LESSON E14_EN. INTERNET PRACTICAL INTEGRATION. CONNECTIONS, TYPE OF CONNECTIONS.

Studying this lesson you will learn:
 You will acquire information regarding main parameters settings for a TCP/IP host and learn how to configure them in Linux and Windows operative systems.

CONTENT OF THE LESSON
1. How to create network connections.
2. How to configure TCP/IP.
3. PPP - Point to Point Protocol.

LEARNING OBJECTIVES:
After learning this lesson you will be able to:
 know main Internet connection types
 know IP parameters configuration procedure in Linux operative systems
 know IP parameters configuration procedure in Windows operative systems

1. How to create network connections

Up to many years ago accessing Internet was possible only by modems with a rate of the order of tens of Kbps.

However the Internet has recently become more than a multimedia resource and web sites provide audio and video downloads and advanced services that make 56 Kbps almost useless. Because of this tendency there has been the development of a large number of new technologies able to provide users with different types of accesses in terms of bandwidth.

The types of Internet connections depends on three main aspects:
- **availability**: many technologies are still not available everywhere: (i.e. ADSL, wireless);
- **cost**: a bandwidth increase implies a cost increase.
- **host number**: it is necessary to define the number of hosts that we want to connect to the Internet;
- **access:** it is necessary to identify some features of the access such as connectivity period, download and upload rate etc.

In the following we will examine some of the most common Internet access types trying to briefly point out features, advantages and disadvantages.

Remote connections:

It is the most widespread type of connection to the Internet, daily used by millions of users. Remote connections are realized by a modem connected to a telephone socket; the access is made dialling a phone number (preferably a local green number not to pay additional costs) that belongs to an ISP (Internet Service Provider). The access is granted when an authentication based on userID and password is done.

Main advantages are:
1. telephone lines are almost everywhere;
2. low costs, related to hardware buying;
3. the existence of a high number of ISPs that provide many services and options to be chosen;

Anyway there are even disadvantages such as:
1. low bandwidth, that usually cannot go over 56 Kbps and which is not enough for several services;
2. possibility of finding the ISP busy in case of users overload;

3. telephone line busy during connection period.

DSL Connections (Digital Subscriber line)

It is a broadband technology that has become more and more popular in these years. It can be used only owning a DSL modem. As for other connections the service exploits public telephone lines but requires an activation by the service provider.

Most of DSL data services use an asymmetric configuration ADSL that divides the telephone line into three channels: voice, data transmission from the computer, data transmission to the computer.

The channel used to receive data has a higher rate than the transmission one because in most cases downloaded data are more than uploaded ones. However other types of service has a symmetric connection, SDSL, that provides the same rate to the upload and to the download channel.

Advantages of this type of access are:

1. quite low costs due to many offers that provides supply to users;
2. good rate guaranteed by connections going from few hundreds of Kbps to many Mbps;
3. connection always available;
4. possibility of making a connection to the Internet and a phone call at the same time.

Disadvantages:
1. activation of the service (from an ISP) required;
2. limited zones in which the service is available.

Satellite connections

Since 2000 there has been the diffusion of Internet connection services by satellite links.

This kind of connections is considered as an alternative to DSL accesses, anyway problems related to delays and service suspensions (due to the technology that requires making very far computer connections basing on satellite paths) does not guarantee an efficiency and an efficacy comparable to the ones provided by a DSL connection.

The connection is made by special modems to be installed, but without the necessity of dialling a telephone number.

Main advantages consist on:
1. good rates, in the order of some hundreds of Kbps
2. connection always available;
3. service available even in zones not easy to be reached (sea, mountains, etc).

Disadvantages:
1. high subscription costs and expensive hardware;
2. requires the installation of a satellite antenna in line of sight with the satellite that provides the service.

Cable connections

It is the main rival of DSL connections, it uses a typical coaxial cable connected to a modem which is then connected to a computer. Usually the cable is used to transmit the television signal, which fills just a part of the available bandwidth, while the remaining bandwidth is used for data transmission. The connection is always up and reaches rates of the order of tens of Kbps to few Mbps.

Problems are caused by the fact that access is not personal but shared among neighbours. This type of solution can cause rate decreases and transmission delays that in some cases can be annoying.

