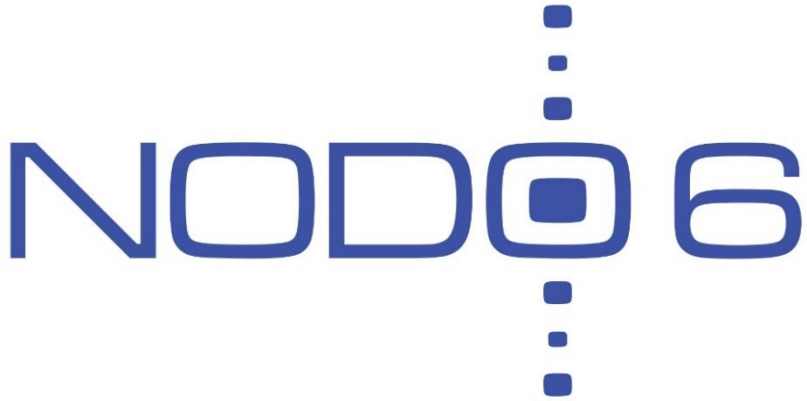

IPv6 Laboratory

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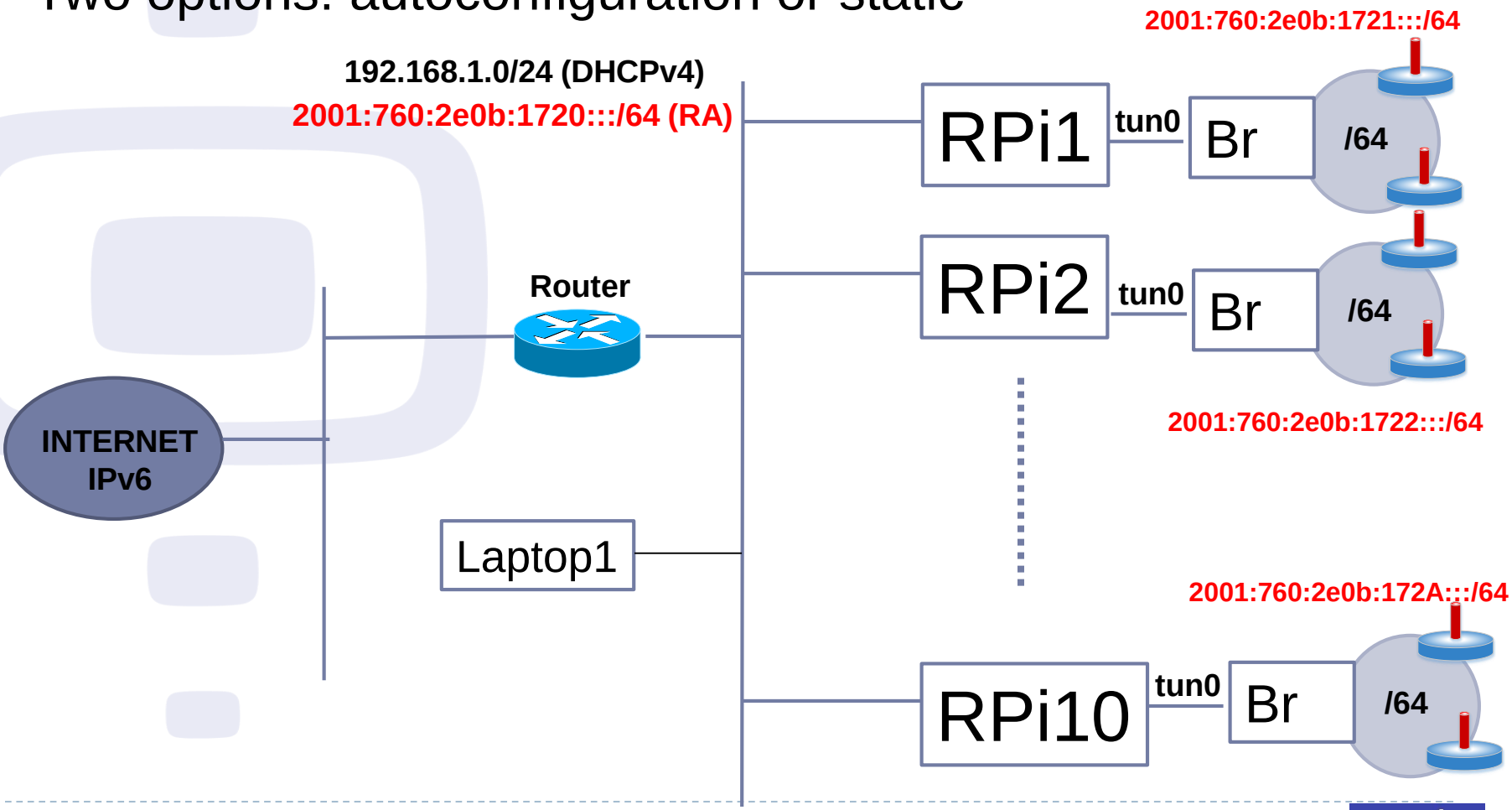
Contents

