



YouTestMe Standard Edition

Installation and Support Manual

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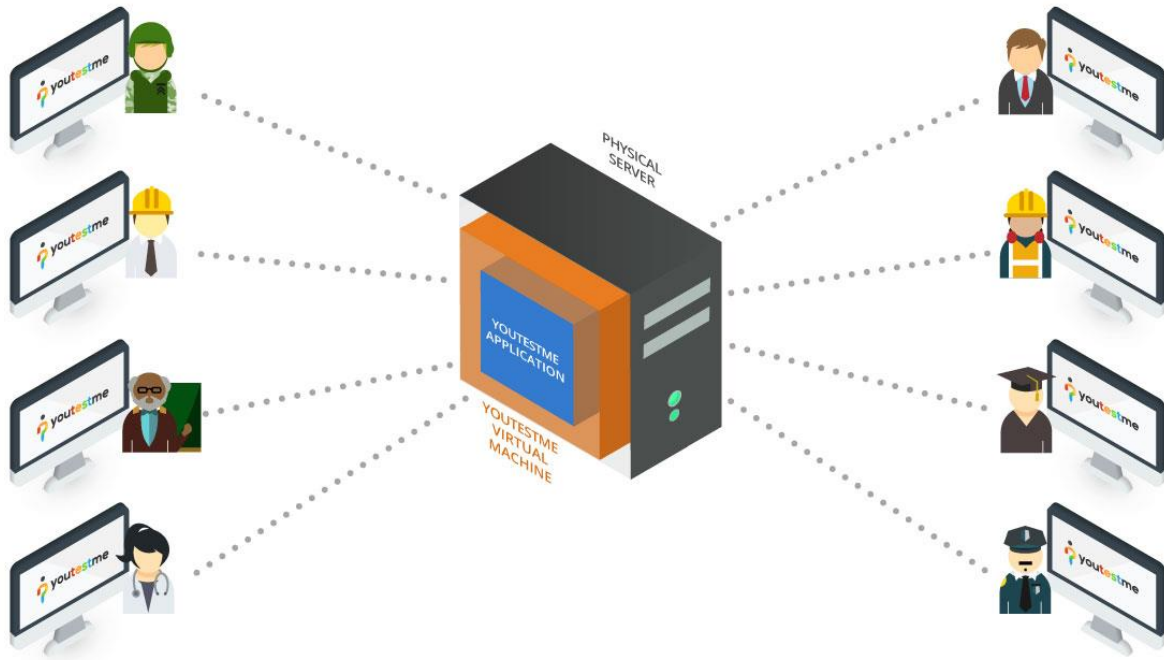
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1 YouTestMe Software Distribution

YouTestMe is a complex server-based system. It comprises the Ubuntu Linux host operating system, Tomcat application server, PostgreSQL database, and utility scripts. They are all packaged in one pre-configured Virtual Appliance called Virtual Machine. Virtualization is a popular concept that significantly simplifies complex computer systems' distribution, installation, configuration, and maintenance.



Hypervisor software is required to run a Virtual Appliance. The following major hypervisor software supports YouTestMe:

Hypervisor Software	Description	Price
Oracle VirtualBox	Suitable for workstations and small to medium servers	Free Download
VMware Workstation Pro	Ideal for workstations and small to medium servers.	Free Download
VMware ESXi	Suitable for data centers. Contact your system administrator for more information.	Free Download

For best performance and reliability, the recommended hypervisor software is VMware ESXi.

Virtualization is a popular concept in data centers, and it is likely that your organization already has an infrastructure with hypervisor software. However, you should check with your system administrators about your organization's standard Virtual Machine platform. Free Oracle VirtualBox will be adequate if you don't have any.

Please check [Appendix A](#) in this document for more information on the advantages of Virtual Machines.

2 System Requirements

2.1 YouTestMe Virtual Machine Hardware Requirements

Hardware	Typical	Enhanced
CPU	4 vCPU cores	8 vCPU cores
RAM	16 GB	32 GB
Storage (HDD or SSD)	80 GB	150 GB
Network Connection	Yes	Yes

Note that the above requirements are for the YouTestMe virtual machine. To be installed on a workstation or small server, a physical device should have at least 8 GB RAM and 50 GB free disk space, more than the above requirements. However, suppose you install a virtual machine on a "bare metal" server with hypervisors like ESXi. In that case, the above conditions equal what you need to be available on the physical server.

2.2 Network Bandwidth Requirements

Ensuring optimal network performance is crucial for a seamless and efficient experience on the GetCertified application. This chapter outlines the network requirements for users engaging in basic/lightweight tests and proctoring-enabled tests, including the integration with our proctoring service.

- **Lightweight Test:**
We recommend a minimum network bandwidth of 1 Mbit/s per user for users participating in lightweight tests. This estimate is based on typical usage scenarios involving text-based questions and minimal multimedia content.
- **Proctoring-Enabled Test:**
The tests include integration with our proctoring service have additional network bandwidth requirements. We recommend a minimum of **12 Mbit/s** per user for a smooth and secure proctoring experience. This higher bandwidth allocation transfers video and audio data to the proctoring service.

Several factors can influence the network bandwidth required, including the complexity of test content, the frequency of interactions, and the presence of multimedia elements. It's advisable to monitor network usage during peak periods and adjust bandwidth accordingly.

Recommendations for Users:

To ensure an optimal testing experience, we recommend the following:

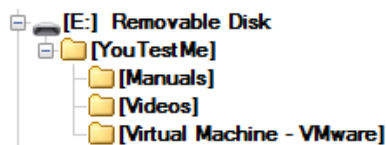
- **Stable Internet Connection:** Users should connect to a stable and reliable internet connection to minimize disruptions during the testing session.
- **Pre-Test Network Check:** Before starting a test, users can perform a pre-test network check to ensure their internet connection meets the recommended bandwidth requirements.
- **Test Environment Considerations:** Consider the test environment, especially for proctoring-enabled tests, and ensure the necessary bandwidth is available for a smooth proctoring experience.

3 Delivery Options

The YouTestMe product package can be shipped as a memory key or downloaded from our secure FTP server via the Internet.

3.1 Memory key

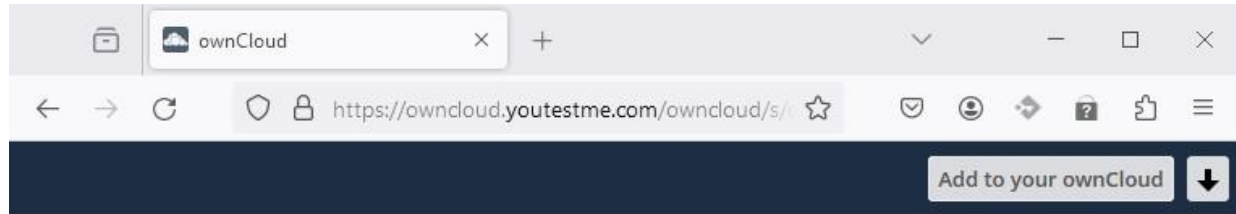
Memory key (USB) can be sent directly to the customer's address via the post or a similar service. In addition, you can find our software packaged as a Virtual Machine with instructional videos and manuals in the enclosed memory key. The directory structure is shown in the picture below.



If you received the YouTestMe product package as a memory key, you should skip to [Chapter 5](#).

4 Download

You will receive the download link by email. The file size is approximately 4 GB - it should take up to 30 minutes to download, depending on the internet connection. You should see a file in your workstation's "Downloads" folder when the download completes.



↓ Download ytm-SE-VirtualAppliance.7z (4 GB)

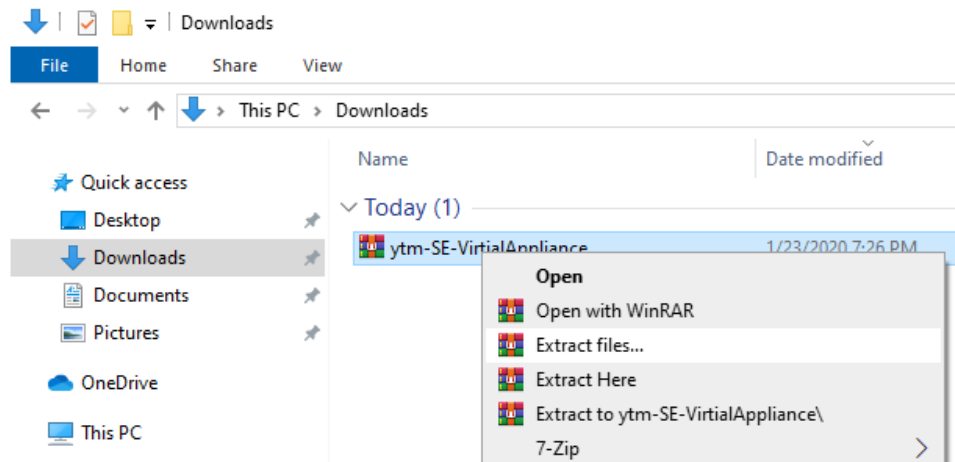
Direct link <https://owncloud.youtestme.com/owncloud/s/clHODuS472KLfZI/download>

ownCloud – A safe home for all your data

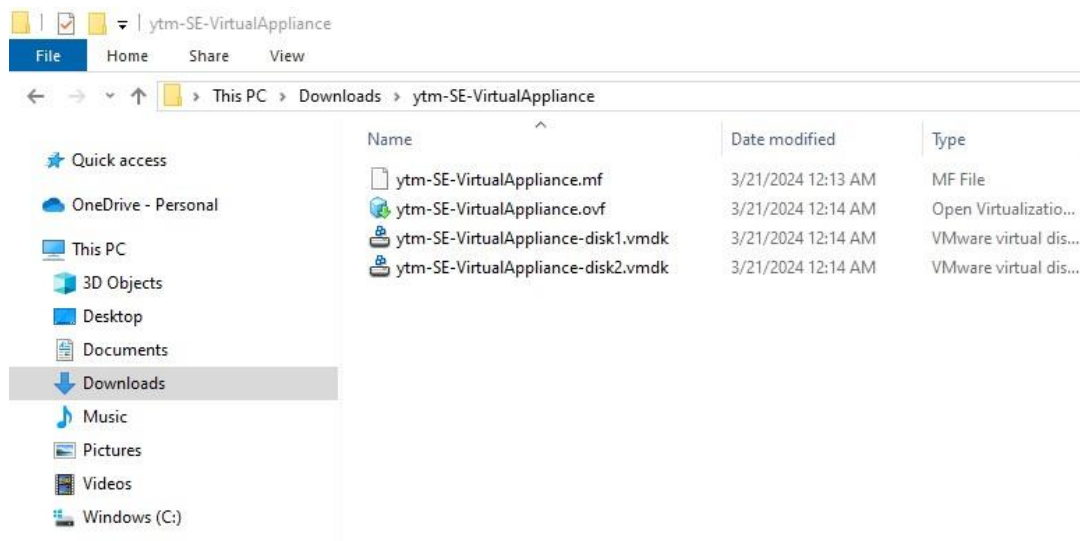
4.1 Extract Downloaded File

The file is downloaded in a ".7z" format and needs to be uncompressed using any popular compression tool (7zip, WinRAR, etc.). To do that:

1. Right-click on the file and choose one of the "extract" options.



2. Once the uncompressing process has been completed, you should see the folder containing the Virtual Machine's files.



Below is the list of free compression tools that can be used to decompress the YouTestMe Virtual Machine file.

