

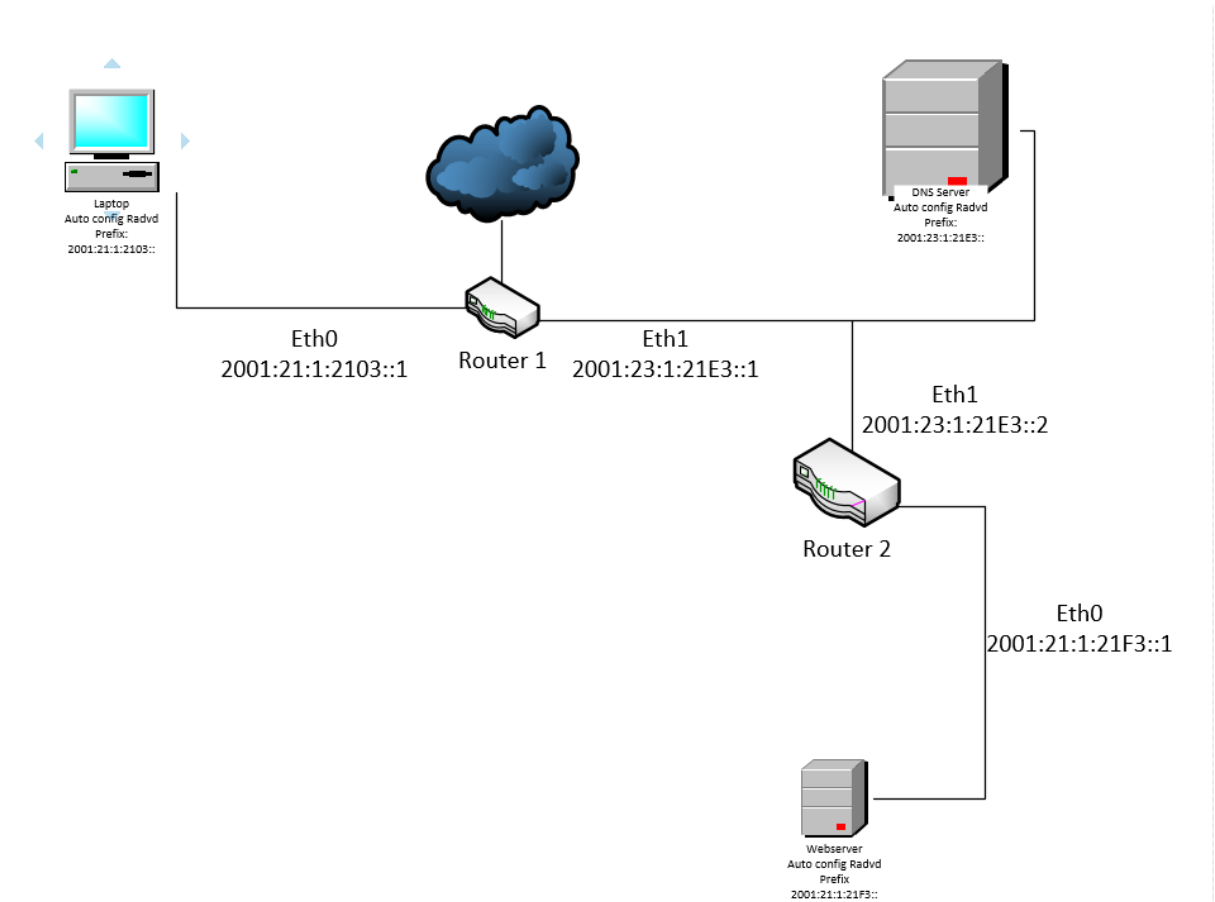


IPv6 Assignment

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Task 2:

Provide adjusted network drawing with the configured interfaces.



For each of the 3 subnetworks provide a screenshot for a successful ping between two nodes of the subnetwork.