Objectives

- Use IPv6 from RPi (with Linux/Ubuntu)
- Understand an IPv6 LAN: addresses, prefix, autoconfiguration or not, gateway, DNS
- Use real-world services over IPv6

Lab Topology (I)

- Two type of devices on the same LAN: RPi & Laptops
- Two options: autoconfiguration or static



Lab Topology (II)

- Check everything is connected: mouse, keyboard, monitor and network
- Plug RPi to turn on
- User / password: pi / walc2015
  - Enters in text mode
- Run windows environment:

```
startx
```

- Turn off RPi:

```
sudo halt
```

IPv6 Configuration (I)

- IPv6 in Linux: supported since kernel 2.4.x
- Now it's part of the kernel
- Enabled by default (most common)
- Sometimes it's a module you have to load (lsmod)
- Useful commands:
  - **ifconfig**: to check IPv6 configuration of network interfaces
  - **ping6** <hostname-with-IPv6>|<IPv6-add>|[-I <interface>] <link-local-ipv6address>
  - **traceroute6** -n < hostname-with-IPv6 >|< IPv6-add>
  - **tracepath6** -n <hostname-with-IPv6 >|< IPv6-add>
  - **tcpdump**: capture packets on an interface
- Two sets of tools to configure/check IPv6:

1. iptools (recommended)
2. ifconfig + route

Packages and Commands

- Update packages information:

```
sudo apt-get update
```

- Check the package that owns a command:

```
apt-cache search <command-name>
```

- Install package:

```
sudo apt-get install <package-name>
```

- Examples of: commands -> packages:
  - dig, nslookup, host -> dnsutils
  - traceroute -> traceroute
  - traceroute6 -> iputils-tracepath
  - tcpdump -> tcpdump
- Exercise: Install the right package containing **tracepath6**

IPv6 Configuration (II)

ifconfig

```
eth0  Link encap:Ethernet  HWaddr 00:E0:81:05:46:57
      inet addr:192.168.88.3  Bcast:192.168.88.255  Mask:255.255.255.0
      inet6 addr: fe80::2e0:81ff:fe05:4657/64 Scope:Link
      inet6 addr: 2001:760:2e0b:1728::3/64 Scope:Global
      UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
      RX packets:2010563 errors:0 dropped:0 overruns:0 frame:0
      TX packets:1700527 errors:0 dropped:0 overruns:2 carrier:0
      collisions:0 txqueuelen:100
      RX bytes:205094215 (195.5 Mb)  TX bytes:247063610 (235.6Mb)
      Interrupt:11 Base address:0xe000 Memory:f8201000-f8201038
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:1675838 errors:0 dropped:0 overruns:0 frame:0
      TX packets:1675838 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:0
      RX bytes:659846244 (629.2 Mb)  TX bytes:659846244 (629.2 Mb)
```