Actually many providers are replacing their infrastructures with new high speed optical-fiber lines the can grant a bandwidth larger than coaxial cables one.

The advantages of this sort of connection are:
1. good transfer rates;
2. quite low costs.

Disadvantages:
1. unavailability of the service where there is lack of coverage;
2. delays caused by the fact that the mean of transport is shared with other users.

Business connections

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In business LANs, that offer Internet connection to internal users, typically, a broadband connection is made, such as a dedicated copper line or optical fibre line with a bandwidth fitting the number of hosts we want to connect.

The advantages of this solution are:
1. possibility of offering the service to a high number of hosts at the same time;
2. good rates available;
3. connection always up.

Disadvantages:
1. high costs for the broadband connection in case of a high number of hosts to connect;
2. necessity of buying specific hardware (routers, firewalls, etc) to configure the network.

Wireless connections

This type of connections is still under development but is available by certain providers in metropolitan areas or in particular zones like: airports, commercial centres etc. It requires a wireless card to be installed on the PC we want to connect to the network. Many problems related to delays and service interruptions makes this kind of access unreliable even if access rates in the order of tens of Mbps make it interesting for services that require high transmission rates.

Advantages:
1. high rates;
2. quite low costs;
3. connection always up.

Disadvantages:
1. possible delays and signal loss;
2. problems related to security;
3. low territory coverage.

2. How to configure TCP/IP

Most networks actually in use, in particular the Internet, are based on TCP/IP protocol stack.
Willing to have a complete and comprehensible vision of this stack it is necessary to know some internal mechanisms, but above all being able to configure basic settings, in particular those settings that allow a correct configuration of the system to grant network access.

2.1. How to configure IP settings

The task of the following paragraphs consists on showing the configuration procedures of the main configuration parameters of the TCP/IP stack, both for Linux and Windows operative system.
How to configure IP Settings in Linux

IP parameters configuration for a machine running Linux operative system can take place in three different ways:
- editing single networking configuration files;
- using shell commands, such as ifconfig, route;
- using configuration tools with a window interface, like netconfig, linuxconf, webmin and others easy to be identified on KDE or GNOME desktops.

KDE
K Desktop Environment, is one environment for Unix workstations. "A network-transparent contemporary desktop environment for UNIX worksta5tions. KDE is part of the free software, or open source, movement, ….
"http://www.webopedia.com/TERM/K/KDE.html.

The putting in function of Red Hat Linux is starting from the Red Hat Linux prompt related to the launching as desktop system→ # **startx** → # **XFree86 -configure** → automatic construction of the file X86Config.new →# **XFree86 –xf86config /root/XF86Config.new** → The opening of the screen System Settings → The opening of the screen Display Settings→ the possibilities of introduction of configuration parameters.

Please see supplementary information in: www.xfree86.org; www.redhat.com/support; the README files (of the software drivers of the video cards) and in the XF86Config manual where the information may to be accomplished with the command:
man XF86Config >

or GNOME desktops

GNOME results from **G**NU **N**etwork **O**bject **M**odel **E**nvironment. "GNOME is part of the GNU project and "part of the free software, or open source movement. GNOME is a Windows-like desktop system that works on UNIX and UNIX-like systems and is not dependent on any one window manager" http://www.webopedia.com/TERM/G/GNOME.html. GNU come from **G**NU's **n**ot **U**NIX, a UNIX -compatible software system developed by the Free Software Foundation (FSF); http://www.webopedia.com/TERM/G/GNU.html.

The first way is probably the most difficult to be used by inexpert users because requires a deep knowledge of the used distribution.

In this document we will see name and location of the main files referring to RedHat distribution.

Some different Linux versions could have different network configuration file names and locations:

/etc/sysconfig/network: includes main Networking configurations like hostname, domain name, default gateway.

With the view to see the content of the system configuration, stored inside the file /etc/sysconfig/network, you may to give, for example the command: # cat /etc/sysconfig/network.
Also may to be used the Linux command: # more /etc/sysconfig/network.

