

Эмуляция и измерение задержек в глобальных сетях

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Основной целью работы является знакомство с NETEM — инструментом для тестирования производительности приложений в виртуальной сети, а также получение навыков проведения интерактивного и воспроизводимого экспериментов по измерению задержки и её дрожания (jitter) в моделируемой сети в среде Mininet.

Выполнение задачи

```
"host: h1" <@mininet-vm>
TX packets 0  bytes 0 (0.0 B)
TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
    inet 127.0.0.1  netmask 255.0.0.0
    loop txqueuelen 1000  (Local Loopback)
    RX packets 1366  bytes 3718152 (3.7 MB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 1366  bytes 3718152 (3.7 MB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@mininet-vm:/home/mininet# ping 10.0.0.2 -c 6
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data:
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=1.34 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.186 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.044 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.060 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=0.045 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=0.157 ms

--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5169ms
rtt min/avg/max/mdev = 0.044/0.306/1.344/0.467 ms
root@mininet-vm:/home/mininet#
```

```
"host: h1" <@mininet-vm>
root@mininet-vm:/home/mininet# tc
Usage: tc [ OPTIONS ] OBJECT { COMMAND | help }
       tc [-force] -batch filename
where  OBJECT := { qdisc | class | filter | chain |
                  action | monitor | exec }
       OPTIONS := { -V[ersion] | -s[tatistics] | -d[etails] | -r[aw] |
                   -o[neline] | -j[son] | -p[retty] | -c[olor]
                   -b[atch] [filename] | -n[etns] name | -N[umeric] |
                   -nm | -nam[es] | { -cf | -conf } path }

root@mininet-vm:/home/mininet# sudo tc qdisc add dev h1-eth0 root netem delay 1
0ms
root@mininet-vm:/home/mininet# ping 10.0.0.2 -c 6
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data:
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=108 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=104 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=111 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=146 ms

--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5165ms
rtt min/avg/max/mdev = 100.726/111.642/145.668/15.631 ms
root@mininet-vm:/home/mininet#
```

Выполнение задачи

```
"host: h1" <@mininet-vm>
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=108 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=104 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=111 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=146 ms

--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5165ms
rtt min/avg/max/mdev = 100.726/111.642/145.668/15.631 ms
root@mininet-vm:/home/mininet# ping 10.0.0.2 -c 6
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=203 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=245 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=231 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=200 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=211 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=201 ms

--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5025ms
rtt min/avg/max/mdev = 200.420/215.277/245.365/17.130 ms
root@mininet-vm:/home/mininet#
```

```
"host: h1" <@mininet-vm>
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=200 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=211 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=201 ms

--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5025ms
rtt min/avg/max/mdev = 200.420/215.277/245.365/17.130 ms
root@mininet-vm:/home/mininet# sudo tc qdisc add dev h1-eth0 root netem delay 5
0ms
Error: Exclusivity flag on, cannot modify.
root@mininet-vm:/home/mininet# sudo tc qdisc change dev h1-eth0 root netem delay 50ms
root@mininet-vm:/home/mininet# ping 10.0.0.2 -c 6
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=107 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=104 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=101 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=104 ms

--- 10.0.0.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5045ms
rtt min/avg/max/mdev = 100.515/102.929/106.691/2.194 ms
root@mininet-vm:/home/mininet#
```


Выполнение задачи

```
root@mininet-vm:/home/mininet# sudo tc qdisc change dev h1-eth0 root netem delay 100ms 20ms distribution normal
root@mininet-vm:/home/mininet# ping 10.0.0.2 -c 20
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data:
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=160 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=144 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=61.9 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=110 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=107 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=112 ms
64 bytes from 10.0.0.2: icmp_seq=7 ttl=64 time=195 ms
64 bytes from 10.0.0.2: icmp_seq=8 ttl=64 time=146 ms
64 bytes from 10.0.0.2: icmp_seq=9 ttl=64 time=124 ms
64 bytes from 10.0.0.2: icmp_seq=10 ttl=64 time=131 ms
^C
--- 10.0.0.2 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9460ms
rtt min/avg/max/mdev = 61.909/129.155/195.409/34.010 ms
root@mininet-vm:/home/mininet# █
```

Спасибо За Внимание