IPv6 Configuration (III)

- Ping examples:

```
ping6 ::1
PING ::1(::1) 56 data bytes
64 bytes from ::1: icmp_seq=1 ttl=64 time=0.047 ms
64 bytes from ::1: icmp_seq=2 ttl=64 time=0.039 ms
64 bytes from ::1: icmp_seq=3 ttl=64 time=0.042 ms
64 bytes from ::1: icmp_seq=4 ttl=64 time=0.020 ms
--- ::1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.020/0.037/0.047/0.010 ms

ping6 -I eth0 fe80::2e0:81ff:fe05:4617
PING fe80::2e0:81ff:fe05:4617(fe80::2e0:81ff:fe05:4617) from ::1 eth0:
56 data bytes
64 bytes from fe80::2e0:81ff:fe05:4617: icmp_seq=1 ttl=64 time=0.056 ms
64 bytes from fe80::2e0:81ff:fe05:4617: icmp_seq=2 ttl=64 time=0.055 ms
64 bytes from fe80::2e0:81ff:fe05:4617: icmp_seq=3 ttl=64 time=0.048 ms
64 bytes from fe80::2e0:81ff:fe05:4617: icmp_seq=4 ttl=64 time=0.128 ms
--- fe80::2e0:81ff:fe05:4657 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 2997ms
rtt min/avg/max/mdev = 0.048/0.071/0.128/0.034 ms
```

IPv6 Configuration (IV)

- Add IPv6 address

```
/sbin/ip -6 addr add <ipv6address>/<prefixlength> dev <interface>
/sbin/ifconfig <interface> inet6 add <ipv6address>/<prefixlength>
```

- Delete IPv6 address

```
/sbin/ip -6 addr del <ipv6address>/<prefixlength> dev <interface>
/sbin/ifconfig <interface> inet6 del <ipv6address>/<prefixlength>
```

- See neighbor cache

```
ip -6 neigh show [dev <device>]
```

- Add an entry to the neighbor cache

```
ip -6 neigh add <IPv6 address> lladdr <link-layer address> dev
  <device>
```

- Delete an entry in the neighbor cache

```
ip -6 neigh del <IPv6 address> lladdr <link-layer address> dev
  <device>
```

IPv6 Configuration (V)

- Check IPv6 routes

```
/sbin/ip -6 route show [dev <device>]
/sbin/route -A inet6
```

- Add route through a gateway

```
/sbin/ip -6 route add <ipv6network>/<prefixlength> via <ipv6address> [dev
  <device>]
/sbin/route -A inet6 add <ipv6network>/<prefixlength> gw <ipv6address> [dev
  <device>]
```

- Delete route through a gateway

```
/sbin/ip -6 route del <ipv6network>/<prefixlength> via <ipv6address> [dev
  <device>]
/sbin/route -A inet6 del <network>/<prefixlength> [dev <device>]
```

- Add route through an interface

```
/sbin/ip -6 route add <ipv6network>/<prefixlength> dev <device> metric 1
/sbin/route -A inet6 add <network>/<prefixlength> dev <device>
```

IPv6 Configuration (VI)

- Delete route through an interface

```
# /sbin/ip -6 route del <ipv6network>/<prefixlength> dev <device>
# /sbin/route -A inet6 del <network>/<prefixlength> dev <device>
```

