Playing with IPv6 at home (Freenet6)

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Resumen

This is an introduction of how to use IPv6 at home with your ADSL or CABLE internet conection. We are going to explain how to compile the kernel and configure our linux system to be able to use IPv6 in our computers at home. We are going to use IPv6 using configured tunnels with the Freenet6 project. Configured tunnel is a transitional method standardized by the IETF to use IPv6 in coexistence with IPv4 by encapsulating IPv6 packets over IPv4. Freenet6 was the first public tunnel server service and one of the most used in the world to delegate automatically one single IPv6 address to any host already connected to an IPv4 network over configured tunnel.

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1. Introduction

This document was developed for Infosec2003, II Information Security Congress at UniNet. In order to allow all the people to "play"with IPv6 i decide to develop an easy introduction of how to use IPv6 at home with our ADSL or CABLE internet connection. The linux kernel (2.4.x version) support IPv6, and is easy to configure, but we need some special tunnels to use IPv6 with the actual IPv4 model. For this reason we are going to use the Freenet6 project.

2. IPv6-ready kernel. Enable IPv6 in the kernel

We can start checking for IPv6 support in the current running kernel. To check if our running kernel support IPv6 we have to look into */proc/net/* and look if there is a file named *if_inet6*. If this file doesn't exists the IPv6 module isn't loaded. We can try to load the module with the command *modprobe IPv6*. If we receive the message *modprobe: Can't locate module IPv6*, the IPv6 module isn't compiled, so we have to recompile the kernel to add the IPv6 module

2.1. Compile kernel with IPv6

We can use the native IPv6 kernel iomplemetation of the linux kernel or try the USAGI patches (in this document i am going to use the linux kernel implentation, but i recommend you to use the USAGI patches. I wanted to describe the installation of the USAGI patches, but i didn't have got enought time, sorry) You should use kernel series 2.4.x or above (in this example i use 2.4.20), because the IPv6 support in series 2.2.x needs some pathes for ICMPv6 and 6to4 support. We recomend the 2.4.x series. To configure the kernel for IPv6 we have to do these steps (i suppose you know how to compile the kernel): *make config or make menuconfig or make xconfig*

and enable the following options:

```
Loadable module support  --->
    [*] Enable loadable module support
    [ ]   Set version information on all module symbols
    [*]   Kernel module loader

  Note: I have to uncheck the second option, because when i tried to insert
        the module i get unresolved Symbol errors. To avoid these errors
        unset the "Set version information on all module symbols"

Networking options --->
    <M> The IPv6 protocol (EXPERIMENTAL)

  Note: You can select it as a module or directly compiled inside the kernel
```

Save the changes and compile the kernel:

make dep, make bzImage, make modules, make modules_install

Install the new kernel, add a line to lilo.conf, install lilo and reboot (all of you know how to make this ;-)) The next time we reboot we will have an IPv6-ready kernel (if we have compiled IPv6 as module we have to insert this in the kernel: *modprobe IPv6*). To check if our intefaces have an IPv6 direction associated, we can use the command *ifconfig -a* (This tool may be able to support IPv6, we will going to see it in the next subsection)

2.2. net-tools and iproute

From Linux IPv6 HOWTO of Peter Bieringer, http://www.cs-ipv6.lancs.ac.uk/ipv6/systems/linux/bieringer/Linux+IPv6-HOWTO/

2.2.1. net-tools

The net-tools package includes tools like ifconfig and route, which will help us to configure IPv6 on an interface. First of all, we have to check if the net-tools package we have installed support IPv6. We have to look the output of ifconfig -? or route -? and look for something like inet6 or IPv6:

```
/sbin/ifconfig -? 2>& 1|grep -qw 'inet6' && echo "utility 'ifconfig' is IPv6-ready"
```

If we don't see the message *utility 'ifconfig' is IPv6-ready* the net-tools package doesn't support IPv6. We need to upgrade to a more recent version.

