LESSON E13_EN. BASIC HARDWARE FOR INTERNET. ESSENTIAL ELEMENTS OF THE HARDWARE.

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Consultations: Every working day between 9.00 to 12.00 a.m

CONTENT OF THE LESSON

LEARNING OBJECTIVES:

After learning this lesson you will be able to:

- Install and configure some types of network adapters in Windows and Linux environments
- Install and configure a modem with Windows and Linux operative systems
- Solve eventual problems detected while installing devices formerly described
- Make a basic router configuration
- Install and configure a Remote Access Service

1. Interfaces

An increasing development of new technologies and materials provides nowadays a wide range of hardware equipments for internetworking and Internet connections.

TCP/IP defines an abstract interface that lets the hardware be accessible. Such interface offers a set of operations, common to all hardware apparatus, that is dedicated to sending and receiving packets on the network.

In the following paragraphs we will briefly describe several interface types, how to install and how to configure them using Windows and Linux operative systems.

1.1. Adapter cards components

The network adapter card is the hardware component required to physically connect the computer to the network. Such component is used to transmit and receive packets at physical layer and is managed by the card drivers, a software dedicated to perform this function.

There are two types of network adapters:

- PCMCIA, typically used on laptops.
- PCI o ISA, widespread inside desktops. Recently ISA cards has been replaced by PCI adapters even if still present on old devices.

In the operative system there must be an interface corresponding to each networking device.
For example, on Linux operative system, Ethernet interfaces are called eth0 and eth1, PPP interfaces (point to point protocol) are called ppp0 and ppp1 and FDDI (Fiber Distributed Data Interface) interfaces are called fddi0 and fddi1.

Interface names are used while configuring a particular physical disposal and have no other meaning.

Each interface, before being ready to be used by TCP/IP protocol, must be assigned an IP address, This address is used as univocal identifier when willing to communicate with the rest of the world.
This address does not depend on the interface name mentioned above.

Many parameters of the network adapter can be configured, for example:

- the maximum dimension of the datagram,
- the Maximum Transfer Unit (MTU) that can be processed by a network.

Fortunately most of these parameters are set by default to a fair value so it is not necessary to make a detailed configuration.

A computer must own a network adapter for each network it is connected to. For example, if a host is connected to two Ethernet LANs then two Ethernet cards are required.

The most used internetworking technologies are:

- Standard Ethernet Version 2
- IEEE 802.3
- Token-ring
- FDDI (Fiber Distributed Data Interface)
- ATM (Asynchronous Transfer Mode)

Ethernet and 802.3 technologies use the same kind of adapter.

Each device has a limited number of expansion slots to be used (all or part of them) for network adapters and can support a limited number of adapters for the same kind of communication. Despite these limitations it is possible to install any kind of combination of adapters until there are available slots.

1.1.1. How to install and configure adapter cards.

Actually Ethernet cards are the most widespread for local network connections because they are relatively cheap and reach transfer rates of 10, 100 and 1000 Mbps. This is why in the following paragraphs we will refer to Ethernet PCI card adapter. The main steps to be followed to install a network adapter are:

1.)- Shut down the computer
2.)- Open the case of the computer
3.)- Find a free slot and insert correctly the adapter into it.
4.)- Close the case of the computer
5.)- Plug in the network cable
6.)- Reboot the computer

Once the card has been inserted we must install and configure it; operations strongly depend on the operative system and we will discuss how to do it considering Windows XP and a Linux distribution with a kernel 2.4 version.

Windows

Once the network card has been installed, if it is a PCI card it is probably also PnP (Plug and Play), so Windows will recognize it automatically and will try to install using its own drivers or asking to insert the CD enclosed with the card.

Differently from the other operative systems, (i.e. Windows 98) Windows XP, if it has the required driver, does not display any message while installing the software.
Moreover, if the installation goes right, automatically installs even other components needed for networking (i.e. TCP/IP protocol) not displaying anything again.

If Windows XP does not have the driver and detects the card shows a message asking to insert the CD or the floppy disk containing the driver.

Once the CD or the floppy disk has been inserted we must wait for few seconds in which Windows will install the driver and the rest of networking components.
Even if the network adapter is supported by Windows XP, sometimes, during the driver installation might be displayed a window warning that the driver has no signature. In this case, if we consider the driver as appropriate to our system, we let the installation continue clicking on “continue” otherwise we abort the installation.

This is the procedure to check if the network card has been properly installed: click *Start*, open the *Control Panel* and select *System properties*, then choose the folder (tab) called *Hardware* and click on *Device Manager*. Once you have clicked on the button a window like the one shown in figure 1.1 will be opened:

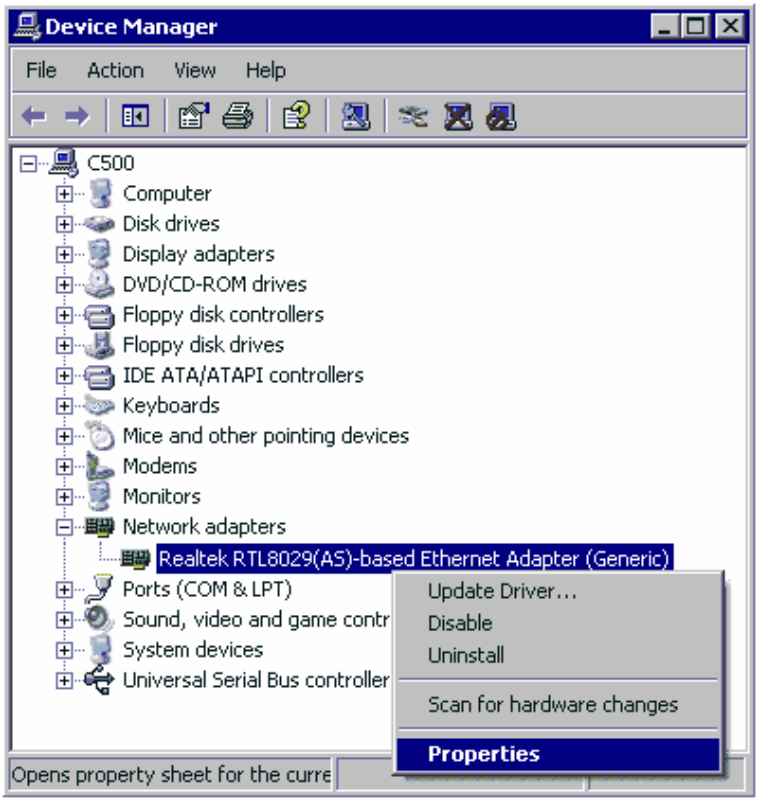

Fig. **Eroare! În document nu există text cu stilul precizat.**.1. Device Manager Window showing the network card type

If there is any problem with the network adapter it can be seen at *Network adapters*, probably with a yellow question/exclamation mark placed side by side to the card name; clicking twice with the left button of the mouse where the problem is displayed we can obtain more details and can follow the required steps to install the driver again and solve the problems detected.