- Default route is written as `default` or `::/0` or `2000::/3`

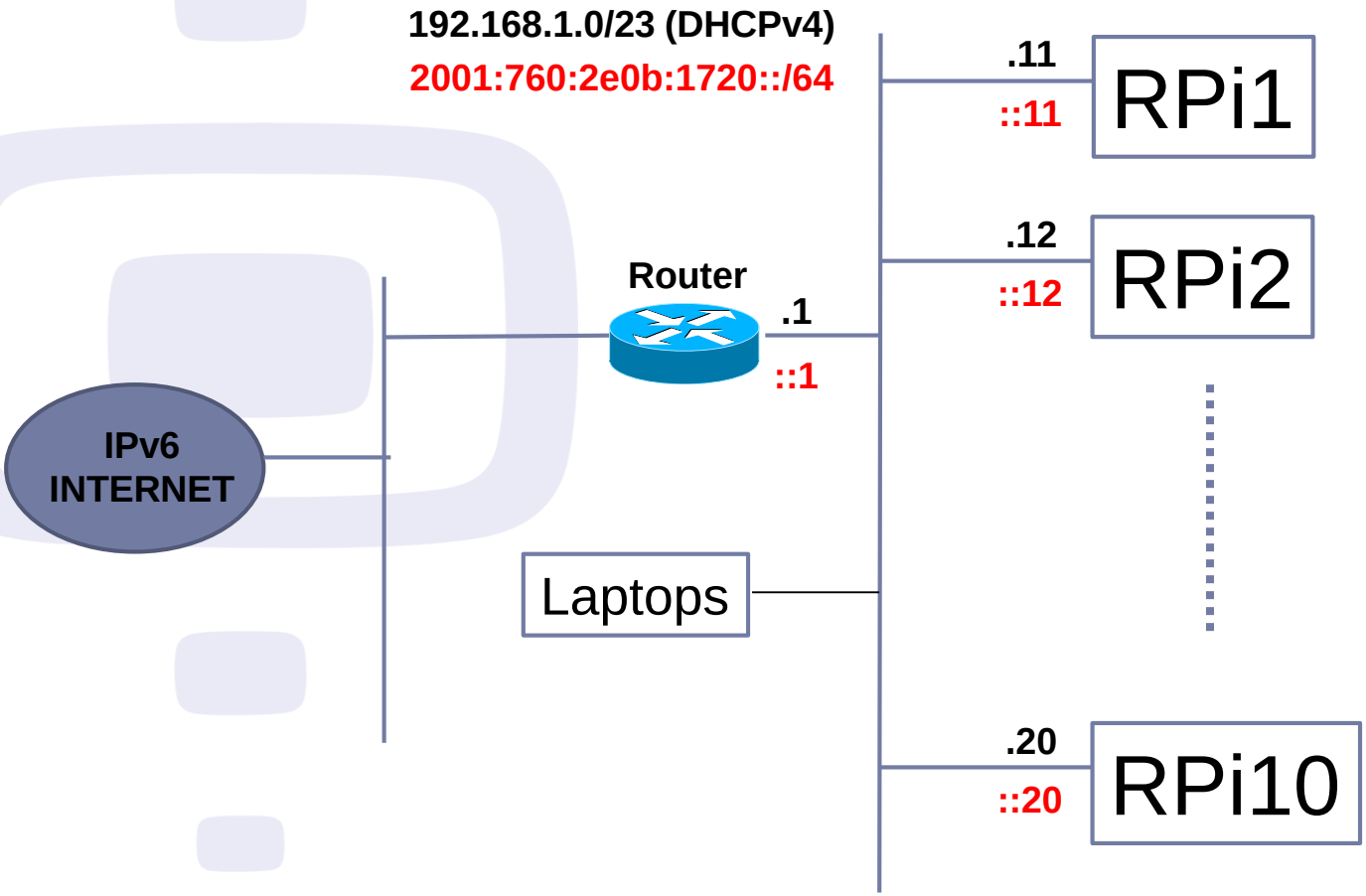
Exercises (I)

1. Write the name of the interfaces with IPv6 enabled.
2. Write the IPv6 addresses of each one.
3. Identify the type of the addresses.

4. Check your neighbor cache
5. Ask other groups about their link-local and global IPv6 addresses. Try to ping them.
6. Check again your neighbor cache, ¿do you see something new?

Exercises (II)

- Configure static IPv6 addresses as shown



Exercises (III)

7. Check your IPv6 routes.
8. What's your IPv6 gateway? Write it. ¿What type of address is it? ¿How do you think it has been configured?

