CSNB113: System Administration

-

11th Topic: Connectivity – "Networking"

Getting Connected

Until now, we haven't done much on the network. We have barely downloaded a few files, using `wget`.

Before connecting to other machines, or offering our own services to the world, we need to understand about the basic theories on links on the network.

1. Addressing – When you want to send something (when your grandparents wanted to send something), the postal service is always a possibility. You put the message into an envelope, then you add a ***recipient's address***, as well as a ***sender's address*** on the envelope.

The postal services will use this address to forward it into the direction of the recipient:

Mr. Recip

Some Street, 37

CC-54321 SomeCity

Another Country

Here we see a hierarchical address: There are a number of levels: country – city – street – house number – person.

It would not be feasible to just write "Mr. Recip" on the envelope, because there might be a number of Mr. Recip-s residing somewhere, anywhere, globally. And nobody would know all of them. So the handler only needs to look at his / her level: A different country: send to that country (disregard the rest). A fifferent city, same country: send it to another city; and disregard street, country, name. Same place, same house: pass it to the letter-box of Mr. Recip; don't bother about street, house number, city, country.

Getting Connected - Phone

The same happens when you consider a phone number, by the way:

00-91-22-66933366

Can you recognize the hierarchies?
How many hierarchies are there?

00-60-12-1234567

Can you recognize the hierarchies?
How many hierarchies are there?

What is so special about the '12'?

Getting Connected - Network

For network addresses, we have a ***hierarchy of two levels*** only:

network
node

When the current addressing scheme was proposed, processing was expensive, storage was expensive. Each and every Byte was costly. Therefore, a combination-addressing was invented, where the address contains both parts of the addressing scheme. It is called Ipv4 (Internet Protocol version 4). There are 4 Bytes only. When one represents those 4 Bytes as decimal numbers, one usually adds a dot inb etween to distinguish the 4 Bytes.
Example: 143.87.4.196

In reality, this address consists of these 4 Bytes:

```
10001111  01010111  00000100  11000100 ← address (binary)
  143        87        4        196    ← address (decimal)
```

The difficult part: which bits define the network address, which define the node address?
Difficult: the answer depends. On what?
The ***netmask***!:

```
10001111  01010111  00000100  11000100 ← address
11111111  11111111  11111111  00000000 ← netmask (binary)
  255       255       255         0    ← netmask (decimal)
```

Network and Node

```
10001111  01010111  00000100  11000100 ← address
11111111  11111111  11111111  00000000 ← netmask (binary)
  255       255       255         0    ← netmask (decimal)
```

With this netmask, the network address is 143.87.4, and the address of the node on that network is 196.

The command to view / set the address is almost identical on *nix and Windows: it is

`ifconfig` ← *nix

`ipconfig` ← Windows

`ifconfig` stands for **i**nter**f**ace **config**uration, while `ipconfig` stands for **ip config**uration

On all platforms, the commands show the configuration of **all** interfaces.

The major differences:

- on Windows, the description is *verbose*, that means in (many) words
- on Linux, the interfaces are distinguished by the **functionality**: eth(ernet), wlan (WiFi – wireless LAN), etc.
- on Unix, the interfaces are distinguished by the **manufacturer** of the interface (chip): xl (3Com), fxp (Intel)

Configuration examples – Windows and Linux

```
> ipconfig

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . : hsd1.ut.comcast.net.
IP Address. . . . . . . . . . . . : 192.168.201.245
Subnet Mask . . . . . . . . . . . : 255.255.255.0
Default Gateway . . . . . . . . . : 192.168.201.1

$ ifconfig
eth0      Link encap:Ethernet  HWaddr 00:26:18:02:ae:52
          inet addr:192.168.116.91  Bcast:192.168.116.255  Mask:255.255.255.0
          inet6 addr: fe80::226:18ff:fe02:ae52/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:773705 errors:0 dropped:0 overruns:0 frame:0
          TX packets:695983 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:596783557 (596.7 MB)  TX bytes:339458556 (339.4 MB)
          Interrupt:43 Base address:0x8000
```