We can see the IPv6 address of our network interfaces:

```
ifconfig -a
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:3247 errors:0 dropped:0 overruns:0 frame:0
          TX packets:3247 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1451140 (1.3 MiB)  TX bytes:1451140 (1.3 MiB)

eth0      Link encap:Ethernet  HWaddr 00:05:1C:06:1D:6A
          inet addr:192.168.13.5  Bcast:192.168.13.255  Mask:255.255.255.0
          inet6 addr: fe80::205:1cff:fe06:1d6a/10 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:687058 errors:0 dropped:0 overruns:0 frame:0
          TX packets:762545 errors:0 dropped:0 overruns:0 carrier:0
          collisions:2804 txqueuelen:100
          RX bytes:77998834 (74.3 MiB)  TX bytes:131804041 (125.6 MiB)
          Interrupt:11 Base address:0x6c00

sit0      Link encap:IPv6-in-IPv4
          NOARP  MTU:1480  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:0
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
```

This is first time we use IPv6 and we can see the link local address of our network interface (eth0). These are special addresses and if we use this address as destination the packet would never pass through a router. These addresses are used to communications like:

- anyone else here on this link
- looking for special addresses, like routers

These addresses begin with:

```
fe8x
fe9x
feax
febx
```

but actually only the first range is in use (fe8x).

The host part of the address is computed by converting the MAC address of an interface (if available), with the EUI-64 method, to a unique IPv6 address. If no MAC address is available for this device (virtual devices), something else (the IPv4 address or the MAC address of a physical interface) is used instead. So in our example:

```
fe80::205:1cff:fe06:1d6a/10
```

the value:

```
205:1cff:fe06:1d6a
```

is the host part and computed from the NIC's MAC address:

```
00:05:1C:06:1D:6A
```

Now we only have this IPv6 address in this network interface. When we setup our tunnel with Freenet6, we will have a global address provided by the Freenet6 server (in our case it will be a 6bone test addresses. It will begin with 3ffe prefix).

2.2.2. iproute

The iproute package of Alexey N. Kuznetsov allow the networks configuration through the netlink device. With this tool we have more functionality than net-tools provide. First we have to see if the version installed support IPv6:

```
/sbin/ip 2>&1 |grep -qw 'inet6' && echo "utility 'ip' is IPv6-ready"
```

If the package doesn't support, update to a more recent version.

If we want to show the address of the network interfaces, we have to execute the following command:

```
ip -6 addr show
1: lo: <LOOPBACK,UP> mtu 16436 qdisc noqueue
inet6 ::1/128 scope host
2: eth0: <BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast qlen 100
inet6 fe80::205:1cff:fe06:1d6a/10 scope link
```

We can see the loopback interface an our network interface card. We can see, as with the ifconfig command, that our inteface has the link local address associated. And finally we can see the ipv6 route table:

```
ip -6 route
fe80::/10 dev eth0  proto kernel  metric 256  mtu 1500 advmss 1440
ff00::/8 dev eth0  proto kernel  metric 256  mtu 1500 advmss 1440
default dev eth0  proto kernel  metric 256  mtu 1500 advmss 1440
```

3. Freenet6 Project

Now we have to configure our tunnel with Freenet6 to use IPv6 over IPv4 In the web page of this project (http://www.freenet6.net) we can read:

```
"Freenet6's TSP is a new initiative launched by Viagénie, a private company
in Canada involved in IPv6 since 1996, to facilitate a faster deployment of
an Internet IPv6.  Internet is world-wide deployed over IPv4, therefore this
project has the main goal of deploying IPv6 at a larger scale by using
configured tunnels.
 Configured tunnel is a transitional method standardized by the IETF to use
IPv6 in coexistence with IPv4 by encapsulating IPv6 packets over IPv4. Any
host already connected to Internet with IPv4 and having an IPv6 stack could
establish link to Internet IPv6."
```

If our ISP doesn't provide us with IPv6, we have to use a "third party provider", like Freenet6 that allow to create configured tunnels to use IPv6 over IPv4.

