Lab 4: Dynamic Tunnel Creation

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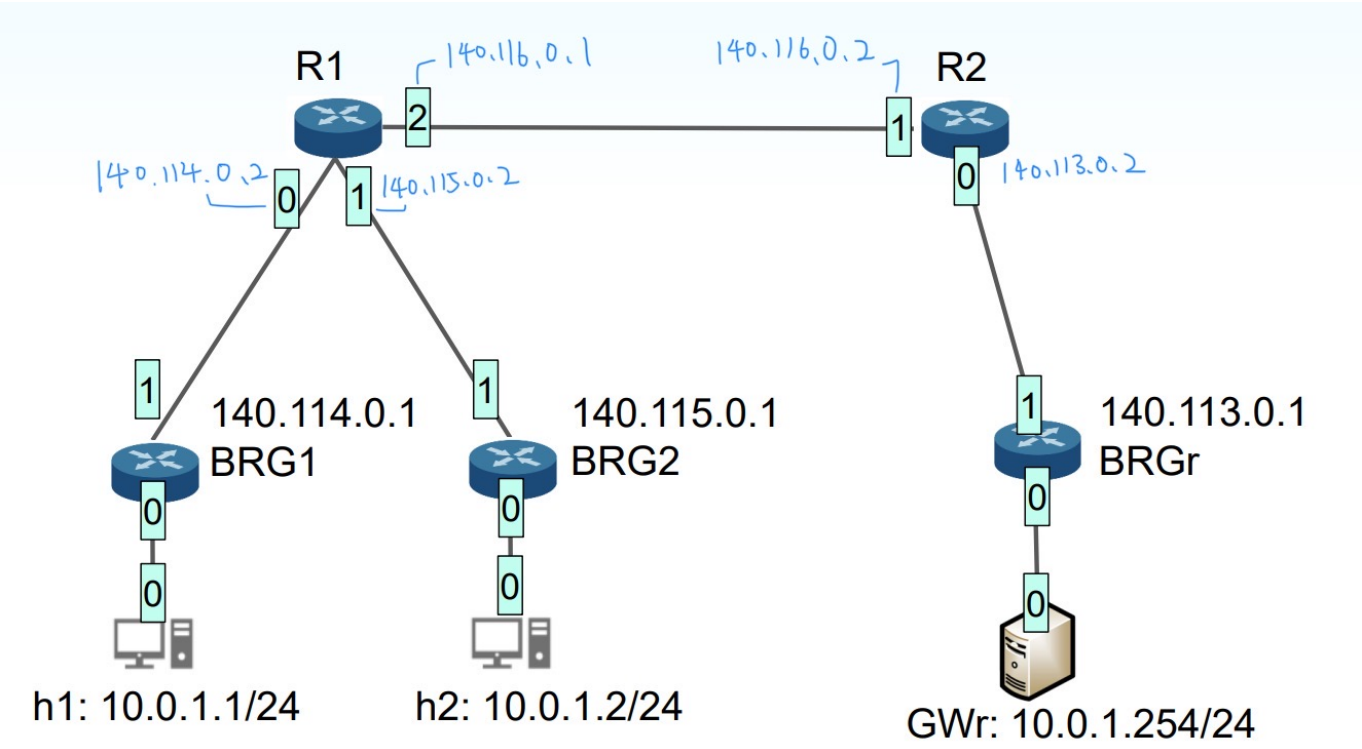
Lab topology



Part 1

1. Show all interfaces of node BRGr and draw the interconnection diagram of interfaces and Linux bridge on BRGr. Explain your diagram with the interface list of BRGr. (10%)