Software	Price	Download Link
7zip	Free	7-zip
WinRAR	Free	WinRAR

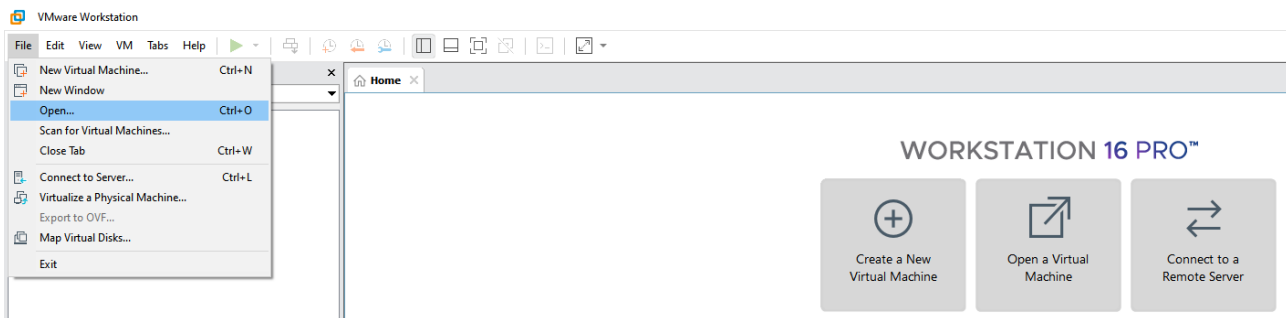
5 YouTestMe Virtual Machine Deployment

For demonstration purposes, we will describe the deployment process in two different environments:

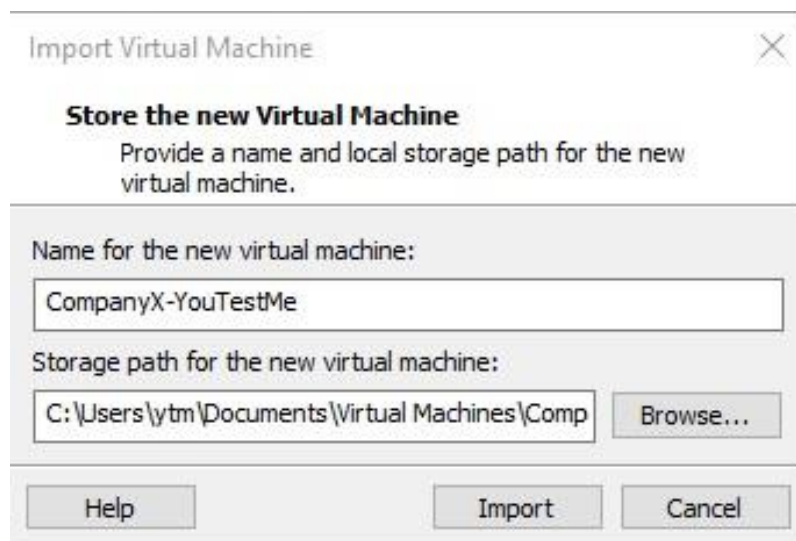
1. VMware Workstation, VMware ESXi
2. Oracle's VirtualBox

5.1 Import YouTestMe using VMware Workstation

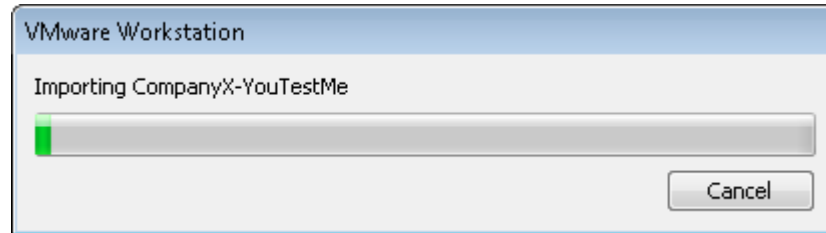
1. In VMware Workstation, choose "File -> Open"
2. Select the file in OVF format



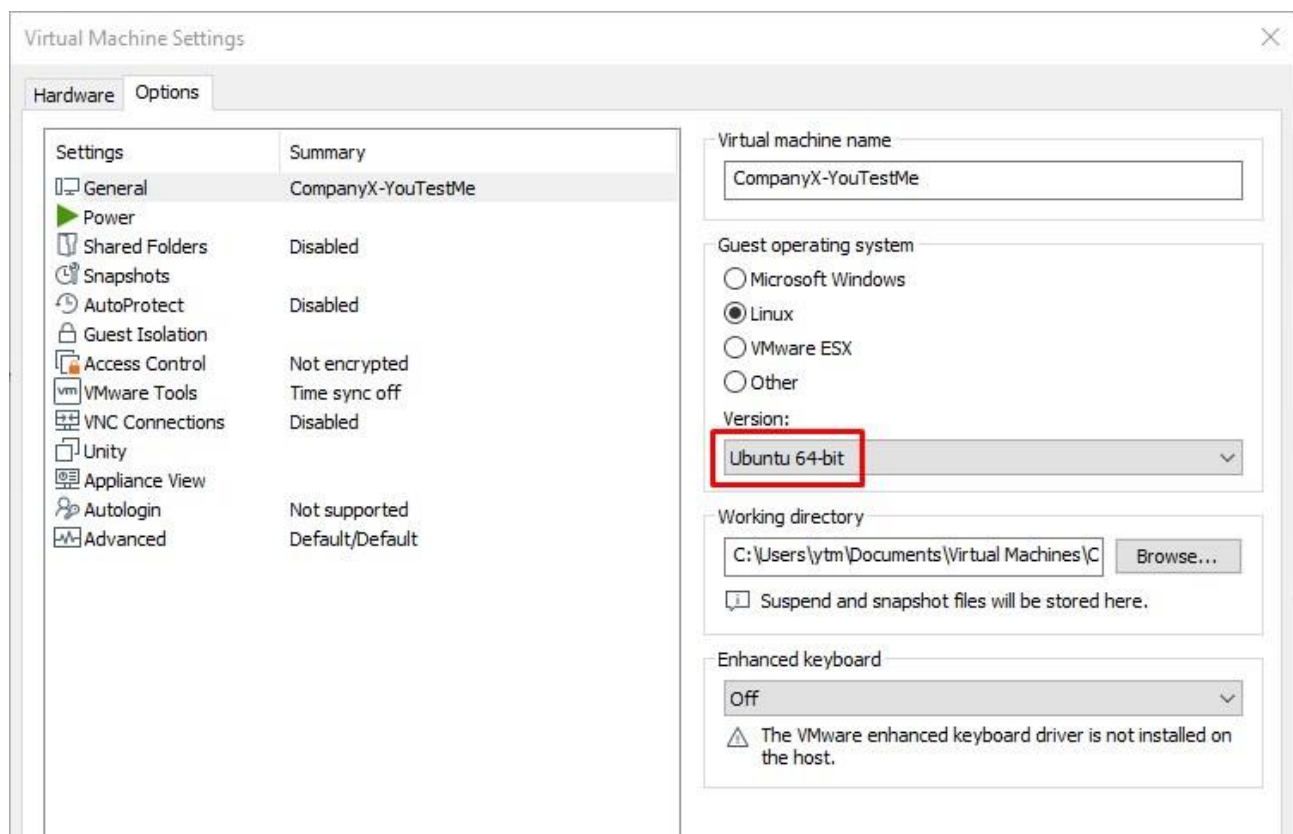
3. Click **Open**
4. In the window below, set the name of your Virtual Machine and the host location where you have at least 350 GB of free disk space. You should choose a local disk drive (not a network drive).



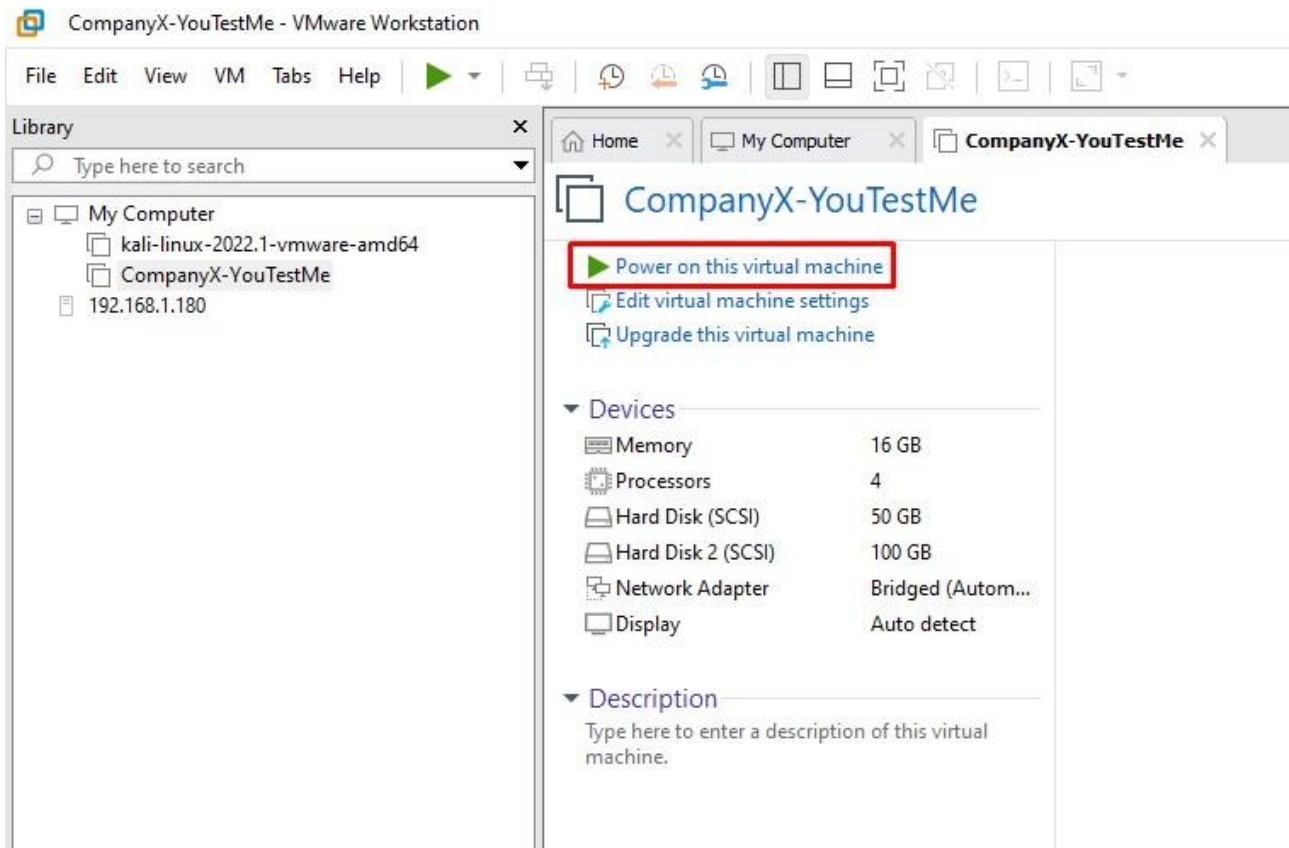
- The virtual machine import process can take up to 15 minutes:



- After importing the Virtual Machine, right-click on its name and select **Settings** -> **Options**. Make sure that "Linux" and "Ubuntu 64-bit" is selected, as shown in the picture below:



7. Start the Virtual Machine up by clicking **Power on this virtual machine**.



8. When the Virtual Machine starts, wait five minutes for all services to start (database, application server, Linux services, etc.)

Check the adequate IP address and subnet mask with your network or system administrator. Then, change it according to the procedure described in the section [Network Configuration](#).

5.2 Import YouTestMe to VMware ESXi using vSphere Client

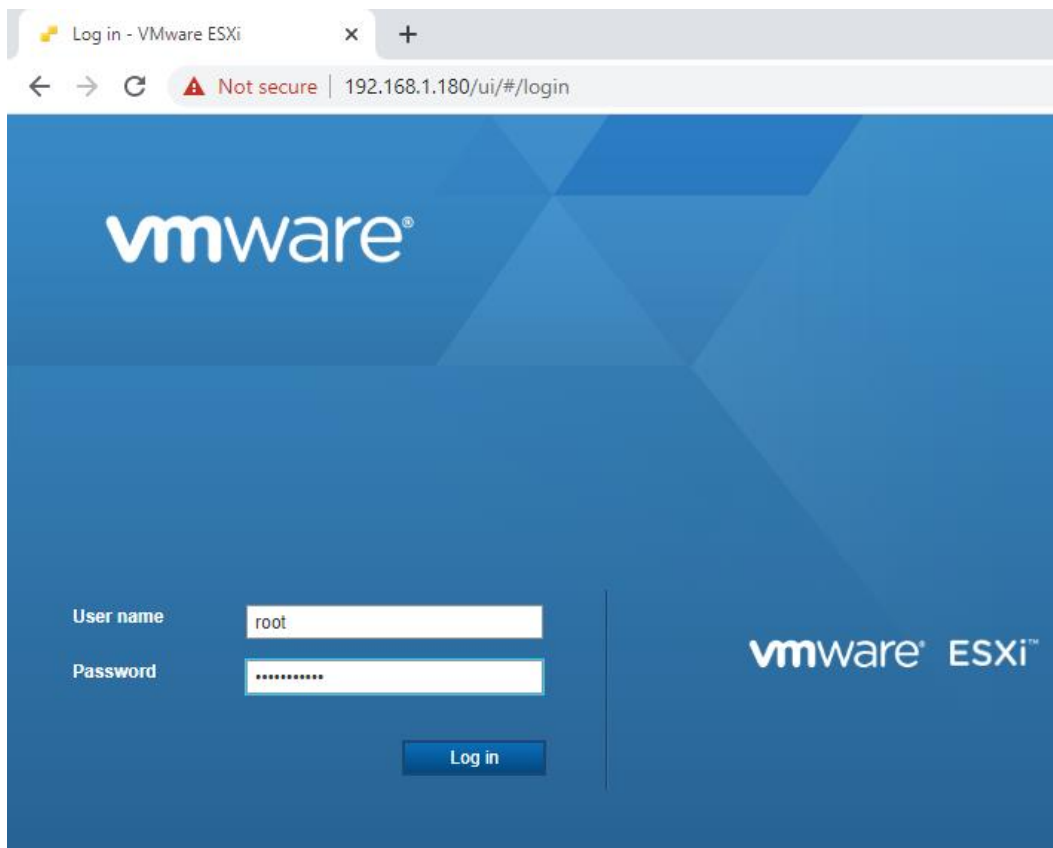
YTM Appliance can be deployed on an ESXi server using the following VMware software:

1. VMware vSphere Web Client
2. VMware vCenter Server

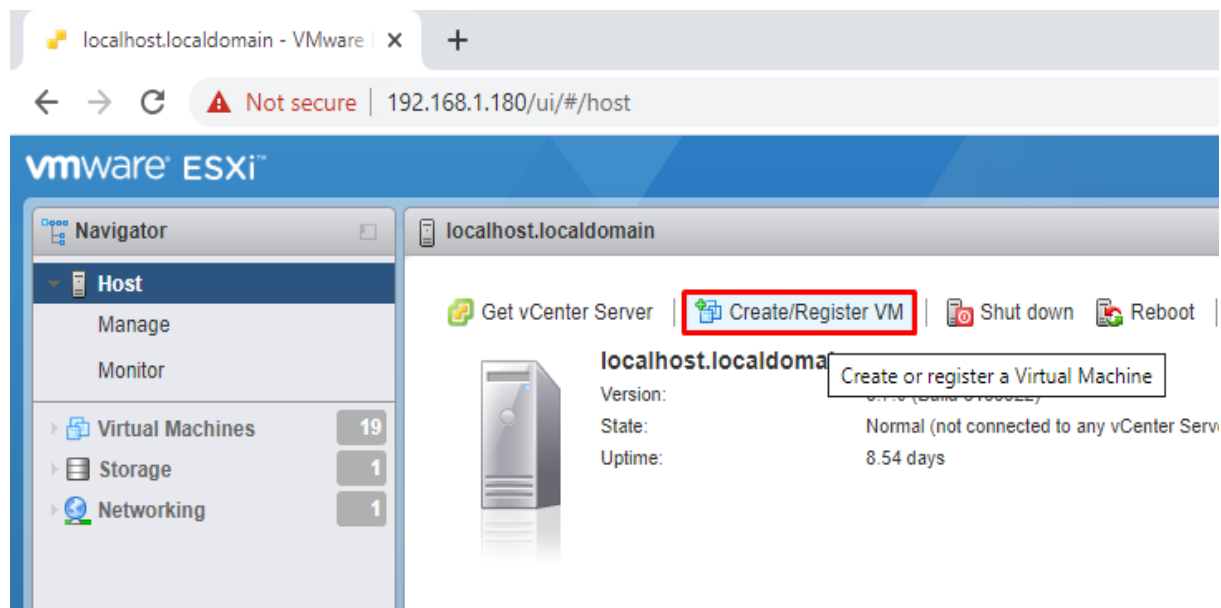
Please consult your system administrator for the recommended practice in your organization.

5.2.1 Import YouTestMe via VMware vSphere Web Client

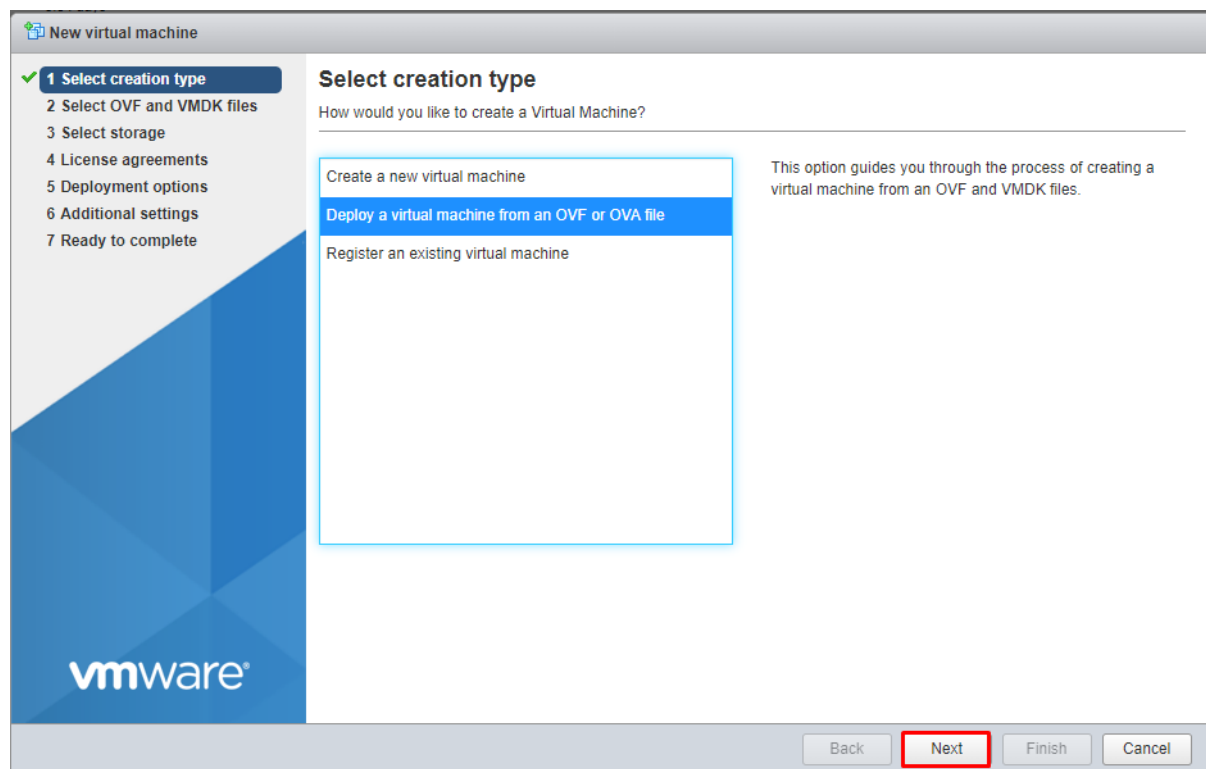
1. Open any browser on your workstation and try to access the ESXi server web console via the ESXi IP address or its domain name:



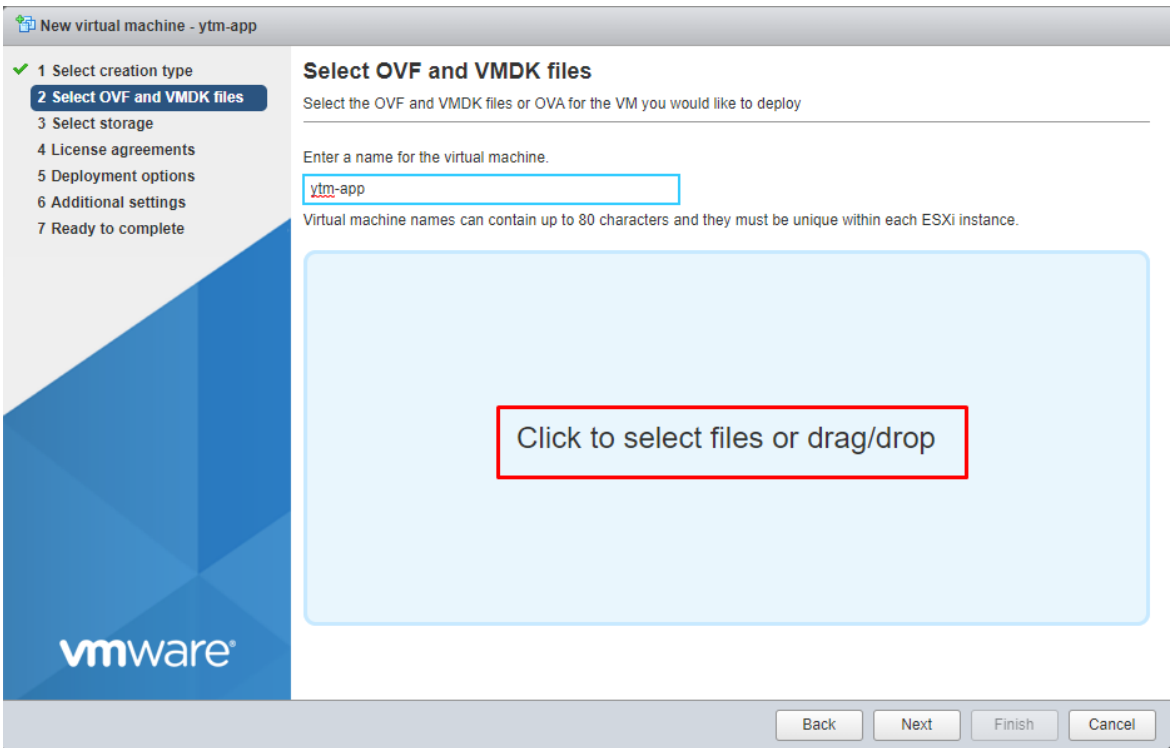
2. Select "Host" from the left menu and start the "Create/Register VM" wizard:



