 sec 20.9 MBytes   175 Mbits/sec 0.076 ms   67307/82432 (82%)
[ 5] 7.00-8.00 sec 20.9 MBytes   175 Mbits/sec 0.077 ms   67422/82545 (82%)
[ 5] 8.00-9.00 sec 20.9 MBytes   175 Mbits/sec 0.110 ms   67564/82680 (82%)
[ 5] 9.00-10.00 sec 20.9 MBytes   175 Mbits/sec 0.097 ms   67450/82569 (82%)
[ 5] 10.00-10.02 sec 426 KBytes    168 Mbits/sec 0.097 ms   1323/1624 (81%)
```

```
-----
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-10.02 sec 209 MBytes    175 Mbits/sec 0.097 ms  673764/825232 (82%) receiver
```

Клиент x86_64 (2 процессора Xeon с общим числом ядер — 40) способен генерировать большой объем трафика, поэтому в этом тесте насыщение скорости определяется возможностями приема пакетов сервером HiFive Unleashed и насыщение наступает в диапазоне скоростей 128-256 Мбит/с, как можно видеть из графика (Рисунок 3).

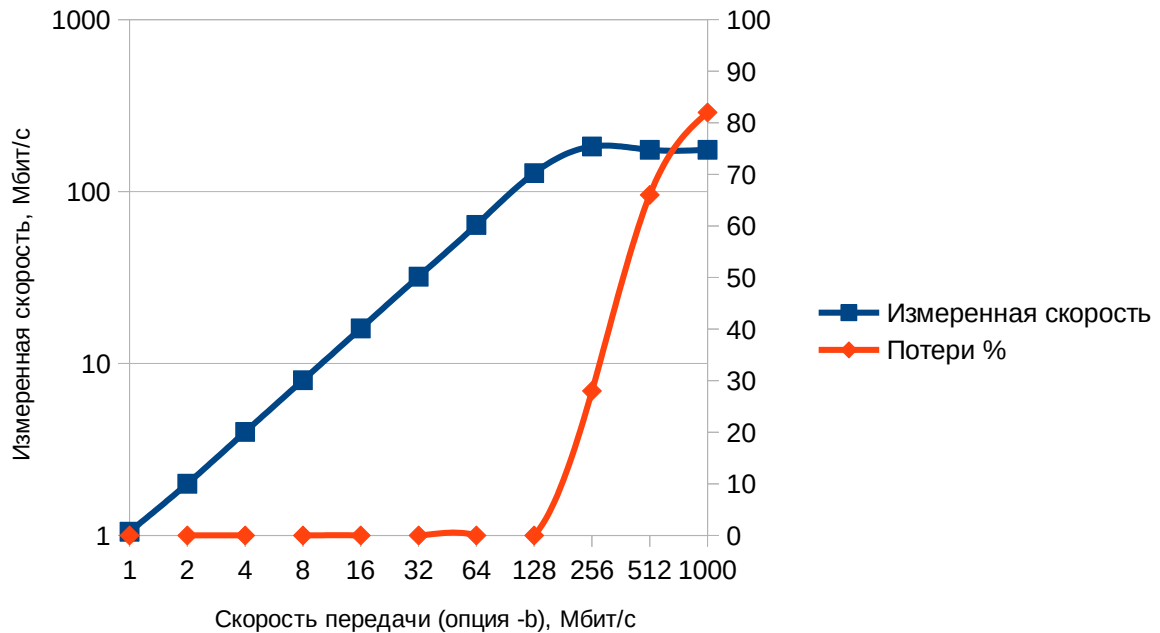


Рисунок 3. Зависимость измеренной скорости от скорости генерации пакетов клиентом x86_64 (опция iperf3 -b).

Как и для случая клиента HiFive рассмотрим область начала насыщения более подробно. На рисунке 4 представлена область насыщения измеренной скорости и кривая роста ошибок (отмеченных клиентом потерь пакетов в %).