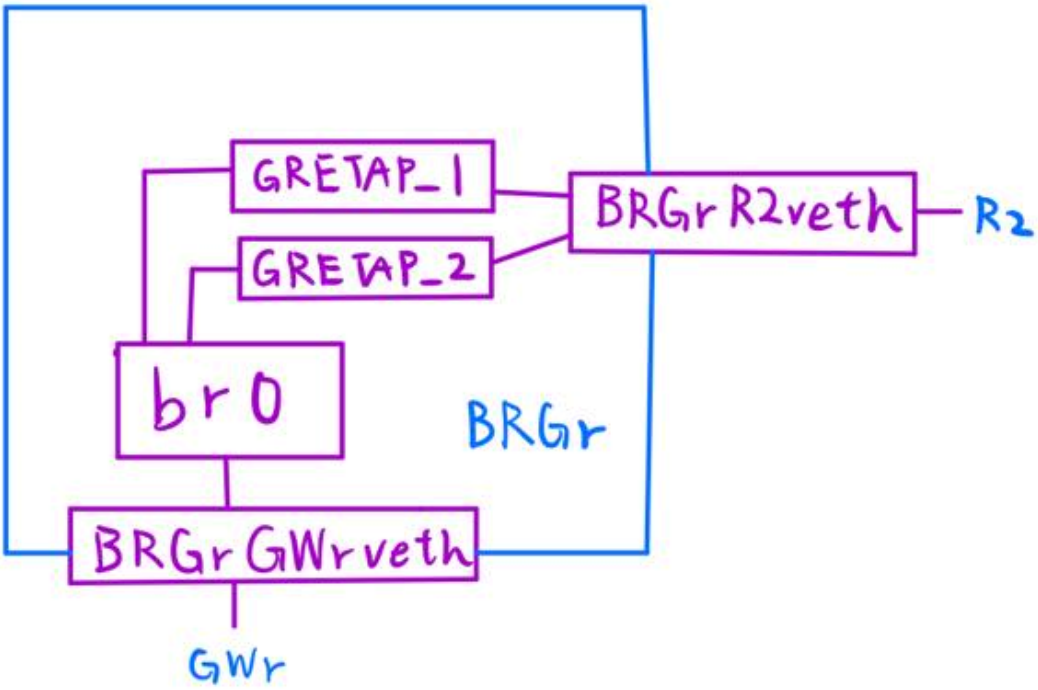
- **BRGrGWrveth** connects **BRGr** and **GWr**.
- **br0** is the Linux bridge. It connects **BRGrGWrveth**, **GRETAP_1** and **GRETAP_2**.
- **GRETAP_1** is the GRE interface paired with **BRG1**'s **GRETAP**.
- **GRETAP_2** is the GRE interface paired with **BRG2**'s **GRETAP**.
- **BRGrR2veth** connects **BRGr** and **R2**.