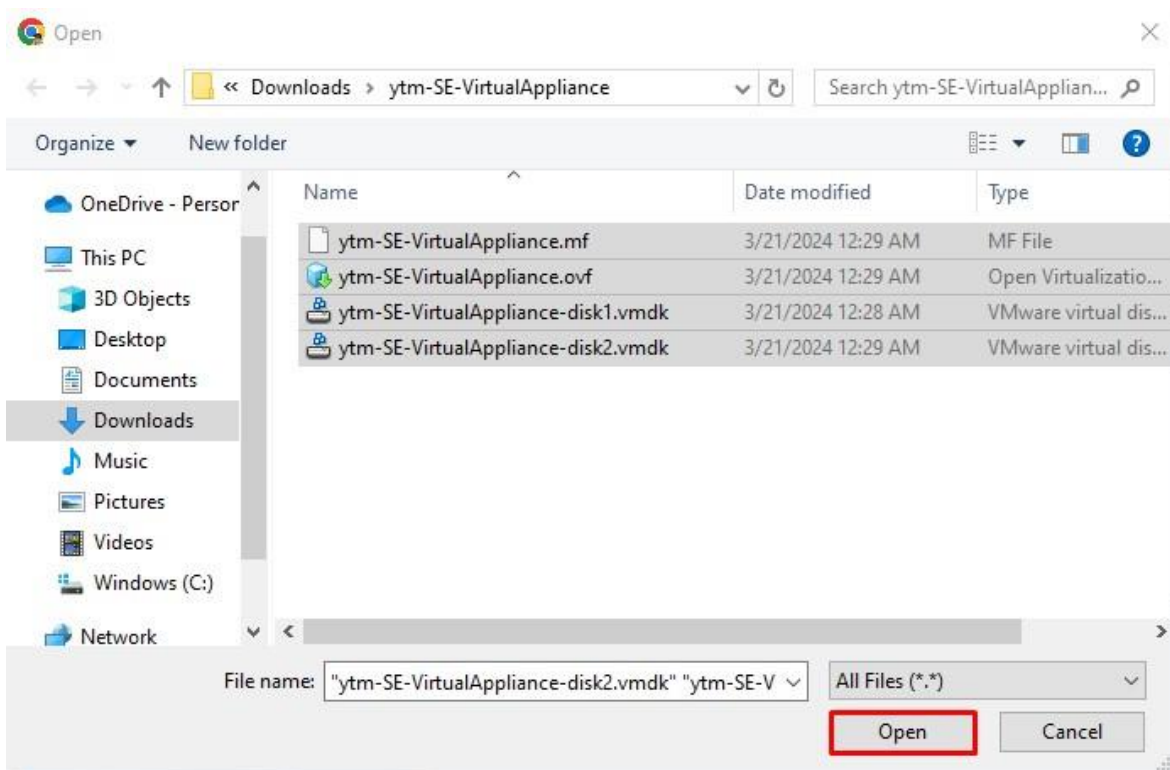
3. Select the "Deploy a virtual machine from an OVF or OVA file" option as the creation type:



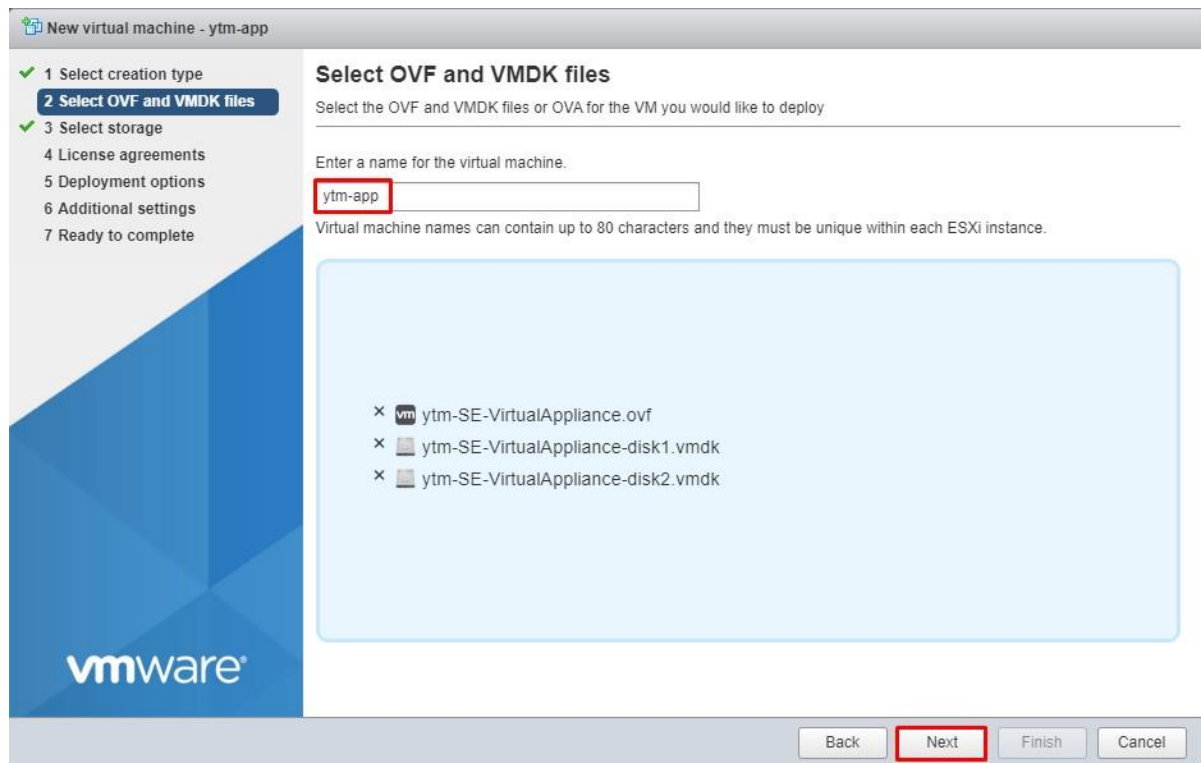
- Specify a name for the virtual machine and choose virtual files for upload:



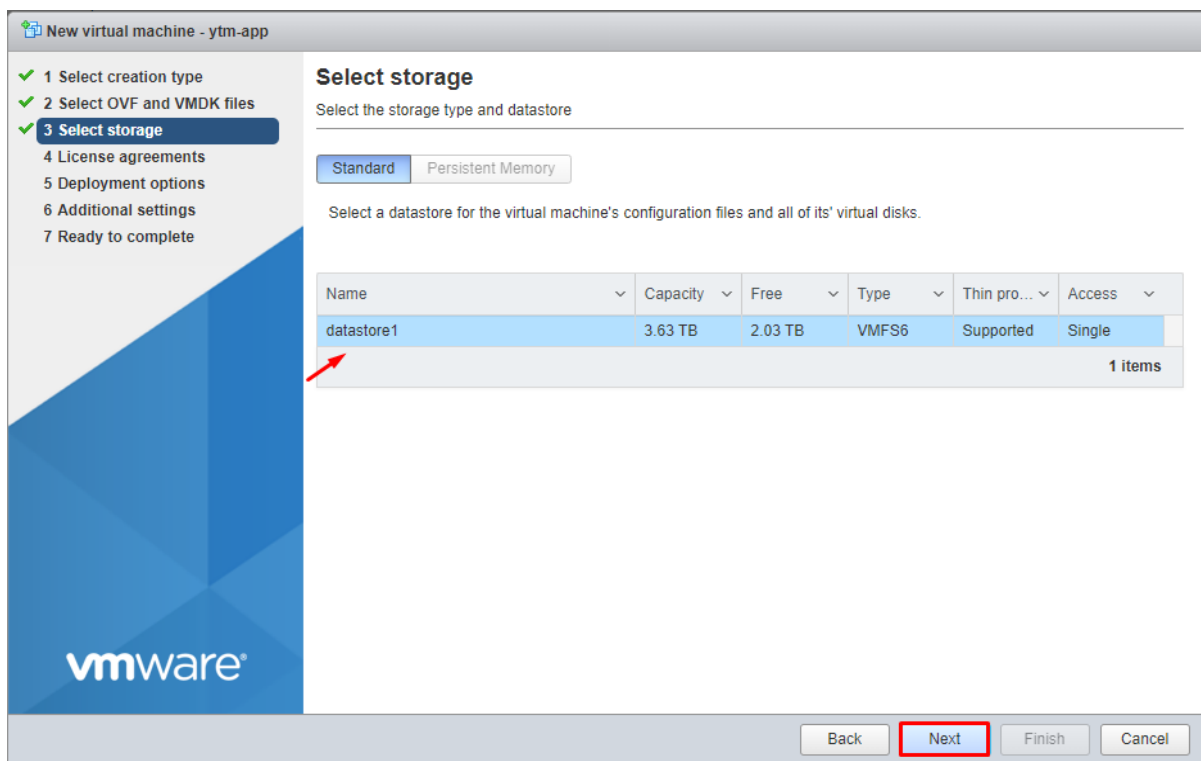
- Select all five virtual files, as shown in the picture below:



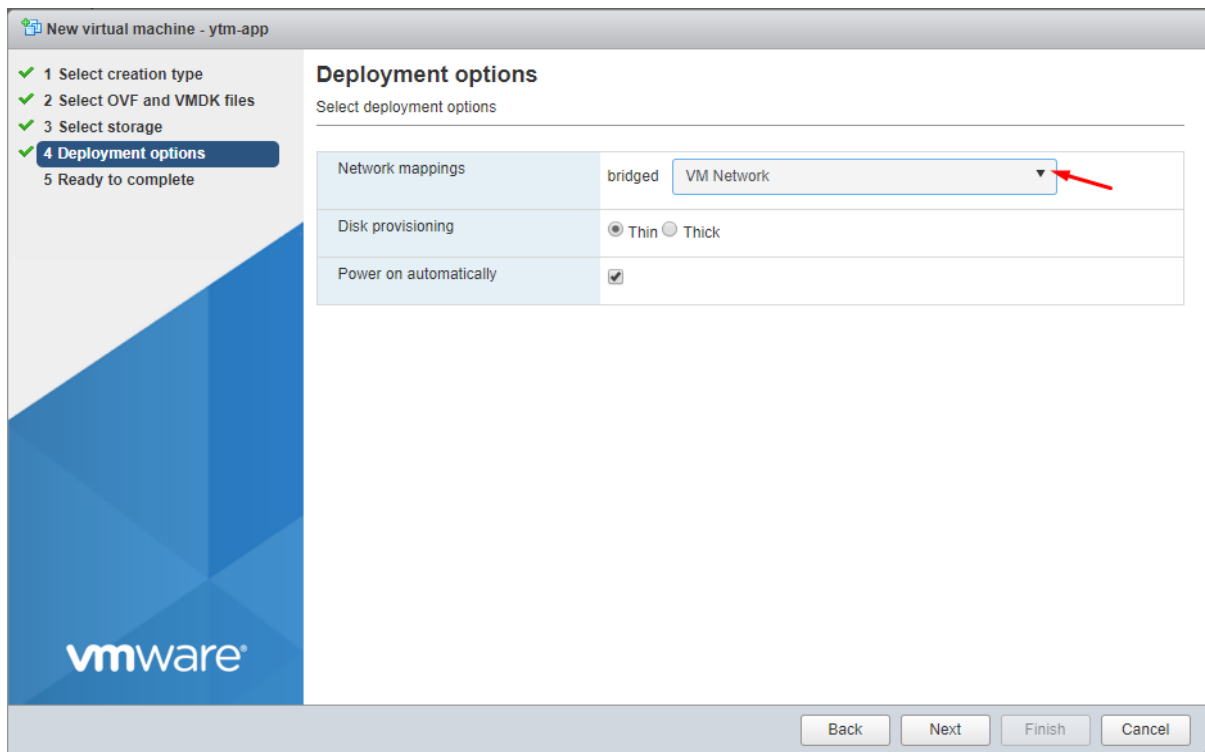
- Manifest file "*.mf" serves for the file's integrity verification, and it will not be shown:



- Select the appropriate datastore if you have more than one created:



8. Select deployment options that suit you best or preserve default settings:

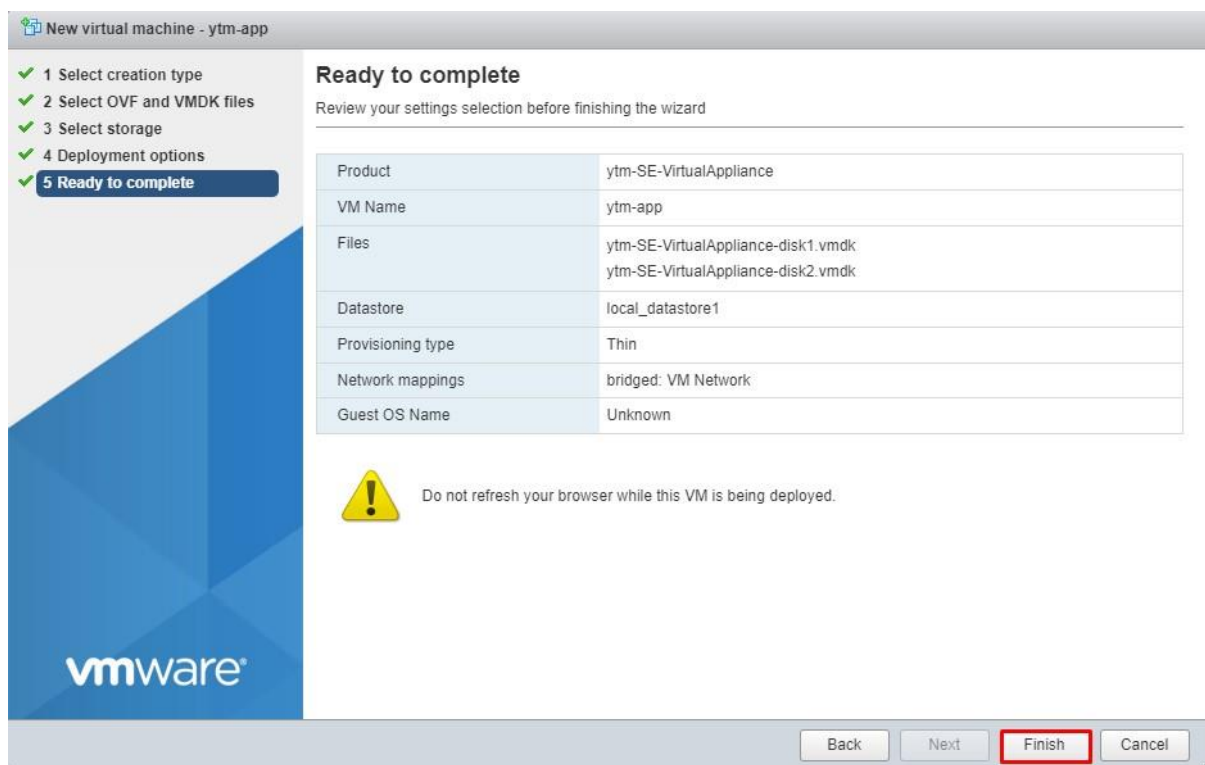


The screenshot shows the 'New virtual machine - ytm-app' wizard. On the left, a progress bar indicates five steps: 1. Select creation type, 2. Select OVF and VMDK files, 3. Select storage, 4. Deployment options (highlighted), and 5. Ready to complete. The main area is titled 'Deployment options' and contains a table with the following settings:

Select deployment options	
Network mappings	bridged VM Network
Disk provisioning	<input checked="" type="radio"/> Thin <input type="radio"/> Thick
Power on automatically	<input checked="" type="checkbox"/>

A red arrow points to the 'VM Network' dropdown menu. At the bottom, there are four buttons: Back, Next, Finish, and Cancel.

9. Review your settings and click the "Finish" button to start deployment:



The screenshot shows the 'New virtual machine - ytm-app' wizard at the 'Ready to complete' step. The progress bar on the left now highlights step 5. The main area is titled 'Ready to complete' and contains a table summarizing the settings:

Review your settings selection before finishing the wizard	
Product	ym-SE-VirtualAppliance
VM Name	ym-app
Files	ym-SE-VirtualAppliance-disk1.vmdk ym-SE-VirtualAppliance-disk2.vmdk
Datastore	local_datastore1
Provisioning type	Thin
Network mappings	bridged: VM Network
Guest OS Name	Unknown

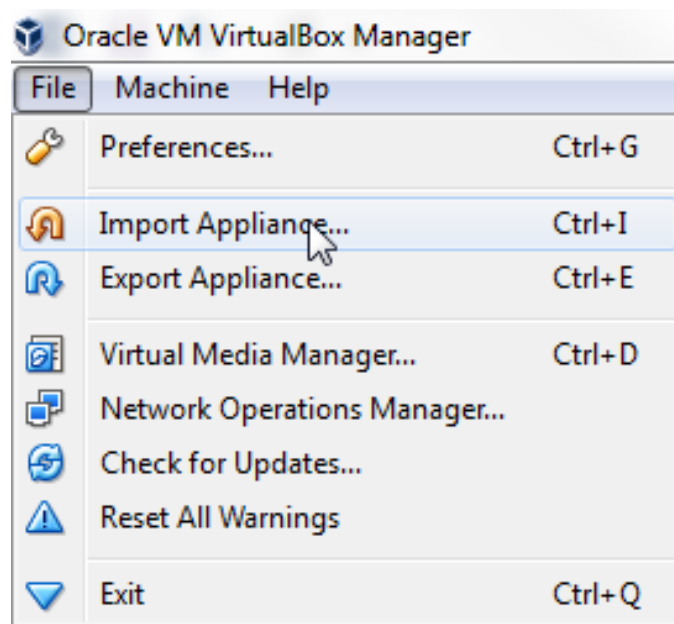
Below the table, there is a yellow warning icon and the text: 'Do not refresh your browser while this VM is being deployed.' At the bottom, there are four buttons: Back, Next, Finish (highlighted with a red box), and Cancel.

10. You can monitor the deployment process under "Recent tasks" located at the bottom of the page:

Result ▲	Completed ▼
<div><div></div></div>	Running... 5 %
<div><div></div></div>	Running... 6 %
<div><div></div></div>	Running... 35 %
<div><div></div></div>	Running... 94 %

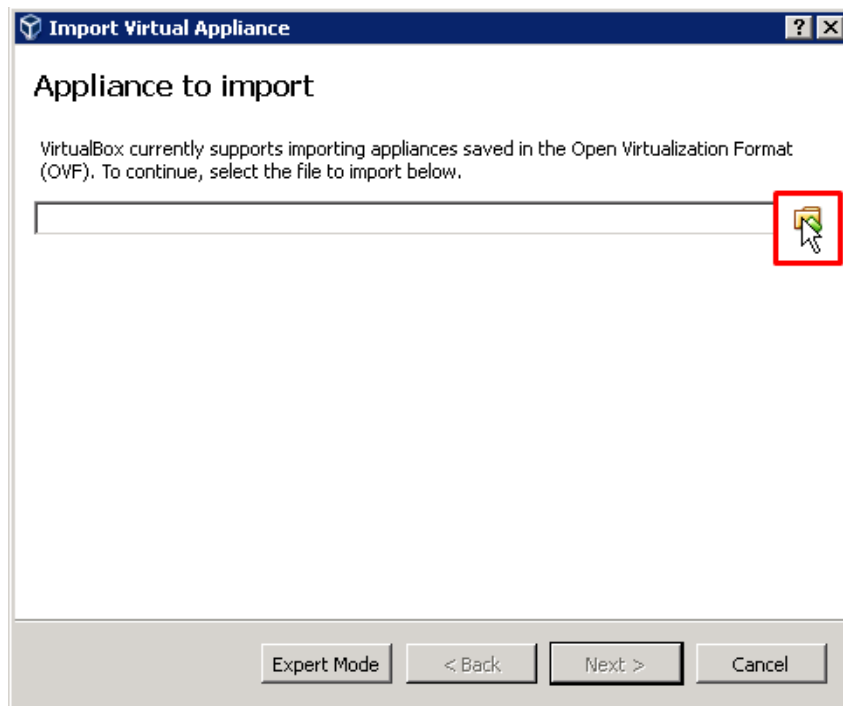
5.3 Importing YouTestMe Virtual Machine into Oracle VirtualBox

1. File -> Import Appliance

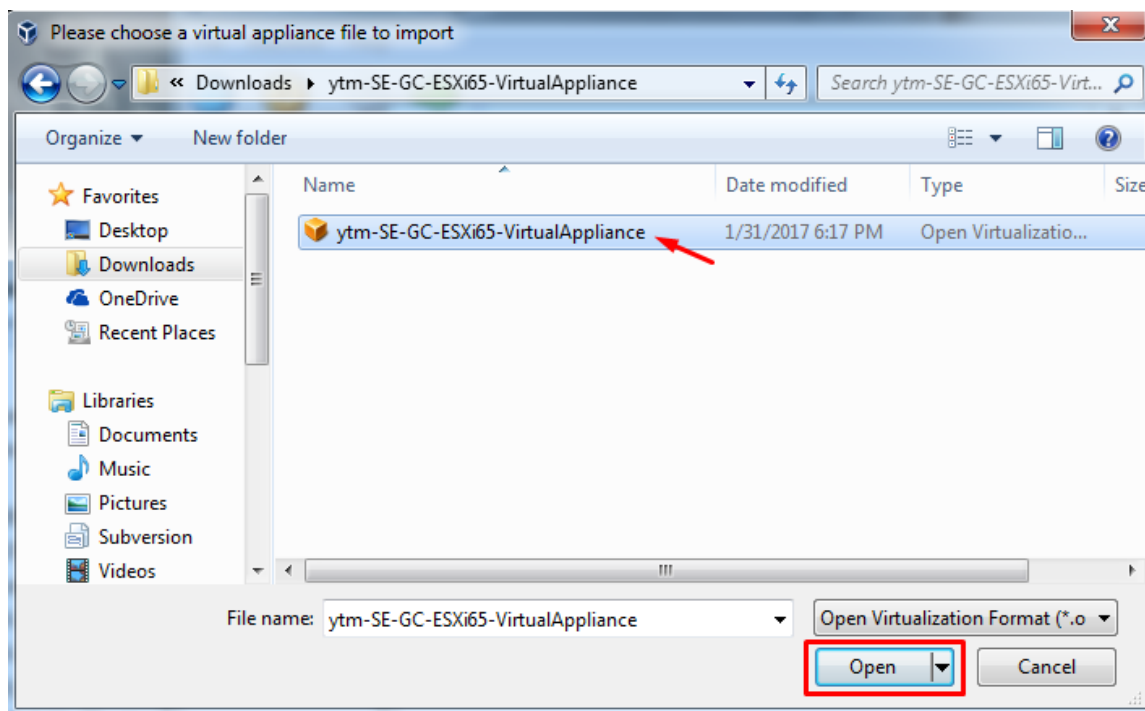


2. Choose the virtual machine to import -> Open -> Next

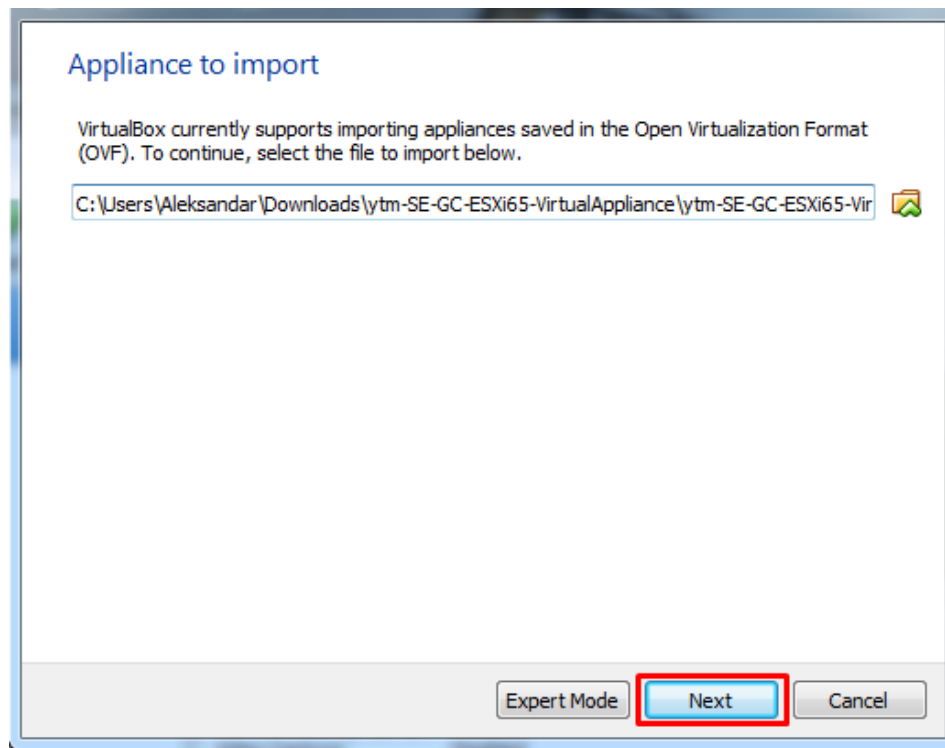
- a. Click on the "Folder" button to search for the downloaded ".ovf" file:



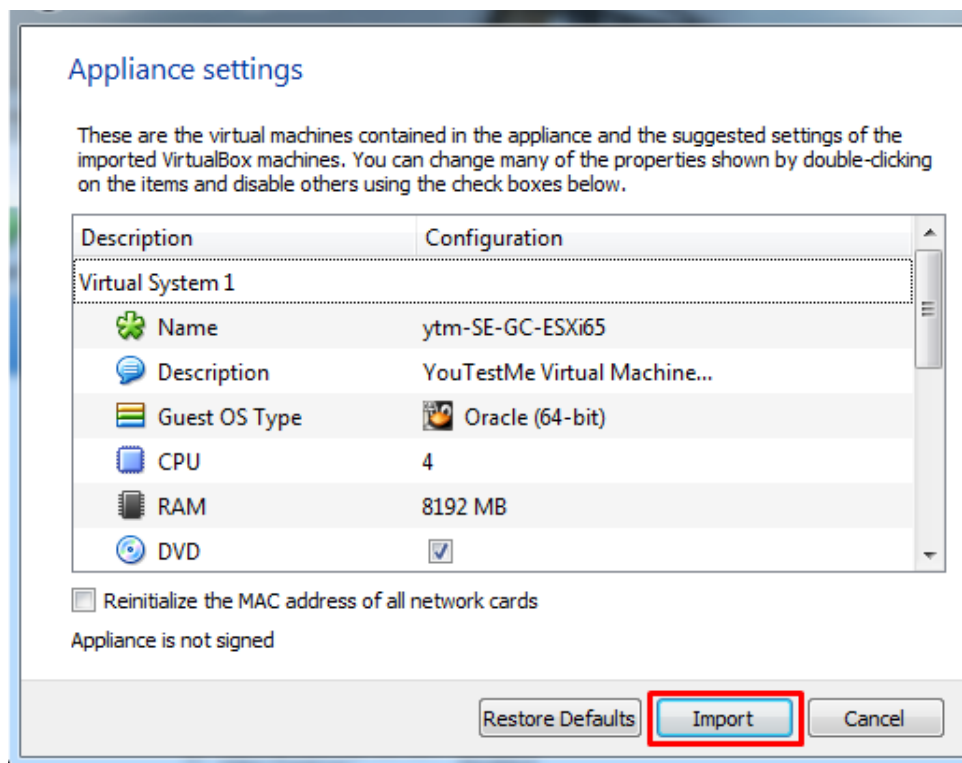
- b. Choose a virtual appliance file to import:

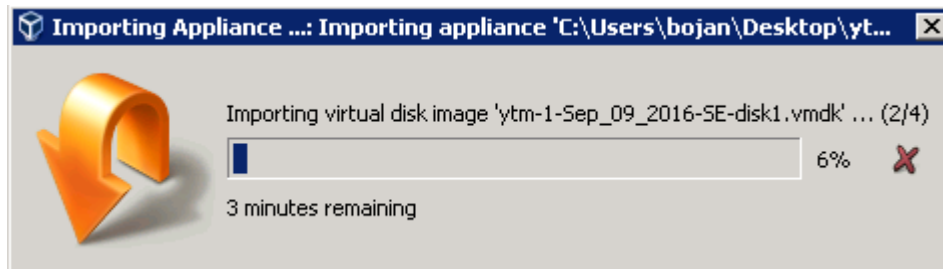


- c. Check if the file path is correct:

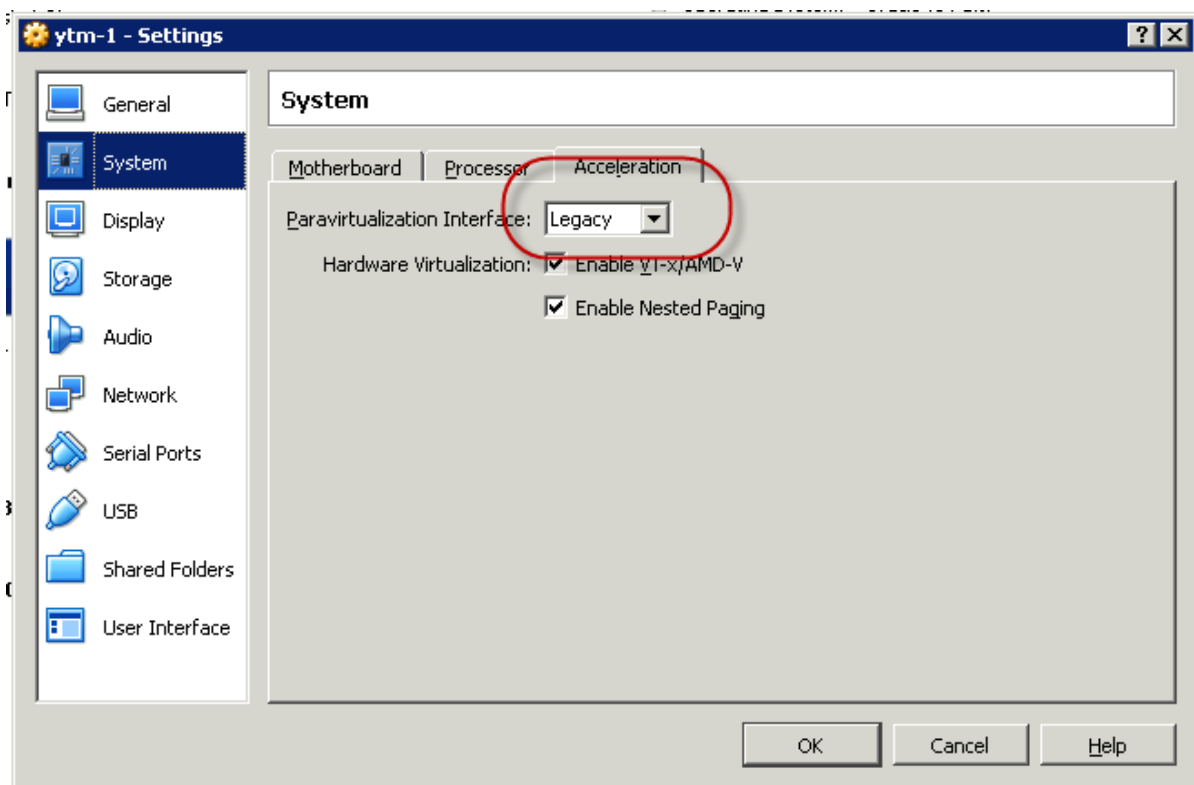


3. Check Appliance settings, change the name, and click "Import":

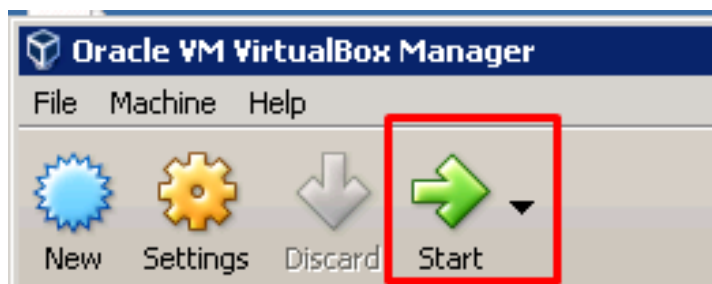




4. **When finished**, the YTM Appliance will be available in the inventory tab under the name given in Step 3. Perform this setting on a Virtual Machine:
 - a. VM Settings -> System -> Acceleration -> Paravirtualization Interface -> Set to "Legacy"

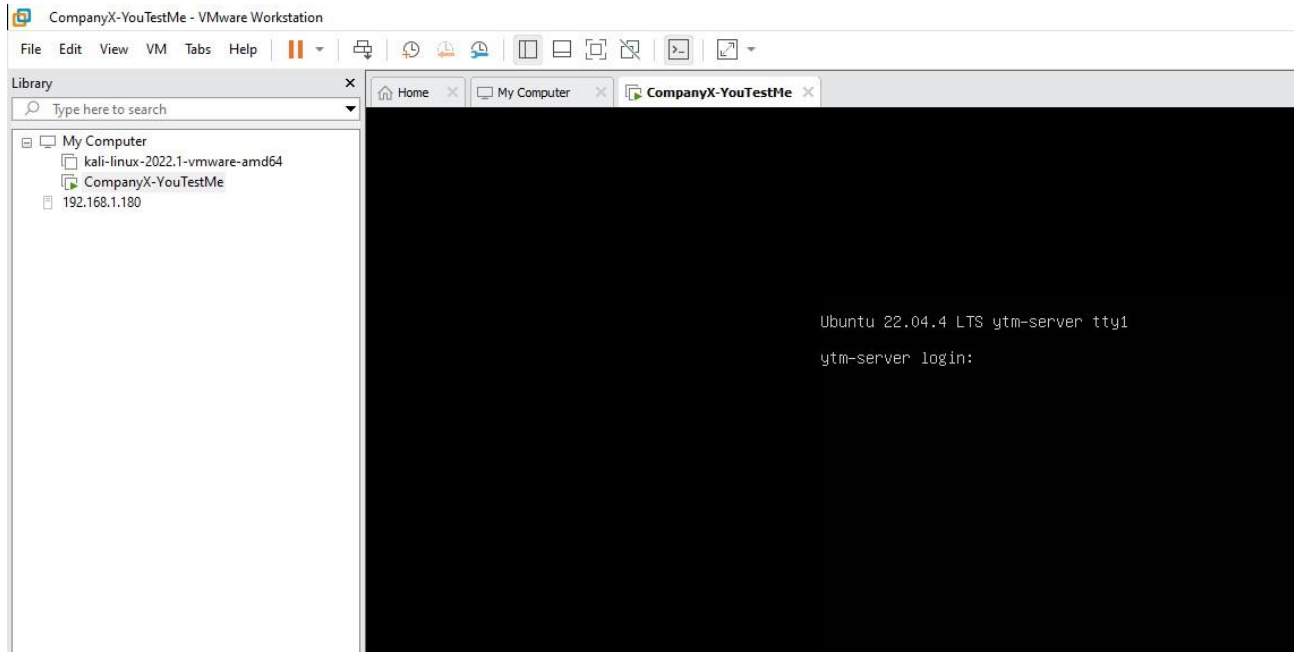


- b. Click on the "**Start**" button to start the virtual machine:



6 First Login

Default login parameters can be found in the chapter [Change Linux User Password](#).



7 Text Editors

You may need to edit some files on the YouTestMe virtual machine to accomplish specific configuration settings. The following text editors are available:

Editor	Description	Example
vi (or vim)	Linux advanced character-based editor	vi file_name
nano	More user-friendly character-based editor	nano file_name

8 Network Configuration

To complete the following procedure, execute the following commands:

1. Check the name of the network interface (default **ens32**):

```
ytmlogin@ytm-server: ~
ytmlogin@ytm-server:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: ens32: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 00:0c:29:23:19:ef brd ff:ff:ff:ff:ff:ff
    altname enp2s0
    inet 192.168.1.100/24 brd 192.168.1.255 scope global ens32
        valid_lft forever preferred_lft forever
    inet6 fe80::20c:29ff:fe23:19ef/64 scope link
        valid_lft forever preferred_lft forever
ytmlogin@ytm-server:~$
```

2. Edit the network configuration file. Update your desired static IP address, DNS server, and gateway where appropriate. Update the name of the network interface if necessary. Save and exit the file after you have applied your changes.

```
$ sudo vim /etc/netplan/50-cloud-init.yaml
```

```
network:
  version: 2
  ethernet:
    ens33:                                     // network interface name
      addresses:
        - 192.168.1.100/24                     // VM static IP / Subnet
      nameservers:
        addresses: [192.168.1.1]               // DNS Server
      routes:
        - to: default
          via: 192.168.1.1                     // Network Gateway
  version: 2
```

3. To apply the new network changes, execute:
\$ sudo netplan try
4. Alternatively, if you run into some issues, run:
\$ sudo netplan --debug apply
5. Confirm your new static IP address by using the command:

```
$ ip a
```

Check the [official Ubuntu documentation](#) to learn more about configuring Ubuntu Server networking.

8.1 Network Troubleshooting

After configuring the server's networking, you should perform a simple network connection test. Values that should be changed are listed below:

#	Value	Description
1.	VM_IP	The static IP address assigned to the Virtual Machine
2.	GATEWAY_IP	The address of your network gateway
3.	NET_MASK	The netmask of your network, usually 255.255.255.0 in the local network
4.	NET_INTERFACE	Network interface - usually has the prefix " ens "

8.1.1 Network diagnostics

Test your network connection by applying the following actions:

1. Connect to the YouTestMe Virtual Machine
2. Try to ping any network device **DEVICE_IP** connected to the same network from the YouTestMe Virtual Machine using the following command:

```
ping DEVICE_IP
```
3. Try to ping **VM_IP** from any network device connected to the same network:

```
ping VM_IP
```
4. Try to ping any publicly available server on the Internet from the deployed YTM Virtual Machine, for example, Google Public DNS server 8.8.8.8 (only if Internet access is allowed):

```
ping 8.8.8.8
```

If the first or second operation fails, a networking problem is probably related to invalid network configuration parameters. Please recheck the specified network parameters and ensure that the **VM_IP** address is not assigned to another device in the same network.

If only the third test fails (can not ping 8.8.8.8 successfully), there is a possible routing issue. Please contact your network administrator for help if the Internet connection is not forbidden for the YouTestMe server.

9 Starting YouTestMe Server Application

The YouTestMe server application will start once the Virtual Machine is turned on. If the network is configured correctly, restart the appliance, and the application will be available.

To restart the appliance, follow the instructions from the [Restarting YouTestMe Virtual Machine](#) section.

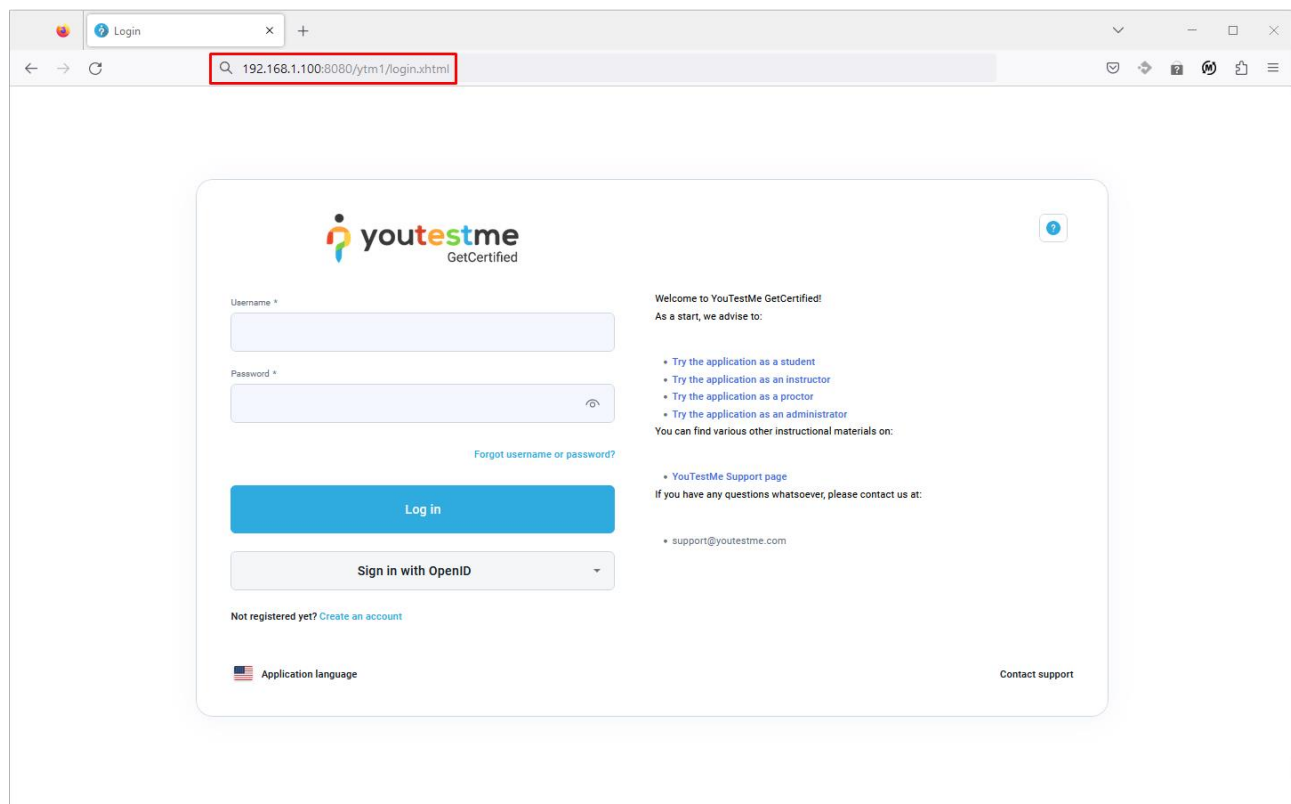
To access the application, type the following string in your browser's address bar:

`http://VM-IP:8080/ytm1/login.xhtml`

For example, <http://192.168.1.100:8080/ytm1/login.xhtml>

VM-IP represents the IP address parameter configured in the [Network Configuration](#) chapter.

Login information and the instructions for configuring recommended initial settings can be found [here](#).



10 Changing Application Default Port

1. Create a snapshot of the Virtual Machine to revert to the previous configuration if something gets corrupted.
2. Log in as a Linux sudo user and check ports that are currently in use by executing this command:
`$ sudo lsof -i -P -n |grep LISTEN`
3. Choose the port that is not currently used
4. Log in as Linux user "ytm1"
5. Edit file: `/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/conf/server.xml`
6. Change the port in the line below:

```
<!-- A "Connector" represents an endpoint by which requests are received
and responses are returned. Documentation at :
Java HTTP Connector: /docs/config/http.html
Java AJP  Connector: /docs/config/ajp.html
APR (HTTP/AJP) Connector: /docs/apr.html
Define a non-SSL/TLS HTTP/1.1 Connector on port 8080
-->
<Connector port="8080" protocol="HTTP/1.1"
           connectionTimeout="20000"
           redirectPort="8443" />
<!-- A "Connector" using the shared thread pool-->
<!--
<Connector executor="tomcatThreadPool"
           port="8080" protocol="HTTP/1.1"
           connectionTimeout="20000"
           redirectPort="8443" />
-->
```

7. Save file
8. Restart Tomcat by executing these two commands:
 - a. `$ tstop`
 - b. wait for 10 seconds to allow Tomcat to shutdown gracefully
 - c. `$ tstart`
9. In case that application does not start:
 - a. Reboot VM:
Log in as a sudo user and execute the command "reboot"
 - b. If the reboot does not solve the problem, try a different port or restore the previous configuration.

