Отчёт по лабораторной работе «Локальные сети»

Trung Luong

26 декабря 2020 г.

Содержание

1. Получение адреса по DHCP

Получение "случайного"IP адреса tcpdump -tenv -s 1000 на r2 eth0.

```
r2:~# tcpdump -tenv -s 1000 -i eth0
tcpdump: listening on eth0, link-type EN10MB (Ethernet), capture size 1000 bytes
10:10:10:10:10:ee > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:ee > 33:33:ff:10:10:ee, ethertype IPv6 (0x86dd), length 78: (hlim 255, next-head
10:10:10:10:10:ee > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:ee
10:10:10:10:10:ee > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:ee
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Discover
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
3a:40:ee:31:9e:cd > ff:ff:ff:ff:ff:ff, ethertype ARP (0x0806), length 42: arp who-has 10.20.0.2
3a:40:ee:31:9e:cd > 10:10:10:10:10:ee, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.20.0.2
```

```
          Client-Ethernet-Address 10:10:10:10:10:ee
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Offer
            Server-ID Option 54, length 4: 10.20.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.20.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:ee > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:ee
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Request
            Server-ID Option 54, length 4: 10.20.0.1
            Requested-IP Option 50, length 4: 10.20.0.2
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
3a:40:ee:31:9e:cd > 10:10:10:10:10:ee, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.20.0.2
          Client-Ethernet-Address 10:10:10:10:10:ee
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: ACK
            Server-ID Option 54, length 4: 10.20.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.20.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
3a:40:ee:31:9e:cd > ff:ff:ff:ff:ff:ff, ethertype ARP (0x0806), length 42: arp who-has 10.20.0.2
3a:40:ee:31:9e:cd > ff:ff:ff:ff:ff:ff, ethertype ARP (0x0806), length 42: arp who-has 10.20.0.2
10:10:10:10:10:ee > 3a:40:ee:31:9e:cd, ethertype ARP (0x0806), length 42: arp reply 10.20.0.2 i
3a:40:ee:31:9e:cd > 10:10:10:10:10:ee, ethertype IPv4 (0x0800), length 62: (tos 0x0, ttl 64, id
10:10:10:10:10:ee > 3a:40:ee:31:9e:cd, ethertype IPv4 (0x0800), length 62: (tos 0x0, ttl 64, id
10:10:10:10:10:ee > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:ee
10:10:10:10:10:ee > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:ee > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:ee
10:10:10:10:10:ee > 3a:40:ee:31:9e:cd, ethertype ARP (0x0806), length 42: arp who-has 10.20.0.1
3a:40:ee:31:9e:cd > 10:10:10:10:10:ee, ethertype ARP (0x0806), length 42: arp reply 10.20.0.1 i
```