It is possible to see if the card has been correctly installed clicking on the '+' on the left of the *Network adapter* icon; in this way all network connections will be shown (in our case a Realtek network card) and clicking with the right button of the mouse its properties can be displayed.

Now the features of the driver and the operations that can be done on it (update, roll back and uninstall) are displayed in detail (as it is possible so see in Figure 1.2)

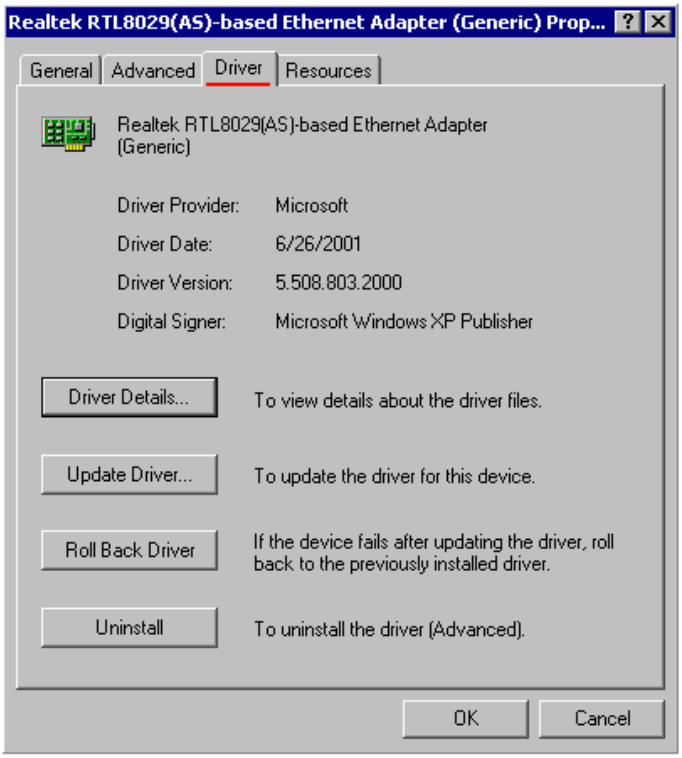

Fig. **Eroare! În document nu există text cu stilul precizat.**.2. Window showing the properties of the network card driver

Linux

If we want to use the network card, the kernel must know a way to communicate with the hardware, that is, it must own the support for that network disposal.

As mentioned above the software that performs these functions is the device driver.

The driver must be able to communicate with the card; in other words it must be able to send the card commands and data, while the card must send all received data to the device driver.

The steps to be followed to make the card work are:

1.)- Owning an expansion Ethernet card or a mother board with integrated Ethernet support
2.)- Define the vendor and the card model or the Ethernet chip model
3.)- Establish if a Linux driver for this card or chipset exists
4.)- Find and load the driver
5.)- Check the output of the driver to verify if it has recognized the network card
6.)- Configure the new network interface

The first thing to be done is to discover the model of the card to verify if Linux has a driver for that particular card. Usually different cards are controlled in a different way and the driver (if existing) includes all the necessary information to control the card in a format that lets Linux use it correctly.

The lspci command,
http://www.videredesign.com/linux_drivers.htm;
http://www-128.ibm.com/developerworks/linux/library/l-vmware/;
http://www.linuxquestions.org/questions/showthread.php?t=71791;
http://www.linuxquestions.org/questions/showthread.php?s=812a7144341ea2349900baa16f18b978&t=316749;
http://www.ledge.co.za/software/lpinotes/101-letter.pdf .

About lpsci:
http://linux.about.com/od/commands/l/blcmdl8_lspci.htm;
Alphabetical Directory of Linux commands: http://www.linuxdevcenter.com/linux/cmd/cmd.csp?path=l/lspci
http://www.reallylinux.com/docs/admin.shtml **Linux Commands for Beginning Server Administrators Brought to you by Mark Rais, senior editor here at ReallyLinux.com.**

If we do not have the manual or other sources about the card model at our disposal we can try to use the *lspci* command to obtain information related to the device installed on the PCI bus of the computer.
Another choice could be using the *cat/proc/pci* command that produces similar information but not as complete as the previous one.

Lspci command is an utility program used to display the information of the PCI bus of the computer and of all the devices connected to this bus.

If we execute the command with the –v option we obtain more detailed information regarding the devices connected to the PCI bus, while –n option also displays the vendor PCI and the code of the device as a number instead of the corresponding literal identifier.

These are the data that can be obtained using the lspci command:

user@host:~$ /sbin/lspci

The above command uses the personalised Linux prompt: user@host:~$. Sure other Linix promptes may to b e used. At the above command, the response may, for instance, to be the following:

00:00.0 Host bridge: Intel Corp. 82845 845 (Brookdale) Chipset Host Bridge (rev 11)
00:01.0 PCI bridge: Intel Corp. 82845 845 (Brookdale) Chipset AGP Bridge (rev 11)
00:1d.0 USB Controller: Intel Corp. 82801DB (ICH4) USB UHCI #1 (rev 01)
00:1d.1 USB Controller: Intel Corp. 82801DB (ICH4) USB UHCI #2 (rev 01)
00:1d.2 USB Controller: Intel Corp. 82801DB (ICH4) USB UHCI #3 (rev 01)
00:1d.7 USB Controller: Intel Corp. 82801DB (ICH4) USB2 EHCI Controller (rev 01)
00:1e.0 PCI bridge: Intel Corp. 82801BA/CA/DB/EB/ER Hub interface to PCI Bridge (rev 81)
00:1f.0 ISA bridge: Intel Corp. 82801DB (ICH4) LPC Bridge (rev 01)
00:1f.1 IDE interface: Intel Corp. 82801DB (ICH4) Ultra ATA 100 Storage Controller (rev 01)
00:1f.3 SMBus: Intel Corp. 82801DB/DBM (ICH4) SMBus Controller (rev 01)
01:00.0 VGA compatible controller: ATI Technologies Inc Radeon RV200 QW [Radeon 7500]
02:03.0 Multimedia audio controller: C-Media Electronics Inc CM8738 (rev 10)
02:0d.0 Ethernet controller: Realtek Semiconductor Co., Ltd. RTL-8139/8139C/8139C+ (rev 10)

and in particular regarding the Ethernet controller:

user@host:~$ /sbin/lspci –vn

00:00.0 Host bridge: Intel Corp. 82845 845 (Brookdale) Chipset Host Bridge (rev 11)
00:01.0 PCI bridge: Intel Corp. 82845 845 (Brookdale) Chipset AGP Bridge (rev 11)
00:1d.0 USB Controller: Intel Corp. 82801DB (ICH4) USB UHCI #1 (rev 01)
00:1d.1 USB Controller: Intel Corp. 82801DB (ICH4) USB UHCI #2 (rev 01)
00:1d.2 USB Controller: Intel Corp. 82801DB (ICH4) USB UHCI #3 (rev 01)
00:1d.7 USB Controller: Intel Corp. 82801DB (ICH4) USB2 EHCI Controller (rev 01)
00:1e.0 PCI bridge: Intel Corp. 82801BA/CA/DB/EB/ER Hub interface to PCI Bridge (rev 81)
00:1f.0 ISA bridge: Intel Corp. 82801DB (ICH4) LPC Bridge (rev 01)
00:1f.1 IDE interface: Intel Corp. 82801DB (ICH4) Ultra ATA 100 Storage Controller (rev 01)
00:1f.3 SMBus: Intel Corp. 82801DB/DBM (ICH4) SMBus Controller (rev 01)
01:00.0 VGA compatible controller: ATI Technologies Inc Radeon RV200 QW [Radeon 7500]
02:03.0 Multimedia audio controller: C-Media Electronics Inc CM8738 (rev 10)
02:0d.0 Ethernet controller: Realtek Semiconductor Co., Ltd. RTL-8139/8139C/8139C+ (rev 10)
… …
02:0d.0 Class 0200: 10ec:8139 (rev 10)
Subsystem: 10ec:8139
Flags: bus master, medium devsel, latency 32, IRQ 9
I/O ports at a400 [size=256]
Memory at ee000000 (32-bit, non-prefetchable) [size=256]
Expansion ROM at <unassigned> [disabled] [size=64K]
Capabilities: [50] Power Management version 2

From this information it is possible to see that the considered computer is provided with a 10/100 Mb/s Ethernet network card produced by Realtek.

In fact, the vendor and the device are specified by the Subsystem tag 10ec:8139, the first number is the vendorID that corresponds to Realtek, whereas the second one is the deviceID that corresponds to the network card model.

Now that we know the type of card owned, we must search for the Linux driver taking into account the card vendor and the model identifier. If the card is catalogued as “not supported” it is not possible to install it. If no information is available we must check if the manual considers it “compatible” with another known type of card.

Supposing our card is supported by Linux we must find and use the driver. The fact that the Linux driver exists does not imply that it is included in any kernel.

Depending on the Linux distribution, there might be only few precompiled kernels and a big set of drivers as small separated module, or different kernels to boot the computer that cover a big amount of combinations of built-in drivers.

Many Linux distributions include a set of modules (the various drivers) that are usually downloaded later during the booting process or under request as soon as a driver is required to access a particular device. Therefore it will be necessary to insert this module into the kernel after the kernel itself has been started.

It we have not found a precompiled kernel for our computer nor the driver in modular appearance, we must compile the kernel again including the driver.

If we want to recompile the kernel we must know which cards or devices are installed on the PC. In this chapter we will analyze only the part regarding network configuration not considering other aspects.

Supposing to use a 2.4 series kernel and wishing to recompile it we must move to the sources directory (usually */usr/src/linux/*) and start the configuration by one of the following commands:

- *make config* just offers an interactive non graphic menu with a set of questions to be answered in sequence

to give the above command, is necessary to be changed, firstly , the directory, with the command cd (representing the command change directory).

user@host:~$ **cd /usr/src/linux/** (Enter)
user@host:~$ **make config** (Enter)

- *make menuconfig* offers an interface based on “ncurses” in which keyboard button are used to move inside the menu and display help pages.
- *make xconfig* offers a graphic interface based on X server.

Supposing to use make xconfig, when the main menu appears we must verify having selected the PCI support in the *General setup*. Once the verification has been made we must;

- select *Network device support* menu, shown in Fig. Eroare! **În document nu există text cu stilul precizat.**.3
  - check the *network device support* entry is selected
- select the *Ethernet (10 or 100Mbit)* submenu, shown in Fig. Eroare! **În document nu există text cu stilul precizat.**.4
  - select the driver for the network card

As shown in Fig. Eroare! **În document nu există text cu stilul precizat.**.4, the driver for the network card can be compiled monolithically in the kernel choosing (y) option or as a module choosing (m).

In fact, more modern monolithic kernels such as Linux, FreeBSD and Solaris can load executable modules at runtime (e.g. driver for external device compiled as a module), allowing easy extension of the kernel's capabilities as required and helping to keep the amount of code running in kernelspace to a minimum.

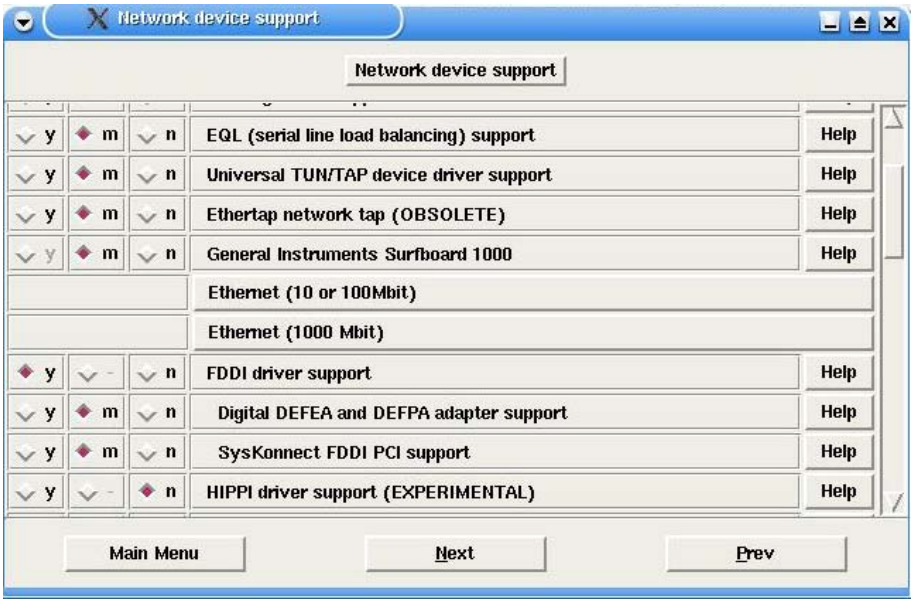

Fig. **Eroare! În document nu există text cu stilul precizat.**.3. Option of the Network device support

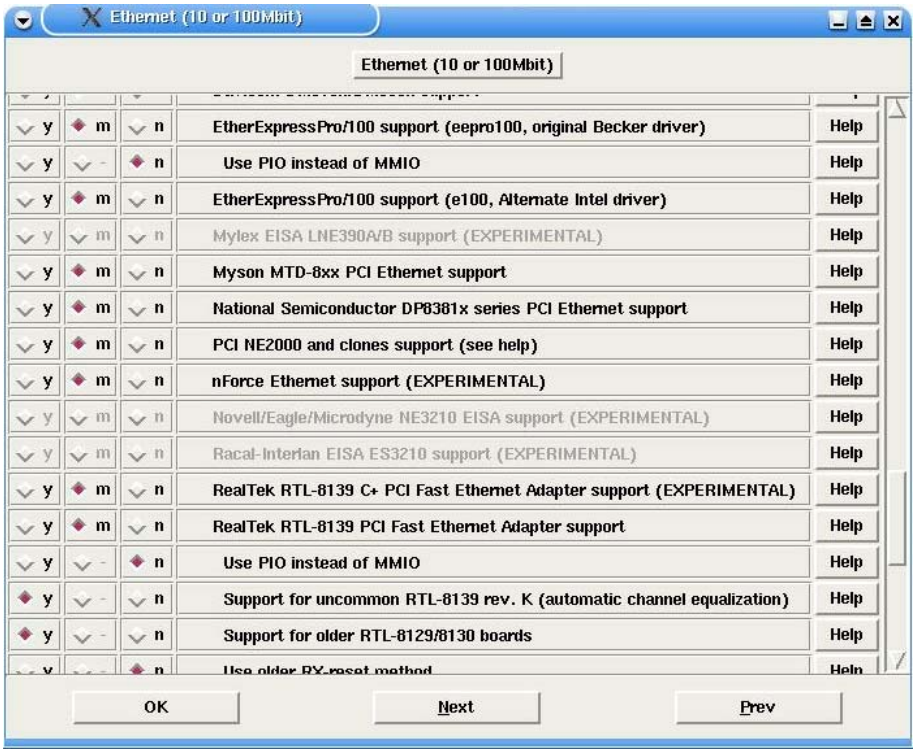

Fig. **Eroare! În document nu există text cu stilul precizat.**.4. Options of the Ethernet (10 or 100Mbit) menu

Now we must end the other sections of the menu due to the hardware of the PC and to the features of the supports we want to insert into the operative system.

Afterwards we must move to the kernel compilation as described on the README included in the documentation of the kernel sources.

Summing up we must digit the following commands from the kernel source directory (usually */urs/src/linux*):

- *make dep* to create dependencies (useless for series 2.6.x kernels)
- *make clean* deletes various object files
- *make bzImage* build the kernel

Once the compilation is finished and kernel has been created (the image of the kernel is called bzImage and is usually in /usr/src/linux/arch/i386/boot/) we must compile and install the modules by the following commands:

- *make module* to compile modules
- *make modules_install* installs compiled modules in the /lib/modules/KERNEL_VERSION directory

At last we must copy the new kernel and the System.map[1] file, produced by the compilation, into the boot directory typing the following commands:

cp /usr/src/linux/arch/i386/boot/bzImage /boot/linux-KERNEL_VERSION
cp /usr/src/linux/System.map /boot/System.map-KERNEL_VERSION

it is used above the cp command, respective copy files and directories,
http://linux.about.com/od/commands/l/blcmdl1_cp.htm

After that we must modify the boot loader config file (/etc/lilo.conf if we are using lilo[2]) to inform the system there is a new kernel to load when booting.

This operation can be executed adding the following lines to the existing configuration file, so to add an alternative kernel to choose while booting the computer:

image=/boot/linux-KERNEL_VERSION
label=New kernel
root=/dev/hda2
read-only

The above setting may to be achieved, for instance, in the lilo configuration file /etc/lilo.conf ; see also http://linux.about.com/library/bl/open/newbie/blnewbie4.1.3.htm; in Focus on Linux, Linux Newbie Administrator FAQ, by Juergern Haas.

The new alternative kernel to choose when booting the computer is placed, as indicated in the above lines in the partition /dev/hda2

We must pay attention to the third line, that specifies the partition where the operative system is. Now the last thing to do is executing "*/sbin/lilo –v*" to update the boot sector.

The command is simple: user@host:~$ "***/sbin/lilo –v***" (Enter); where user@host:~$ is in this case the system prompt

The -v parameter is not compulsory but it is useful to verify executed operations. If lilo displays mistakes it is highly probable that a wrong kernel image o a wrong partition has been specified.

After *lilo* has updated the boot sector we must reboot the computer, start the kernel just compiled and load the driver modules if they are not incorporated into the kernel.

If we want to verify if the kernel has detected the card or not, after having started the kernel and having loaded all the modules, we can digit *dmesg | more*:

```
user@host:~$ dmesg
...
All processors have done init_idle
PCI: PCI BIOS revision 2.10 entry at 0xfb330, last bus=0
PCI: Using configuration type 1
PCI: Probing PCI hardware
PCI: Probing PCI hardware (bus 00)
Limiting direct PCI/PCI transfers.
Activating ISA DMA hang workarounds.
isapnp: Scanning for PnP cards...
```

[1] Humans prefer to use symbol names instead of variables and function address used by the kernel. Normally, this doesn't present a problem. The kernel is mainly written in C, so the compiler/linker allows us to use symbol names when we code and allows the kernel to use addresses when it runs. There are situations, however, where we need to know the address of a symbol (or the symbol for an address). This is done by a symbol table, that is a list of all symbols with their address written into System.map file.

[2] LILO is a versatile boot loader for Linux. It does not depend on a specific file system, can boot Linux kernel images from floppy disks and hard disks, and can even boot other operating systems. Various parameters, such as the root device, can be set indepenantly for each kernel.

```
isapnp: No Plug & Play device found
Linux NET4.0 for Linux 2.4
Based upon Swansea University Computer Society NET3.039
Initializing RT netlink socket
Starting kswapd
Journalled Block Device driver loaded
devfs: v1.12c (20020818) Richard Gooch (rgooch@atnf.csiro.au)
devfs: boot_options: 0x1
...

hda: Maxtor 6E040L0, ATA DISK drive
hda: attached ide-disk driver.
hda: host protected area => 1
hda: 80293248 sectors (41110 MB) w/2048KiB Cache, CHS=4998/255/63, (U)DMA
Linux Kernel Card Services 3.1.22
  options:  [pci] [cardbus] [pm]
…
3c59x: Donald Becker and others. www.scyld.com/network/vortex.html
See Documentation/networking/vortex.txt
00:0f.0: 3Com PCI 3c905B Cyclone 100baseTx at 0x6100. Vers LK1.1.18-ac
 00:10:5a:16:2b:07, IRQ 10
  product code 5152 rev 00.12 date 08-07-98
  Internal config register is 1800000, transceivers 0xa.
  8K byte-wide RAM 5:3 Rx:Tx split, autoselect/Autonegotiate interface.
  MII transceiver found at address 24, status 786d.
  Enabling bus-master transmits and whole-frame receives.
00:0f.0: scatter/gather enabled. h/w checksums enabled
```

This command allows watching again the messages the kernel has displayed during the starting process. If the card has been detected it should be possible to see in that list a message of the card driver starting with eth0 and telling the name of the driver and hardware parameters it has been configured with (interrupts configurations, addresses of input/output ports, etc.).

Analyzing dmseg messages we must consider that Linux, while starting, lists al the PCI cards installed on the system without taking care of the available drivers, so we must not confuse this with driver detection that happens later. If a driver identification message like this is not displayed then the driver has not detected its card and we must check again previous steps.

It the card is detected but the detection message includes any mistake, as a resource conflict, probably the driver has not been initialized correctly and the card will still not be available. If the detection message is correct the network card has been correctly detected with all the parameters we can pass to the software configuration through the *ifconfig* and *route* commands, otherwise there is a software configuration mistake or a hardware configuration mistake.

A software configuration error is found when network addresses are not properly configured, while a hardware configuration error is found when any resource conflict or configuration error (the driver has not detected during the starting phase) does not let the card work correctly. This can be noticed in various ways:

1.)- if an error message is found (like "SIOCSFFLAGS: Try again") when ifconfig tries to open the disposal to use it;
2.)- if the driver reports error messages on eth0 (can be seen using *dmesg* | *more* command) or strange contradictions any time it tries to send o receive data;
3.)- if digiting *cat /proc/net/dev* command nonzero numbers appear in one of the errs, drop, fifo, frame o carrier columns corresponding to the interface we are configuring (eth0 …);
4.)- if digiting *cat /proc/interrupts* a null interrupt number appears for the card.

If digiting *ifconfig ethx* no error has been detected it should be possible to see something like this:

```
eth0   Link encap:Ethernet  HWaddr 00:00:B4:AA:17:D9
       inet addr:0.0.0.0  Bcast:0.0.0.0  Mask:255.255.255.255
       UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
       RX packets:322 errors:0 dropped:0 overruns:0 frame:0
       TX packets:317 errors:0 dropped:0 overruns:0 carrier:0
       collisions:0 txqueuelen:1000
       Interrupt:9 Base address:0x1000
```

and we can move to the IP addresses configuration as described in LESSON 5.

Linux kernel also includes the support for "*IP aliasing*", that allows a Ethernet card to work simultaneously with two different IP addresses. Some types of kernel include the support for IP aliasing by default, otherwise we must recompile the kernel including such support. If you want to configure a card with another IP address it is enough to substitute ethx with ethx:y, where varying y it is possible to add virtual interfaces that physically refer to the same network card.

1.1.2. How to install Modems and other Interfaces.

There are many types of modem; a first distinction, between internal and external modems, refers to their collocation. First ones are plugged inside the computer while the second ones are connected to a serial port connector on the PC. Internal modems are cheaper than external ones and fill up less space while external modems are easier to be installed and have lights that can give information on what is going on.

Wishing to install an internal modem we must open the case of the computer and insert the modem card into a free slot of the mother board. There are modems for ISA slots and other for PCI ones.
On the contrary, external modems must be connected to the serial port. Internal modems have a serial port built inside the modem itself , that is, a modem card is both a serial port and modem.

Internal modems are software modems and pass the majority of the work to the chip of the main processor (CPU). Vendors drivers perform exactly this function on the CPU. Most of internal modems do not work on Linux right because they are software modems working only on Windows and because of this they are often called “winmodems”.

Using Ms Windows we can install almost any type of modem thanking the drivers availability for these operative systems.

On Linux it is not so easy and, considering that winmodem installation depends on the type of chip, in next sections we will consider the installation of external modems connected to the serial port (port COM or RS232) both for windows and linux operative systems.

Just few steps are required to connect an external modem: first of all connect correctly the external modem to one of the serial ports of the computer. After that, if it possible to accept the IRQ and the default IP address of the port we are connecting the modem to, you should be ready to launch the configuration program of the modem itself.

Windows

Once the modem has been connected to the computer we must click on the *Start* button, open the *Control panel* or select the Modem properties (*Phone and Modem Options).* In *Modem* folder installed and configured modems appear: if there is not any modem it is possible to access the configuration of a new disposal clicking on *Add* button.

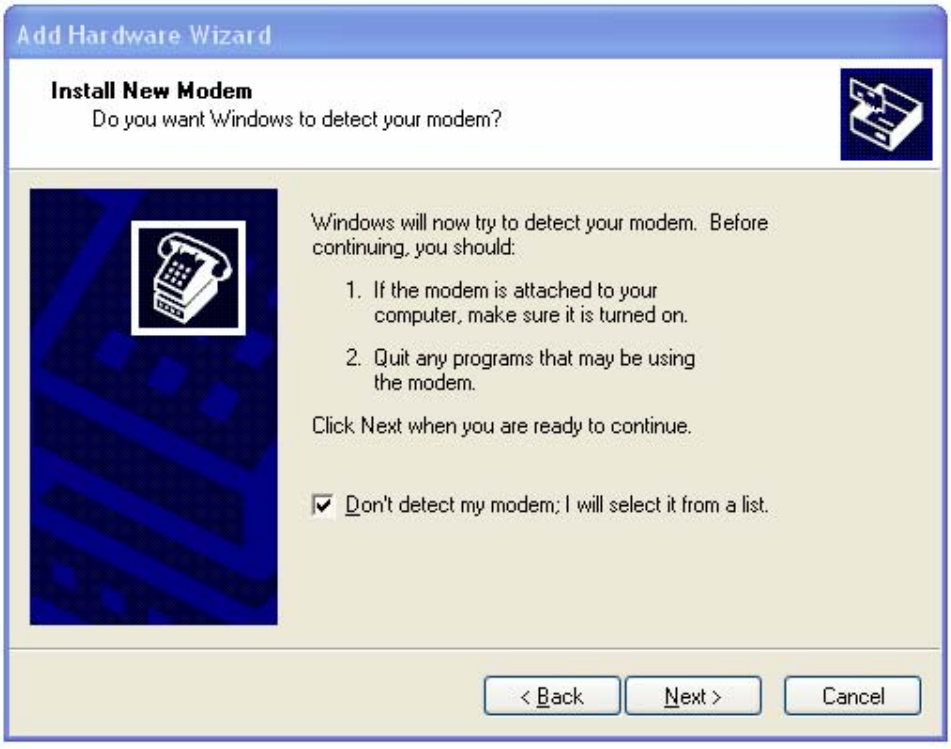

Fig. **Eroare! În document nu există text cu stilul precizat.**.5. Window for installing a new modem

In the next window we must activate the option to avoid modem detection and click on *Next* button as shown in Figure 1.5.