9. Using commands, configure the global IPv6 address assigned to your RPi
10. Using commands configure the default route towards the IPv6 router in our lab
11. Check your IPv6 routes again
12. What's your IPv6 gateway? Write it. ¿What type of address is it? ¿How do you think it has been configured?

IPv6 Configuration (VII)

- Permanent configuration in Debian/Ubuntu:
  - Edit **/etc/network/interfaces** for network, IPv4 and IPv6:

```
iface eth0 inet6 static
        address 2001:db8:1:A::1
        netmask 64
        gateway 2001:db8:1234:5::1
```

  - Edit **/etc/resolv.conf** for DNS servers, IPv4 and IPv6 :

```
nameserver 2001:4860:4860::8888
nameserver 2001:4860:4860::8844
```

- ADD the IPv6 configuration, leave the IPv4 one
- Reload network configuration:

1. `sudo /etc/init.d/networking restart`
2. `sudo ifdown eth0`
   `sudo ifup eth0`

Exercices (IV)

13. Using commands, delete the address and the default route added before
14. Configure permanently the global IPv6 address assigned to the RPi
15. Configure permanently the default route towards the lab IPv6 router
16. Check again your IPv6 routes
17. What's your IPv6 gateway? Write it. ¿What type of address is it? ¿How do you think it has been configured?

Use IPv6 (I)

- Check IPv6 services running on your Linux:

```
# netstat -tan
   Active Internet connections (servers and established)
   Proto Recv-Q Send-Q Local Address  Foreign Address      State
   ...
   tcp6   0      0      :::80         :::*               LISTEN
   ...

# netstat -uan
```

- SSH to RPi
  - From Linux use the command line: ssh

    For user/password on host 2001:db8:1:2::A use

```
#ssh user@2001:db8:1:2::A
password
```

Use IPv6 (II)

- DNS resolution in Linux: **dig / host / nslookup**
- To resolve www.example.com on 2001:db8:1::53 server

```
# dig any www.example.com @2001:db8:1::53
# host -t ANY www.example.com 2001:db8:1::53
# host -t AAAA www.example.com 2001:db8:1::53
```

- You can use different parameters with dig:
  - **any/a/aaaa/mx/ns** to indicate any type of information related with the domain name or specific IPv4 (a), IPv6(aaaa), mail exchange (mx) or name server (ns) information
  - **+short** to have a short answer, not so verbose
  - **+trace** to see the resolution path through different servers
- You can use different parameters with host:
  - -t any/aaaa/a/mx/ns

Exercises (V)

18. What are your IPv6 DNS servers?
19. Configure the following public IPv6 DNS servers:

```
nameserver 2001:4860:4860::8888
nameserver 2001:4860:4860::8844
```

20. Use them to resolve (take note of the addresses):
    - www.facebook.com
    - www.google.com
    - www.wikipedia.org
    - www.youtube.com
    - www.yahoo.com
    - maps.google.com
    - docs.google.com

Exercises (VI)

21. Ping the IPv4 and IPv6 addresses of the sites mentioned before.
22. Traceroute the IPv4 and IPv6 addresses of the web sites mentioned before.
23. Check services running on your host:
    - What IPv6 services do you see running on with TCP?
    - What IPv6 services do you see running on with UDP?
24. SSH to the IPv6 address of another RPi