Interfaces

```
soulr@ubuntu:~/Desktop/lab4$ sudo docker exec -it BRGr ifconfig
BRGrGWrveth Link encap:Ethernet  HWaddr 16:8d:bd:2a:f3:5a
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:108 (108.0 B)

BRGrR2veth Link encap:Ethernet  HWaddr da:d6:b6:1e:8e:94
          inet addr:140.113.0.1  Bcast:0.0.0.0  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:6 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:564 (564.0 B)  TX bytes:452 (452.0 B)

GRETAP_1  Link encap:Ethernet  HWaddr 8a:39:08:82:cb:ed
          UP BROADCAST RUNNING MULTICAST  MTU:1462  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:80 (80.0 B)

GRETAP_2  Link encap:Ethernet  HWaddr f6:cc:55:05:6b:24
          UP BROADCAST RUNNING MULTICAST  MTU:1462  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:80 (80.0 B)
```

```
br0       Link encap:Ethernet  HWaddr 16:8d:bd:2a:f3:5a
          UP BROADCAST RUNNING MULTICAST  MTU:1462  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:108 (108.0 B)

eth0      Link encap:Ethernet  HWaddr 02:42:ac:11:00:07
          inet addr:172.17.0.7  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:392 errors:0 dropped:0 overruns:0 frame:0
          TX packets:343 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:735076 (735.0 KB)  TX bytes:19619 (19.6 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

Interconnection diagram



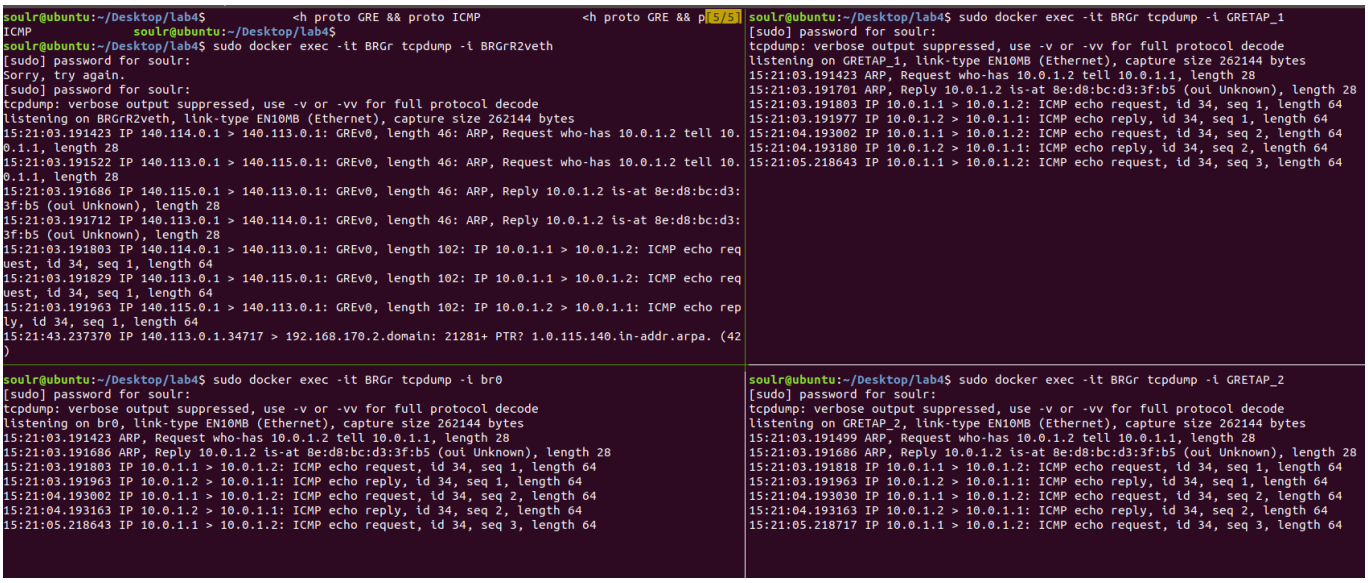
2. Let h1 and h2 ping GWr and take screenshot of ping results. (5%)

```
soulr@ubuntu:~/Desktop/lab4$ sudo docker exec -it h1 ping 10.0.1.254 -c 3
[sudo] password for soulr:
PING 10.0.1.254 (10.0.1.254) 56(84) bytes of data.
64 bytes from 10.0.1.254: icmp_seq=1 ttl=64 time=0.616 ms
64 bytes from 10.0.1.254: icmp_seq=2 ttl=64 time=0.271 ms
64 bytes from 10.0.1.254: icmp_seq=3 ttl=64 time=0.768 ms

--- 10.0.1.254 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 0.271/0.551/0.768/0.209 ms
soulr@ubuntu:~/Desktop/lab4$ sudo docker exec -it h2 ping 10.0.1.254 -c 3
PING 10.0.1.254 (10.0.1.254) 56(84) bytes of data.
64 bytes from 10.0.1.254: icmp_seq=1 ttl=64 time=0.473 ms
64 bytes from 10.0.1.254: icmp_seq=2 ttl=64 time=0.695 ms
64 bytes from 10.0.1.254: icmp_seq=3 ttl=64 time=0.382 ms