Laptop to eth0 of Router1:

```
NT2 Lab 1: A Day in the Life scenario
----- Netkit phase 2 initialization terminated -----

Laptop login: root (automatic login)
Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686
Welcome to Netkit

root@Laptop:~# ping6 2001:21:1:2103::1
PING 2001:21:1:2103::1(2001:21:1:2103::1) 56 data bytes
64 bytes from 2001:21:1:2103::1: icmp_seq=1 ttl=64 time=0.316 ms
64 bytes from 2001:21:1:2103::1: icmp_seq=2 ttl=64 time=0.278 ms
64 bytes from 2001:21:1:2103::1: icmp_seq=3 ttl=64 time=0.281 ms
64 bytes from 2001:21:1:2103::1: icmp_seq=4 ttl=64 time=0.300 ms
64 bytes from 2001:21:1:2103::1: icmp_seq=5 ttl=64 time=0.292 ms
64 bytes from 2001:21:1:2103::1: icmp_seq=6 ttl=64 time=0.147 ms
^C
--- 2001:21:1:2103::1 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5026ms
rtt min/avg/max/mdev = 0.147/0.269/0.316/0.055 ms
root@Laptop:~#
```

```
Router1 login: root (automatic login)
Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686
Welcome to Netkit

root@Router1:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 2a:06:e8:3e:f1:7c
          inet addr:68.80.3.254  Bcast:68.80.3.255  Mask:255.255.255.0
          inet6 addr: fe80::2806:e8ff:fe3e:f17c/64 Scope:Link
          inet6 addr: 2001:21:1:2103::1/64 Scope:Global
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1 errors:0 dropped:0 overruns:0 frame:0
          TX packets:23 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:64 (64.0 B)  TX bytes:2446 (2.3 KiB)
          Interrupt:5

eth1      Link encap:Ethernet  HWaddr 56:b3:15:dc:42:60
          inet addr:68.80.0.254  Bcast:68.87.255.255  Mask:255.248.0.0
          inet6 addr: fe80::54b3:15ff:fedc:4260/64 Scope:Link
          inet6 addr: 2001:23:1:21e3::1/64 Scope:Global
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:20 errors:0 dropped:0 overruns:0 frame:0
```

Dns to eth1 of Router2:

```

DnsServer
-----
Netkit phase 2 initialization terminated

DnsServer login: root (automatic login)
Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686
Welcome to Netkit

root@DnsServer:~# ping 2001:23:1:21e3::2
ping: unknown host 2001:23:1:21e3::2
root@DnsServer:~# ping6 2001:23:1:21e3::2
PING 2001:23:1:21e3::2(2001:23:1:21e3::2) 56 data bytes
64 bytes from 2001:23:1:21e3::2: icmp_seq=1 ttl=64 time=1.25 ms
64 bytes from 2001:23:1:21e3::2: icmp_seq=2 ttl=64 time=0.198 ms
64 bytes from 2001:23:1:21e3::2: icmp_seq=3 ttl=64 time=0.318 ms
64 bytes from 2001:23:1:21e3::2: icmp_seq=4 ttl=64 time=0.255 ms
^C
--- 2001:23:1:21e3::2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3012ms
rtt min/avg/max/mdev = 0.198/0.507/1.253/0.436 ms
root@DnsServer:~#

Router2
-----
RX bytes:336 (336.0 B) TX bytes:3586 (3.5 KiB)
Interrupt:5

eth1 Link encap:Ethernet HWaddr 76:ef:8a:01:ba:dd
inet addr:68.80.0.253 Bcast:68.87.255.255 Mask:255.248.0.0
inet6 addr: fe80::74ef:8aff:fe01:badd/64 Scope:Link
inet6 addr: 2001:23:1:21e3::2/64 Scope:Global
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:35 errors:0 dropped:0 overruns:0 frame:0
TX packets:31 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:3244 (3.1 KiB) TX bytes:3386 (3.3 KiB)
Interrupt:5

lo Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING MTU:16436 Metric:1
RX packets:18 errors:0 dropped:0 overruns:0 frame:0
TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:976 (976.0 B) TX bytes:976 (976.0 B)

root@Router2:~#