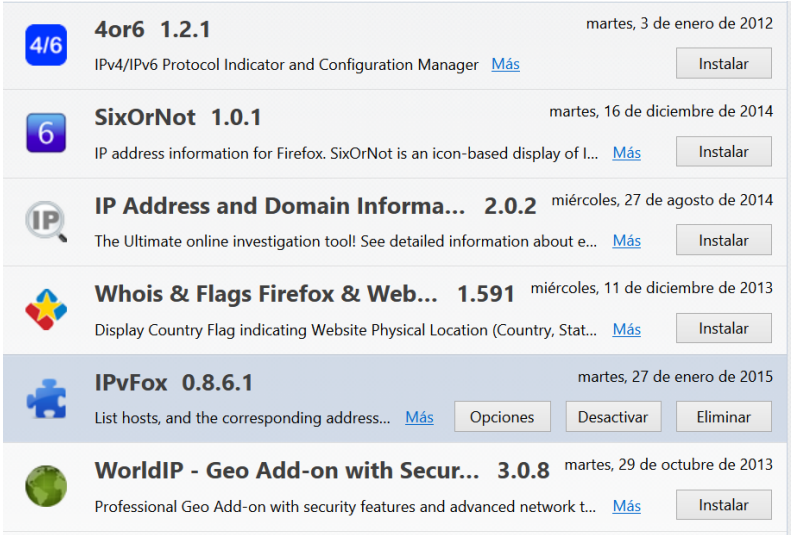
Thanks!

- Questions?

- Contact: info@nodo6.com / training@nodo6.com
- http://www.nodo6.com
- https://www.linkedin.com/company/nodo6
- https://twitter.com/NODO6_RRSS

IPv6 Plugins on Browsers: Firefox (I)

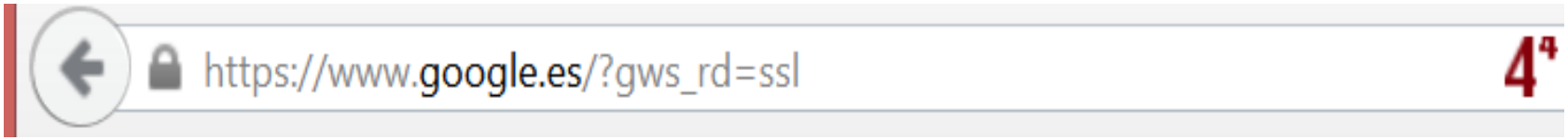
- There are a various Firefox plugins related with IPv6, in order of preference:
  - **IPvFox** (0.8.6.1 from 6/1/2015)
  - **SixOrNot** (1.0.1 from 16/12/2015)
  - 4or6 (1.2.1 from 3/1/2012)
- To look for plugins in Firefox:
  - Tools -> Plugins -> Search: ipv6



IPv6 Plugins on Browsers: Firefox (II)

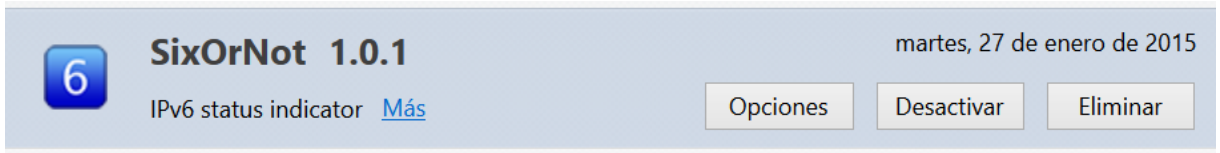
- **IPvFox** could be directly installed clicking on ‘Install’.

- From now on in the navigation bar there will be an indicator of the protocol version used to access the contents, for example, with IPvFox:

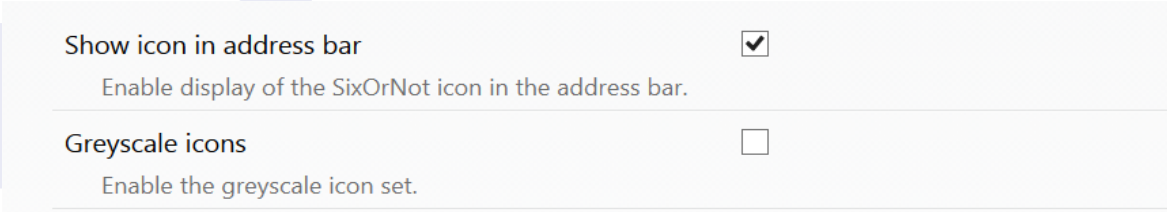


IPv6 Plugins on Browsers: Firefox (III)

