



CASO DE ESTUDIO:

VIRTUALIZACIÓN DE ROUTEROS ORIENTADO A LA ENSEÑANZA DE REDES DE COMUNICACIÓN BASADAS EN MIKROTIK.

Implementación en ambientes de virtualización del sistema operativo RouterOS orientado a la enseñanza de redes y comunicaciones basadas en MikroTik, permitiendo a los estudiantes simular escenarios reales de implementación y resolución de problemas.

Ing. Juan Casierra Cavada
Docente Redes y Comunicación
Pontificia Universidad Católica del Ecuador
Sede Esmeraldas

Argentina. 10 de Noviembre 2015

ANTECEDENTES DEL CASO

LABORATORIO DE REDES UNIVERSIDAD



Equipos especializados para las diferentes practicas a realizarse en el transcurso de la enseñanza.

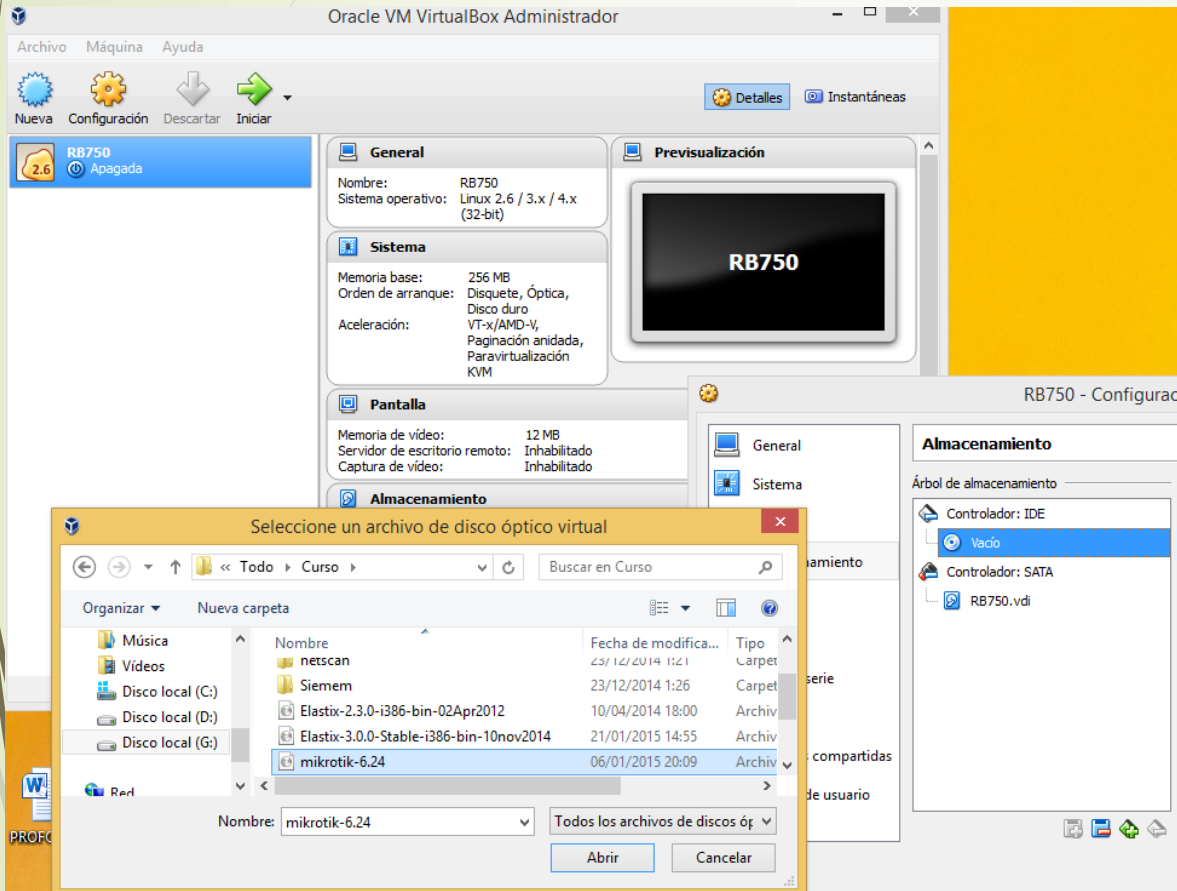
Restricción del acceso en lo diferente a horarios no académicos.

Múltiples estudiantes interactuando en la configuración de los equipos.

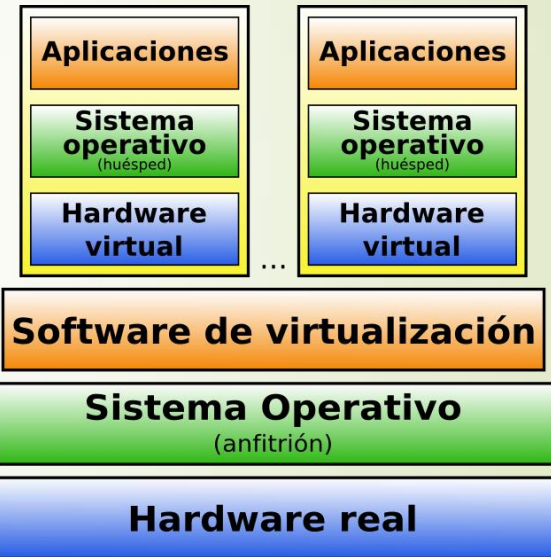
Perdida de tiempo en carga y descarga de información

Posibles daños de puertos físicos en proceso de conexión y desconexión

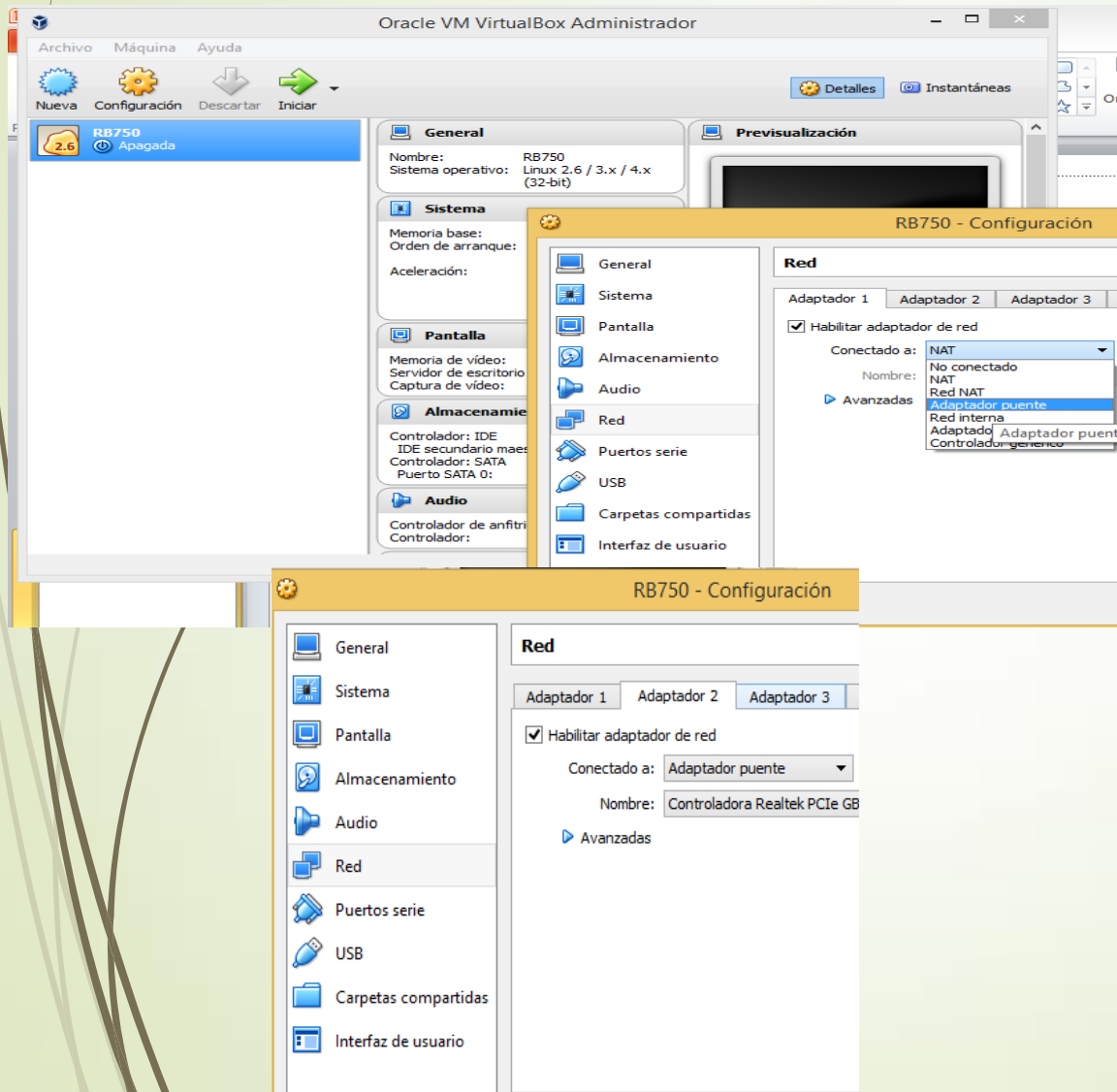
Virtual Box selección de ISO Routeros



➤ Plataforma virtual para instalación de RouterOS



VIRTUALIZACIÓN DE INTERFACE DE RED



➤ Creación de interfaces de red virtuales con la opción puente.

➤ Se comparte el medio físico con interfaces virtuales

➤ Capacidad de un direccionamiento independiente al nativo del equipo.

INSTALACIÓN ISO ROUTEOS

WINBOX

```
Welcome to MikroTik Router Software installat

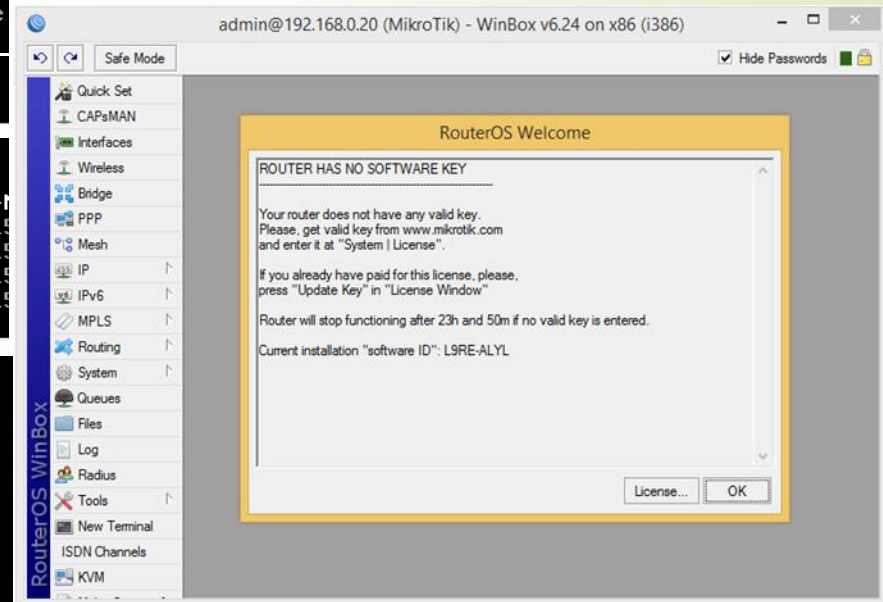
Move around menu using 'p' and 'n' or arrow keys, select with
Select all with 'a', minimum with 'm'. Press 'i' to install l
cancel and reboot.
```

```
[X] system          [X] ipv6          [X] rout
[X] ppp             [X] isdn          [X] secu
[X] dhcp            [X] kvm           [X] ups
[X] advanced-tools  [X] lcd           [X] user
[X] calea           [X] mpls          [X] wire
[X] gps             [X] multicast     [X] wire
[X] hotspot         [X] ntp
```

```
[admin@MikroTik] > _
```

```
[admin@MikroTik] </interface> print
Flags: D - dynamic, X - disabled, R - running, S - slave
#    NAME    TYPE    ACTUAL-IP
0    R ether1  ether   192.168.0.1
1    R ether2  ether   192.168.0.2
2    R ether3  ether   192.168.0.3
3    R ether4  ether   192.168.0.4
[admin@MikroTik] </interface> _
```

```
[admin@MikroTik] > ip dns print
servers:
dynamic-servers:
allow-remote-requests: no
max-udp-packet-size: 4096
query-server-timeout: 2s
query-total-timeout: 10s
cache-size: 2048KiB
cache-max-ttl: 1w
cache-used: 8KiB
```



ROUTEROS EN EJECUCIÓN

The image shows three Oracle VM VirtualBox windows, each running a MikroTik RouterOS instance. The windows are titled 'RB750 [Corriendo]', 'RB751 [Corriendo]', and 'RB752 [Corriendo]'. Each window displays the output of the 'ip address print' command, showing the IP addresses assigned to the interfaces.