```

Webserver to eth0 of Router2:

```

WebServer
-----
Description:
NT2 Lab 1: A Day in the Life scenario

-----
Netkit phase 2 initialization terminated

WebServer login: root (automatic login)
Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686
Welcome to Netkit

root@WebServer:~# ping 2001:21:1:21f3::1
ping: unknown host 2001:21:1:21f3::1
root@WebServer:~# ping6 2001:21:1:21f3::1
PING 2001:21:1:21f3::1(2001:21:1:21f3::1) 56 data bytes
64 bytes from 2001:21:1:21f3::1: icmp_seq=1 ttl=64 time=0.389 ms
64 bytes from 2001:21:1:21f3::1: icmp_seq=2 ttl=64 time=0.278 ms
64 bytes from 2001:21:1:21f3::1: icmp_seq=3 ttl=64 time=0.276 ms
^C
--- 2001:21:1:21f3::1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2006ms
rtt min/avg/max/mdev = 0.276/0.314/0.389/0.054 ms
root@WebServer:~#

Router2
-----
NT2 Lab 1: A Day in the Life scenario

-----
Netkit phase 2 initialization terminated

Router2 login: root (automatic login)
Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686
Welcome to Netkit

root@Router2:~# ifconfig
eth0 Link encap:Ethernet HWaddr 8e:72:1c:2a:56:bc
inet addr:64.233.64.254 Bcast:64.233.79.255 Mask:255.255.240.0
inet6 addr: fe80::8c72:1c2a:56bc/64 Scope:Link
inet6 addr: 2001:21:1:21f3::1/64 Scope:Global
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:5 errors:0 dropped:0 overruns:0 frame:0
TX packets:33 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:336 (336.0 B) TX bytes:3586 (3.5 KiB)
Interrupt:5

eth1 Link encap:Ethernet HWaddr 76:ef:8a:01:ba:dd

```

Task 3:

Provide screenshots of the following successful IPv6 pings:

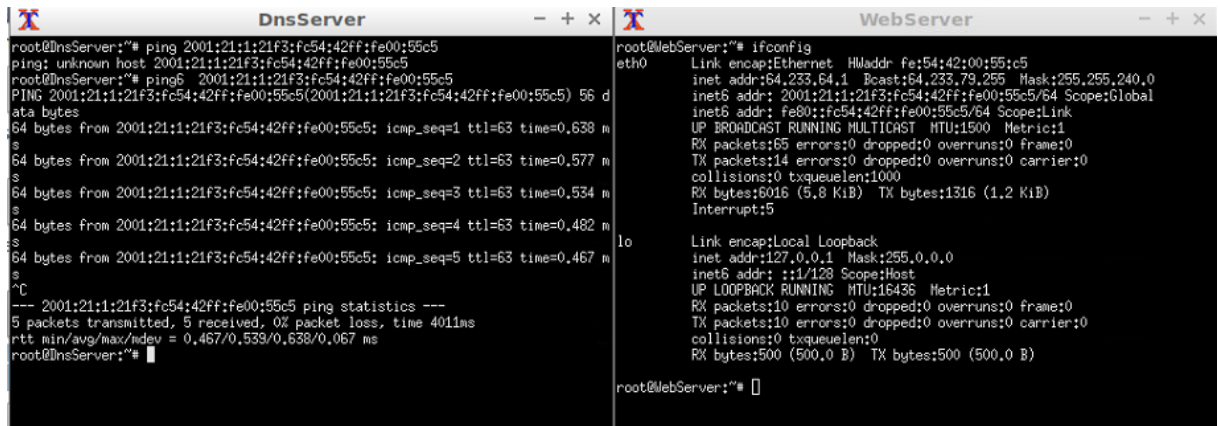
1. Laptop to WebServer

```
Laptop                               WebServer
┌──────────────────────────────────┐ ┌──────────────────────────────────┐
│                                                                            │
│ Laptop login: root (automatic login)                                     │
│ Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686 │
│ Welcome to Netkit                                                         │
│                                                                            │
│ root@Laptop:~# ping 2001:21:1:21f3:fc54:42ff:fe00:55c5                  │
│ ping: unknown host 2001:21:1:21f3:fc54:42ff:fe00:55c5                  │
│ root@Laptop:~# ping6 2001:21:1:21f3:fc54:42ff:fe00:55c5                │
│ PING 2001:21:1:21f3:fc54:42ff:fe00:55c5(2001:21:1:21f3:fc54:42ff:fe00:55c5) 56 d │
│ ata bytes                                                                │
│ 64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=1 ttl=62 time=1.13 ms │
│ 64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=2 ttl=62 time=0.427 m │
│ s                                                                        │
│ 64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=3 ttl=62 time=0.541 m │
│ s                                                                        │
│ 64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=4 ttl=62 time=0.575 m │
│ s                                                                        │
│ 64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=5 ttl=62 time=0.649 m │
│ s                                                                        │
│ ^C                                                                        │
│ --- 2001:21:1:21f3:fc54:42ff:fe00:55c5 ping statistics ---            │
│ 5 packets transmitted, 5 received, 0% packet loss, time 4000ms          │
│ rtt min/avg/max/mdev = 0.427/0.665/1.137/0.248 ms                      │
│ root@Laptop:~# [ ]                                                       │
│                                                                            │
│ Welcome to Netkit                                                         │
│ root@WebServer:~# ifconfig                                              │
│ eth0                                                                    │
│   Link encap:Ethernet  HWaddr fe:54:42:00:55:c5                        │
│   inet addr:64.233.64.1  Bcast:64.233.79.255  Mask:255.255.240.0        │
│   inet6 addr: 2001:21:1:21f3:fc54:42ff:fe00:55c5/64 Scope:Global        │
│   inet6 addr: fe80::fc54:42ff:fe00:55c5/64 Scope:Link                  │
│   UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1                  │
│   RX packets:15 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:1256 (1.2 KiB)  TX bytes:476 (476.0 B)                      │
│   Interrupt:5                                                           │
│                                                                            │
│ lo                                                                        │
│   Link encap:Local Loopback                                             │
│   inet addr:127.0.0.1  Mask:255.0.0.0                                  │
│   inet6 addr: ::1/128 Scope:Host                                        │
│   UP LOOPBACK RUNNING  MTU:16436  Metric:1                             │
│   RX packets:10 errors:0 dropped:0 overruns:0 frame:0                  │
│   TX packets:10 errors:0 dropped:0 overruns:0 carrier:0                │
│   collisions:0 txqueuelen:0                                              │
│   RX bytes:500 (500.0 B)  TX bytes:500 (500.0 B)                      │
│   Interrupt:5                                                           │
│                                                                            │
│ root@WebServer:~# [ ]
```