More information: Linux **Newbie** Administrator Guide at http://linux-newbie.sunsite.dk/

Example:
> NETWORKING = yes ; Enables networking;
> HOSTNAME = test ; Host name;
> GATEWAY = 10.0.0.10 ; Default gateway IP address;

/etc/hosts: includes addresses and hostnames and aliases mapping, i.e.:
> 127.0.0.1 localhost.localdomainlocalhost;
> 10.0.0.22 test.mydomain.it test prova;

/etc/services: includes port numbers and service names mapping, it is the file that usually is not modified, except adding custom ports and protocols;

/etc/host.conf: specifies the order in which the system will perform information research to resolve addresses;

/etc/resolv.conf: DNS client configuration file; includes DNS server addresses, a possible host domain and research order:
> nameserver 10.0.0.34 ; primary DNS server IP address
> nameserver 192.168.1.10 ; secondary DNS server IP address
> domain mydomain.it ; name of the domain where the host is located
> options timeout:10 ; sets DNS query timeout to 10 seconds.

We can now analyze main commands provided by all Linux versions to configure network parameters through the terminal; in particular we will see two commands, "**ifconfig**" and **"route"**.

The first one is used to assign an interface its IP address and the second configures all the parameters necessary to forward packets. In the following there is a detailed description of main parameters syntax.

IFCONFIG the command is of the form # **ifconfig:**
> If invoked without any parameter lists active interfaces:

```
# ifconfig
eth0    Link encap:Ethernet  HWaddr 00:01:02:2F:AD:32
        inet addr:192.168.34.25  Bcast:192.168.34.255  Mask:255.255.255.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:82075264 errors:0 dropped:0 overruns:0 frame:0
        TX packets:51585638 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:100
        RX bytes:3154578779 (2.6 GiB)  TX bytes:3324455867 (2.3 GiB)
        Interrupt:10 Base address:0x8800

eth0:0  Link encap:Ethernet  HWaddr 00:01:02:2F:AD:32
        inet addr:192.168.1.1  Bcast:192.168.1.255  Mask:255.255.255.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        Interrupt:10 Base address:0x8800
```

```
eth1      Link encap:Ethernet  HWaddr 00:11:2F:25:59:17
          inet addr:192.168.2.1  Bcast:192.168.2.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  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:100
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
          Interrupt:9 Base address:0x6000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:10226970 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10226970 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1385547296 (1.2 GiB)  TX bytes:1385547296 (1.2 GiB)
```

please look also at http://www.reallylinux.com/docs/setupltsp.html

In this example we can see this machine has three interfaces;
o two of them (*eth0* and *eth1*) are network interfaces and
o the third (*lo*) is a logic interface, also known as *loopback.* It is used for local communications and must be always up even for computers not connected to a network.

It is worth noticing that eth0 is *multihomed*; that is it has two different addresses (identified by *eth0* and *eth0:1*). It is possible to have a multihomed interface only after having properly configured the computer, enabling a specific support included in the kernel

The command displays even the characteristics of the interfaces: IP address, MAC address, card status, number of received and transmitted packets, MTU dimensions, errors, dropped packets etc.

The first thing to do to configure an interface is verifying if it is up or down. Considering the first interface of the previous example, such check is done by "ifconfig eth0" call, that will show interface status.
Supposing it is already up and we want to disable it, the command to be used is:

ifconfig eth0 down

It is now needed to assign the interface a new IP address; the complete command is:

ifconfig eth0 192.168.0.1 netmask 255.255.255.128 broadcast 192.168.0.127 up

It assigns at the interface the IP address 192.168.0.1 and enables the interface creating the netmask 192.168.0.0/25 (in this way the C class address is divided into two 126-addresses subnets) defining 192.168.0.127 as a broadcast address.

For further information and more detailed descriptions regarding the parameters provided by the command see the command manual page (use command: man ifconfig on a linux shell).

As seen before, even if ifconfig is present in all Linux distributions, often some versions of this operative system provide the user graphic tools for network interfaces configuration: netconfig, linuxconfig, webmin.

Despite graphic approach for IP addresses configuration is often preferred by users, we must remember that it does not allows the user to modify all configurable parameters in a detailed manner.

Hence, even if it is not useful in most cases, in some others managing directly some values can lead to better performances.