Получение фиксированного IP адреса на примере s11 tcpdump -tenv -s 1000 на r1 eth0.

```
r1:~# tcpdump -tenv -s 1000 -i eth0
tcpdump: listening on eth0, link-type EN10MB (Ethernet), capture size 1000 bytes
10:10:10:10:20:aa > ff:ff:ff:ff:ff:ff, ethertype ARP (0x0806), length 42: arp who-has 10.10.0.1
0e:ab:f8:0c:10:4b > 10:10:10:10:20:aa, ethertype ARP (0x0806), length 42: arp reply 10.10.0.1 i
```

```
10:10:10:10:20:aa > 0e:ab:f8:0c:10:4b, ethertype IPv4 (0x0800), length 342: (tos 0x0, ttl 64, i
          Client-IP 10.10.4.10
          Client-Ethernet-Address 10:10:10:10:20:aa
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Release
            Server-ID Option 54, length 4: 10.10.0.1
10:10:10:10:20:aa > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:20:aa > 33:33:ff:10:20:aa, ethertype IPv6 (0x86dd), length 78: (hlim 255, next-head
10:10:10:10:20:aa > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:20:aa
10:10:10:10:20:aa > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:20:aa
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Discover
            Requested-IP Option 50, length 4: 10.10.4.10
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:20:aa, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.4.10
          Client-Ethernet-Address 10:10:10:10:20:aa
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Offer
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:20:aa > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:20:aa
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Request
            Server-ID Option 54, length 4: 10.10.0.1
            Requested-IP Option 50, length 4: 10.10.4.10
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:20:aa, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.4.10
          Client-Ethernet-Address 10:10:10:10:20:aa
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: ACK
            Server-ID Option 54, length 4: 10.10.0.1
```

```
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:20:aa > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:20:aa > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:20:aa
10:10:10:10:20:aa > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:20:aa
10:10:10:10:20:bb > ff:ff:ff:ff:ff:ff, ethertype ARP (0x0806), length 42: arp who-has 10.10.0.1
0e:ab:f8:0c:10:4b > 10:10:10:10:20:bb, ethertype ARP (0x0806), length 42: arp reply 10.10.0.1 i
10:10:10:10:20:bb > 0e:ab:f8:0c:10:4b, ethertype IPv4 (0x0800), length 342: (tos 0x0, ttl 64, i
          Client-IP 10.10.4.20
          Client-Ethernet-Address 10:10:10:10:20:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Release
            Server-ID Option 54, length 4: 10.10.0.1
10:10:10:10:20:bb > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:20:bb > 33:33:ff:10:20:bb, ethertype IPv6 (0x86dd), length 78: (hlim 255, next-head
10:10:10:10:20:bb > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:20:bb > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:20:bb
10:10:10:10:20:bb > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:20:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Discover
            Requested-IP Option 50, length 4: 10.10.4.20
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:20:bb, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.4.20
          Client-Ethernet-Address 10:10:10:10:20:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Offer
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:20:bb > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:20:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Request
            Server-ID Option 54, length 4: 10.10.0.1
```

```
            Requested-IP Option 50, length 4: 10.10.4.20
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:20:bb, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.4.20
          Client-Ethernet-Address 10:10:10:10:20:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: ACK
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:20:bb > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:20:bb
10:10:10:10:20:bb > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:20:bb
10:10:10:10:10:ba > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:ba > 33:33:ff:10:10:ba, ethertype IPv6 (0x86dd), length 78: (hlim 255, next-head
10:10:10:10:10:ba > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:ba
10:10:10:10:10:ba > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:ba
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Discover
            Requested-IP Option 50, length 4: 10.10.1.1
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:10:ba, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.1.1
          Client-Ethernet-Address 10:10:10:10:10:ba
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Offer
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:ba > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:ba
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Request
```

```
            Server-ID Option 54, length 4: 10.10.0.1
            Requested-IP Option 50, length 4: 10.10.1.1
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:10:ba, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.1.1
          Client-Ethernet-Address 10:10:10:10:10:ba
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: ACK
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:ba > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:ba
10:10:10:10:10:ba > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:ba > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:ba
10:10:10:10:10:bb > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:bb > 33:33:ff:10:10:bb, ethertype IPv6 (0x86dd), length 78: (hlim 255, next-head
10:10:10:10:10:bb > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Discover
            Requested-IP Option 50, length 4: 10.10.2.1
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:10:bb, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.2.1
          Client-Ethernet-Address 10:10:10:10:10:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Offer
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:bb > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Request
```

```
            Server-ID Option 54, length 4: 10.10.0.1
            Requested-IP Option 50, length 4: 10.10.2.1
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:10:bb, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.2.1
          Client-Ethernet-Address 10:10:10:10:10:bb
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: ACK
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:bb > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:bb
10:10:10:10:10:bb > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:bb
10:10:10:10:10:bb > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:bb > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:bb
10:10:10:10:10:bc > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:bc > 33:33:ff:10:10:bc, ethertype IPv6 (0x86dd), length 78: (hlim 255, next-head
10:10:10:10:10:bc > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:bc
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Discover
            Requested-IP Option 50, length 4: 10.10.3.1
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:10:bc, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.3.1
          Client-Ethernet-Address 10:10:10:10:10:bc
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Offer
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:bc > ff:ff:ff:ff:ff:ff, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Client-Ethernet-Address 10:10:10:10:10:bc
          Vendor-rfc1048 Extensions
```

```
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: Request
            Server-ID Option 54, length 4: 10.10.0.1
            Requested-IP Option 50, length 4: 10.10.3.1
            Parameter-Request Option 55, length 12:
              Subnet-Mask, BR, Time-Zone, Default-Gateway
              Domain-Name, Domain-Name-Server, Option 119, Hostname
              Netbios-Name-Server, Netbios-Scope, MTU, Classless-Static-Route
0e:ab:f8:0c:10:4b > 10:10:10:10:10:bc, ethertype IPv4 (0x0800), length 342: (tos 0x10, ttl 128,
          Your-IP 10.10.3.1
          Client-Ethernet-Address 10:10:10:10:10:bc
          Vendor-rfc1048 Extensions
            Magic Cookie 0x63825363
            DHCP-Message Option 53, length 1: ACK
            Server-ID Option 54, length 4: 10.10.0.1
            Lease-Time Option 51, length 4: 43200
            Subnet-Mask Option 1, length 4: 255.255.0.0
            Default-Gateway Option 3, length 4: 10.10.0.1
            Domain-Name-Server Option 6, length 4: 192.168.100.1
10:10:10:10:10:bc > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:bc
10:10:10:10:10:bc > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:bc
10:10:10:10:10:bc > 33:33:00:00:00:16, ethertype IPv6 (0x86dd), length 90: (hlim 1, next-header
10:10:10:10:10:bc > 33:33:00:00:00:02, ethertype IPv6 (0x86dd), length 70: (hlim 255, next-head
          source link-address option (1), length 8 (1): 10:10:10:10:10:bc
```

