1. Show the ping results to test reachability (5%)

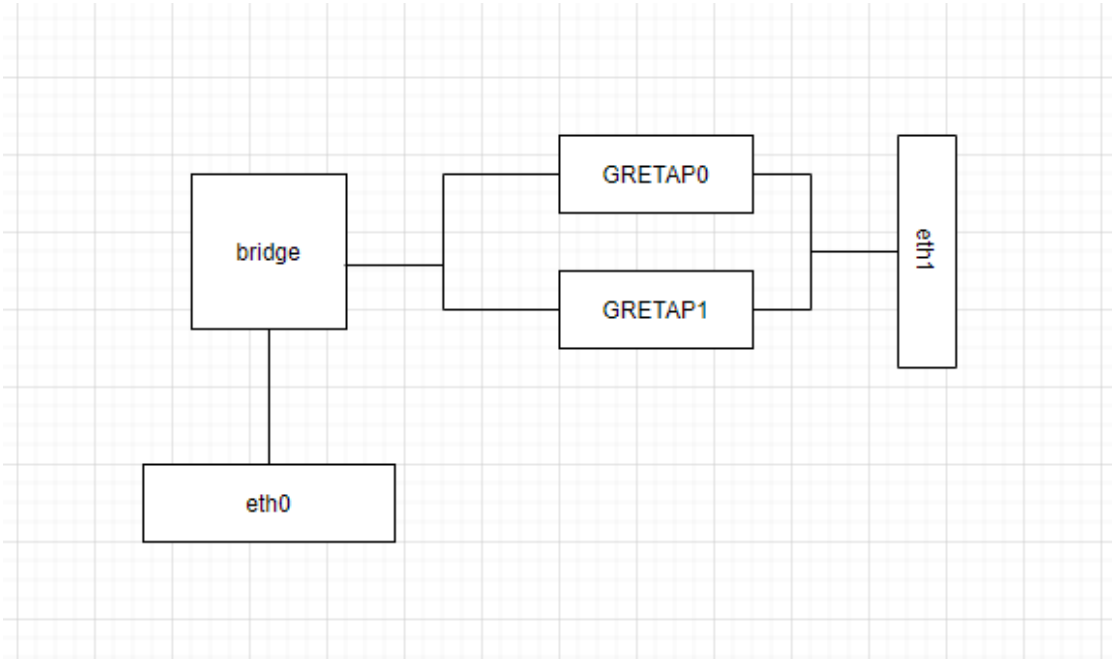
```
mininet> h1 ping 10.0.0.3
PING 10.0.0.3 (10.0.0.3) 56(84) bytes of data.
64 bytes from 10.0.0.3: icmp_seq=1 ttl=64 time=2041 ms
64 bytes from 10.0.0.3: icmp_seq=2 ttl=64 time=1016 ms
64 bytes from 10.0.0.3: icmp_seq=3 ttl=64 time=0.775 ms
64 bytes from 10.0.0.3: icmp_seq=4 ttl=64 time=0.080 ms
64 bytes from 10.0.0.3: icmp_seq=5 ttl=64 time=0.269 ms
64 bytes from 10.0.0.3: icmp_seq=6 ttl=64 time=0.066 ms
^C
--- 10.0.0.3 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5113ms
rtt min/avg/max/mdev = 0.066/509.880/2041.212/778.966 ms, pipe 3
mininet> h2 ping 10.0.0.3
PING 10.0.0.3 (10.0.0.3) 56(84) bytes of data.
64 bytes from 10.0.0.3: icmp_seq=1 ttl=64 time=0.138 ms
64 bytes from 10.0.0.3: icmp_seq=2 ttl=64 time=0.192 ms
64 bytes from 10.0.0.3: icmp_seq=3 ttl=64 time=0.195 ms
64 bytes from 10.0.0.3: icmp_seq=4 ttl=64 time=0.184 ms
64 bytes from 10.0.0.3: icmp_seq=5 ttl=64 time=0.191 ms
64 bytes from 10.0.0.3: icmp_seq=6 ttl=64 time=0.190 ms
64 bytes from 10.0.0.3: icmp_seq=7 ttl=64 time=0.192 ms
^C
--- 10.0.0.3 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6140ms
rtt min/avg/max/mdev = 0.138/0.183/0.195/0.020 ms
```

