Socket Programming

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1.拓扑结构解释

一个作为服务器的 host h1，通过一个 switch 与所有的客户端 host 连接（明明分别为 h2、h3、h4……）并传输数据

2.如何运行程序

（1）首先通过 3 个命令编译 show.cc、client.cc 与 server.cc

gcc server.cc –o server –lpthread

gcc client.cc –o client

gcc show.cc –o show

```
spoilvoid@ubuntu:~/Desktop/socket programming$ gcc server.cc -o server -lpthread
spoilvoid@ubuntu:~/Desktop/socket programming$ gcc client.cc -o client
spoilvoid@ubuntu:~/Desktop/socket programming$ gcc show.cc -o show
```

其中 server.cc 为服务器 host 执行的源代码，将监听拓扑结构上的客户端请求，当连接时会创建一个子线程用于处理客户端文件请求由于多线程，需要参数-lpthread；client.cc 为客户端 client 执行的源代码，用于接收文件并保存到本地文件中；show.cc 的作用为显示后台执行程序打印的信息，由于我们需要多个 host 执行命令，所以需要多 host 同时执行任务，所以需要后端执行，但这不会在 cmd 中打印信息，需要一个 default 程序在前台执行完成打印信息。

（2）执行拓扑结构的构造

sudo python3 topo.py

```
spoilvoid@ubuntu:~/Desktop/socket programming$ sudo python3 topo.py
input the num of clients(<=20):
```

输入需要产生的 clients 数量（小于等于 20 是由于 server 端监测的 BUFFER_SIZE 大小仅为 20），完成拓扑结构构造并进入 Mininet CLI

（3）指定不同的 host 完成不同的任务

指定 h1 执行 server 端任务（h1 ./server &），让剩下的 host 执行 client 程序（由于需要多 host 执行，都需要后台执行）（h2 ./client &），在完成传输后使用 h2 ./show 查看结果，计算时间

Tips:本地文件是根据拓扑结构中的名字命名的 txt 文件, server 端保存着的是 file.txt 文件（一个 50MB 的文本文件），可以用 gedit h2.txt 命令打开查看

3.测试结果

（1）测试截图

```
*** Configuring hosts
h1 (cfs 50000/100000us) h2 (cfs 50000/100000us)
*** Starting controller
c0
*** Starting 1 switches
s1 ...(10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss)
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client
begintime:Thu Oct  7 04:57:54 2021
endtime:Thu Oct  7 04:58:36 2021
```

单 client

```
*** Configuring hosts
h1 (cfs 50000/100000us) h2 (cfs 50000/100000us) h3 (cfs 50000/100000us)
*** Starting controller
c0
*** Starting 1 switches
s1 ...(10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss)
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
h3 h3-eth0:s1-eth3
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client &
mininet> h3 ./client
begintime:Thu Oct  7 05:21:40 2021
endtime:Thu Oct  7 05:22:59 2021

mininet> h2 ./show
begintime:Thu Oct  7 05:21:35 2021
endtime:Thu Oct  7 05:22:29 2021
```

双 clients

```
*** Configuring hosts
h1 (cfs 50000/100000us) h2 (cfs 50000/100000us) h3 (cfs 50000/100000us) h4 (cfs 50000/100000us)
*** Starting controller
c0
*** Starting 1 switches
s1 ...(10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss)
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
h3 h3-eth0:s1-eth3
h4 h4-eth0:s1-eth4
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client &
mininet> h3 ./client &
mininet> h4 ./client
begintime:Thu Oct  7 05:44:52 2021
endtime:Thu Oct  7 05:46:49 2021

mininet> h2 ./show
begintime:Thu Oct  7 05:44:43 2021
endtime:Thu Oct  7 05:45:50 2021

mininet> h3 ./show
begintime:Thu Oct  7 05:44:47 2021
endtime:Thu Oct  7 05:46:31 2021
```

3 clients

```
*** Configuring hosts
h1 (cfs 50000/100000us) h2 (cfs 50000/100000us) h3 (cfs 50000/100000us) h4 (cfs 50000/100000us) h5 (cfs 50000/100000us)
*** Starting controller
c0
*** Starting 1 switches
s1 ...(10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% l
oss)
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
h3 h3-eth0:s1-eth3
h4 h4-eth0:s1-eth4
h5 h5-eth0:s1-eth5
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client &
mininet> h3 ./client &
mininet> h4 ./client &
mininet> h5 ./client
begintime:Thu Oct  7 05:01:14 2021
endtime:Thu Oct  7 05:03:50 2021

mininet> h2 ./show
begintime:Thu Oct  7 05:01:02 2021
endtime:Thu Oct  7 05:02:24 2021

mininet> h3 ./show
begintime:Thu Oct  7 05:01:06 2021
endtime:Thu Oct  7 05:03:36 2021

mininet> h4 ./show
begintime:Thu Oct  7 05:01:09 2021
endtime:Thu Oct  7 05:03:34 2021
```