2. Использование VPN

ip r на маршрутизаторе r1, r2 после VPN и работы RIP

```
r1:~# service openvpn restart

r1:~# ip r
10.100.100.2 dev tun0  proto kernel  scope link  src 10.100.100.1
10.20.0.0/16 via 10.100.100.2 dev tun0  proto zebra  metric 2
10.10.0.0/16 dev eth0  proto kernel  scope link  src 10.10.0.1
172.16.0.0/16 dev eth1  proto kernel  scope link  src 172.16.1.3
default via 172.16.1.2 dev eth1

**********************************************************************

r2:~# service openvpn restart

r2:~# ip r
10.100.100.1 dev tun0  proto kernel  scope link  src 10.100.100.2
10.20.0.0/16 dev eth0  proto kernel  scope link  src 10.20.0.1
10.10.0.0/16 via 10.100.100.1 dev tun0  proto zebra  metric 2
172.16.0.0/16 dev eth1  proto kernel  scope link  src 172.16.1.4
default via 172.16.1.2 dev eth1
```

ip -4 a на маршрутизаторе r1, r2

```
r1:~# ip -4 a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue
    inet 127.0.0.1/8 scope host lo
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 1000
    inet 172.16.1.3/16 brd 172.16.255.255 scope global eth1
4: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 1000
    inet 10.10.0.1/16 brd 10.10.255.255 scope global eth0
5: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 100
    inet 10.100.100.1 peer 10.100.100.2/32 scope global tun0

*****************************************************************

r2:~# ip -4 a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue
    inet 127.0.0.1/8 scope host lo
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 1000
    inet 172.16.1.4/16 brd 172.16.255.255 scope global eth1
4: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 1000
    inet 10.20.0.1/16 brd 10.20.255.255 scope global eth0
5: tun0: <POINTOPOINT,MULTICAST,NOARP,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 100
    inet 10.100.100.2 peer 10.100.100.1/32 scope global tun0
```

просшулка сообщений RIP на tun0

```
r1:~# tcpdump -tnvn -i tun0 udp
tcpdump: listening on tun0, link-type RAW (Raw IP), capture size 96 bytes
IP (tos 0x0, ttl 1, id 0, offset 0, flags [DF], proto UDP (17), length 52) 10.100.100.2.520 > 2
        RIPv2, Response, length: 24, routes: 1
          AFI: IPv4:       10.20.0.0/16, tag 0x0000, metric: 1, next-hop: self
IP (tos 0x0, ttl 1, id 0, offset 0, flags [DF], proto UDP (17), length 52) 10.100.100.1.520 > 2
        RIPv2, Response, length: 24, routes: 1
          AFI: IPv4:       10.10.0.0/16, tag 0x0000, metric: 1, next-hop: self
```

Проверка работы VPN

```
ws21:~# traceroute 10.10.4.10
traceroute to 10.10.4.10 (10.10.4.10), 64 hops max, 40 byte packets
 1  10.20.0.1 (10.20.0.1)  4 ms  1 ms  1 ms
 2  10.100.100.1 (10.100.100.1)  2 ms  4 ms  2 ms
 3  10.10.4.10 (10.10.4.10)  14 ms  1 ms  0 ms
```

3. Правила фильтации пакетов и трансляции пдресов

```
#!/bin/sh

LAN=eth0
INET=eth1
VPN=tun0
```

```
# Удаление всех правил в таблице "filter" (по-умолчанию).
iptables -F

# Удаление правил в таблице "nat" (её надо указать явно).
iptables -F -t nat

# По-умолчанию все маршрутизируемые пакеты выбрасываются.
iptables --policy FORWARD DROP

# ICMP разрешим
iptables -A FORWARD -p icmp -j ACCEPT

# Разрешаем любую маршрутизацию для интерфейса VPN
iptables -A FORWARD -i $VPN -j ACCEPT
iptables -A FORWARD -o $VPN -j ACCEPT

# Включение SNAT для маршрутизируемых пакетов, выходящих
# через eth1. Это правило выполняется после самой маршрутизации
# (POSTROUTING) и помещается в таблицу правил "nat".
iptables -t nat -A POSTROUTING -o $INET -j MASQUERADE

# Разрешение пакетов-ответов (они отслеживаются как
# -- state ESTABLISHED)
iptables -A FORWARD -m state --state ESTABLISHED -i $INET -j ACCEPT

# DNAT
iptables -t nat -A PREROUTING -p tcp --dport 80 -j DNAT --to 10.10.4.10:80 -i $INET

iptables -A FORWARD -d 10.10.4.10/16 -j ACCEPT

# DNS
iptables -A FORWARD -p UDP --dport 53 -o $INET -j ACCEPT
```

```
r1:~# iptables -L -nv
Chain INPUT (policy ACCEPT 97 packets, 17311 bytes)
 pkts bytes target     prot opt in     out     source               destination

Chain FORWARD (policy DROP 0 packets, 0 bytes)
 pkts bytes target     prot opt in     out     source               destination
    6   504 ACCEPT     icmp --  *      *       0.0.0.0/0            0.0.0.0/0
    0     0 ACCEPT     all  --  tun0   *       0.0.0.0/0            0.0.0.0/0
    0     0 ACCEPT     all  --  *      tun0    0.0.0.0/0            0.0.0.0/0
    0     0 ACCEPT     all  --  eth1   *       0.0.0.0/0            0.0.0.0/0           state E
    0     0 ACCEPT     all  --  *      *       0.0.0.0/0            10.10.0.0/16
    0     0 ACCEPT     udp  --  *      eth1    0.0.0.0/0            0.0.0.0/0           udp dpt

Chain OUTPUT (policy ACCEPT 53 packets, 4058 bytes)
 pkts bytes target     prot opt in     out     source               destination
```

```
r1:~# iptables -L -nv -t nat
Chain PREROUTING (policy ACCEPT 33 packets, 5585 bytes)
```

```
 pkts bytes target     prot opt in     out     source               destination
    0     0 DNAT       tcp  --  eth1   *       0.0.0.0/0            0.0.0.0/0           tcp dpt

Chain POSTROUTING (policy ACCEPT 12 packets, 704 bytes)
 pkts bytes target     prot opt in     out     source               destination
    5   366 MASQUERADE  all  --  *      eth1    0.0.0.0/0            0.0.0.0/0

Chain OUTPUT (policy ACCEPT 15 packets, 902 bytes)
 pkts bytes target     prot opt in     out     source               destination
```