ROUTE

Even if the IP address has been set on the network card we are still not able to access the Internet until we set data flow forwarding too.

Route command is used to set the correct parameters. A first example shown below consists on the output generated by route –n, which displays forwarding tables of the local host using only numerical values.

```
# route -n
Kernel IP routing table
```

Destination	Gateway	Genmask	Flags	Metric	Ref	Use Iface
194.177.127.0	0.0.0.0	255.255.255.0	U	0	0	0 eth0
192.168.1.0	0.0.0.0	255.255.255.0	U	0	0	0 eth0
192.168.168.0	0.0.0.0	255.255.255.0	U	0	0	0 eth1
0.0.0.0	194.177.127.1	0.0.0.0	UG	0	0	0 eth0

Obtained result shows available paths and in particular: the first column identifies the destination, the second one the gateway, the third one the destination subnet and the last one the interface used to send packets. Remaining columns specify other values that are explained on route command manual.

Going into particulars of the previous example is worth noticing that three different destinations are associated to three different subnets and two of them depend on the same interface.
For all of these destinations a gateway is not required because paths are directly accessible by a local interface (in fact the second column contains null addresses).

Last line indicates the default gateway; packets that have not a specified path must be sent to that address. In that case displayed destination is null address. The explicit command to set the default gateway is:

```
# route add default gw 194.177.127.1
```

Remember that, like in the previous example, in which a default gateway is specified for any address, the forwarding table can include different paths towards the same destination.
Usually Linux kernel rearranges them checking the path to associate to a packet, starting from the most specific interface, and forwards the packets as soon as a valid path is found. So doing (in the example) packets whose destination is 194.177.127.243 will never be sent to the server but will directly forwarded by the network card corresponding to eth0.

2.2. How to configure IP Settings in MS Windows

In this paragraph we will show procedures used to configure IP parameters in Microsoft Windows operative system.

As usual in Windows operative system, the steps to be followed to set appropriate details will be executed by the graphic interface that allows setting al necessary values for the card functioning.

This is the procedure to follow:

From button select **Control panel**

Double click on **Network connections** icon

Double click on **Local network connection (LAN)** icon**:** the following window will appear. It displays the connection status, how long the connection has been active and statistics regarding sent and received packets.
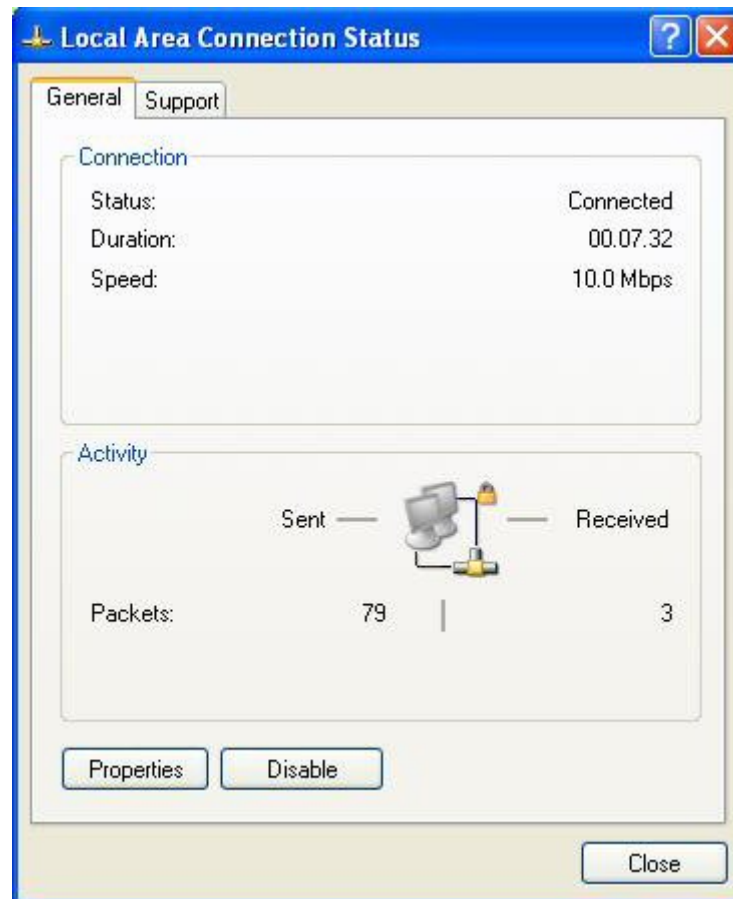
Figure 2.1: connections status

Click on **Properties** button**:** as it is possible to see from the following image a set of information and configuration parameters is displayed.