3.1. Tunnel Setup Protocol

FREENET6's TSP is a new model based on a client/server approach, a protocol is used to request a single IPv6 address to a full IPv6 prefix from a client to a tunnel server. We can use Freenet6 as an anonymous user or as an authenticated user:

- Anonymous user of Freenet6 will not have a static IPv6 assigned to them, the address will change when we run again the TSP client and Freenet6 provides one single IPv6 address to a client without authentication. If the IPv4 address changes then the IPv6 assigned will change also. Anonymous tunnels will expire 5 days after the last TSP client connection.
- If we are authenticated users Freenet6 provides one single address and a /48 IPv6 prefix to a client after a successful authentication to the server. If we have a dynamic IPv4 address, we will be able to update our tunnel each time our IPv4 changes by running the TSP client and preserving the IPv6 address. Authenticated tunnels will expire 3 months after the last TSP client connection.

3.2. Configuring Freenet6

First, we have to download the TSP client from http://www.freenet6.net. Then compile and install it. If we want to be an authenticated user, we have to create our account in the web form http://www.freenet6.net/cgi-bin/new_account.pl, enter an userid and an email address (to receive the password that Freenet6 will randomly be generated). Now we are going to configure the tspc.conf file.

3.2.1. tspc.conf

When we install the tsp client, we have a tspc.conf file. We have to modufy some prameters:

```
client_v4=OUR_REAL_IPv4_IP
```

Here we have to put the real ip of our ADSL/CABLE internet connection.

We need to specify the logical interface name that will be used to establish the configured tunnel (IPv6 over IPv4).

Under any Linux platform including the USAGI stack:

```
if_tunnel=sit1
```

Add our userid and password to create the tunnel as authenticated user:

```
userid=USERID
passwd=PASSWORD
```

To configure our system and our interface, TSP client will run a configuration script, depending on the OS. By default, when we install the TSP client it detect the system and select this parameter:

```
template=linux
```

If template is set to checktunnel (template=checktunnel) only displays the values passed to the template.

The next variables describes parameters to use in order to request /48 or /64 IPv6 prefixes to the server. Before requesting an IPv6 prefix, it is mandatory to have valid userid and password in the server.

If we want to use our computer as an IPv6 router, we have to informs the template to enable the ipv6_forwarding on your computer:

```
host_type=router
```

with this command the tscp client will enable the ipv6_forwarding in our computer.

We can request a /48 or a /64 IPv6 prefixes to the server. The /48 is recommanded for large site with multiple subnets while the /64 is for network with only one subnet. We will select this with the following parameter:

```
prefixlen=64
or
prefixlen=48
```

If we want all IPv6 nodes connected on the same subnet will be able to autoconfigure their IPv6 addresses by themselves, we have to enable automatically Router Advertisement on a network interface of the computer. With this option, one /64 of the prefix gotten will be advertised on a network interface. The syntax is:

```
if_prefix=eth0
```

NOTE: We have to have the radvd binary installe in our system. (Debian GNU/Linux users: apt-get install radvd)

And finally the dns_server parameter. This parameter is used to specify the DNS servers that should be used for reverse DNS delagation of the prefix allocated. Only if we have a dns server:

```
dns_server=NAME_NAMESERVER1:NAME_NAMESERVER2
```

NOTE: Never use an ip address as a DNS server name.

You can see more options in the tscp.conf man page.tscp.conf(5)

I have to modify thing in the template used by the TSP client (in my case the file template/linux.sh):

```
Search te text "Default route" and Add the line:
ExecNoCheck $route -A inet6 del 2000::/3 2>/dev/null # delete old 2000::/3 route
after the line:
ExecNoCheck $route -A inet6 del ::/0 2>/dev/null # delete old default route
```

If we don't delete the old 2000::/3 route, if we relaunch the TSP client, it will fail when it try to add this route again.

Other made changes are about Router Advertisement:

First, create a user to execute radvd.

Then update the line:

```
Exec $rtadvd -u radvd -C $rtadvdconfigfile
```

to

```
Exec $rtadvd -u radvd -p /var/run/radvd/radvd.pid -C $rtadvdconfigfile
```

We need to create the directory /var/run/radvd/ and chmod this to the user radvd.