4. Проверка трансляции SNAT

На s11 ping bmstu.ru
Дамп SNAT в LAN (на r1 tcpdump -tnv -i any icmp)

```
r1:~# tcpdump -tnv -i any icmp
tcpdump: listening on any, link-type LINUX_SLL (Linux cooked), capture size 96 bytes
IP (tos 0x0, ttl 64, id 0, offset 0, flags [DF], proto ICMP (1), length 84) 10.10.4.10 > 195.19
IP (tos 0x0, ttl 63, id 0, offset 0, flags [DF], proto ICMP (1), length 84) 172.16.1.3 > 195.19
IP (tos 0x0, ttl 60, id 64582, offset 0, flags [none], proto ICMP (1), length 84) 195.19.50.247
IP (tos 0x0, ttl 59, id 64582, offset 0, flags [none], proto ICMP (1), length 84) 195.19.50.247
```

Дамп SNAT (снаружи tcpdump -tnv -i `nk_tap_trungluo`)

```
(base) trungluong@trungluong:~$ sudo tcpdump -tnv -i nk_tap_trungluo
tcpdump: listening on nk_tap_trungluo, link-type EN10MB (Ethernet), capture size 262144 bytes
IP (tos 0x0, ttl 63, id 28878, offset 0, flags [DF], proto UDP (17), length 54)
    172.16.1.3.50288 > 192.168.0.1.53: 36332+ A? bmstu.ru. (26)
IP (tos 0x0, ttl 59, id 21573, offset 0, flags [none], proto UDP (17), length 143)
    192.168.0.1.53 > 172.16.1.3.50288: 36332* 1/2/2 bmstu.ru. A 195.19.50.247 (115)
IP (tos 0x0, ttl 63, id 0, offset 0, flags [DF], proto ICMP (1), length 84)
    172.16.1.3 > 195.19.50.247: ICMP echo request, id 48642, seq 1, length 64
IP (tos 0x0, ttl 60, id 59939, offset 0, flags [none], proto ICMP (1), length 84)
    195.19.50.247 > 172.16.1.3: ICMP echo reply, id 48642, seq 1, length 64
IP (tos 0x0, ttl 63, id 28881, offset 0, flags [DF], proto UDP (17), length 72)
    172.16.1.3.32777 > 192.168.0.1.53: 59916+ PTR? 247.50.19.195.in-addr.arpa. (44)
IP (tos 0x0, ttl 59, id 21577, offset 0, flags [none], proto UDP (17), length 178)
    192.168.0.1.53 > 172.16.1.3.32777: 59916* 1/2/2 247.50.19.195.in-addr.arpa. PTR h247.net50.
```

5. Проверка правил фильтрации

На ws11 telnet bmstu.ru 80 – не работает

```
Trying 195.19.50.247...
telnet: Unable to connect to remote host: Connection timed out
```

На ws11 ping bmstu.ru – работает

```
PING bmstu.ru (195.19.50.247) 56(84) bytes of data.
64 bytes from h247.net50.bmstu.ru (195.19.50.247): icmp_seq=1 ttl=54 time=6.74 ms
```

Проверка, что по VPN все работает
На ws21 telnet 10.10.4.10 80

```
s11:~# service apache2 start

ws21:~# telnet 10.10.4.10 80
Trying 10.10.4.10...
Connected to 10.10.4.10.
Escape character is '^]'.
Hello
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>501 Method Not Implemented</title>
</head><body>
<h1>Method Not Implemented</h1>
<p>Hello to /index.html not supported.<br />
</p>
<hr>
<address>Apache/2.2.9 (Debian) Server at 127.0.0.1 Port 80</address>
</body></html>
Connection closed by foreign host.
```

6. Проверка доступа к внутреннему серверу

Используем telnet / веб-браузер на реальной машине. Должен быть виден DNAT и разрешённый доступ.