We can modify network card configuration but we will not examine this aspect because it is not the subject of this lesson.

It is also possible to install protocols and specific functionalities regarding the connection; QoS (Quality Of Service) management, files and printers sharing, optional protocols like NetBEUI etc.
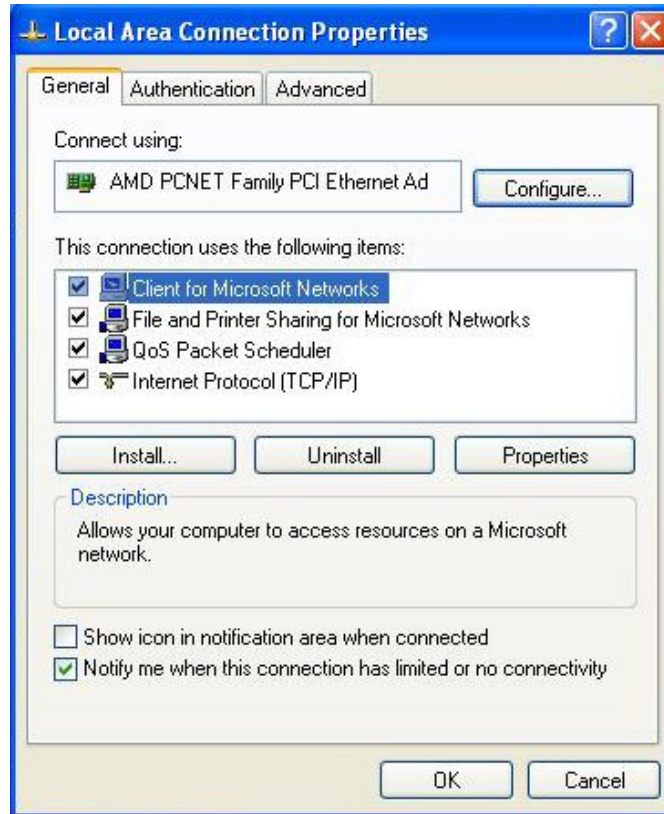
Figure 2.2: connections properties

Double click on **Internet Protocol [TCP/IP]:** the window shown will let you insert IP configuration data.

As first we can decide weather automatically obtain settings through DHCP (Dynamic Host Configuration Protocol) or set values by hand.

If we have decided to insert values click on **Use the following IP address** item and insert:
- IP address
- Subnet mask
- Default Gatewey
- Default DNS (Domain Name System) Server (*primary DNS*)
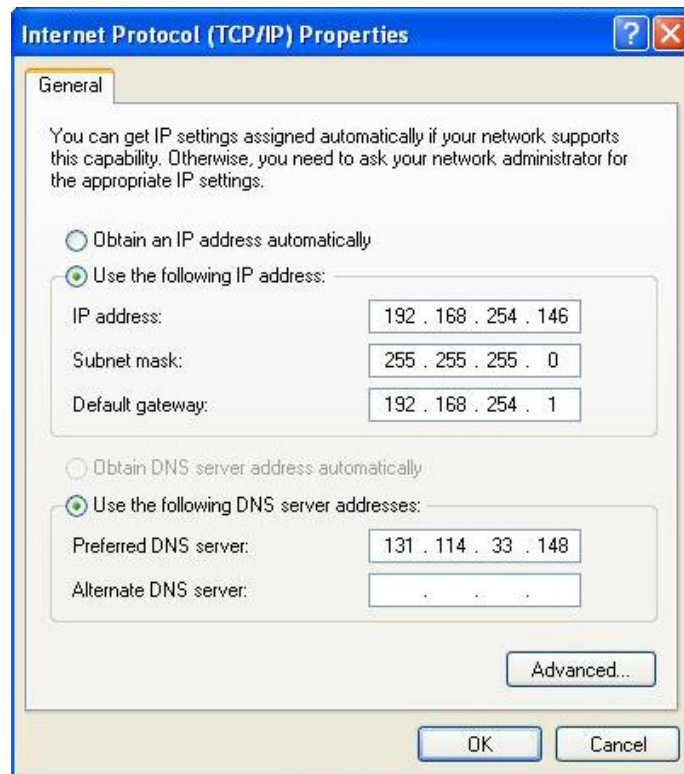- Alternative DNS (Domain Name System) Server (*secondary DNS*)