2. Show all interfaces of Node BRGr after h1 and h2 can ping GWr

```
mininet> BRGr ip link show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: gre0@NONE: <NOARP> mtu 1452 qdisc noop state DOWN mode DEFAULT group default qlen 1000
    link/gre 0.0.0.0 brd 0.0.0.0
3: gretap0@NONE: <BROADCAST,MULTICAST> mtu 1462 qdisc noop state DOWN mode DEFAULT group default qlen 1000
    link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff
4: erspan0@NONE: <BROADCAST,MULTICAST> mtu 1450 qdisc noop state DOWN mode DEFAULT group default qlen 1000
    link/ether 00:00:00:00:00:00 brd ff:ff:ff:ff:ff:ff
5: BRGr-eth0@if5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue master br0 state UP mode DEFAULT group default qlen 1000
    link/ether c6:11:cf:0c:88:04 brd ff:ff:ff:ff:ff:ff link-netnsid 0
6: BRGr-eth1@if5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP mode DEFAULT group default qlen 1000
    link/ether 22:77:ab:21:f5:80 brd ff:ff:ff:ff:ff:ff link-netnsid 1
7: br0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1462 qdisc noqueue state UP mode DEFAULT group default qlen 1000
    link/ether 4e:7a:f6:6f:68:5b brd ff:ff:ff:ff:ff:ff
8: GRETAP0@NONE: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1462 qdisc fq_codel master br0 state UNKNOWN mode DEFAULT group default qlen 1000
    link/ether 4e:7a:f6:6f:68:5b brd ff:ff:ff:ff:ff:ff
9: GRETAP1@NONE: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1462 qdisc fq_codel master br0 state UNKNOWN mode DEFAULT group default qlen 1000
    link/ether fe:cd:30:b9:52:92 brd ff:ff:ff:ff:ff:ff
```

3. Draw the interconnection diagram of interfaces and Linux bridge on BRGr. Explain your diagram with the screenshot of interface list of BRGr

   GRETAP0 和 GRETAP1 是由程式自動產生的 gretab interface，bridge 就是 br0，eth0 和 eth1 就是 router 的兩個 port。



4. Explain how Linux kernel of BRGr determines which gretap interface to forward packets from GWr to hosts (h1 or h2)?
   在 BRGr 不知道傳給哪一個 GRE tunnel 時他會發 broadcast 給全部的 GRE neighbors，然後再看是收到哪一個 neighbor 的回覆再把它紀錄在 fdb 裡面。

```
mininet> BRGr bridge fdb show | grep GRETAP
ca:3e:48:97:8c:eb dev GRETAP0 master br0
56:03:18:88:ac:fd dev GRETAP0 master br0
4e:7a:f6:6f:68:5b dev GRETAP0 vlan 1 master br0 permanent
4e:7a:f6:6f:68:5b dev GRETAP0 master br0 permanent
33:33:00:00:00:01 dev GRETAP0 self permanent
01:00:5e:00:00:01 dev GRETAP0 self permanent
33:33:ff:6f:68:5b dev GRETAP0 self permanent
fe:cd:30:b9:52:92 dev GRETAP1 vlan 1 master br0 permanent
fe:cd:30:b9:52:92 dev GRETAP1 master br0 permanent
33:33:00:00:00:01 dev GRETAP1 self permanent
01:00:5e:00:00:01 dev GRETAP1 self permanent
33:33:ff:b9:52:92 dev GRETAP1 self permanent
```

5. Run tcpdump on h1 to capture packet and take screenshot to explain why or why not h1 is aware of GRE tunneling
   因為在 packet 經過 tunnel 時會自動把 gre 的 header 拿掉所以 h1 會沒有發現 tunnel 的存在。

```
root@wc-VirtualBox:/media/network/Lab4# tcpdump ip
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on BRGr-eth0, link-type EN10MB (Ethernet), capture size 262144 bytes
16:24:37.479794 IP 10.0.0.1 > 10.0.0.3: ICMP echo request, id 14154, seq 1, length 64
16:24:37.479814 IP 10.0.0.3 > 10.0.0.1: ICMP echo reply, id 14154, seq 1, length 64
^C
2 packets captured
2 packets received by filter
0 packets dropped by kernel
```