--- 10.0.1.254 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2054ms
rtt min/avg/max/mdev = 0.382/0.516/0.695/0.134 ms
soulr@ubuntu:~/Desktop/lab4$
```

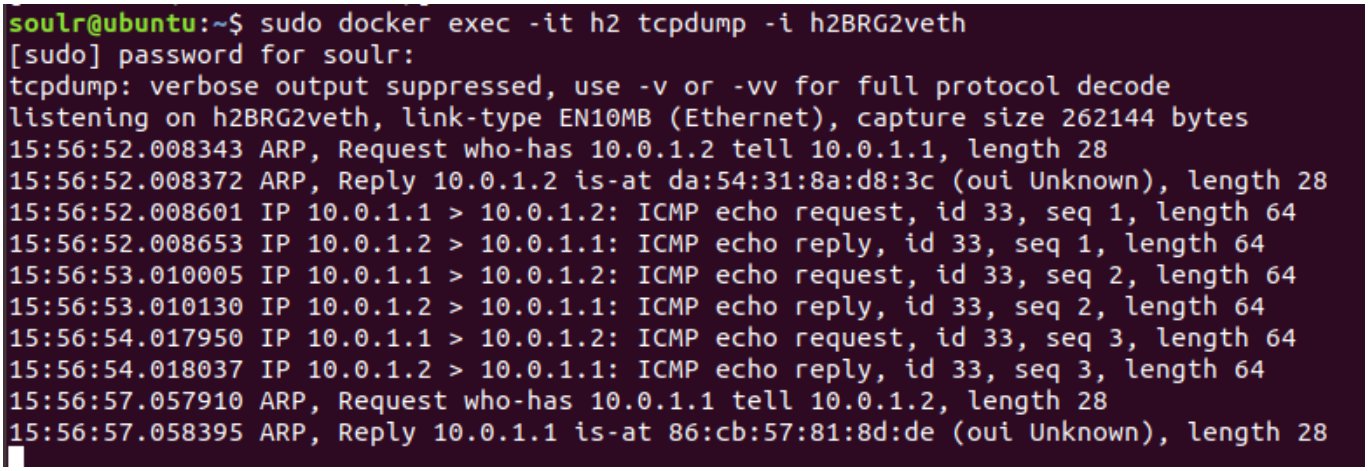
3. Can h1 ping h2? Take screenshots to explain why or why not (10%)

Yes. The packet will first send to BRG1, add GRETAP protocol (BRG1 to BRGr), send to BRGr, remove GRETAP protocol, add GRETAP protocol(BRGr to BRG2), send to BRG2, remove GRETAP protocol, then send to h2.

interfaces on BRGr



h2BRG2veth on h2



4. Explain how Linux kernel of BRGr determines which gretap interface to forward packets from GWr to hosts (h1 or h2)? Describe your answer with appropriate screenshots. (5%)

br0 will decide send the packet to **GRETAP_1** or **GRETAP_2** according to its ARP table. (port 2 is connected to **GRETAP_1**, port 1 is connected to **GRETAP_2**)

```
soulr@ubuntu:~$ sudo docker exec -it BRGr brctl showmacs BRGrR2veth
read of forward table failed: Operation not supported
soulr@ubuntu:~$ sudo docker exec -it BRGr brctl showmacs br0
port no mac addr                is local?       ageing timer
  3     22:82:7b:69:40:fd       yes                0.00
  3     22:82:7b:69:40:fd       yes                0.00
  2     86:cb:57:81:8d:de       no                10.18
  2     ae:94:1e:a2:e0:68       yes                0.00
  2     ae:94:1e:a2:e0:68       yes                0.00
  1     ca:48:e1:70:eb:e2       yes                0.00
  1     ca:48:e1:70:eb:e2       yes                0.00
  3     da:54:31:8a:d8:3c       no                10.18
soulr@ubuntu:~$ sudo docker exec -it h1 ifconfig h1BRG1veth
h1BRG1veth Link encap:Ethernet  HWaddr 86:cb:57:81:8d:de
          inet addr:10.0.1.1  Bcast:0.0.0.0  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:20 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1704 (1.7 KB)  TX bytes:1596 (1.5 KB)

soulr@ubuntu:~$ sudo docker exec -it h2 ifconfig h2BRG2veth
h2BRG2veth Link encap:Ethernet  HWaddr da:54:31:8a:d8:3c
          inet addr:10.0.1.2  Bcast:0.0.0.0  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:20 errors:0 dropped:0 overruns:0 frame:0
          TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1704 (1.7 KB)  TX bytes:1596 (1.5 KB)

soulr@ubuntu:~$
```

5. Is h1 aware of GRE tunneling? Take screenshot to explain why or why not (5%)

No. The screenshot shows that h1 doesn't know the existence of GRE tunneling.