Figure 2.3: TCP/IP properties

It is now necessary to change some advanced settings. Click on **Advanced**, choose **DNS** menu and disable **Append parent suffixes of the primary DNS suffix**
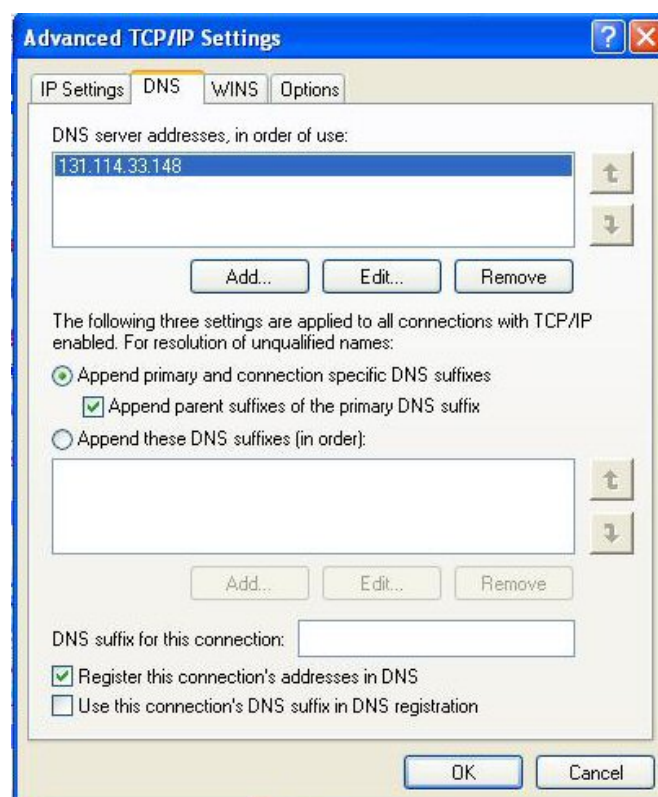

Figure 2.4: advanced TCP/IP properties, DNS

Advanced settings let the user configure also other parameters related to WINS configuration, TCP/IP filters setting and optional network interface addresses .

The following screenshots show the interface and configuration possibilities offered to the user.
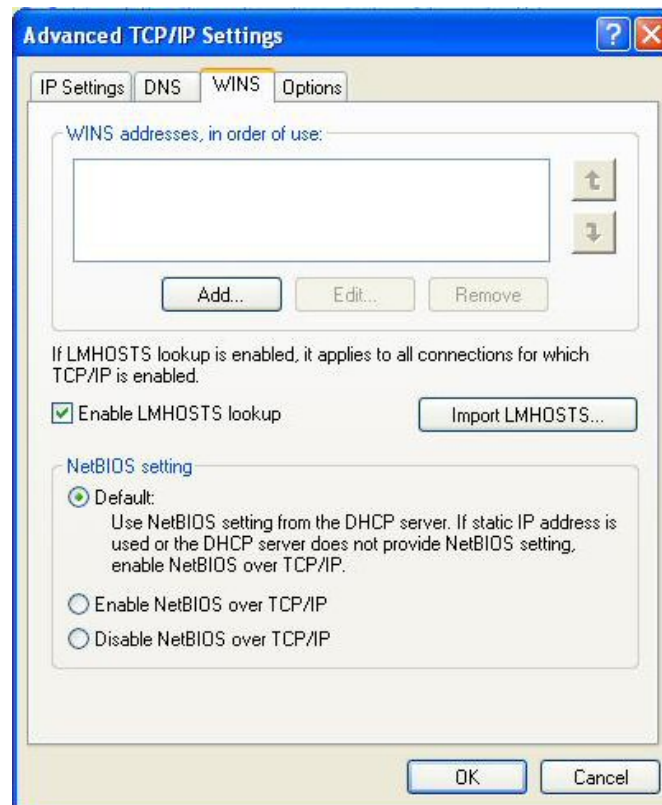