2. DnsServer to Laptop

```
Laptop                               DnsServer
┌──────────────────────────────────┐ ┌──────────────────────────────────┐
│                                                                            │
│ root@Laptop:~# ifconfig                                              │
│ eth0                                                                    │
│   Link encap:Ethernet  HWaddr da:b8:d7:94:8b:e7                        │
│   inet addr:68.80.3.1  Bcast:68.80.3.255  Mask:255.255.255.0          │
│   inet6 addr: 2001:21:1:2103:d8b8:d7ff:fe94:8be7/64 Scope:Global        │
│   inet6 addr: fe80::d8b8:d7ff:fe94:8be7/64 Scope:Link                  │
│   UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1                  │
│   RX packets:42 errors:0 dropped:0 overruns:0 frame:0                  │
│   TX packets:12 errors:0 dropped:0 overruns:0 carrier:0                │
│   collisions:0 txqueuelen:1000                                          │
│   RX bytes:3924 (3.8 KiB)  TX bytes:1152 (1.1 KiB)                      │
│   Interrupt:5                                                           │
│                                                                            │
│ lo                                                                        │
│   Link encap:Local Loopback                                             │
│   inet addr:127.0.0.1  Mask:255.0.0.0                                  │
│   inet6 addr: ::1/128 Scope:Host                                        │
│   UP LOOPBACK RUNNING  MTU:16436  Metric:1                             │
│   RX packets:10 errors:0 dropped:0 overruns:0 frame:0                  │
│   TX packets:10 errors:0 dropped:0 overruns:0 carrier:0                │
│   collisions:0 txqueuelen:0                                              │
│   RX bytes:500 (500.0 B)  TX bytes:500 (500.0 B)                      │
│                                                                            │
│ root@Laptop:~# [ ]                                                       │
│                                                                            │
│ [ ok ] Starting enhanced syslogd: rsyslogd.                             │
│                                                                            │
│ DnsServer login: root (automatic login)                                │
│ Linux rootstrap 3.2.54-netkit-ng-K3.2 #2 Tue Nov 11 11:42:04 CET 2014 i686 │
│ Welcome to Netkit                                                         │
│                                                                            │
│ root@DnsServer:~# ping 2001:21:1:2103:d8b8:d7ff:fe94:8be7            │
│ ping: unknown host 2001:21:1:2103:d8b8:d7ff:fe94:8be7                │
│ root@DnsServer:~# ping6 2001:21:1:2103:d8b8:d7ff:fe94:8be7            │
│ PING 2001:21:1:2103:d8b8:d7ff:fe94:8be7(2001:21:1:2103:d8b8:d7ff:fe94:8be7) 56 d │
│ ata bytes                                                                │
│ 64 bytes from 2001:21:1:2103:d8b8:d7ff:fe94:8be7: icmp_seq=1 ttl=63 time=0.856 m │
│ s                                                                        │
│ 64 bytes from 2001:21:1:2103:d8b8:d7ff:fe94:8be7: icmp_seq=2 ttl=63 time=0.547 m │
│ s                                                                        │
│ 64 bytes from 2001:21:1:2103:d8b8:d7ff:fe94:8be7: icmp_seq=3 ttl=63 time=0.457 m │
│ s                                                                        │
│ 64 bytes from 2001:21:1:2103:d8b8:d7ff:fe94:8be7: icmp_seq=4 ttl=63 time=0.357 m │
│ s                                                                        │
│ ^C                                                                        │
│ --- 2001:21:1:2103:d8b8:d7ff:fe94:8be7 ping statistics ---            │
│ 4 packets transmitted, 4 received, 0% packet loss, time 3015ms          │
│ rtt min/avg/max/mdev = 0.357/0.554/0.856/0.187 ms                      │
│ root@DnsServer:~# [ ]
```