Now we can choose the modem on the right; for each vendor we can find modem models supported by Windows (in Figure 1.6 it is shown the example of a standard 56 Kbps modem).

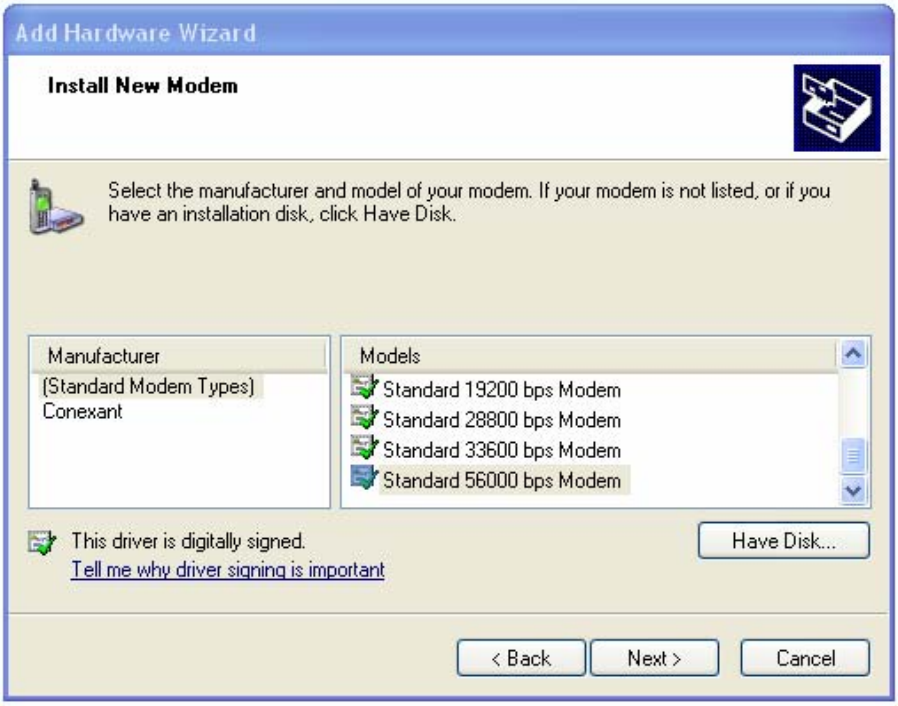

Fig. **Eroare! În document nu există text cu stilul precizat.**.6. Window to choose the modem to install

If the modem to install does not appear in the list click on *Have disk* and insert the vendor floppy-disk or CD where Windows XP drivers have been inserted; now click on *Browse*, choose the folder including the driver and continue the installation.
If the modem is supported then select it and install the appropriate driver.

In the following window you are asked to select the port the modem is connected to. We have to remember that usually any PC has more than a serial port (also called COM), so we must check which port the modem is connected to. Then enable *Selected port* option and select the serial port the modem is connected to. After having chosen the port proceed clicking on *Next* and then on *End*.

If you want to verify the modem configuration go back to *Modem* folder, select the installed modem and click on *Properties*. In this window it is possible, using various tabs, to check the speaker volume, the port rate and disable the option: wait for the line signal before dialling the number.

Diagnostics folder lets us interrogate the modem; in this way the computer sends the modem some diagnostic commands to verify if it responds correctly. It is worth underlining that such diagnostic only verifies the correct communication between modem and computer and not the connection to the Internet.

If the computer does not manage to communicate with the modem an error message appears; so it is required to check if the modem is switched on, if it is correctly connected to the COM port and if it has been associated during the configuration phase.

If the modem does not respond to the diagnostic it is possible to create a new remote connection selecting *Start, Control Panel* and, inside the control panel, double clicking on *Network Connections* followed by *Create a new connection.* The following steps must be followed in order to configure the connection:

- Set *Internet connection* and continue,
- *Set connection manually* and continue,
- Select *Connect with remote modem* and insert the name to be assigned to the connection,
- Set ISP parameters to be used (i.e. telephone number),
- Insert login and password,
- Enable the option to create on the desktop a link to the connection just created.

Now it is just necessary to click on the connection icon on the Desktop and insert login and password to be connected to the Internet through the modem just installed.

Linux

If we have an external modem we don not need further drivers nor particular modules, the only required thing is the PPP protocol support in the kernel we are using (See the related lessons).

First of all we have to connect the modem to the computer through the serial port and verify the PPP protocol support is enabled. After, we must configure it by communication programs as wvdial and pppsetup or graphic programs provided by windows managers like kppp or gnome-ppp.

These ones also provide dialogue windows to interrogate the modem through AT commands, so to verify the communication between modem and computer.

A necessary information to interrogate the modem, not depending on the program used to configure the connection, is the serial ports device (COM1, COM2, etc.). In Linux systems this usually corresponds to /dev/ttyS0, /dev/ttyS1, etc… or to /dev/modem which is a symbolic link to the modem device.

During the connection configuration by an ISP it is necessary to assign the modem device and also parameters like connection rate; select the flow control; put ISP settings (user name, password, DNS …) and so on, as shown in figure 1.7.

Once data have been inserted we should be able to make a connection. If the connection fails we must try to solve problems basing on the kind of error detected.
It might be a configuration error related to a wrong IPS data insertion or an installation error due to the communication between modem and computer.
In the first case we must check all configuration parameters, on the contrary, in the second one, we must check the existence of the serial communication support for PPP protocol and that the connection of the devices has been made correctly.