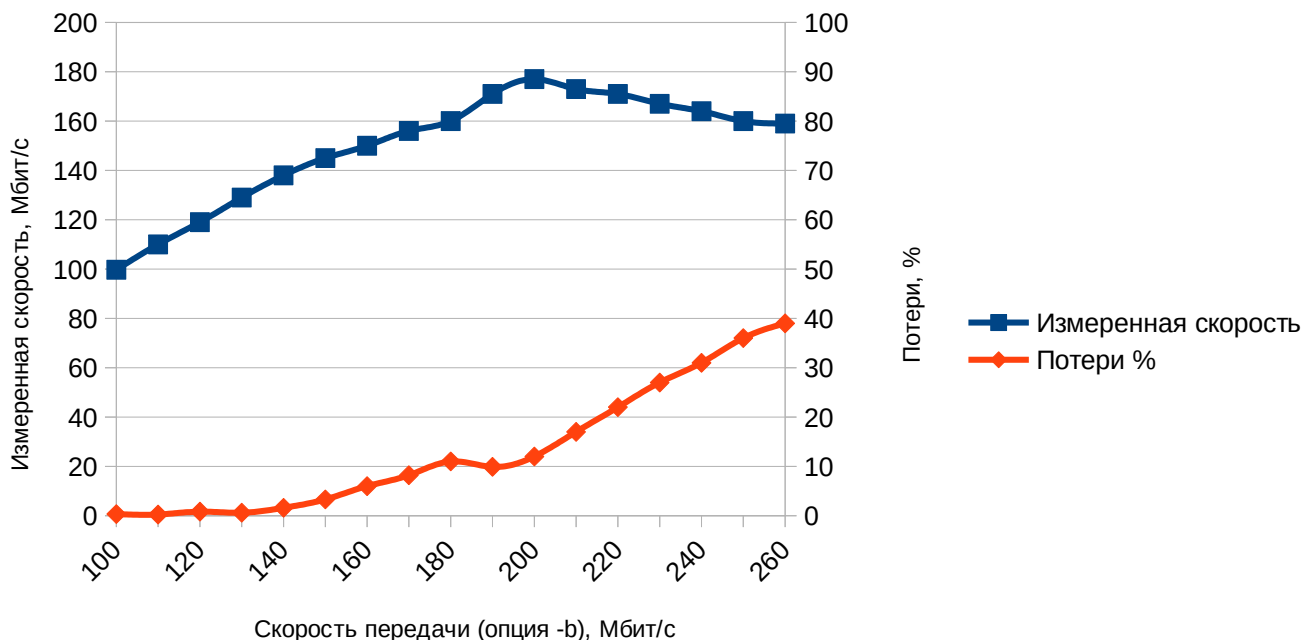


Рисунок 4. Насыщение скорости и рост числа потерянных пакетов

Здесь также программа iperf3 на стороне сервера HiFive Unleashed занимала практически все ресурсы процессора, поэтому измерение скорости и уровень потери в разных интервалах одного теста iperf3 менялись в широких пределах, как можно видеть из представленного ниже вывода для генерации тестовых пакетов клиентом со скоростью 160 Мбит/с. Это обусловлено нагрузкой на процессоры, создаваемой системными процессами, которые имеют более высокий приоритет, нежели задача iperf3.

Server listening on 5201

Accepted connection from 192.168.0.10, port 37206

```
[ 5] local 192.168.0.3 port 5201 connected to 192.168.0.10 port 56421
[ ID] Interval      Transfer      Bitrate      Jitter      Lost/Total Datagrams
[ 5] 0.00-1.00    sec 17.8 MBytes  149 Mbits/sec 0.078 ms    912/13801 (6.6%)
[ 5] 1.00-2.00    sec 19.1 MBytes  160 Mbits/sec 0.099 ms     0/13809 (0%)
[ 5] 2.00-3.00    sec 18.0 MBytes  151 Mbits/sec 0.172 ms   654/13696 (4.8%)
[ 5] 3.00-4.00    sec 12.8 MBytes  107 Mbits/sec 0.165 ms  4361/13638 (32%)
[ 5] 4.00-5.00    sec 18.5 MBytes  155 Mbits/sec 0.106 ms   681/14106 (4.8%)
```

[5]	5.00-6.00	sec	17.9 MBytes	150 Mbits/sec	0.131 ms	757/13699 (5.5%)
[5]	6.00-7.00	sec	13.4 MBytes	112 Mbits/sec	0.191 ms	4124/13804 (30%)
[5]	7.00-8.00	sec	16.4 MBytes	137 Mbits/sec	0.072 ms	2071/13933 (15%)
[5]	8.00-9.00	sec	14.7 MBytes	124 Mbits/sec	0.195 ms	3043/13705 (22%)
[5]	9.00-10.00	sec	13.3 MBytes	112 Mbits/sec	0.148 ms	4134/13793 (30%)

[ID]	Interval		Transfer	Bitrate	Jitter	Lost/Total Datagrams
[5]	0.00-10.00	sec	162 MBytes	136 Mbits/sec	0.148 ms	20737/137984 (15%) receiver

Заключение

Проведенные измерения показывают, что максимальная скорость генерации трафика UDP программой iperf3 на плате HiFive Unleashed составляет приблизительно 80 Мбит/с, а максимальная скорость приема той же программой примерно вдвое выше. Это задает диапазон скоростей приема и передачи пакетов, для которых целесообразно снять профили загрузки процессоров с целью получения более подробной информации об использовании системных ресурсов и узких местах системы.

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