Configuration examples - Unix

```
$ ifconfig
fxp0: flags=8802<BROADCAST,SIMPLEX,MULTICAST> mtu 1500
        lladdr 00:08:02:86:3b:97
        priority: 0
        media: Ethernet autoselect (none)
        status: no carrier
xl0: flags=8a43<UP,BROADCAST,RUNNING,ALLMULTI,SIMPLEX,MULTICAST> mtu 1500
        lladdr 00:60:97:69:f8:88
        priority: 0
        groups: egress
        media: Ethernet autoselect (100baseTX full-duplex)
        status: active
        inet 172.16.0.4 netmask 0xffffff00 broadcast 172.16.0.255
        inet6 fe80::260:97ff:fe69:f888%xl0 prefixlen 64 scopeid 0x2
```

Windows – complete configuration

```
>ipconfig /all

Windows IP Configuration

    Host Name . . . . . . . . . . . . : computer
    Primary Dns Suffix . . . . . . . :
    Node Type . . . . . . . . . . . . : Hybrid
    IP Routing Enabled. . . . . . . . : No
    WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Local Area Connection:

        Host Name . . . . . . . . . . : host.grape-info.com
        DNS Servers . . . . . . . . . : 10.1.0.200
        Description . . . . . . . . . : 3Com 3C90x Ethernet Adapter
        Physical Address. . . . . . . : 00-60-08-3E-46-07
        DHCP Enabled. . . . . . . . . : Yes
        Autoconfiguration Enabled . . : Yes
        IP Address. . . . . . . . . . : 192.168.0.112
        Subnet Mask . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . : 192.168.0.2
        DHCP Server . . . . . . . . . : 192.168.0.1
        Primary WINS Server . . . . . : 192.168.0.1
        Secondary WINS Server . . . . : 192.168.0.3
        Lease Obtained. . . . . . . . : Wednesday, September 02, 1998 10:32:13 AM
        Lease Expires . . . . . . . . : Friday, September 18, 1998 10:32:13 AM
```

Configuration examples - set

Display details of all interfaces, including **disabled** interfaces

```
$ ifconfig -a
```

Disable an interface

```
$ ifconfig eth0 down
```

Enable an interface

```
$ ifconfig eth0 up
```

Assign 192.168.2.2 as the IP address for the interface eth0

```
$ ifconfig eth0 192.168.2.2
```

Change Subnet mask of the interface wlan0

```
$ ifconfig wlan0 netmask 255.255.255.0
```

Assign ip-address and netmask at the same time to interface eth0

```
$ ifconfig eth0 192.168.2.2 netmask 255.255.255.0
```

localhost

```
$ ifconfig
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host

$ ifconfig
lo0: flags=8049<UP,LOOPBACK,RUNNING,MULTICAST> mtu 33200
        priority: 0
        groups: lo
        inet 127.0.0.1 netmask 0xff000000
```

This is another type of IP-address; the so-called ***localhost***.

The localhost is often known as ***local loopback***. This is because it allows a machine to talk to itself, even if there is no network connected. This is used for test purposes, for example.

To be noted: the IP-address of **all** and any localhost is always and on **all** machines 127.0.0.1; with a netmask of 255.0.0.0.

If you don't want to see it, and you know which interface is connected to the network, of course, you can always request that interface name:

```
$ ifconfig eth0

$ ifconfig lo

$ ifconfig lo0
```

MAC-Address

```
$ ifconfig eth0

eth0   Link encap:Ethernet  HWaddr 00:2D:32:3E:39:3B
inet addr:192.168.2.2  Bcast:192.168.2.255  Mask:255.255.255.0


xl0: flags=8a43<UP,BROADCAST,RUNNING,ALLMULTI,SIMPLEX,MULTICAST> mtu 1500
        lladdr 00:60:97:69:f8:88
```

There is yet another address, the ***MAC-address***. MAC stands for *Media Access Control*, and is a ***unique hardware*** address.

What does this mean? It means that it is an address burnt into the hardware during production. The first 6 (Hexadecimal) numbers identify the **manufacturer**, the last 6 (Hexadecimal) numbers constitute a **serial number**.

While this hardware address is burnt into the interface and cannot be changed, the IP-address can be modified (see earlier slides). So, setting the IP-address is possible, and actually desired, while the MAC-address is persistent.

References

- http://www.thegeekstuff.com/2009/03/ifconfig-7-examples-to-configure-network-interface/
- http://www.computerhope.com/ipconfig.htm
- http://www.windowsnetworking.com/articles_tutorials/w2ktcpip.html