4 clients

```
h1 (cfs 50000/100000us) h2 (cfs 50000/100000us) h3 (cfs 50000/100000us) h4 (cfs 50000/100000us) h5 (cfs 50000/100000us) h6 (cfs 50000/100000us) h7 (cfs 50000/100000us)
*** Starting controller
c0
*** Starting 1 switches
s1 ...(10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% l
oss) (10.00Mbit 5ms delay 0.00000% loss) (10.00Mbit 5ms delay 0.00000% loss)
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
h3 h3-eth0:s1-eth3
h4 h4-eth0:s1-eth4
h5 h5-eth0:s1-eth5
h6 h6-eth0:s1-eth6
h7 h7-eth0:s1-eth7
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client &
mininet> h3 ./client &
mininet> h4 ./client &
mininet> h5 ./client &
mininet> h6 ./client &
mininet> h7 ./client
begintime:Thu Oct  7 06:06:23 2021
endtime:Thu Oct  7 06:10:02 2021

mininet> h2 ./show
begintime:Thu Oct  7 06:06:02 2021
endtime:Thu Oct  7 06:07:42 2021

mininet> h3 ./show
begintime:Thu Oct  7 06:06:05 2021
endtime:Thu Oct  7 06:09:07 2021

mininet> h4 ./show
begintime:Thu Oct  7 06:06:09 2021
endtime:Thu Oct  7 06:10:14 2021

mininet> h5 ./show
begintime:Thu Oct  7 06:06:13 2021
endtime:Thu Oct  7 06:10:14 2021

mininet> h6 ./show
begintime:Thu Oct  7 06:06:19 2021
endtime:Thu Oct  7 06:10:03 2021
```

6 clients

```
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client &
mininet> h3 ./client &
mininet> h4 ./client &
mininet> h5 ./client &
mininet> h6 ./client &
mininet> h7 ./client &
mininet> h8 ./client &
mininet> h9 ./client
begintime:Thu Oct  7 06:24:49 2021
endtime:Thu Oct  7 06:29:54 2021

mininet> h2 ./show
begintime:Thu Oct  7 06:24:22 2021
endtime:Thu Oct  7 06:26:12 2021

mininet> h3 ./show
begintime:Thu Oct  7 06:24:25 2021
endtime:Thu Oct  7 06:28:25 2021

mininet> h4 ./show
begintime:Thu Oct  7 06:24:29 2021
endtime:Thu Oct  7 06:29:39 2021

mininet> h5 ./show
begintime:Thu Oct  7 06:24:32 2021
endtime:Thu Oct  7 06:28:54 2021

mininet> h6 ./show
begintime:Thu Oct  7 06:24:36 2021
endtime:Thu Oct  7 06:29:53 2021

mininet> h7 ./show
begintime:Thu Oct  7 06:24:41 2021
endtime:Thu Oct  7 06:29:58 2021

mininet> h8 ./show
begintime:Thu Oct  7 06:24:44 2021
endtime:Thu Oct  7 06:29:45 2021
```

8 clients

```
Dumping host connections
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
h3 h3-eth0:s1-eth3
h4 h4-eth0:s1-eth4
h5 h5-eth0:s1-eth5
h6 h6-eth0:s1-eth6
h7 h7-eth0:s1-eth7
h8 h8-eth0:s1-eth8
h9 h9-eth0:s1-eth9
h10 h10-eth0:s1-eth10
h11 h11-eth0:s1-eth11
*** Starting CLI:
mininet> h1 ./server &
mininet> h2 ./client &
mininet> h3 ./client &
mininet> h4 ./client &
mininet> h5 ./client &
mininet> h6 ./client &
mininet> h7 ./client &
mininet> h8 ./client &
mininet> h9 ./client &
mininet> h10 ./client &
mininet> h11 ./client &
mininet> h2 ./show
begintime:Thu Oct  7 06:44:32 2021
endtime:Thu Oct  7 06:47:10 2021

mininet> h3 ./show
begintime:Thu Oct  7 06:44:35 2021
endtime:Thu Oct  7 06:49:54 2021

mininet> h4 ./show
begintime:Thu Oct  7 06:44:38 2021
endtime:Thu Oct  7 06:51:19 2021
```

```
mininet> h5 ./show
begintime:Thu Oct  7 06:44:42 2021
endtime:Thu Oct  7 06:51:00 2021

mininet> h6 ./show
begintime:Thu Oct  7 06:44:45 2021
endtime:Thu Oct  7 06:51:12 2021

mininet> h7 ./show
begintime:Thu Oct  7 06:44:50 2021
endtime:Thu Oct  7 06:50:02 2021

mininet> h8 ./show
begintime:Thu Oct  7 06:44:55 2021
endtime:Thu Oct  7 06:51:17 2021

mininet> h9 ./show
begintime:Thu Oct  7 06:44:59 2021
endtime:Thu Oct  7 06:51:31 2021

mininet> h10 ./show
begintime:Thu Oct  7 06:45:02 2021
endtime:Thu Oct  7 06:51:03 2021

mininet> h11 ./show
begintime:Thu Oct  7 06:45:05 2021
endtime:Thu Oct  7 06:51:21 2021
```

10 clients

（2）结果汇总

客户端数量	1	2	3	4	6	8	10
开始时间	04: 57: 54	05: 21: 35	05: 44: 43	05: 01: 02	06: 06: 02	06: 24: 22	06: 44: 32
结束时间	04: 58: 36	05: 22: 59	05: 46: 49	05: 03: 50	06: 10: 14	06: 29: 58	06: 51: 21
总用时	42s	84s	126s	168s	252s	336s	409s

（3）分析总结

当同时请求的服务端数量增加时，总共的下载时间将会增加。可能是由于总信道的带宽固定，即使可以多线程传输数据，总的传输量也有上限，在 server-client 模型中，客户端增加，总的下载量增加，时间也就增加了。