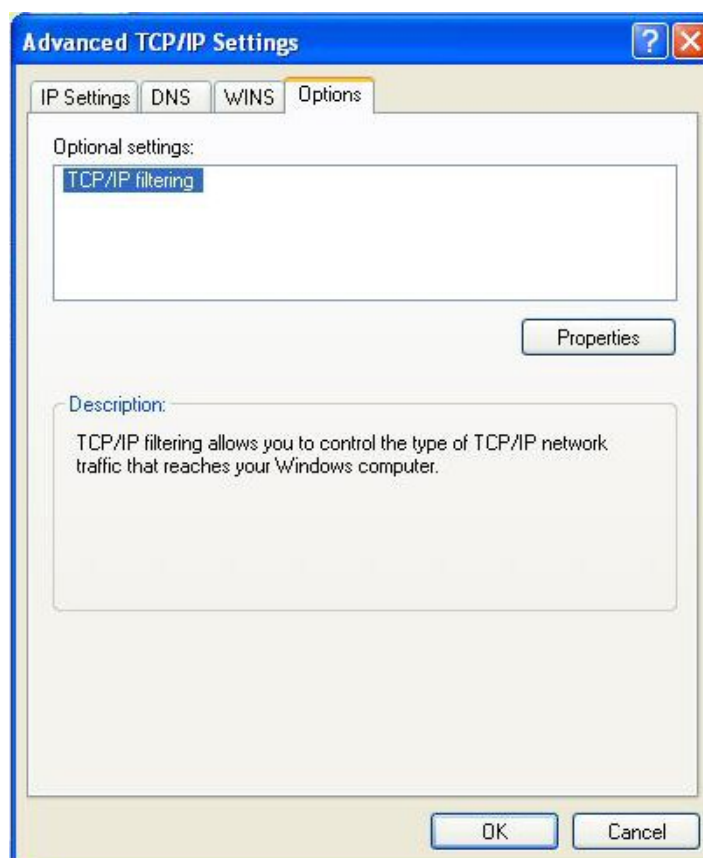Figure 2.5: advanced TCP/IP properties, WINS

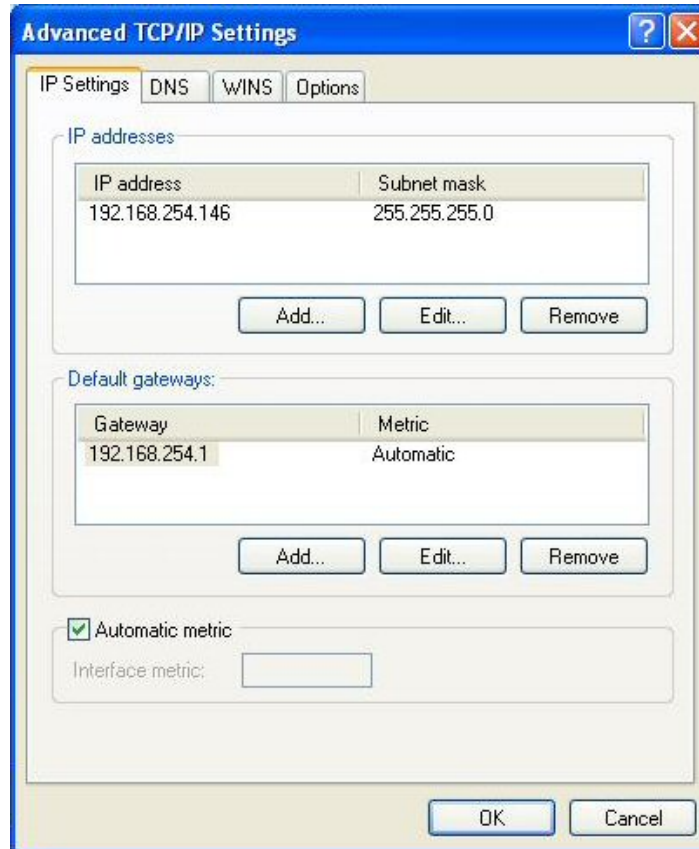Figure2. 6: advanced TCP/IP properties, options

Figure 2.7: advanced TCP/IP properties, IP settings

Once that parameters setting procedure is over you must save TCP/IP configuration.