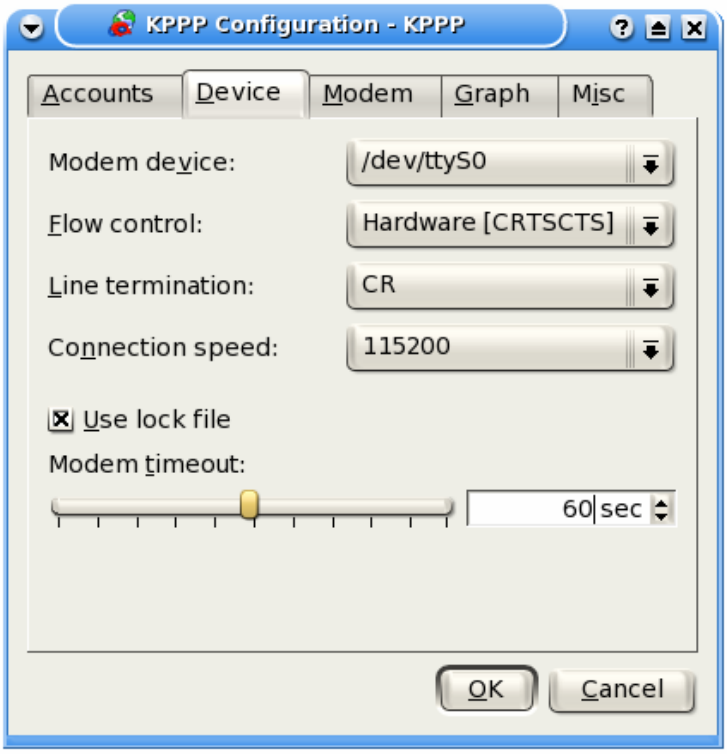

Fig. **Eroare! În document nu există text cu stilul precizat.**.7. Kpp dialogue window to configure the modem

About KPPP you may to consult: http://docs.kde.org/stable/en/kdenetwork/kppp/index.html which inform: “KPPP is a dialer and front end for pppd, allowing for interactive script generation and network setup”.

1.2. Routers and Special Servers.

Routers are devices that allow interconnection between two or more different networks and let different protocols be interfaced. The task of these apparatus consists in forwarding the data packets on the appropriate interface toward other Router placed on the way toward the destination.

1.2.1. How to install and configure Routers.

There are many vendors and most of all many router models. Among the main features that distinguish a router from another we can fin the number and the type of interfaces.
Moreover the variety of available routers allows a careful choice basing on requirements and costs.

One of the most famous vendors is the American Cisco, that produces routers developing hardware and software. Because of this the description offered in the following will refer to Cisco devices even if valid for most of commercial routers.

As mentioned above a router can make two or more protocols communicate through its interfaces; because of this each interface must be configured to be able to perform functions correctly. If you want to do that you must connect to the router.

Typically any router has a port called "console" that is physically a RJ-45 or a V-24 so, to be connected to the router, it is required a "twisted pair" cable (usually provided by the vendor) and a computer with a terminal emulator set on 9600 bps rate, 8-bit data, no parity and stop-bit=1.

If the computer we want to use to connect to the router runs Windows operative system then the program to be used is Hyper Terminal or any other software that allows connection through a console (a low rate serial port).

Once the connection is made it is possible to view the bootstrap[3] of the router while it is booting.
When the router is booted the operative system is loaded on the RAM and uncompressed, the hardware check on the interfaces is done and at last the router "configuration" is loaded.

The configuration consists on a set of instructions used by the router to have information regarding working mode. Now the router must be configured basing on own requirements.
Once the bootstrap is over, if the router has not been configured yet, a sequence of questions will be asked for the auto-configuration. If the router had already been configured its name will be used as prompt.

The configuration is set in a non-volatile memory.
When the rooter is booted it loads the configuration on a volatile RAM memory. If we apply any modification this is accepted in real time but it is loaded only on the volatile memory. This means that non saved modification to the configuration are lost as soon as the machine is reset.

The first useful command to be always considered is the question mark "?", which is a sort of help composed by a set of commands with a brief explanation.

Entering in advanced mode it is possible to see and modify the configuration. In order to do this you must type *"enable"* command, which modifies also the prompt in the command line.
Now the configuration can be displayed and modified.

The router configuration is on a non-volatile memory and can be viewed by *"show configuration"* command while the active one is on the RAM memory and can be displayed by *"show running-config"*.

If you want to configure a port of the router you must, as first, enter configuration mode by *configure terminal* command and then start configuring the available interfaces helped by the "?" guide or the router manual.

Almost all available commands are the same for all routers and can differ also on the software version used. Router Cisco Systems usually use the Internetworking Operating System (IOS).

Once that interfaces, routing protocols, filters etc have been configured, it is possible to type "*CTRL + z*" or "*exit*" command to exit the configuration.

It is important to always remember that modifies applied to router configuration are accepted in real-time and new settings are not saved into the memory until *"write"* command is used.

1.2.2. How to install and configure Remote Access components

[3] The bootstrap is a short program loaded by the BIOS (Basic Input Output System) upon system startup. The BIOS has no information about the environment required by the operating system and therefore can do nothing to initialize the system beyond putting the hardware into a known state. This is where the bootstrap program comes into play. The BIOS loads the bootstrap from a known location and transfers control. It is the bootstrap's responsibility to load code and build an appropriate operating environment.

Remote Access Service (RAS) allows remote users to work as if they were connected directly to the network. In this paragraph we will take into account Windows NT operative system.

Windows NT RAS connects remote or mobile workers to corporate networks and appears on the desktop as a Dial-Up Networking icon.

Users run the RAS graphical phonebook on a remote computer and then initiate a connection to the RAS server using a local modem, X.25, or ISDN card; we will consider local modem way. The RAS server, running on a Windows NT Server computer, authenticates the users and services the sessions until terminated by the user or network administrator. All services typically available to a LAN-connected user (including file- and print-sharing, database access and messaging) are enabled by means of the RAS connection.

Clients connecting to Windows NT RAS servers must have a modem (9600 baud or above is recommended for acceptable performance), an analog telephone line or other WAN connection, and remote access software installed.

Windows NT Server administrators use the Remote Access Admin program to control the Remote Access server, view users, grant permissions, and monitor Remote Access traffic. The server must have a multiport adapter or modems (9600 baud or above is recommended for acceptable performance), analog telephone lines or other WAN connections, and the RAS software installed.

If the server will provide access to the network, a separate network adapter card must be installed and connected for each network the server will provide access to.

We will consider RAS connection by means of modem, both on client and server.

The following paragraphs describe how to install Windows NT Remote Access Service on your computer and how to configure the service to work on your network.
Although RAS is part of Windows NT Setup, you can also install it using the Network icon in Control Panel after you have installed Windows NT. To install and configure RAS, you must be logged on as a member of the Administrators group.