3. DnsServer to WebServer



The screenshot shows two terminal windows side-by-side. The left window, titled 'DnsServer', shows a series of ping commands from a laptop to the DnsServer. The first ping fails with 'ping: unknown host'. Subsequent pings succeed, showing 64 bytes from the DnsServer with increasing sequence numbers and decreasing times. A 'ping statistics' summary shows 5 packets transmitted, 5 received, 0% packet loss, and a time of 401ms. The right window, titled 'WebServer', shows the output of the 'ifconfig' command for the 'eth0' interface. It displays the link encap as Ethernet, the hardware address as fe:54:42:00:55:c5, and the IPv4 address as 64.233.64.1. It also shows the IPv6 address as 2001:21:1:21f3:fc54:42ff:fe00:55c5/64. The 'lo' interface is also shown with its loopback configuration.

```
root@DnsServer:~# ping 2001:21:1:21f3:fc54:42ff:fe00:55c5
ping: unknown host 2001:21:1:21f3:fc54:42ff:fe00:55c5
root@DnsServer:~# ping6 2001:21:1:21f3:fc54:42ff:fe00:55c5
PING 2001:21:1:21f3:fc54:42ff:fe00:55c5(2001:21:1:21f3:fc54:42ff:fe00:55c5) 56 d
ata bytes
64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=1 ttl=63 time=0.638 m
s
64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=2 ttl=63 time=0.577 m
s
64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=3 ttl=63 time=0.534 m
s
64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=4 ttl=63 time=0.482 m
s
64 bytes from 2001:21:1:21f3:fc54:42ff:fe00:55c5: icmp_seq=5 ttl=63 time=0.467 m
s
^C
--- 2001:21:1:21f3:fc54:42ff:fe00:55c5 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 401ms
rtt min/avg/max/mdev = 0.467/0.533/0.638/0.067 ms
root@DnsServer:~#

root@WebServer:~# ifconfig
eth0:
Link encap:Ethernet  HWaddr fe:54:42:00:55:c5
inet addr:64.233.64.1 Bcast:64.233.79.255 Mask:255.255.240.0
inet6 addr: 2001:21:1:21f3:fc54:42ff:fe00:55c5/64 Scope:Global
inet6 addr: fe80::fc54:42ff:fe00:55c5/64 Scope:Link
UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
RX packets:65 errors:0 dropped:0 overruns:0 frame:0
TX packets:14 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:6016 (5.8 KiB) TX bytes:1316 (1.2 KiB)
Interrupt:5

lo:
Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING  MTU:16436  Metric:1
RX packets:10 errors:0 dropped:0 overruns:0 frame:0
TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:500 (500.0 B) TX bytes:500 (500.0 B)

root@WebServer:~#
```