```
soulr@ubuntu:~$ sudo docker exec -it h1 tcpdump -i h1BRG1veth -exX
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on h1BRG1veth, link-type EN10MB (Ethernet), capture size 262144 bytes
02:49:48.187817 86:cb:57:81:8d:de (oui Unknown) > Broadcast, ethertype ARP (0x0806), length 42: Request who-has 10.0.1.254 tell 10.0.1.1, length 28
        0x0000:  0001 0800 0604 0001 86cb 5781 8dde 0a00  ..........W.....
        0x0010:  0101 0000 0000 0000 0a00 01fe            ............
02:49:48.187955 36:c4:8e:32:92:e3 (oui Unknown) > 86:cb:57:81:8d:de (oui Unknown), ethertype ARP (0x0806), length 42: Reply 10.0.1.254 is-at 36:c4:8e:32:92:e3 (oui Unknown), length 28
        0x0000:  0001 0800 0604 0002 36c4 8e32 92e3 0a00  ........6..2....
        0x0010:  01fe 86cb 5781 8dde 0a00 0101            ....W.......
02:49:48.187967 86:cb:57:81:8d:de (oui Unknown) > 36:c4:8e:32:92:e3 (oui Unknown), ethertype IPv4 (0x0800), length 98: 10.0.1.1 > 10.0.1.254: ICMP echo request, id 91, seq 1, length 64
        0x0000:  4500 0054 ec4c 4000 4001 375e 0a00 0101  E..T.L@.@.7^....
        0x0010:  0a00 01fe 0800 93ee 005b 0001 cca2 4f62  .........[....Ob
        0x0020:  0000 0000 86dd 0200 0000 0000 1011 1213  ................
        0x0030:  1415 1617 1819 1a1b 1c1d 1e1f 2021 2223  ............ !"#
        0x0040:  2425 2627 2829 2a2b 2c2d 2e2f 3031 3233  $%&'()*+,-./0123
        0x0050:  3435 3637                                4567
02:49:48.188009 36:c4:8e:32:92:e3 (oui Unknown) > 86:cb:57:81:8d:de (oui Unknown), ethertype IPv4 (0x0800), length 98: 10.0.1.254 > 10.0.1.1: ICMP echo reply, id 91, seq 1, length 64
        0x0000:  4500 0054 9ea6 0000 4001 c504 0a00 01fe  E..T....@.......
        0x0010:  0a00 0101 0000 9bee 005b 0001 cca2 4f62  .........[....Ob
        0x0020:  0000 0000 86dd 0200 0000 0000 1011 1213  ................
        0x0030:  1415 1617 1819 1a1b 1c1d 1e1f 2021 2223  ............ !"#
        0x0040:  2425 2627 2829 2a2b 2c2d 2e2f 3031 3233  $%&'()*+,-./0123
        0x0050:  3435 3637                                4567
```

Part 2

Run Tunnel Auto Creation Program on BRGr and show the parsed result of one captured packet. (5%)

```
Device 0: br0
Device 1: eth0
Device 2: BRGrGWrveth
Device 3: BRGrR2veth
Device 4: any
Device 5: lo
Device 6: nflog
Device 7: nfqueue
Device 8: usbmon1
Device 9: usbmon2
Insert a number to select interface:
3
Interface: 3 BRGrR2veth
Start listening at BRGrR2veth
Insert BPF filter expression:
ip proto gre
filter: ip proto gre

Waiting packets...
------------------------------
Packet   1 captured
Packet capture length: 80
Packet total length 80
Source MAC: 12:1d:b6:e6:60:db
Destination MAC: 3e:ef:7f:f5:9e:11
Ethernet type: IPv4
Source IP: 140.114.0.1
Destination IP: 140.113.0.1
Next layer protocol: GRE
Found GRETAP
Inner source MAC: 26:f9:70:e2:25:81
Inner destination MAC: ff:ff:ff:ff:ff:ff
GRE tunnel 0 builded.
Byte code:
   0  3e ef 7f f5 9e 11 12 1d b6 e6 60 db 08 00 45 00
  16  00 42 2d 37 40 00 3e 2f f6 70 8c 72 00 01 8c 71
  32  00 01 00 00 65 58 ff ff ff ff ff ff 26 f9 70 e2
  48  25 81 08 06 00 01 08 00 06 04 00 01 26 f9 70 e2
  64  25 81 0a 00 01 01 00 00 00 00 00 00 0a 00 01 02
```