To add the Remote Access software:

- In Control Panel, click the Network icon.
- In the Services tab, click Add.
- From the Network Service box, select Remote Access Service and then click OK. When prompted for the path to the distribution files, provide the path and click OK. The RAS files will be copied to your computer.
- If you have no devices installed on your computer, the Modem Wizard appears and helps you install a RAS capable device.
- The Add RAS Device dialog box displays a list of all ports available to Windows NT for RAS. If you have successfully installed a multiport adapter, ISDN card, X.25 card, or other device, it will appear in this list. Select the port you will use for remote access, and click OK.
- Click Install Modem to have RAS Setup automatically detect the modem connected to the selected port. If RAS Setup cannot distinguish between two or more modems, a dialog box will appear, requiring you to select your modem from a short list.
- In the Remote Access Setup dialog box, select the port and click Configure. In the Configure Port Usage box, choose how the port is to be used and click OK.
  - Dial out only means the computer will be a RAS client only.
  - Receive calls only means the computer will be a RAS server only.
  - Dial out and Receive calls means the computer can be a client or server. (Note: The computer cannot be both at the same time.)
- In the Remote Access Setup dialog box, configure RAS network-wide settings by clicking Network.
- Click Continue when you are finished setting up the port and network configurations. RAS Server Configuration dialog boxes will appear for the protocols installed on your computer. See the appropriate topics in the following section for configuring LAN protocols for RAS use.
- Click Close in the Confirmation dialog box, and click OK in the Network dialog box. You might be prompted to confirm network protocols or other settings.
- You must restart your computer for the Remote Access installation and configuration take effect.

The Remote Access software includes the following applications:

- Dial-Up Networking is the client version of RAS and is used to connect to dial-up servers. The Dial-Up Networking icon is located in the My Computer dialog box and in the Accessories folder on the Start menu.

Dial-Up Networking Monitor, used to monitor connections and devices, is located in Control Panel.

- Remote Access Admin, used to monitor remote users connecting to a RAS server, is located in the Administrative Tools folder on the Start menu.

Key Point Summary Conclusions and Recommendations

1. Before buying and installing any type of network card adapter it is necessary to check if it compatible with the operative system used and if do drivers exist.
2. Before installing it read carefully the user's manual provided with the hardware to be installed and execute all indicated operations.
3. If errors are detected while configuring the device check carefully in all indicated steps have been followed and look for the FAQs before asking commonly asked questions.

Study Guide

ESSENTIAL QUESTIONS TO VERIFY ACCOMPLISHED KNOWLEDGE

1. How it is possible to remove and/or update the drivers of a network card adapter in Windows environments?
2. If a manual or other sources are not available how is it possible to get information regarding the devices installed on the PCI of the computer in Linux environments?
3. Why most of winmodems is not supported by Linux?
4. Which supports are required to be present in the kernel to install an external modem with a Linux operative system?
5. What are routers? What are they used for?

BIBLIOGRAPHY. REFERENCES.

[1.] S. Gai, P.L. Montessoro, P. Nicoletti, "*Reti Locali: dal Cablaggio all'Internetworking*", SSGRR (Scuola Superiore G. Reiss Romoli), 1995, ISBN 88-85280-22-6.
[2.] Radia Perlman, "*Interconnections: Bridges and Routers*", Addison-Wesley, 1992, ISBN 0-201-56332-0.
[3.] Sam Halabi, Danny McPherson, "*Internet Routing Architectures*", Second Edition, Cisco Press, August 2000 ISBN: 1-57870-233-X,

SUPPLEMENTARY IMPORTANT BIBLIOGRAPHY. REFERENCES. (www)

[SUPP 1.] http://www.tldp.org/, The Linux Documentation Project.
[SUPP 2.] http://support.microsoft.com/default.aspx?pr=winxp, Microsoft Corporation.
[SUPP 3.] http://www.oucs.ox.ac.uk/network/, Robin Stevens, Oxford University Computing Services, January 2002.
[SUPP 4.] http://www.cisco.com/univercd/cc/td/doc/product/access/acs_fix/831/qsg/, Cisco System.
<[SUPP 5.] http://www.ledge.co.za/software/lpinotes/101-letter.pdf; Leading Edge Business Solutions; 2006; Linux 101 Examination Modular Training Notes Complete e-Handbook of 233 pages; http://www.ledge.co.za>
<[SUPP 6.] http://www.ledge.co.za/ LeadingEdge, Linux Training Software networking.>
<[SUPP 7.] http://www.linuxdevcenter.com/linux/cmd/cmd.csp?path=l/lspci; Linux in a Nutshell, 5-th Edition, (Alphabetical Directory of Linux commands); by : Stephen Figgins, Robert Love, Arnold Robbins, Ellen Siever, Aaron Weber; Publisher: **O'Reilly; 2005; 0-596-00930-5; Pages 944**.>
<[SUPP 8.] http://www.reallylinux.com/docs/admin.shtml; Linux Commands for Beginning Server Administrators by Mark Rais, senior editor at ReallyLinux.com www.reallylinux.com>.
<[SUPP.9.] http://docs.kde.org/stable/en/kdenetwork/kppp/index.html; The KPPP Handbook; Lauri Watts (lauri kde.org); Revision 1.01.00 (2001-06-11); Copyright © 2001 Lauri Watts>.

RESPONSES TO THE QUESTIONS

1. The procedure to remove or update the drivers of a network card is the following: click on Start, open the Control Panel and select System properties. Now select the folder (tab) with Hardware written on and click on Device Manager. After clicking this button a dialogue window will be opened showing a list of hardware features of the computer with related icons among which there is the network card; clicking with the right button it is possible to display the card properties, the driver properties and the operations that can be done on it (update, roll back, uninstall etc.).
2. If a manual or other sources are not available it is possible to use lspci command to collect information about the disposals installed on the PCI bus of the computer. Executing the program with the –v option we obtain more detailed information regarding the devices connected to the PCI bus and with –n option even the vendor PCI and the code of the disposal (as number instead of literal identifier) are shown.
3. Winmodem are software modems and pass most of the work to the chip of the main processor (CPU). Different vendors (hence not available for open source operative systems like windows) make the CPU execute some functions via software making hardware part simpler, lighter and less expensive.
4. If the modem is an external modem there is no need for further drivers nor for particular modules except the PPP protocol support in the kernel we are using.
5. Routers are devices that allow interconnection between two or more different networks and let different protocols be interfaced. . The task of these apparatus consists in forwarding the data packets on the appropriate interface toward other Router placed on the way toward the destination.

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