Explain how your automatic IPv6 addresses were formed based on one example autoconfigured IPv6 address.

in the radvd.conf file, we gave every eth interface a network prefix like the following radvd.conf file that is located in the router1 folder:



The screenshot shows a text editor window titled '<radvd.conf>'. The file contains configuration for two interfaces, eth0 and eth1. Both interfaces are configured with 'AdvSendAdvert on;', 'MinRtrAdvInterval 3;', 'MaxRtrAdvInterval 10;', and a 'prefix' block. The prefix for eth0 is '2001:21:1:2103::/64' and for eth1 is '2001:23:1:21E3::/64'. Each prefix block includes 'AdvOnLink on;', 'AdvAutonomous on;', and 'AdvRouterAddr on;'. The configuration is enclosed in curly braces for each interface and terminated with a semicolon.

```
<radvd.conf>
File Edit Search Options Help
interface eth0 {
    AdvSendAdvert on;
    MinRtrAdvInterval 3;
    MaxRtrAdvInterval 10;
    prefix 2001:21:1:2103::/64 {
        AdvOnLink on;
        AdvAutonomous on;
        AdvRouterAddr on;
    };
};
interface eth1 {
    AdvSendAdvert on;
    MinRtrAdvInterval 3;
    MaxRtrAdvInterval 10;
    prefix 2001:23:1:21E3::/64 {
        AdvOnLink on;
        AdvAutonomous on;
        AdvRouterAddr on;
    };
};
```

The interface eth0 got the laptop network prefix, and the eth1 got the dns server prefix. By doing this, laptop and dns server got an automatic assigned ipv6 address because of radvd. In the interfaces of laptop and dnsserver we had to add the following line to make them able to get an automatic ipv6 address:

```
iface eth0 inet6 auto
```

We also did the same thing in router2. This router has a different radvd.conf file:



```
<radvd.conf>
File Edit Search Options Help
interface eth0 {
    AdvSendAdvert on;
    MinRtrAdvInterval 3;
    MaxRtrAdvInterval 10;
    prefix 2001:21:1:21F3::/64 {
        AdvOnLink on;
        AdvAutonomous on;
        AdvRouterAddr on;
    };
};
interface eth1 {
    AdvSendAdvert on;
    MinRtrAdvInterval 3;
    MaxRtrAdvInterval 10;
    prefix 2001:23:1:21E3::/64 {
        AdvOnLink on;
        AdvAutonomous on;
        AdvRouterAddr on;
    };
};
```

The interface eth0 got the webserver network prefix, and the eth1 got the dns server prefix. By doing this, webserver and dns server got an automatic assigned ipv6 address because of radvd. We chose to auto assign the dns server again here, to eliminate the need of choosing what you have to boot first. In the interfaces of webserver and dnsserver we had to add the following line to make them able to get an automatic ipv6 address:

```
iface eth0 inet6 auto
```

Task 4:

1. Why don't we need ARP in IPv6 anymore ?

ARP uses MAC-Addresses to know to which host in a specific network it should send a package. IPv4 addresses were translated to MAC-addresses because there were some IPv4 addresses that could be used multiple times. Using the translated MAC-address, the computer knew where exactly to send the package to.

With IPv6, this is not needed, because there is no such thing as IPv6 addresses that could be used multiple times. There are simply enough IPv6 addresses for that to not be an issue. Because of this, ARP is not needed if you are using IPv6.

2. What is the difference between Stateful and Stateless DHCPv6 ?

A **Stateful** address assignment involves someone keeping track of the *State*. Which is to say, some system exists that provides a log that certain IP addresses were assigned to certain MAC addresses. DHCP / DHCPv6 keeps track of such information.

A **Stateless** address assignment does not keep track of what has or hasn't been assigned. It simply determines what address it should use on a particular network.

In short, **Stateful** requires a DHCP server to have been configured to hand out addresses. While **Stateless** address assignment simply requires the Router/Default-Gateway to understand and implement RFC 4862 (This means stateless address autoconfiguration).