3.3. Run tspc

Once we have installed the client and make the changes to the confige file, we can run tspc:

```
PATH_TO_FREENET/bin/tspc -vf PATH_TO_CONF_FILE/tspc.conf
```

If nothing happen and all has work well, now we will have a new interface sit1

```
5: sit1@NONE: <POINTOPOINT,NOARP,UP> mtu 1480 qdisc noqueue
inet6 fe80::c0a8:d05/10 scope link
inet6 3ffe:b80:3:9678::2/128 scope global
inet6 fe80::a00:5/10 scope link
```

and we will have our network inteface (Ej: eth0) with our new IPv6 address assigned:

```
2: eth0: <BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast qlen 100
    inet6 fe80::205:1cff:fe06:1d6a/10 scope link
    inet6 3ffe:b80:3:23b:1::1/64 scope global
```

We have a 6bone test addresses. Let's try to probe:

```
ping6 www.kame.net
bombero:/home/ismak# ping6 www.kame.net
PING www.kame.net(2001:200:0:4819:203:47ff:fea5:3085) 56 data bytes
64 bytes from 2001:200:0:4819:203:47ff:fea5:3085: icmp_seq=1 ttl=54 time=607 ms
64 bytes from 2001:200:0:4819:203:47ff:fea5:3085: icmp_seq=2 ttl=54 time=626 ms

--- www.kame.net ping statistics ---
2 packets transmitted, 2 received, 0% loss, time 1001ms
rtt min/avg/max/mdev = 607.225/617.012/626.800/9.818 ms
```

Congratulations!! we are connected to the 6bone ;-)

You can try to connect to the web page of kamei (you have to use an IPv6 compatible web browser, like Mozilla), to see the dancing kame (we will see an animated turtle only if we are connecting with IPv6).

NOTE: Another example: www.ipv6.elmundo.es

3.4. Reverse DNS for prefix

If we have add the option dns_server=fqdn.of.your.dns.server[:other-ns] in out tspc.conf, we can do the following steps to delegate the Reverse DNS to our dns server.

Reverse DNS allows host to map IP addresses to hostnames.

To delegate the reverse DNS of our /48 or /64 to our dns server, we have to do the following:

- Edit our named.conf and add the following line (you have to change the value 1.2.3.4 with you real values)

```
zone "4.3.2.1.0.8.b.0.e.f.f.3.ip6.int" {
   type master;
   file "reverse-3ffe-b80-1234.ip6.int";
   allow-transfer {none;};
};
```

- Create the reverse-3ffe-b80-1234.ip6.int file (adjust the values to your real case) and fill it with something like this:

```
$TTL 3D

@       IN      SOA     ipv6.nowhere.net. postmaster.nowhere.net. (
                           2001110500  ; serial
                           3H          ; refresh
                           15M         ; retry
                           1W          ; expiry
                           1D )        ; mininum
        IN      NS      ns.nowhere.net.

;
;---------------------------------------,
; network part /64   | Host part 64 bits |
;--------------------|-------------------'
; 3ffe:0b80:1234:0001:0000:0000:0000:0001

;       --------------------------------,
;  Your Network| Your prefix (48 bits) |
;       -------|-------|-------|-------|
$ORIGIN 1.0.0.0.4.3.2.1.0.8.b.0.e.f.f.3.ip6.int.

; Hosts of your network
;------------------------------
; 64 bit host address part.
;------|-------|-------|-------
1.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0   in ptr  first.ipv6.nowhere.net.

; End of zone
```

- Restart bind and check if there is some error in the log file.
- Try it. Teste the delegation:

```
dig 4.3.2.1.0.8.b.0.e.f.f.3.ip6.int NS
```

and now test your dns:

```
dig 4.3.2.1.0.8.b.0.e.f.f.3.ip6.int SOA
```

If it works well, reverse DNS should now be delegated to your server.

Ok, that's all. Now you can start to play with IPv6, try if your tools are IPv6 compatible and amuse with it.

4. Bibliography

- Linux IPv6 HOWTO, Peter Bieringer
- Linux Kernel Documentation
- Freenet6 Project

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