- For **SixOrNot**, after installing it, you have to enter into Options:



- And activate “Show Icon in the address bar”:



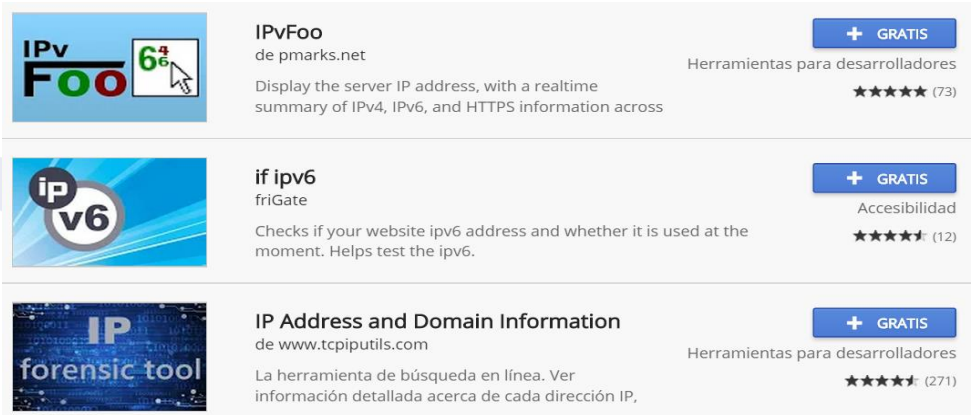
- Icon in navigation bar showing info about domain names (IPv4, IPv6 or both). Color indicate IPv4 (red) or IPv6 (green).

IPv6 Plugins on Browsers: Chrome (I)

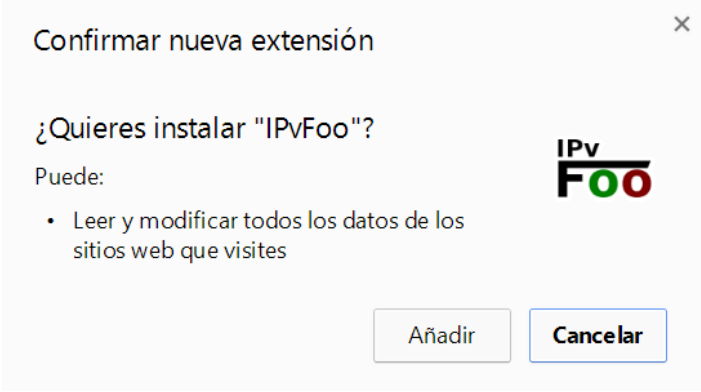
- There are some extensions for Chrome related with IPv6, in order of preference::
  - **IPvFoo** (version 1.31 from 18/1/2015)
  - **IP Address and Domain Information** (version 3.33 from 26/8/2014)
  - if ipv6 (version 1.2 from 10/9/2013)
- Look in the “Extensions” menu or write in the address bar “chrome://extensions/”. Once there, click in “Obtain more extensions”
- Write ipv6 in the upper left search box and press ENTER

IPv6 Plugins on Browsers: Chrome (II)

- Click the blue button “+ FREE” to install the extension

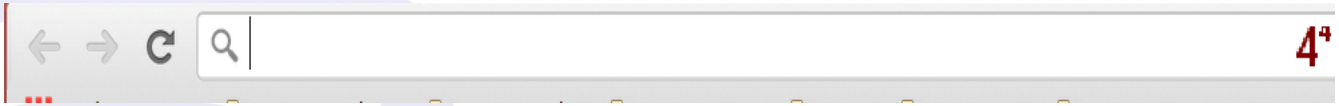


- It ask to confirm we want to give the required permissions, click in “Add”:



IPv6 Plugins on Browsers: Chrome (III)

- **IPvFoo** icon in the address bar indicate if you can access to the contents of the web page using IPv4, IPv6 or both.



- Clicking the **IP Address and Domain Information** icon shows detailed information about the domain and the IPs: