

CSE 6032 Computer Networks 2021/22 Spring Term

Project: 1 - Part 1
Topic: Deploying Virtualization Platform
Date: 15.02.2022 – 26.02.2022

Objectives:

- to explore and configure basic network settings
- to deploy **Oracle VM VirtualBox** virtualization platform
- to import, configure and test a Guest VM

References:

- Oracle VM VirtualBox User Manual (<https://www.virtualbox.org/manual/UserManual.html>)
- Microsoft Virtual Machine Downloads (<https://developer.microsoft.com/en-us/microsoft-edge/tools/vms/>)

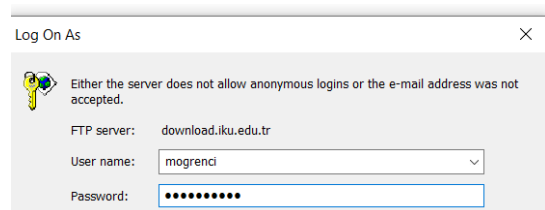
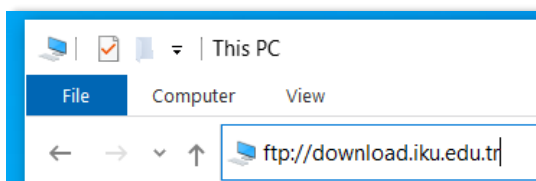
Section A. Downloading the VM Appliance

Deployment of project's platform requires the **creation** of several **Guest Systems** that will run over Oracle VM VirtualBox virtualization platform as independent **Virtual Machines** (VM). The **Guest** you will deploy is relatively small **VM** (512 MB) running the **Windows Enterprise 7** OS distributed by **Microsoft** for a limited free evaluation period (check **Microsoft Virtual Machine Downloads reference site**). This **Guest** has been reconfigured based on the needs of our project platform and stored at University's **ftp site** "**download.iku.edu.tr**" as the **VM appliance** under the name **W7-Ref.ova**.

As the **first step** of this project **download** the **VM appliance** using one of the procedures defined here after. Note that, the appliance size is **5,746,700 KB** and its downloading may last from **45 minutes to 3 hours**, based on the speed of your Internet connection and its quality. To decrease error rates, thus the download duration, you are advised to connect your **workstation** to the **ISP router** with a **cable** rather than using the **wireless** access.

A.1 Downloading the Guest using the File Browser

Login into University's ftp site using your **file browser** (left screen shut); enter the **username** "**mogrenci**" and the **password** "**mogrenci234**" (right screen shut), drag & drop or copy the **W7-Ref.ova** file to your workstation. Note that most login errors are due to **wrong passwords**.

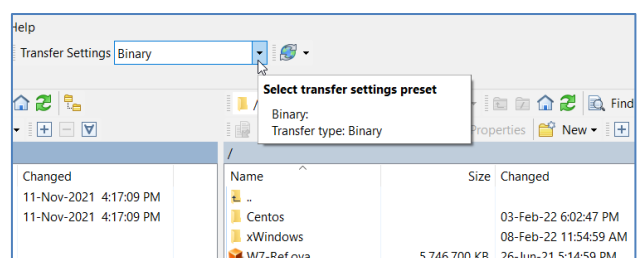
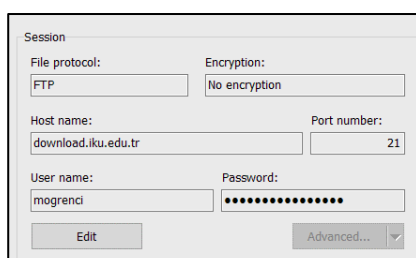


You may have also used a web browser that would have probably required the setup of security clearances for this site.

A.2 Downloading VM Appliance using an ftp Client

Alternatively, you may download the **W7-Ref.ova** file using the file transfer client of your choice. The example here after depicts the configuration for the **WinSCP** tool (<https://winscp.net/eng/download.php>).

Run the tool and define a "**New Site**" (left screen shut), **login** action opens local & remote directories as shown on the right screen shut. From menu bar set "**Transfer Settings**" to "**binary**"; then **copy** the **W7-Ref.ova** file into your directory.



Section B. Exploring and Configuring Basic Network Settings

B.1 Network Adapter Addresses

Computer systems connect to a network using **real** or **virtual adapters** that are identified with 2 class of **addresses**.

- i) **Physical address (MAC address)**
is a **48 bits number** that defines the adapter **uniquely** within the LAN. It is represented in **hexadecimal** (base 16) using groups of **2 digits** separated by dashes e.g. **"90-2B-34-77-57-D6"** (12 digits x 4 bits = 48 bits).
- ii) **CIDR IPv4 address (Classless Interdomain Routing Internet Protocol version 4)**
is the **"IPv4 address"** and the **"subnet mask"** pair that define together:
 - > the unique **network identifier** (number) to which the adapter is connected to; and
 - > the unique **adapter identifier** (ordinal) within this specific network (subnet).

The **"IPv4 @"** and the **"subnet mask"** are encoded as **32 bits** values that are represented in **dotted decimal form** in groups of **8 bits** separated by a **dot**.

For instance, the CIDR IPv4@ **"192.168.0.14"** and **"255.255.255.0"** indicates that the network adapter

- > is connected to the network **"192.168.0"** (first 24 bits of the 32 bit value indicated by **"255.255.255"**)
- > is identified as the adapter # **"14"** on this subnet (last 8 bits of the 32 bit value indicated by the mask).

Alternatively, **UNIX-like** systems represent the **CIDR IPv4 address** tuple, using the **dotted decimal form** for the **"IPv4 @"** followed by the length of **length** of network identifier field e.g. **"192.168.0.14 / 24"**

B.2 Network Connection vs Network Adapter

Network adapters are assigned their **CIDR IP@** either manually or dynamically by a **DHCP** server. Adapters may also be associated with several other network addresses, defining the systems they lead to, such as:

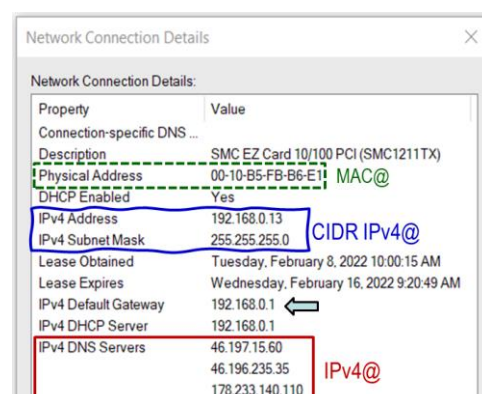
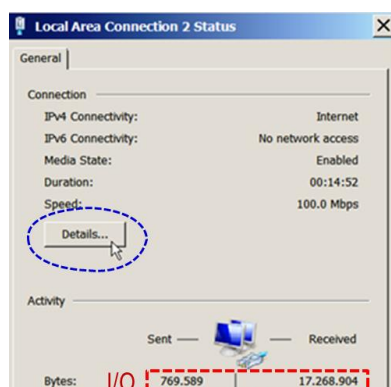
- ✓ subnet's **gateway** to external networks (the default gateway)
- ✓ the **IP@** list of DNS servers
- ✓ the **IP@** of DHCP server

A configured **network adapter** is referred in the operating system terminology as a **Network Connection**. Obviously, a given **adapter** may be connected to various networks and configured differently in time (e.g. a laptop's wireless adapter)!

A network adapter may have several connection names!

B.3 Exploring Network Settings through Windows GUI

- i) From **Control Panel** open **"Network and Sharing Center"**; click on **"Change adapter settings"** on the left pane to open the **"Network Connections"** window where **connection icons** are listed.
- ii) Click on the icon representing the adapter connected to the **Internet** (e.g. **"Local Area Connection Status 2"** on the left screen-shut). Note that connection label will differ on your system-. Adapter **I/O** activity, the count of **sent** and **received** byte are displayed at the bottom of the window.
- iii) Click on **"Details"** button to open **"Network Connection Details"** window (right screen-shut); and identify the configuration parameters listed in **Section B.2** (have you noticed anything unusual or irregular?)



Obviously, the IP@ of the network adapter is defined in the CIDR form (IPv4@ and Subnet Mask), whereas Default Gateway, DHCP Server, DNS Server IP@ are not associated with a Subnet Mask, why?

→ **Subnet Mask** is used to isolate the **Network-Id** and **Host-Id** (adapter-Id) components in a 32-bit IP@ entity.

A system needs to know these components only when it makes a **forwarding** decision to answer the question:

“is destination network adapter connected to the same subnet as one of my adapters?”

To answer this question, the system masks the destination IP@ with network adapter's Subnet Mask and compares if they are connected to the same subnet. Check first if the **first n-bits** of these IP@ are the same (e.g. it is 24-bits for the mask “255.255.255.0”). If they match, they are on the same subnet as your adapter. This should be the case for the default gateway and DHCP server, whereas DNS servers are not! (system will try to reach them via default gateway).

B.4 Exploring Workstation's Network Settings from Command Line Interface

- i) Start command line interface “**cmd.exe**” with **administrative privileges** - in **Win'10** open power users menu by pressing “**Windows+X**”- then click on “**Command Prompt (Admin)**” or “**Power Shell (Admin)**” program.
- ii) Enter “**ipconfig /all**” command to display network settings of your system and your connections (adapters).

✓ The top section “**Windows IP Configurations**” header displays system settings, notably:

- **Host name** (if any);
- **Domain suffix** (if any) to be used to generate fully qualify domain names;
- **IP Routing Enabled “No”** implies that system **does not** act as a **router** (does not forward fames it receives but not sent to its IP@).

```
Windows IP Configuration

Host Name . . . . . : W7-Ent
Primary Dns Suffix . . . . . :
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
```

✓ **Connection sections** (cross check if adapter's configurations match with those of GUI's outputs)

- **Physical Address (MAC address);**
- **CIDR IPv4** address tuple (IPv4 Address and Subnet Mask);
- Acquiring network settings (e.g. DHCP IP@) from a DHCP server or not (**DHCP Enabled**);
- **IPv4** address of the **Default Gateway** (note that it is defined w/o the network mask!);
- **IPv4** addresses of **DHCP** and **DNS** servers.

```
Ethernet adapter Local Area Connection 2:

Connection-specific DNS Suffix . :
Description . . . . . : Realtek PCIe GBE Family Controller
Physical Address. . . . . : 90-2B-34-77-57-D6
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes
IPv4 Address. . . . . : 192.168.0.14(Preferred)
Subnet Mask . . . . . : 255.255.255.0
Lease Obtained. . . . . : 08 Şubat 2021 Pazartesi 14:38:46
Lease Expires . . . . . : 15 Şubat 2021 Pazartesi 14:38:46
Default Gateway . . . . . : 192.168.0.1
DHCP Server . . . . . : 192.168.0.1
DNS Servers . . . . . : 46.197.15.60
                        178.233.140.110
                        176.240.150.250
```

✓ Optionally **ISATAP** (*Intra-site Automatic Tunnel Addressing Protocol*) tunnel adapters, introduced to ease the transition process from IPv4 32-bit addresses to IPv6 64-bit addresses (**you may ignore them**)

```
Tunnel adapter isatap.{3180A06C-6812-45A9-A7D6-E3331BE64D28}:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Description . . . . . : Microsoft ISATAP Adapter
Physical Address. . . . . : 00-00-00-00-00-00-E0
DHCP Enabled. . . . . : No
Autoconfiguration Enabled . . . . : Yes
```

B.5 Project Report

Use the information and procedures provided so far to start answering the **Host Network Configuration** questions of the **Pri1-Part1 Report** stored at CATS course portal under the **Resources/Project Appendices** folder.

Section C. Deploying ORACLE VM VirtualBox Virtualization Platform

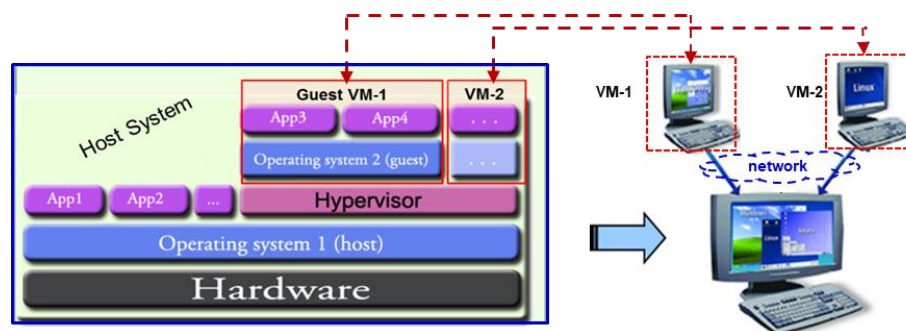
C.1 Hosting Virtual Computer Systems

Modern CPUs offer extended **hardware protection** and **emulation** support such as “**VT-x / AMD V**” that enables the **hosting** of **virtual computer systems** running on a real computer and sharing its physical resources.

A **virtual system** consists of a **Virtual Machine** (VM) running its **own operating system** (OS) and set of applications. Note that **VMs** may have **different hardware** architectures than their **host**, as well as may run different **OSs**.

The **Host** system creates and controls **VMs** through a special **virtualization** layer, the **hypervisor**. It is **deployed** between its operating system and these **virtual machines**. Moreover, the virtualization platform supports the creation of **virtual network appliances** (adapters, bridges, switches) connecting **VMs** to a **real** or a **virtual computer network**.

The drawing on the left depicts a **host** system configured with a **hypervisor** that controls **two VMs**. The picture on the right shows how the **Host** and **VMs** are connected to a **real** or **virtual network** and operate seamlessly.



C.2 Virtualization Terminology Summary

The following outlines the virtualization terminology used in our projects.

- **Host**. The workstation that can support a virtualization platform (the hypervisor and configuration utilities).
- **Guest**. The Virtual Machine (computer system hardware) created & controlled by the hypervisor.
- **Hypervisor**. The virtualization layer deployed over Host OS e.g.: **ORACLE VM VirtualBox**.
- **Host Operating System**. The **OS** installed on the **Host** (e.g. **W'10**).
- **Guest Operating System**. The **OS** installed on a **Guest** e.g. **W'7**, **Linux** etc.
- **Host/Guest System**. A **Host/Guest** hardware configured with an **OS**.

C.3 Installing ORACLE VM VirtualBox

i) Checking Host Computer Settings

ORACLE VM VirtualBox platform requires the “**VT-x / AMD V**” support to host **VMs** running **64-bit OSs**. Check your workstation’s **BIOS / UEFI** settings and verify if **CPU’s virtualization support** is enabled. If not, refer to your system manuals, or look up on the **Internet** the topic “**how to enable virtualization support**” for the **brand** and **type** of your computer system.

In case you cannot access/modify your **BIOS / UEFI** settings now, you may still **proceed** with the installation **VirtualBox** and **import** the **VM appliance** you have downloaded in **Section A**. Once deployed, the **VirtualBox Manager** will warn you if the required hardware support is enabled and will refuse to run the **VM** if not.

ii) Downloading and Installing ORACLE VM VirtualBox

The latest version of **ORACLE VM VirtualBox** is **6.1.32**. You do not need to download newer versions that will be announced cannot access, unless explicitly advised by the instructors.

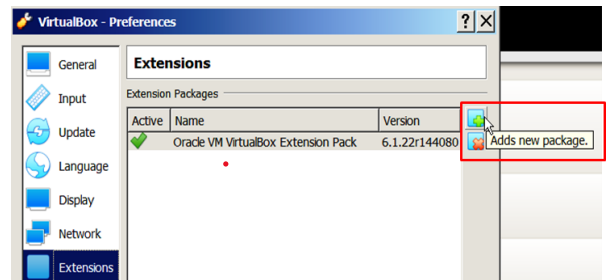
Download from **VirtualBox** web site (<https://www.virtualbox.org>) the platform matching the OS installed on your host. During **VirtualBox** installation **accept** **default setting** options, including the downloading & installation of.

- ✓ “**Guest Additions**” package; and
- ✓ the **VirtualBox Extension Pack**, common to all supported platforms.

iii) Verifying ORACLE VM VirtualBox Installation

Once the installation is done, run **VirtualBox Manager** to check if the **VirtualBox Extension Pack** is installed.

- ✓ Open “**File->Preferences**” menu, select “**Extensions**” entry shown on the right.
- ✓ Verify that the extension pack is installed (the pane is not empty) and its version is correct.
- ✓ In case of a version mismatch remove extension pack, or the line is empty; download the package from the site; install it using “**add new package**” icon shown on the right (pointed icon mouse).



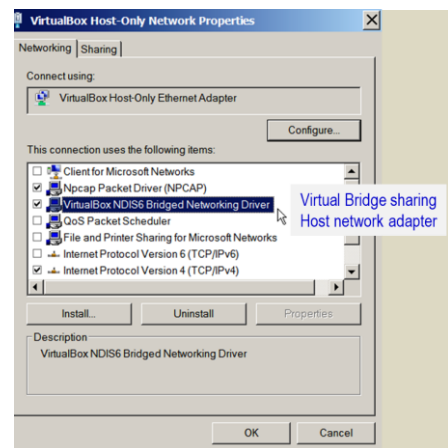
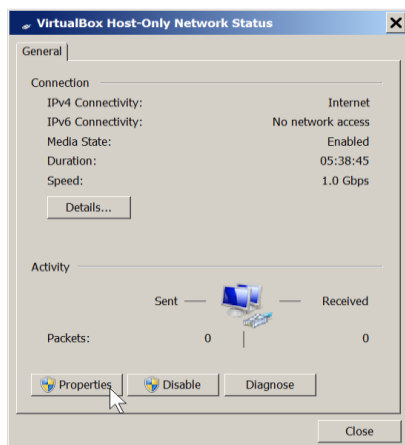
C.4 Configuring Host's 'VirtualBox Host-Only Connection (Network Adapter)

Installation of the **ORACLE VM VirtualBox** platform creates on the host **two virtual network appliances**:

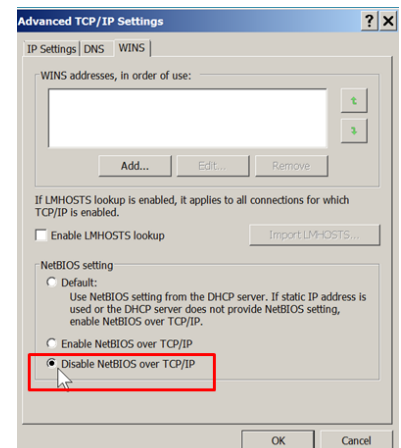
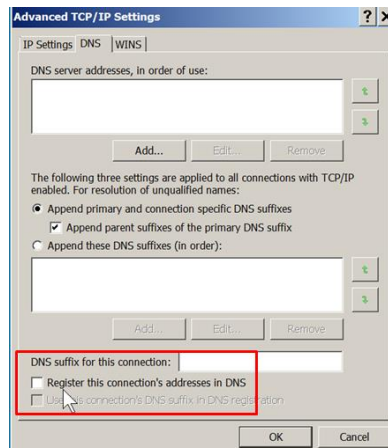
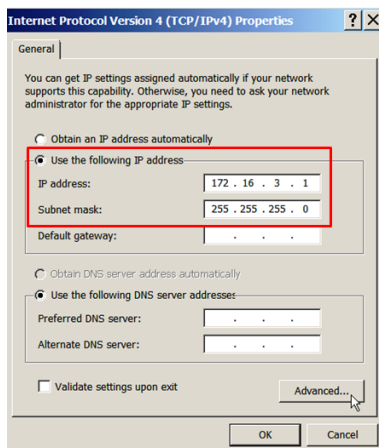
- ✓ A **virtual bridge** that will share **host's physical network adapter** with the **Guests**. It is the **VirtualBox NDIS6** driver highlighted line on the right screen shut of the next section (right screen shut here after).
- ✓ A **virtual network adapter**, labelled as the **Host-Only Network Adapter**, that can be configured through two user interfaces:
 - > **VirtualBox Management Interface**.; or
 - > Windows GUI the “**Network Connections**” introduced in **Section B.3**.

For the project you will use the **Windows GUI** to have access to all the settings (VirtualBox offers only limited options).

- i) Open the “**VirtualBox Host-only Network Status**” window (left screen shut).
- ii) Click on the **Properties** button to open adapter's properties menu (right screen shut here after).
- iii) Uncheck **all** the options (Microsoft nw. services, TCP/IPv6 etc.) **except** those in the following list, press “**OK**”.
 - “VirtualBox NDIS6 Bridged Network Driver”,
 - “Internet Protocol Version 4 (TCP/IPv4); and
 - “Npcap Packet Driver (NPCAP)” -the entry may not be there but will be installed later by Wireshark-



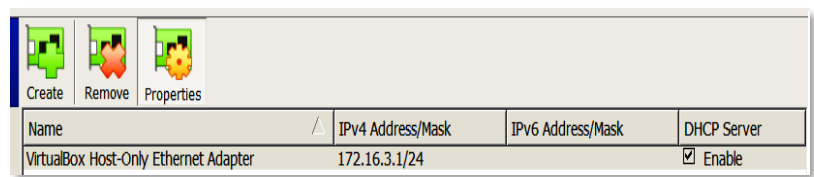
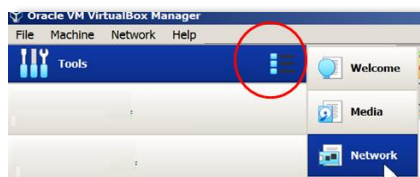
- iv) From **VirtualBox Host Only Network Properties** window double click the “**Internet Protocol Version 4**” entry to open **TCP/IPv4 Properties** menu (left screen shut here after).
- v) Select the “**Use the following IP address**” option and set its **CIDR IPv.4 @** to : **172.16.3.1 / 24**
 - ✓ **IP address**: **172.16.3.1**
 - ✓ **Subnet mask**: **255.255.255.0** (corresponding to the network mask /24)
- vi) Click on the “**Advanced**” button to open “**Advanced TCP/IP Settings**” window (middle screen shut); select the “**DNS**” Tab; uncheck the “**Register this connection's address in DNS**” box (shown by the pointer).
- vii) Select the “**WINS**” Tab to open the window (right screen shut); check only the “**Disable NetBIOS over TCP/IP**” box; accept all the changes by clicking on successive “**OK**” buttons.



C.5 Configuring VirtualBox DHCP Service for the Host-Only Network

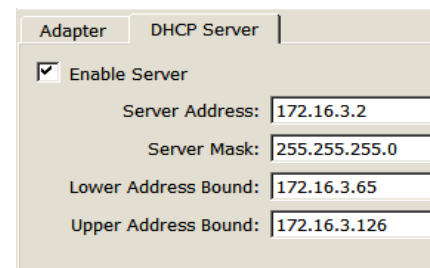
VirtualBox comes with a **DHCP server** that provides a limited service for configuring only the **CIDR IPv4@** of **Guests**. Configure the **DHCP server** with the project settings following the procedures outlined here after.

- Start **ORACLE VirtualBox Manager**; select **"Tools"** icon on the top left corner (left screen shut here after).
- Click-on the operations icon (within the red circle) to open the drop-down list and select the **"Network"** entry.
- On the top right window check the **CIDR IPv4@** of the **VirtualBox Host-Only Ethernet Adapter** and verify that it matches the values you have defined in **Section C.5** (right screen shut).



- Select **'DHCP Server' Tab** at the bottom window (screen shut here after) and check the **'Enable Server'** box.
- Set **DHCP server CIDR IPv.4 @** to: **172.16.3.2 /24**
 - ✓ Server address: **172.16.3.2**
 - ✓ Server mask: **255.255.255.0**
- Configure **DHCP server IP @** allocation range by defining the **"Lower"** and **"Upper"** address bounds

172.16.3.65 – 172.16.3.126



- Press **'Apply.'**; then restart ORACLE VirtualBox VM to let the settings take effect.

Section D. Deploying the Guest System

D.1 Adding Guest Systems

There are **3 alternatives** for adding new **Guests** to the virtualization platform.

- Creating** a new **Virtual Machine** by defining its hardware components; installing and configuring **Guest OS** following similar procedures to those used in **real** system installations.
- Importing** a **VM appliance** that has been created then **exported** as a file for distribution.
- Cloning** an existing **Guest** (replicating it from an existing virtual system).

Procedures for creating a new **VM** are defined in the **Oracle VM VirtualBox User Manual**; you may use them to generate your own **Guests**. For instance, you may download the **Windows Enterprise 7 (IE11) VM appliance** distributed by **Microsoft** and configure it for the project as specified in **Section D.2**.

For course projects, you are advised to **import** the **VM appliances** that are created and stored at University's ftp server, to avoid wasting time with OS generation / configuration details, and to minimize potential mistakes. **Cloning** process will be used as needed, to replicate your **Guests** for other uses, or to create spare copies (backups).

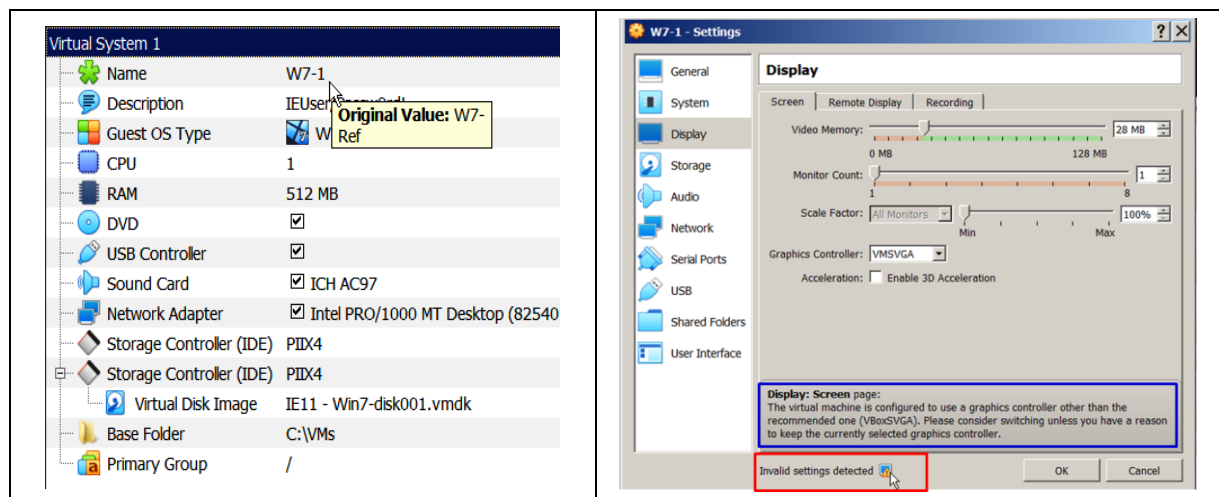
D.2 Characteristics of the VM Appliance

The **Guest** you have downloaded in **Section A** is the **Windows Enterprise 7 (IE11) VM appliance** distributed by **Microsoft**. It has been configured as outlined here after then re-exported as **"W7-Ref.ova"**:

- **Memory size** is set to **512 Mbytes** as the it will be used with a limited number of applications.
- The **Pointing Device** is set as the **"USB Tablet"** (VM System Parameters) to ease the use of pointer and keyboard devices before customizing the OS (before installing the **"VirtualBox Guest Additions"** package).
- **Network adapter 1** has been configured to **'Obtain an IP address automatically'** from a DHCP server; and **"Advanced TCP/IP Settings"** are defined using similar procedures to those outlined in **Section C.4**.
- **VM** has been activated on **26 June 2020**, running the command **"slmgr /ato"** with administrator privileges.
- **Automatic updates** are **disabled** (Control Panel -> System and Security -> Windows Updates menu, using 'Change Settings' option to set 'never check for updates'.
- **Windows Firewall** for **Home** and **Public Networks** are **disabled** (Control Panel -> System and Security -> Firewall menu, using 'Turn Windows Firewall On or Off' option).
- **Power option** that turns off the **display** and the **disk** are set to **several hours**. (Control Panel -> System and Security -> Power options menu).
- **Turkish keyboard** layout has been added; **Region** is set to Turkey.
- **Time Zone** is set to Istanbul; "Internet Time Synchronization" is disabled.
- **Wireshark** packet analyzer has been installed.
- **NMAP** ("Network Mapper") an open-source network discovery and security auditing tool is installed.
- **IIS 7 web** server activated.

D.3 Importing the VM Appliance

- Start VirtualBox; use **"File->Preferences"** path to set **"Default Machine Folder"** to a folder of your choice e.g. **"C:\VMs"**. Project documents will refer to this folder as **"C:\VMs"**, always substitute this path with yours.
- Open "Import Virtual Appliance" menu ("File->Import Appliance"); select the **"W7-Ref.ova"** appliance file you have downloaded in **Section A**; and click **"Next"**.
- In the **"Appliance Settings"** menu change VM name to **"W7-1"** (left screen shut), click on the **"Import"** button.
- Once the appliance is imported, **VirtualBox Manger** will display the **"W7-1"** label on its left pane; select it (do not run) and review its settings by clicking on the **"Settings"** icon.



- Verify especially that there is no **"Invalid Settings Detected"** warning(s) displayed at the bottom of the **"W7-1 Settings"** window as shown on the right window above.

Settings errors may occur if your workstation configuration is different than the system on which the **VM appliance** has been produced (instructor's workstation).

→ To resolve setting errors, **if any**, document your problem with the screen shuts and ask on **Project-1 Forum** opened at CATS for assistance. Correct configuration of your **Guest** is **essential** for implementing the project.

D.4 Customizing Native Guest OS

i) The Rationale

Native **OS** (W7) installed on the **Guest** is unaware that it is running on a **VM** and sharing system resources with its **Host**! Physical resources that are **virtualized** - the **memory**, **CPUs**, **network adapters** etc.- can be shared by the Host and its Guests without problem. But resources that are shared serially, such as the **keyboard** and the **mouse**, requires the coordination between **Host** & **Guest OSs**.

ii) Resource Sharing Scenario under Native Guest OS

Native Guest OS will manage the **keyboard** and the **mouse** as their **exclusive owner**. The **Host OS** running the workstation e.g. W710 **has been configured** to share these resources with its **Guests** when the **hypervisor** (e.g. ORACLE VM VirtualBox) was installed.

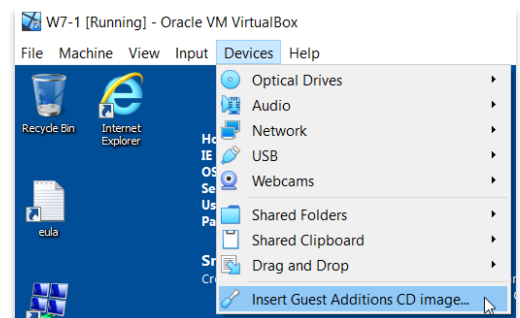
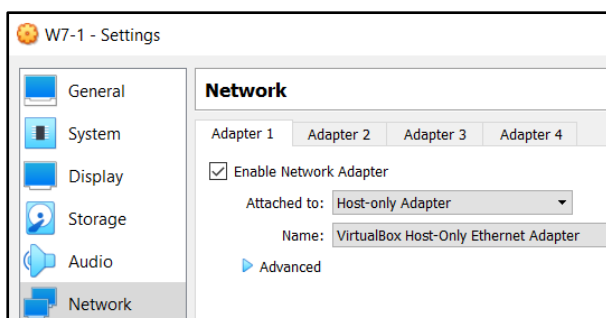
The following depicts the scenario "*How a Guest running under native (unmodified) OS shares the **keyboard** and the **mouse** with its Host?*".

- **Host OS** on the workstation tracks the mouse pointer and as it detects a mouse click over a window that belongs to a **Guest**, it releases their control and notifies the **hypervisor** (**VirtualBox**), which passes their control to the selected **VM**.
- **Guest OS** controlling the **keyboard** and the **mouse** is unaware of the fact that they are shared and should be released on demand. Consequently, when the mouse pointer reaches the boundaries of the Guest screen -*which is a host OS window*- the **Guest OS** does not release them unless the **Guest pointing device** was configured with the "**USB Tablet**" option. Although the mouse is preempted (taken) by the Host **Guest OS** continues to display its own mouse pointer (there will be 2 of them on the screen)!
- The **hypervisor** installation configured the **Host OS** with an escape mechanism; thus the user may press the "**host key**" (the '**right control**' key) to gain the control of the keyboard and the mouse at the **Host**.

iii) Customizing Guest OS with Guest Additions

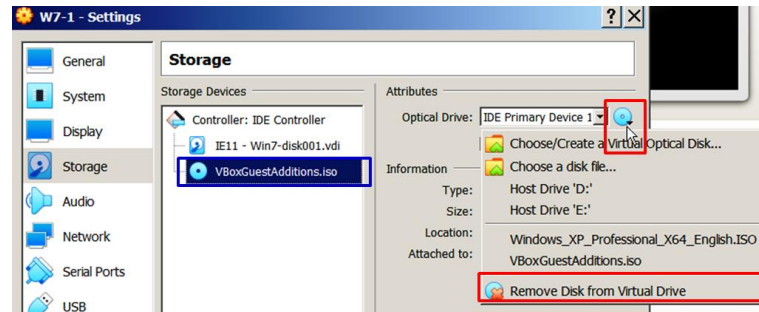
To implement **seamless resource sharing** between the **Host** and the **Guest**, the **Guest OS** (W7) needs to be customized by installing the "**VirtualBox Guest Additions**" package downloaded in **Section C.3/ii**.

- > Run **VirtualBox Manager** and select **W7-1** (do not run it!); click on its "**Network**" definitions on the right pane to open the "**W7-1 Settings**" window (screen shut on the left).
- > Select the "**Adapter 1**" tab; verify that
 - the "**Enable Network Adapter**" box is checked; and
 - it is "**Attached to**" to the "Host-only Adapter"; if not select this adapter using the pull-down menu.
- > Start **W7-1**; once running select "**Devices**" Tab from the menu bar of its screen (screen shut on the right); and click-on the "**Insert Guest Additions CD Image**" entry
- > Run the "Guest Additions" update, ignore W7 warnings about "**counterfeiting**".
- > Once the installation ends DO NOT Reboot **W7-1**, just **shut it down**.



D.5 Validating Host-only Network Settings

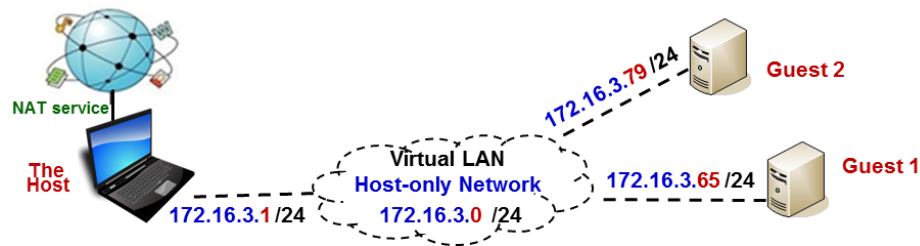
- i) Remove the “VBoxGuestAdditions.iso” you have inserted at the previous step by:
 - > opening “Storage” configuration window shown here after;
 - > selecting “VBoxGuestAdditions.iso” label on the middle pane; and clicking on the CD/DVD icon;
 - > finally selecting the “Remove Disk from Virtual Drive” option from pull-down menu.



- ii) Connecting a VM to the Host-Only Network

You may connect a **Guest** to the **virtual LAN** (created by VirtualBox) referred as the “**Host-only Network**” by attaching **any** of its network adapters [numbered 1 to 4 on the GUI] as the “**Host-only Adapter**” type. The **Host** is also connected to this virtual network via its “**Host-only Adapter**” that you have configured in **Section C.3**.

As shown in the drawing below, the **Guest** will acquire from the VirtualBox DHCP Server you have configured in **Section C.5/vi** a **CIDR IPv4** @ from the range **172.16.3.65 /24 – 172.16.3.126 /24**

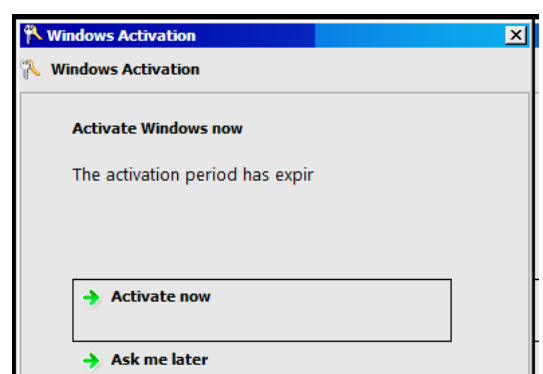
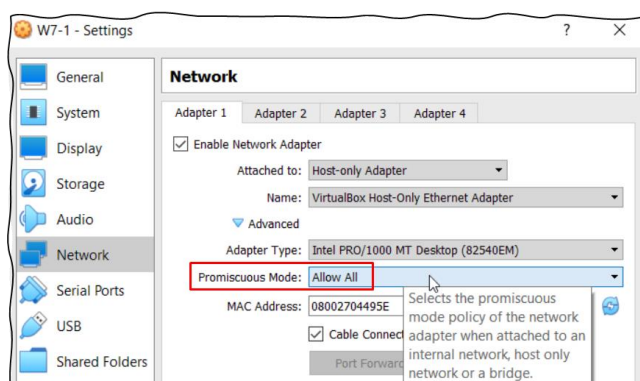


All the **VMs** connected to the “**Host-only Network**” referred as “**172.16.3.0 /24**” can communicate with each other and with the **Host** as if they were connected through a **physical Hub**.

Yet, **VMs** cannot access external networks. However, you may configure the **Host** to provide the **NAT** (Network Address Translation) service allowing **Guests** to use the **Host** as their **Internet gateway**. Nevertheless, the **Guests** will be **invisible** from external networks as **Host-only Network** is private and hidden behind the **Host**.

- iii) Configuring VM Host-Only Network Attachment

- > From **VirtualBox Manager** select **W7-1** (do not run it!); open “**Network**” entry in “**W7-1 Settings**” window.
- > Select the “**Adapter 1**” Tab; confirm that it is **enabled** and “**Attached to**” the “**Host-only Adapter**” as you have configured it in **Section D.4/iii**.
- > Expand “**Advanced**” submenu (left screen shot below); set “**Promiscuous Mode**” to “**Allow All**” mode, to capture all network traffic even if it is not sent from your adapter; or to your adapter.



iv) Testing Host-Only Network Configurations

- > Start **W7-1** if the license **activation warning** shown on the right screen shut above is displayed you may “cancel” it or select the **Ask me later** option, you **will configure it** when you connect the **VM** to Internet.
- > Display network settings of the **Guest**; and identify the **IPv4@** acquired by the **Host-only Network Adapter**.
- > On the **Host** open the command line interface (command prompt) and run the “**ping**” command requesting only one ‘echo’ reply from **Guest**’s **Host-only Network Adapter**. Use the command syntax here after where option “-n” defines the number of echo request sent, and “xx” denotes target “Host-Id” (adapter-Id)

```
> ping -n 1 172.16.3.xx
```

If the test is **successful CONGRATULATIONS**. Your **Host-only Network** configurations are correct, you may proceed with the remainder; **if not** revise your settings and try again. **Still unsuccessful?** Ask for assistance on the **Project-1 Forum** opened at CATS and post your configuration screen shuts.

- > If the previous test is **successful**, you may try to “**ping**” the **Host** from your **Guest** with:

```
> ping -n 1 172.16.3.xx
```

In case you receive **no reply** be aware that the **firewall** at your **Host** eliminated the echo request message before it reached OS reply service. **It is OK** do not try to remedy it (e.g. stopping Host’s firewall).

- > Shutdown the **Guest**.

D.6 Project Report

Use the information and procedures provided so far to answer **Host-Only Network** questions in the **Pri1-Part1 Report** stored at CATS course portal under the **Resources/Project Appendices** folder.

D.7 Connecting Virtual Machines to a Real Network (Internet)

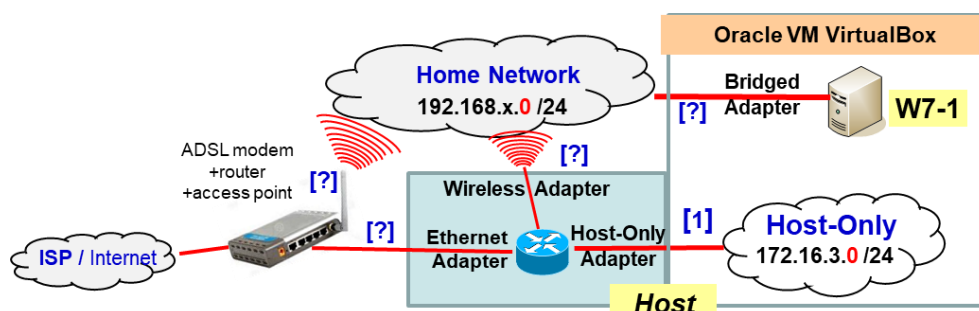
i) Project Testbed Topology

You may connect a **Guest** to the same **physical LAN** as its **Host** by attaching any of its adapters with the “**Bridged Adapter**” type. The virtualization platform provides a **virtual bridge** emulation via “VirtualBox NDIS6 Bridged Network Driver (refer to **Section C.4/iii**) allowing **Guests** to share **Host’s physical network adapter**.”

Drawing here after depicts likely topology of your **home testbed** after **VirtualBox** has been deployed.

- ✓ The **ADSL** modem/router that connects your “**Home Network**” to the **ISP** is a composite device that serves as a “**Bridge**” interconnecting two LANs:
 - the wireless LAN controlled by the **Access Point**, and
 - the wired LAN (if any) providing a limited number of **switched** connections.
- ✓ Your workstation may be connected to **Home Network** either via a **wired** or **wireless** network adapter.
- ✓ **ADSL** modem/router is likely configured to provide the **DHCP** service to systems connected to the **Home Network**. Drawing assumes that the **DHCP** server assigns **IPv.4 @** from the “**192.168.x.0 /24**” block; please overwrite this address block with the one defined by your **DHCP** service.

Note that the drawing shows **Host-Ids** within braces, e.g. [1] for the **Host-only adapter**; substitute unspecified **Host-Ids** [?] with the value assigned at your testbed.



ii) **Connecting VM to Home Network and Rearming the License**

- > Attach **W7-1** network Adapter **1** as “**Bridged Adapter**” following the procedures outlined in **Section D.5/iii**; do not forget to set its “**Promiscuous Mode**” to “**Allow All**”.
- > Start **W7-1** and if the license **activation warning** shown on the right screen in **Section D.5/iii** is displayed:
 - cancel the activation request and close the warning window;
 - open command line interface **with administrative rights**; enter the command “**slmgr /rearm**”;
 - a success message should be displayed; restart the **VM** as advised; once running you may use the command “**slmgr /dlv**” to display the remaining activation period and rearming count.

iii) **Testing Home Network Connection**

- > On the **Guest** open command line interface and display network setting`s with “**ipconfig /all**”; and identify the **IPv4@** acquired by the **Bridged Network Adapter**.
- > On the **Host** open command line interface and run the “**ping**” command requesting only one ‘**echo**’ reply from **Guest**’s **Bridged Network Adapter** using a similar command where “xx” is adapter’s “Host-Id”.

> ping -n 1 192.168.0.xx
- > On the **Guest** run the “**ping**” command requesting only one ‘**echo**’ reply from the default gateway of the **Home Network**.

D.8 Project Report

Use the information and procedures provided to answer **Bridged Network** questions in the **Pri1-Part1 Report** stored at CATS course portal under the **Resources/Project Appendices** folder.

Section E. Project Report

On the **Host** open the command line interface; use the “**ipconfig**” command to display your network settings and store its output to a text file labelled with your **student-id** with the following command:

```
“ipconfig /all > c:\.....\190000xxxx.txt”
```

Note that the submission of this file is **compulsory**; and your project will not be graded if you omit to provide it or its contents are tempered.

Compress the files here after using the **Compress Project Reports** document stored under **Resources/How to?** folder.

- ✓ **Prj1-Part1-Report.docx**
- ✓ **190000xxxx.txt**

Store compressed report in the **Prj1-Part1** folder located under **Assignments** heading at the course portal CATS **CSE6032-SectionX**; where “X” stands for (1.2.3.4), the laboratory session group you are registered in.

Collaboration Rules: What is Allowed What is NOT

Collaboration is a great way to learn. Students are encouraged to **discuss** project concepts and confer on **implementation** procedures with their peers. The key is to **use collaboration** as a way to **enhance learning**, **not** as a way of **sharing answers without understanding**

To avoid **plagiarism** all prose and code that you write for projects must be your own original work. Any other source you use must clearly identify and accurately cited.

Submitted work should be exclusively yours; **copying** or **getting help** from a third party is prohibited. Your submissions should be kept **confidential**, **sharing** them is **cheating**. No distinction will be made between those who cheat and who facilitate cheating by revealing their submissions.