RB750 [Corriendo] - Oracle VM VirtualBox

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
# ADDRESS NETWORK INTERFACE
0 192.168.10.1/24 192.168.10.0 ether2
1 D 10.0.5.22/24 10.0.5.0 ether1
[admin@MikroTik] >
```

RB751 [Corriendo] - Oracle VM VirtualBox

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
# ADDRESS NETWORK INTERFACE
0 192.168.10.2/24 192.168.10.0 ether1
1 192.168.20.1/24 192.168.20.0 ether2
[admin@MikroTik] >
```

RB752 [Corriendo] - Oracle VM VirtualBox

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
# ADDRESS NETWORK INTERFACE
0 192.168.20.2/24 192.168.20.0 ether1
1 192.168.30.1/24 192.168.30.0 ether2
line 2 of 2>
```

- Imagen ilustra los diferentes sistemas RouterOS habilitados.
- Ejecutándose cada uno con su interface virtual corriendo sobre la física.

The image shows a WinBox v6.24 on x86 (i386) window. The 'Route (Running)' window is open, displaying a table of routes and their status. The table has columns for Host, Loss, Sent, Last, Avg., Best, Worst, Std. Dev., History, and Status. The status column shows 'host unreachable from 192.168.33.178' for all routes.

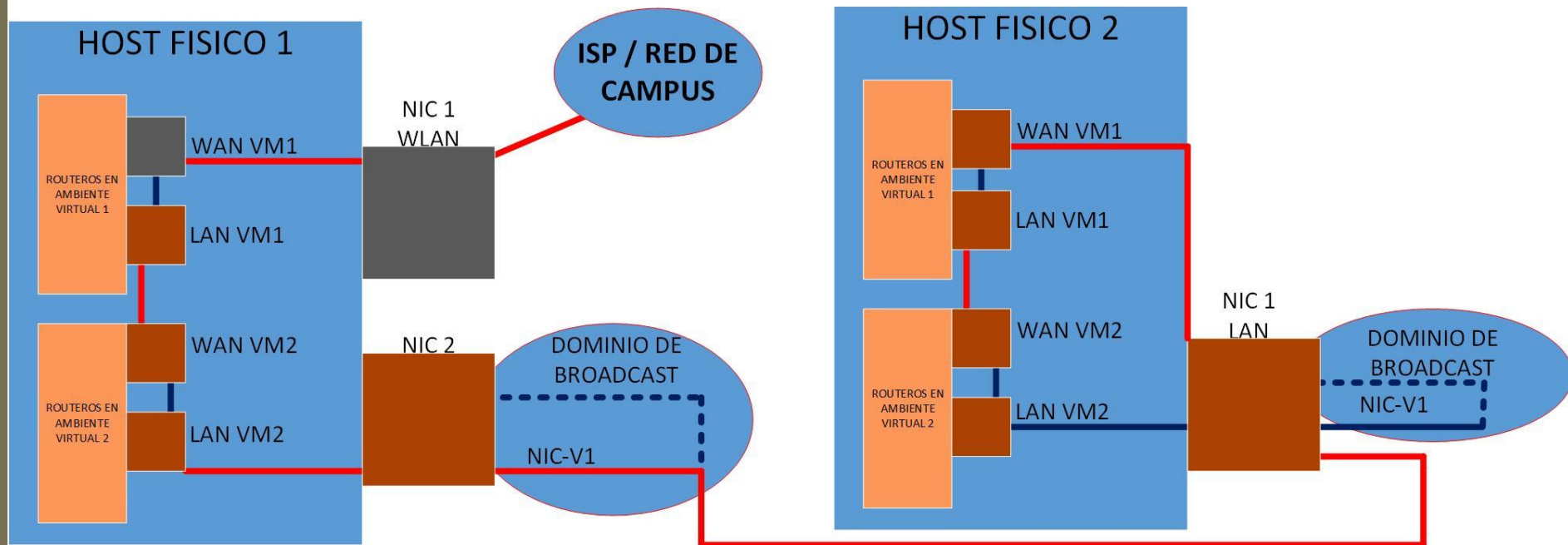
Host	Loss	Sent	Last	Avg.	Best	Worst	Std. Dev.	History	Status
5 186.42.182.1, 192.168.33.178	22.6%	93	timeout	33.4	2.7	978.1	159.7		host unreachable from 192.168.33.178
6 10.31.0.33, 192.168.33.178	21.7%	93	timeout	37.5	2.9	966.4	157.0		host unreachable from 192.168.33.178
7 190.152.252.181, 192.168.33.178	5.4%	92	978.2ms	206.6	9.1	991.2	428.9		host unreachable from 192.168.33.178
8 190.152.252.110, 192.168.33.178	21.7%	92	timeout	46.7	9.2	969.6	152.8		host unreachable from 192.168.33.178
9 190.152.251.189, 192.168.33.178	22.8%	92	timeout	104.4	79.3	977.8	142.3		host unreachable from 192.168.33.178
10 190.152.251.130, 192.168.33.178	6.5%	92	989.7ms	278.7	80.7	990.7	451.1		host unreachable from 192.168.33.178
11 190.152.251.82, 192.168.33.178	22.8%	92	timeout	119.6	78.8	970.3	176.1		host unreachable from 192.168.33.178
12 216.239.50.55, 192.168.33.178	23.9%	92	timeout	113.2	88.6	966.5	140.7		host unreachable from 192.168.33.178
13 216.239.50.101, 192.168.33.178	4.3%	92	958.9ms	286.9	84.9	990.1	456.4		host unreachable from 192.168.33.178
14 8.8.8.8, 192.168.33.178	22.8%	92	timeout	132.5	88.5	984.5	200.7		host unreachable from 192.168.33.178

ns (1 selected)

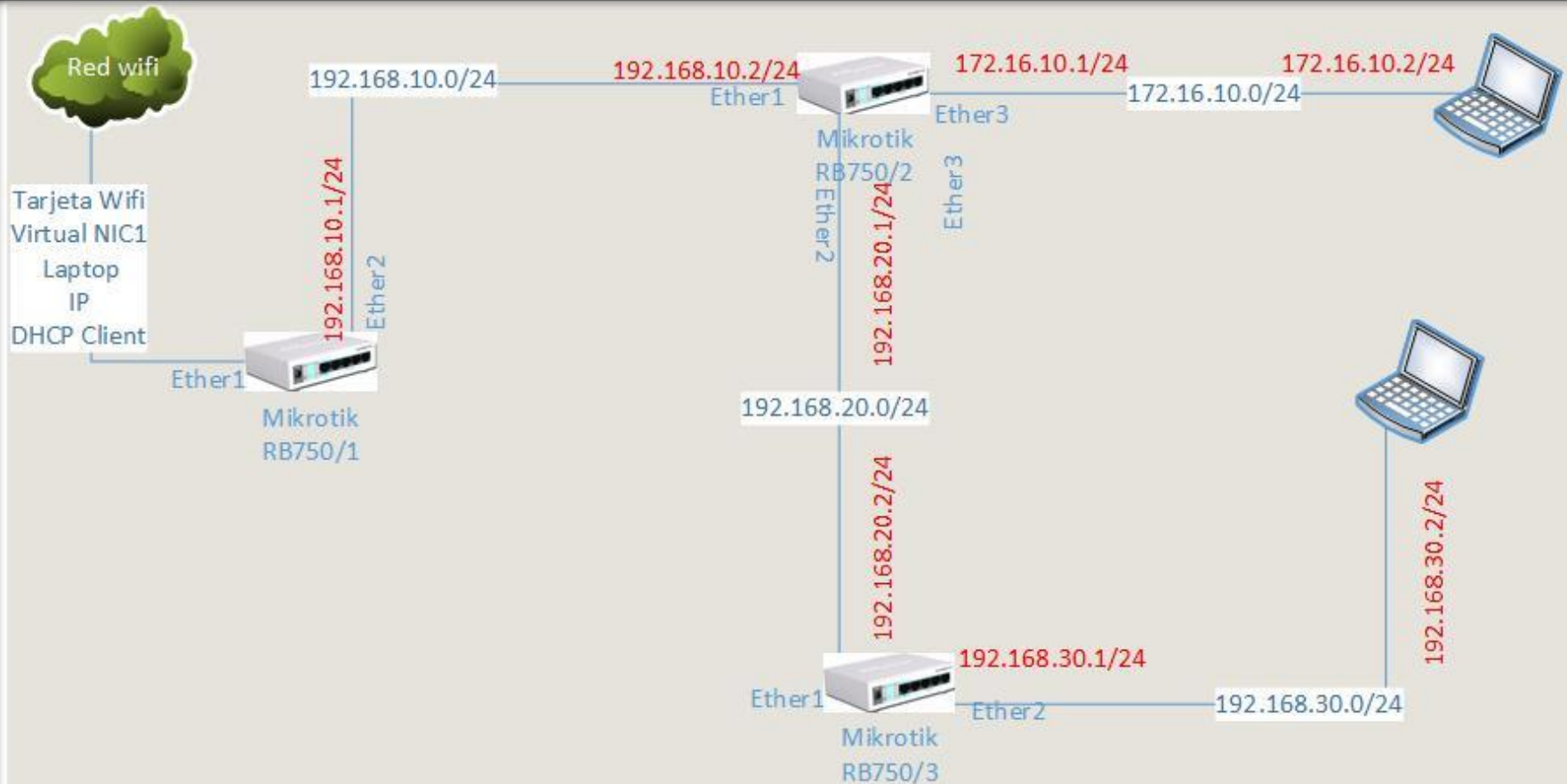
```
1 1 ns <1 ns <1 ns 192.168.50.1
2 1 ns 3 ns 2 ns 192.168.40.1
3 2 ns 1 ns 2 ns 192.168.10.1
4 5 ns 6 ns 3 ns 192.168.33.1
5 * * 192.168.33.178 informes: Host de destino inaccesible
```

Trazo completa.

PROCESO DE COMUNICACIÓN ENTRE MEDIOS FISICOS Y VIRTUALES EN LA SIMULACION

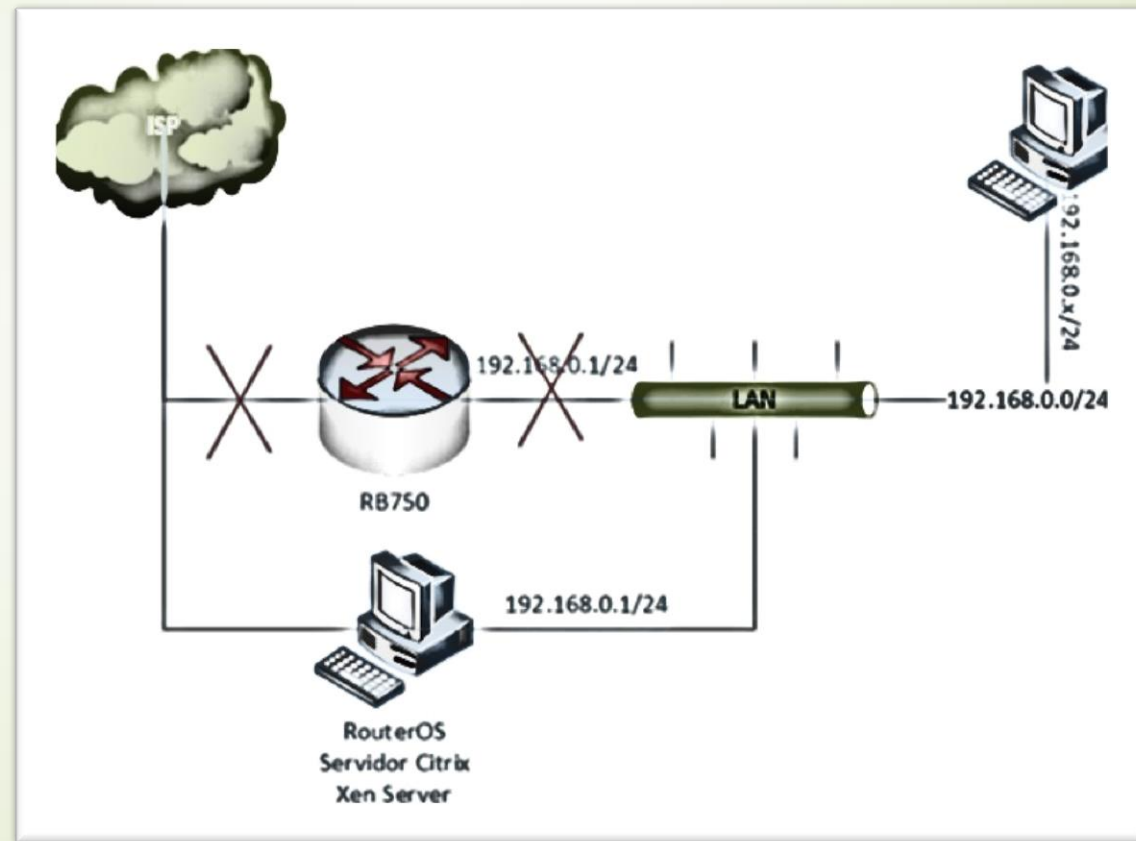


PRACTICA EN PROCESOS EDUCATIVIVOS EJECUTADOS

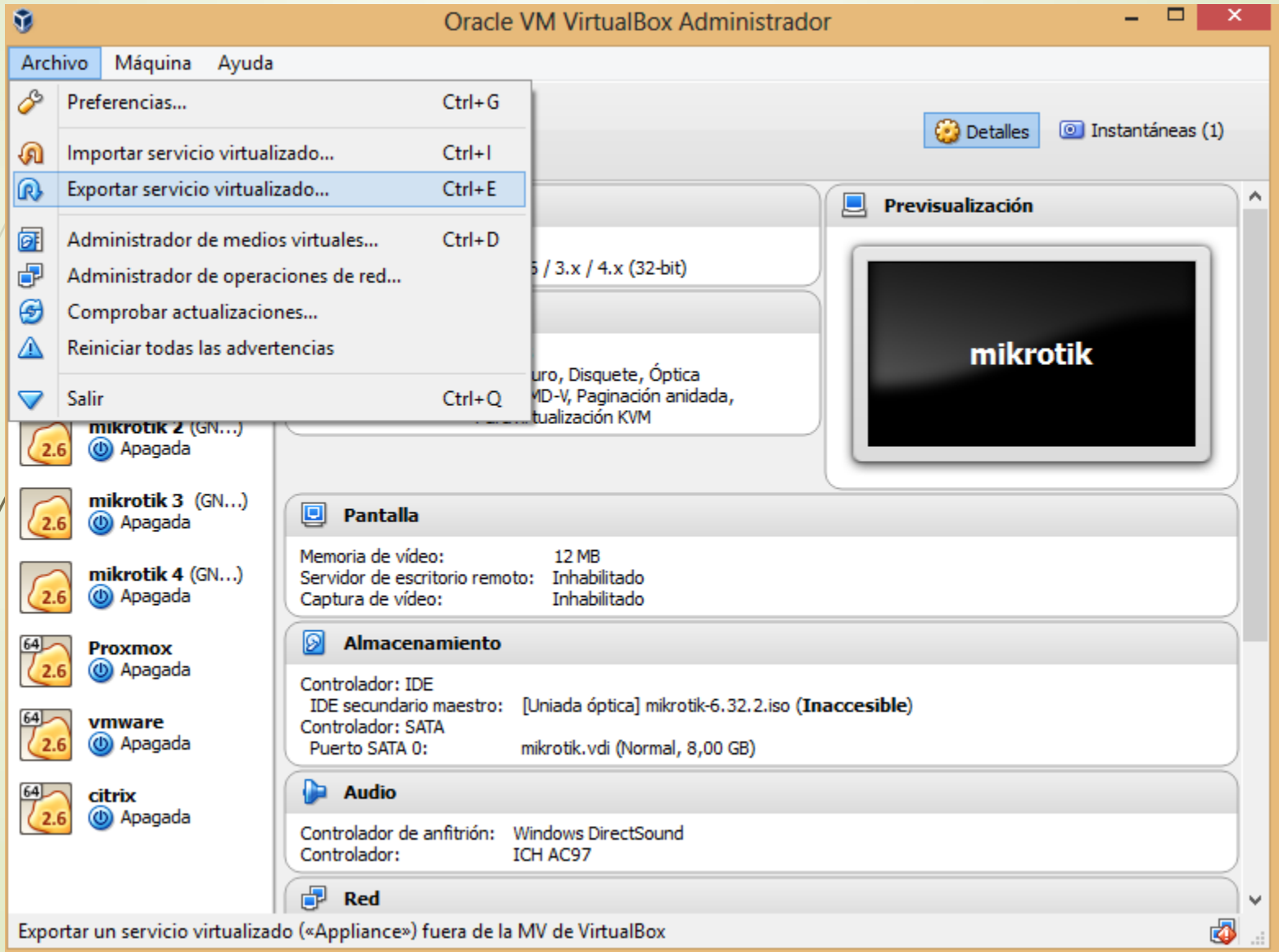


Proceso ejecutado en un pc explotando recursos VM

RECUPERAR LA OPERATIVIDAD DE LA RED



ROUTEROS Y CITRIX XEN SERVER EXPORTAR SERVICIO VIRTUALIZADO



ROUTEROS Y CITRIX XEN SERVER

EXPORTAR DE VIRTUALBOX EN FORMATO *.ova

Exportar servicio virtualizado

Máquinas virtuales a exportar

-  citrix
-  mikrotik
-  mikrotik 1
-  mikrotik 2
-  mikrotik 3
-  mikrotik 4
-  Proxmox
-  RB01
-  vmware

Preferencias de servicio virtualizado