Click on **OK** button and in the following window (*Local Area Connection properties*) click again on **OK,** then click on **Close** to end the configuration procedure.

3. PPP - Point to Point Protocol

See previous lessons and chapters related to the PPP

Key Point Summary Conclusions and Recommendations

The knowledge of main parameters configuration methods to set network cards does not provide the user a complete view of the most important TCP/IP protocol functioning mechanisms.
We suggest the user to read configuration procedures shown in this lesson but at the same time examine functioning details and TCP/IP stack properties closely reading more specific texts.

Study Guide
ESSENTIAL QUESTIONS TO VERIFY ACCOMPLISHED KNOWLEDGE

1. What are the advantages of a DSL connection?
2. What type of connection is worth using when willing to connect a high number of PCs to the Internet?
3. What is resolv.conf file used for?
4. What is ifconfig command used for?
5. What kind of information is required by the screenshot regarding connection status in Windows operative system?
6. Is it possible to configure filters during Windows IP configuration?

BIBLIOGRAPHY. REFERENCES.

[1] BLACK, Uyless [1995] *Il manuale TCP/IP. Protocolli di trasmissione*, traduzione di Cristina Nazarri, Milano, McGraw-Hill Italia (*TCP/IP and related protocols*, 2nd ed., Berkeley, McGraw-Hill, 1995).
[2] GARGANTINI, Mauro [1996] *La grande guida TCP/IP*, coordinamento editoriale Mauro Gargantini, traduzione di Annalisa Fabrizio, Milano, Jackson libri (*Inside TCP/IP*, second edition, Indianapolis, New riders, 1995).

SUPPLEMENTARY IMPORTANT BIBLIOGRAPHY. REFERENCES.   (www)

[SUPP 1.] www.Microsoft.com
[SUPP 2.] www.linux.org

[SUPP 3.] www.tldp.org
<[SUPP 4.] http://www.linuxdevcenter.com/linux/cmd/ ; Linux in a Nutshell, Fifth Edition; O'Reilly; by Ellen Siever, aaron Weber, Stephen Figgins; Rober Love; Arnold Robbins; Fifth Edition July 2005; Pages: 942.>
<[SUPP 5.] http://www.computerhope.com/unix.htm; UNIX / LINUX AND VARIANTS; Additional information and help with UNIX / Linux and variants>
<[SUPP 6.] http://www.unixguide.net/linux/linuxshortcuts.shtml; Linux Shortcuts and Commands; in Stan and Peter Klimas: Linux Newbie Administrator Guide; Copyright (c) <1999-2004> http://linux-newbie.sunsite.dk/ >
<[SUPP 7.] http://www.reallylinux.com/docs/setupltsp.html; 45 Minutes to a Linux Terminal Server; *by Mark Rais, senior editor for reallylinux.com;* www.reallylinux.com; International Site for Linux beginners. © 1999 - 2006 Reallylinux.com   All Rights Reserved.>

SUPPLEMENTARY INDICATIONS ABOUT THE CONTENT OF THE LESSON

http://linux-newbie.sunsite.dk/**;**   http://www.linuxdevcenter.com/linux/cmd/;] www.linux.org; www.reallylinux.com **International Site for Linux beginnrers**

RESPONSES TO THE QUESTIONS

1. Quite low costs, connection always up, possibility of connecting to the Internet and making a phone call at the same time, higher bandwidth: download 640 Kbps Upload 256 Kbps.
2. Business or LANconnection.
3. Includes information regarding DNS configuration in Linux systems.
4. Allows configuring IP address interface configuration in Linux systems.
5. Connection status and lasting, packets sent and received.
6. Yes, through Options menu in TCP/IP advanced settings window.

WORDS TO THE LEARNER: <*"Do not wait for opportunities. Create them"* (After Bernard Show)>.