Descripción	Configuración
Sistema virtual 1	
 Nombre	mikrotik
 Producto	
 URL del producto	
 Vendedor	
 URL del vendedor	
 Versión	
 Descripción	
 Licencia	

Preferencias de almacenamiento

Archivo: 

Formato:

☐ Guardar archivo Manifest

Modo guiado Restaurar valores predeterminados **Exportar** Cancelar

ROUTEROS Y CITRIX XEN SERVER IMPORTAR EN SERVIDOR CITRIX

Import OVF/OVA Package

Locate the file you want to import

Import Source

- EULAs
- Location
- Storage
- Networking
- Security
- OS Fixup Settings
- Transfer VM Settings
- Finish

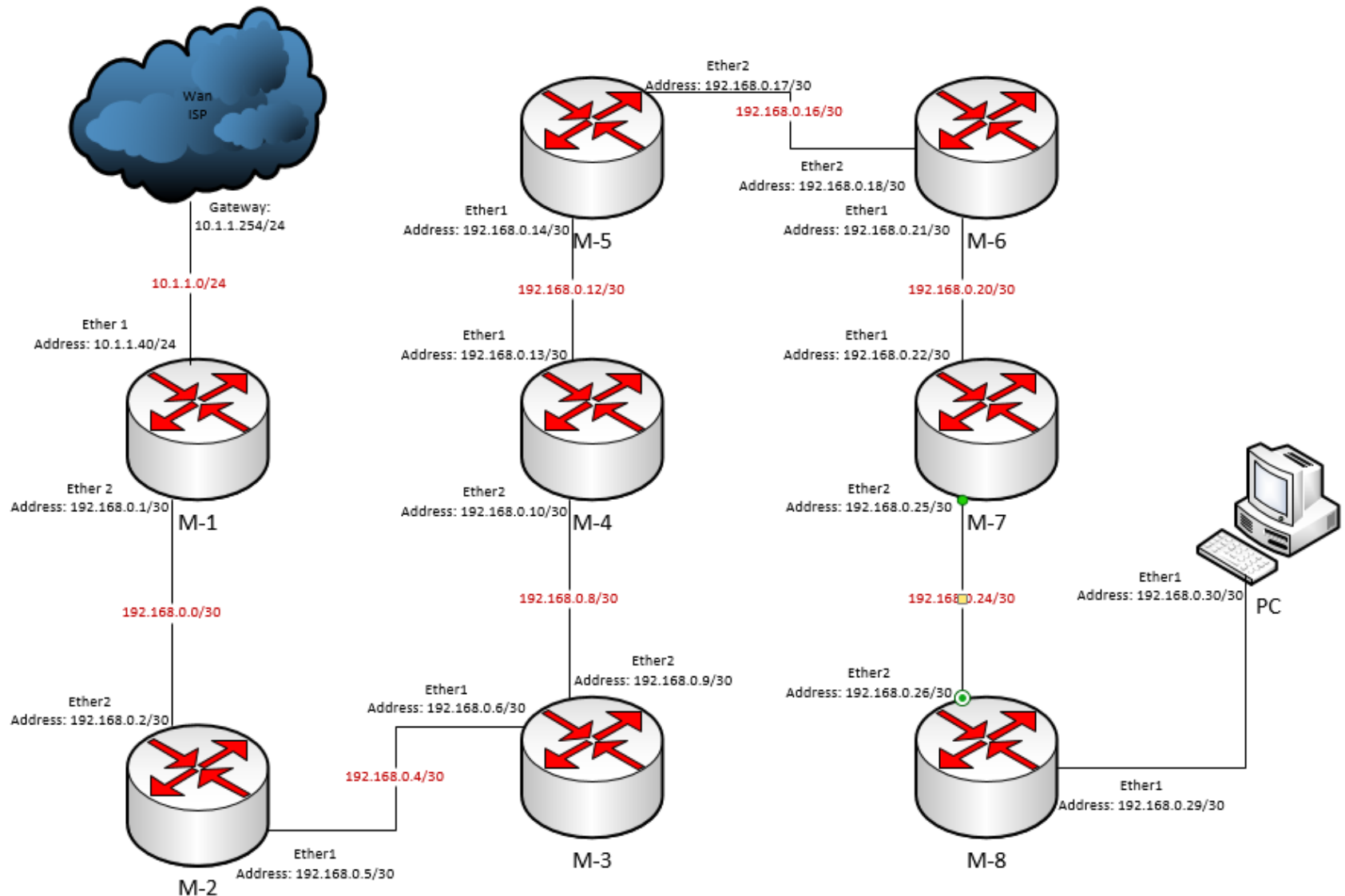
Enter the pathname of an exported VM or template, an OVF/OVA package or a virtual hard disk image file or click Browse to find the file you want.

Filename: C:\Users\password\Desktop\Escritorio\mikro\mikro1.ovf

CITRIX

< Previous **Next >** Cancel

COPIA Y CONFIGURACIÓN DE MAQUINAS VIRTUALES



MAQUINAS VIRTUALES EN EJECUCIÓN CON CONFIGURACIONES ESPECIFICAS

XenCenter

File View Pool Server VM Storage Templates Tools Window Help

Back Forward Add New Server New Pool New Storage New VM Shut Down Reboot Suspend

Views: Server View

Search...

XenCenter

- servidor3
- Servidor5
- Servidor6
 - M-1
 - M-2
 - M-3
 - M-4
 - M-5
 - M-6
 - M-7
 - M-8
 - ubuntu
 - UBUNTU_1
 - DVD drives
 - ISOs
 - ISOs
 - Local storage
 - Removable storage

Search

General Memory Storage Networking NICs Console Performance Users Logs

Servidor6 Overview

Search Options

Name	CPU Usage	Used Memory	Disks (avg / max KB)
Servidor6			
Default install of XenServer	46% of 2 CPUs	3970 of 4058 MB	-
M-1	3% of 1 CPU		XenServer Tools not installed
M-2	3% of 1 CPU		XenServer Tools not installed
M-3	3% of 1 CPU		XenServer Tools not installed
M-4	3% of 1 CPU		XenServer Tools not installed
M-5	3% of 1 CPU		XenServer Tools not installed
M-6	3% of 1 CPU		XenServer Tools not installed
M-7	3% of 1 CPU		XenServer Tools not installed
M-8	3% of 1 CPU		XenServer Tools not installed

ACCESIBILIDAD DE LOS SISTEMAS VIRTUALES DESDE WINBOX

The image displays a multi-instance WinBox v6.2.4 interface, showing the configuration of various virtual systems. The interface is divided into a left sidebar with navigation options and a main content area with a 'Dashboard' and an 'Address List' table.

Navigation Sidebar (Left):

- Quick Set
- CAPsMAN
- Interfaces
- Wireless
- Bridge
- PPP
- Mesh
- IP
- IPv6
- MPLS
- Routing
- System
- Queues
- Files
- Log
- Radius
- Tools
- New Terminal
- ISDN Channels
- KVM
- Make Supout.tif
- Manual
- New WinBox

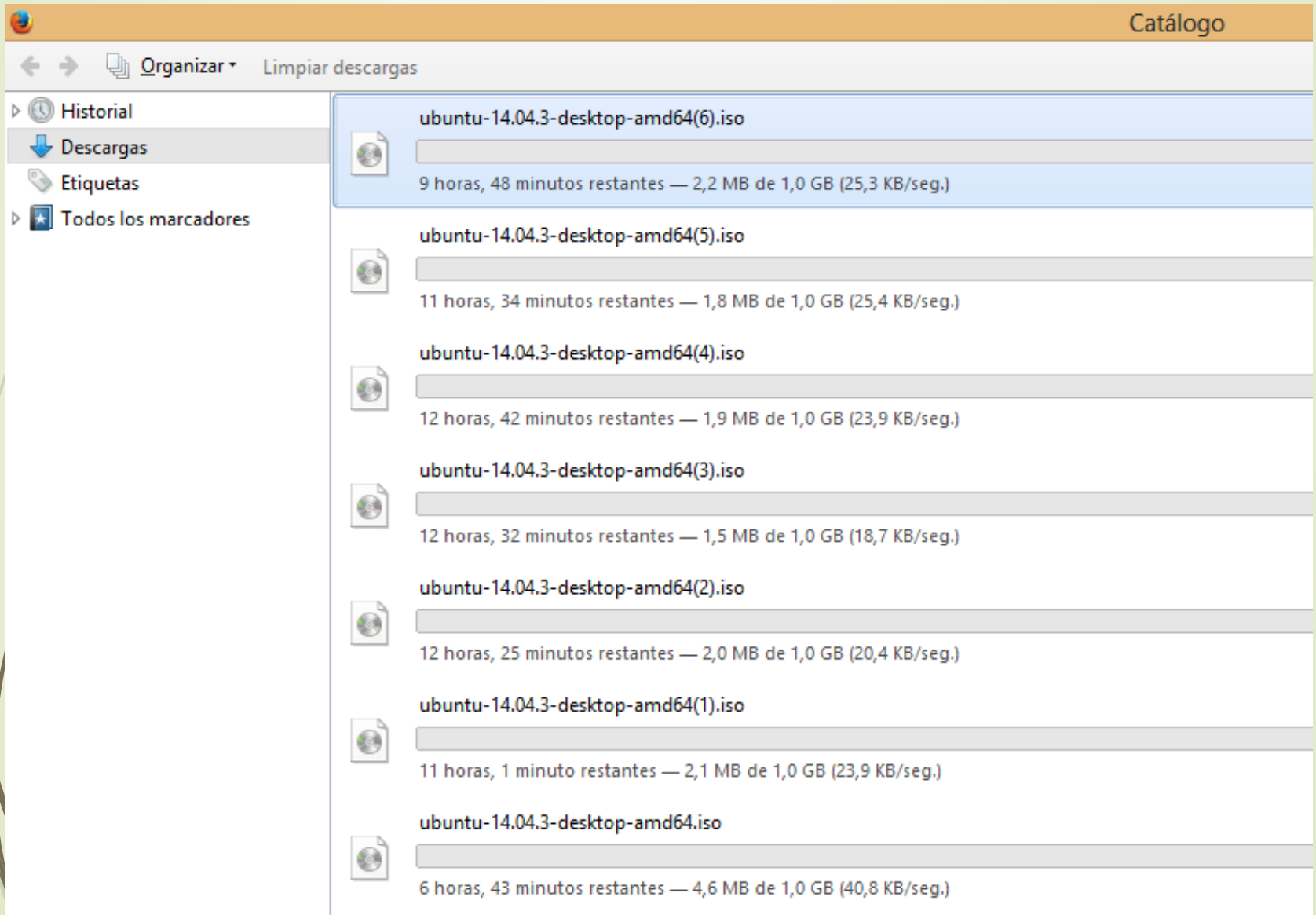
Address List Table (Main Content):

Address	Network	Interface
Wan		
10.1.1.40/24	10.1.1.0	ether1
Lan 1		
192.168.0.1/30	192.168.0.0	ether2

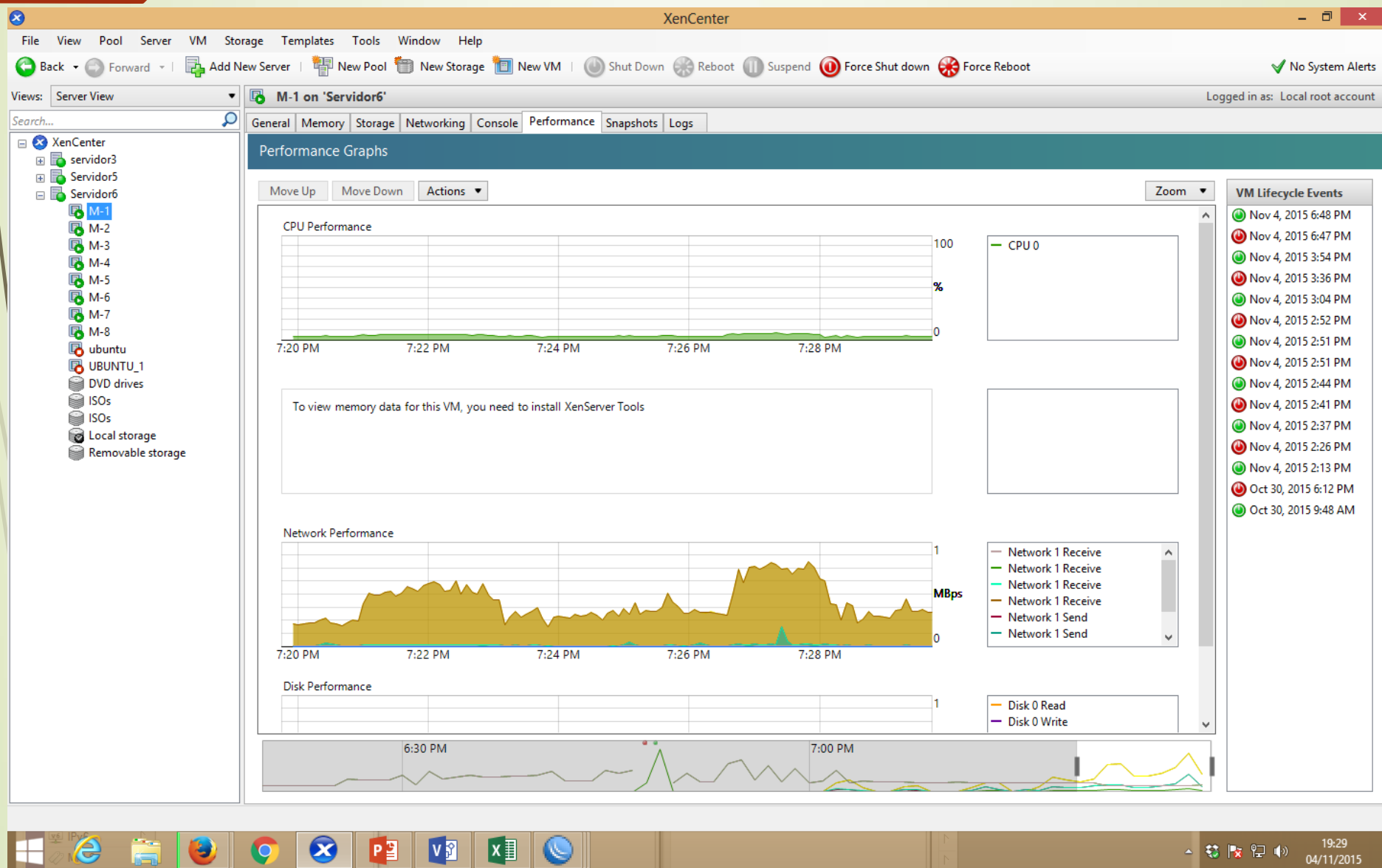
Virtual System Sessions (Top Bar):

- admin@192.168.0.1 (M-1) - WinBox v6.2...
- 8.0.5 (M-2) - WinBox v6.2...
- 0.9 (M-7) - WinBox v6.2...
- 0.13 (M-4) - WinBox v6.2...
- admin@192.168.0.29 (M-8) - WinBox v6.2...
- 5 (M-7) - WinBox v6.24 on ...
- 21 (M-6) - WinBox v6.24 ...
- 58.0.17 (M-5) - WinBox ...

TRAFICO DESDE HOST CONECTADO A ROUTEROS EN CITRIX



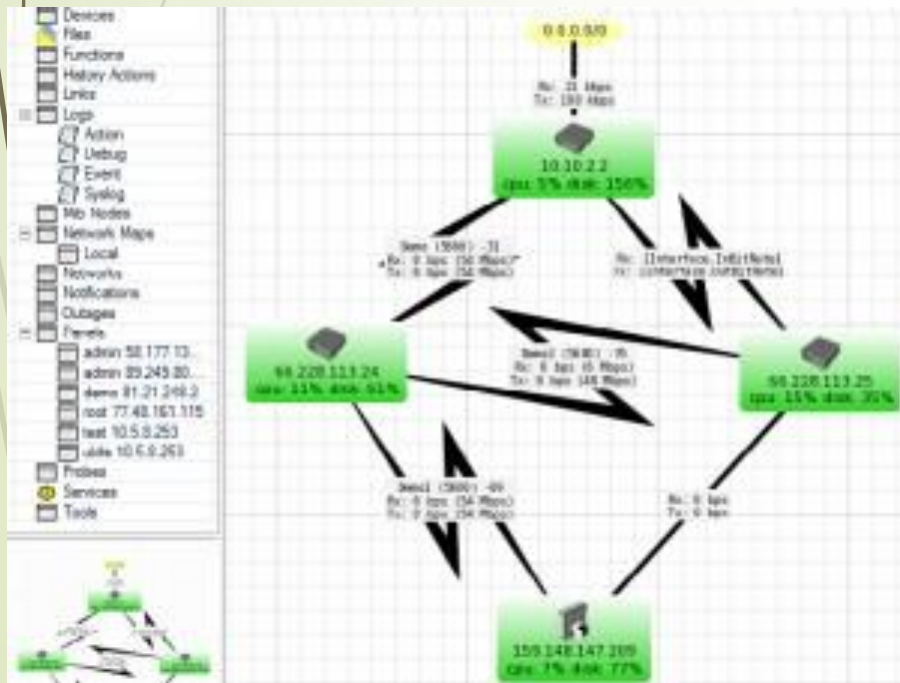
PERFORMANCE DE ROUTEROS VIRTUAL Y EN LÍNEA.



GESTIÓN DE REDES

MONITOREO SNMP

THE DUDE



LORIOT-PRO

The screenshot shows the 'LORIOT-PRO' network monitoring software interface. At the top is a menu bar with 'TOOLS', 'CONFIGURE', 'WINDOW', and 'HELP'. Below the menu is a toolbar with icons for 'MIB Bar', 'Directory', 'MIB Output', 'Events', 'Mini Map', 'MIB Tree', 'Report Center', 'Routers', 'Services', and 'Tasks'. The main area is divided into two panes. The left pane, titled 'MiniMap', shows a network topology diagram with nodes and links. The right pane, titled 'Agent Name', displays a table of agents with columns for 'Agent Name', 'IP address', and 'SysName'. The table contains the following data:

Agent Name	IP address	SysName
MyOrganisation	192.168.204.1	
>192.168.204.1	192.168.204.1	
>192.168.207.239	192.168.207.239	
>192.168.56.1	192.168.56.1	

Below the table is a 'Syslogs' section with a table showing log entries. The table has columns for 'TimeStamp', 'Agent', 'Facility', 'Level', and 'Alert'. The log entries are filtered by 'Syslogs(GLOBAL)', 'Syslogs(1)', 'Syslogs(2)', and 'Syslogs(3)'. At the bottom of the interface is a status bar with various indicators, including 'ODBC: OFF', 'DISCOVER: OFF', and 'RESERVED: MAJ NUM DEF'.

MONITOREO CON SOFTWARE LOROTPRO DE PLATAFORMA VIRTUAL CON 8 ROUTEROS EN LINEA

LoriotPro V7.00, (-bl) - Free Edition

File View Directory Routers MIB Services Monitor Tools Configure Window Help

Text Map Bar Search Bar Host Bar Directory Bar Health Bar MIB Bar Directory MIB Output Events Mini Map MIB Tree Report Center Routers Services Tasks

Router Space

- Root
 - [M-1]
 - (10.1.1.40) M-1
 - (192.168.0.1) M-1
 - [M-2]
 - (192.168.0.2) M-2
 - (192.168.0.5-ether1) M-2
 - [M-3]
 - (192.168.0.6-ether1) M-3
 - (192.168.0.9-ether2) M-3
 - [M-4]
 - (192.168.0.10-ether2) M-4
 - (192.168.0.13-) M-4
 - [M-5]
 - (192.168.0.14-) M-5
 - (192.168.0.17-ether2) M-5
 - [M-6]
 - (192.168.0.18-ether2) M-6
 - (192.168.0.21-ether1) M-6
 - [M-7]
 - (192.168.0.22-ether1) Agent
 - (192.168.0.25-ether2) Agent
 - [M-8]
 - (192.168.0.26-ether2) M-8
 - (192.168.0.29-192.168.0.28/255.255.255.252) M-8

MiniMap

Agent Name	IP address	Sys...	SysObjectID	Mac Address	Node Service	User 1
Network 192.168.0.28	192.168.0.28					
M-8	192.168.0.29	M-8	enterprises.14988.1	2A:AE:8B:BD:BF:3D	Router	
> 192.168.0.30	192.168.0.30			B8:97:5A:6A:8A:76		

Trans

Syslogs

TimeStamp	Agent	Facility	Level	Alert
-----------	-------	----------	-------	-------

LoriotPro - Internetwork Map

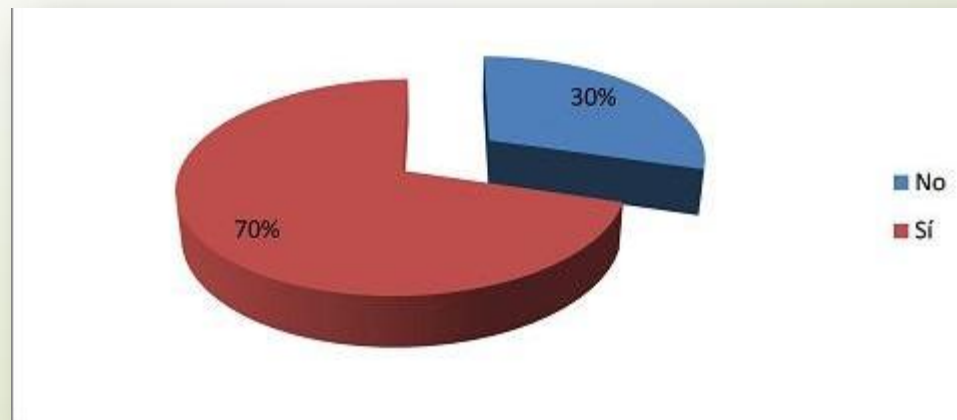
View Insert Supervise Options Help

Ready

QDBC OFF DISCOVER OFF AUDIT OFF RESERVED MA NUM DEF

NIVEL DE EFECTIVIDAD EN LO ACADÉMICO.

- Los procesos generados desde ambientes virtuales no remplazan al 100% las practicas con equipos físicos, pero si permiten el desarrollo de un 90% mas de practicas en la especialidad, generando posibilidades de tener un laboratorio en casa.
- Se logro incrementar un 70% de practicas adicionales a las presenciales en los laboratorios especializados, así como abrir un horizonte a las tendencias de virtualización de componentes en hardware bajo software especializado.





➡ **Gracias.**
casierrajuan@hotmail.com

MikroTik Solutions
MikroTik
<http://www.e-learning-mikrotik.com/>