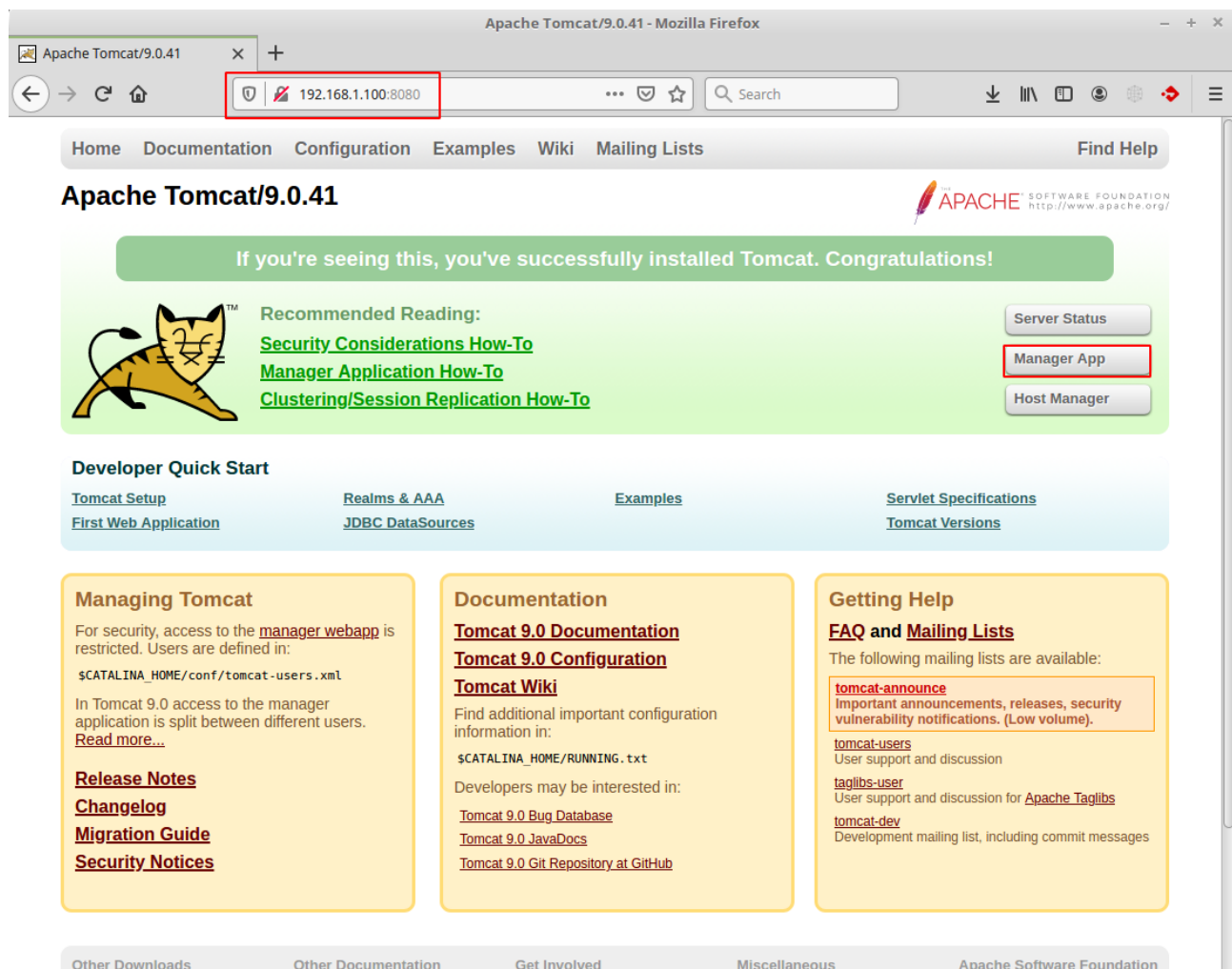
11 Tomcat Manager

Tomcat Manager App is a web application packaged with the Tomcat server and provides us with the basic functionality we need to manage our deployed web applications.

To access the Tomcat Manager application, do the following steps:

1. Open any browser and type the following URL:

`http://VM-IP:8080`



- Access to Tomcat Manager is allowed only from localhost by default for security reasons. To change it, do the following:

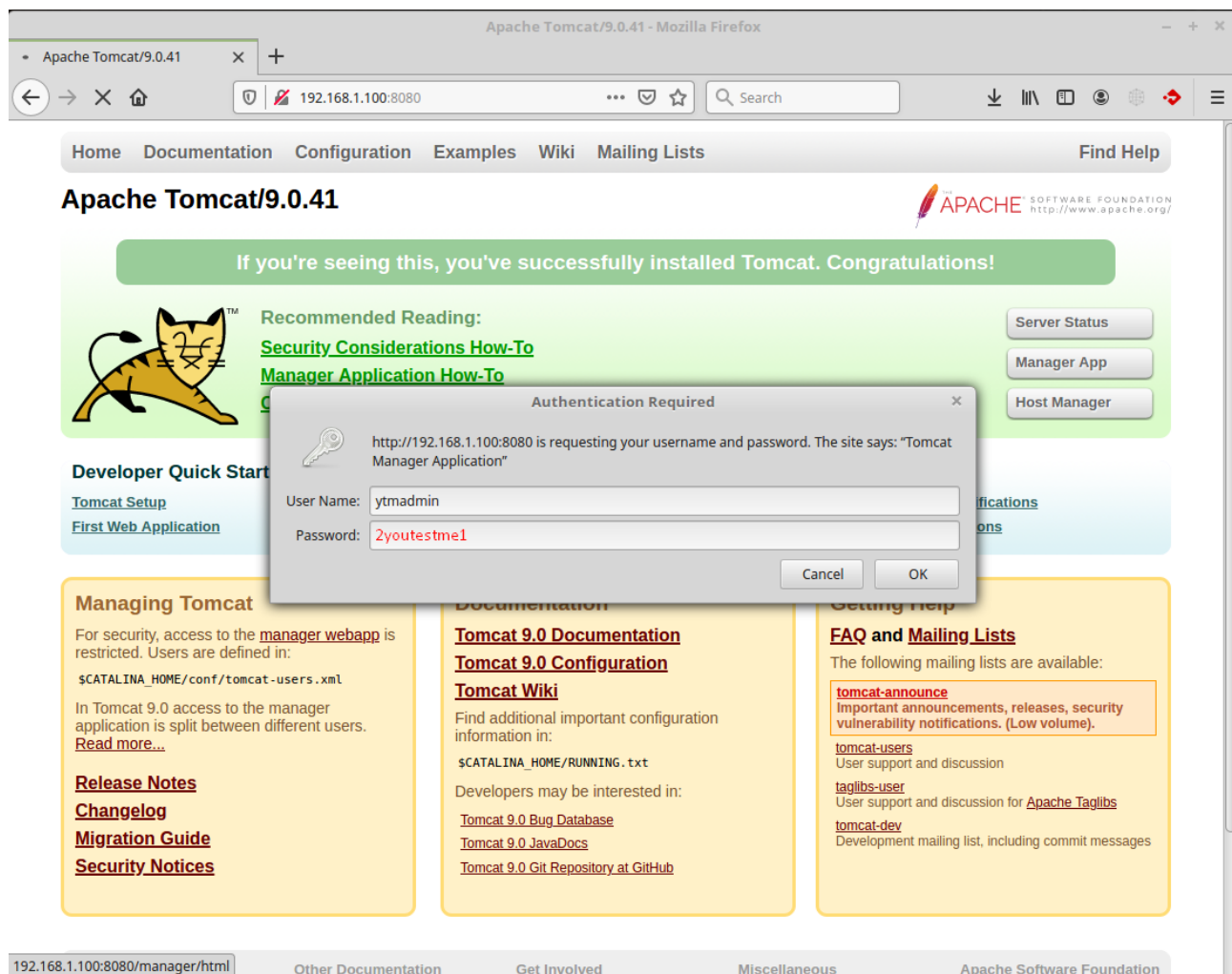
Edit the following configuration file (**Valve** component) and specify the IP address of your workstation.

```
$ nano ${HOME}/ytm/res/ProgramFiles/tomcat/apache-tomcat-
{TOMCAT_VERSION}/webapps/manager/META-INF/context.xml
```

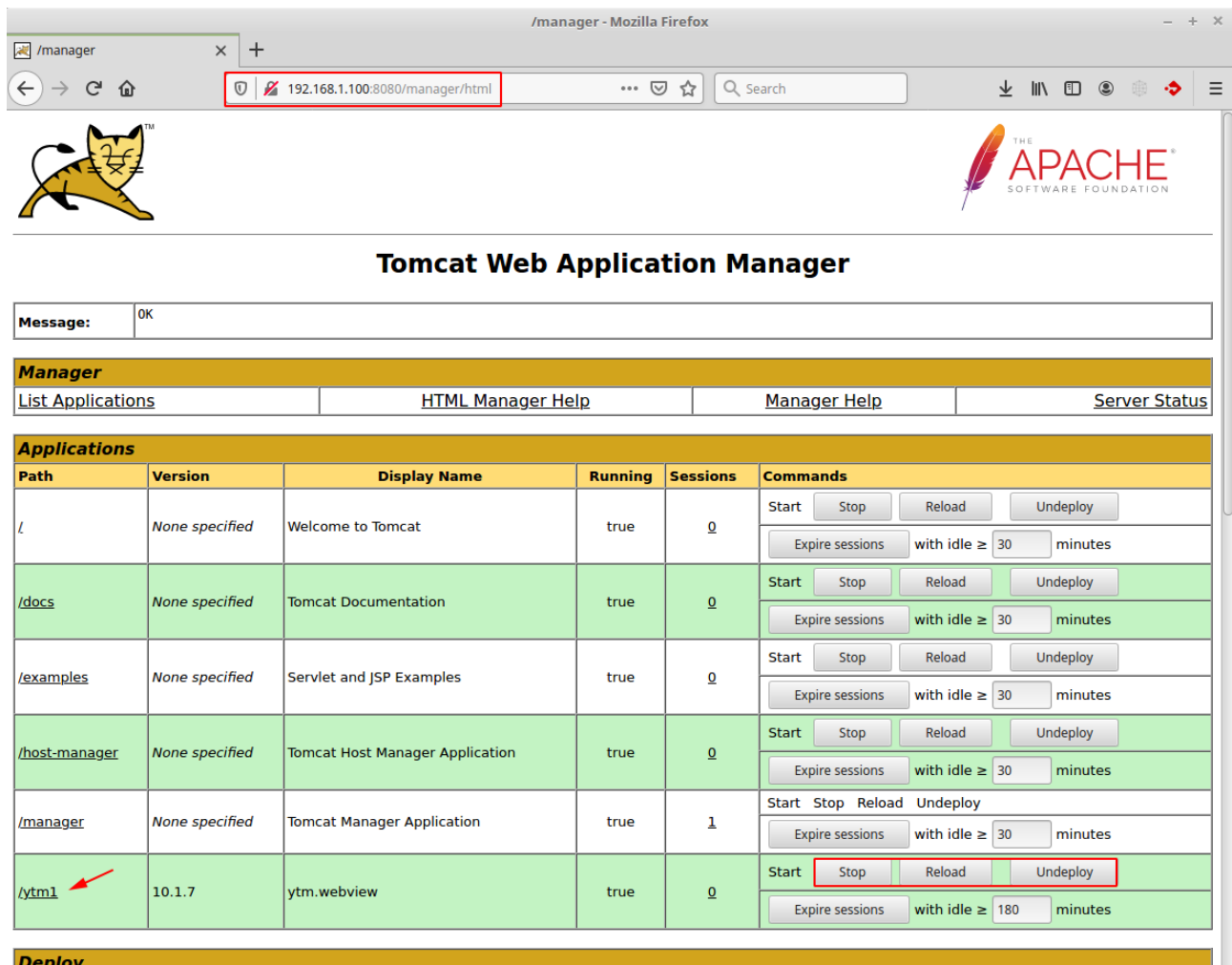
Example: Allow Tomcat manager access from the private IP address 192.168.1.80.

```
<Valve className="org.apache.catalina.valves.RemoteAddrValve"
  allow="127\.\d+\.\d+\.\d+|::1|0:0:0:0:0:0:1|192\.168\.1\.80" />
```

- Click on the "Manager App" button and enter the login credentials shown in the picture below:



- Now, you can easily manage the YouTestMe application from the GUI as an alternative to the Linux command executed in the Terminal.



Tomcat Web Application Manager

Message: OK

Manager

[List Applications](#) [HTML Manager Help](#) [Manager Help](#) [Server Status](#)

Applications					
Path	Version	Display Name	Running	Sessions	Commands
/	None specified	Welcome to Tomcat	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/docs	None specified	Tomcat Documentation	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/examples	None specified	Servlet and JSP Examples	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/host-manager	None specified	Tomcat Host Manager Application	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/manager	None specified	Tomcat Manager Application	true	1	Start Stop Reload Undeploy Expire sessions with idle ≥ 30 minutes
/ytm1	10.1.7	ytm.webview	true	0	Start Stop Reload Undeploy Expire sessions with idle ≥ 180 minutes

Deploy

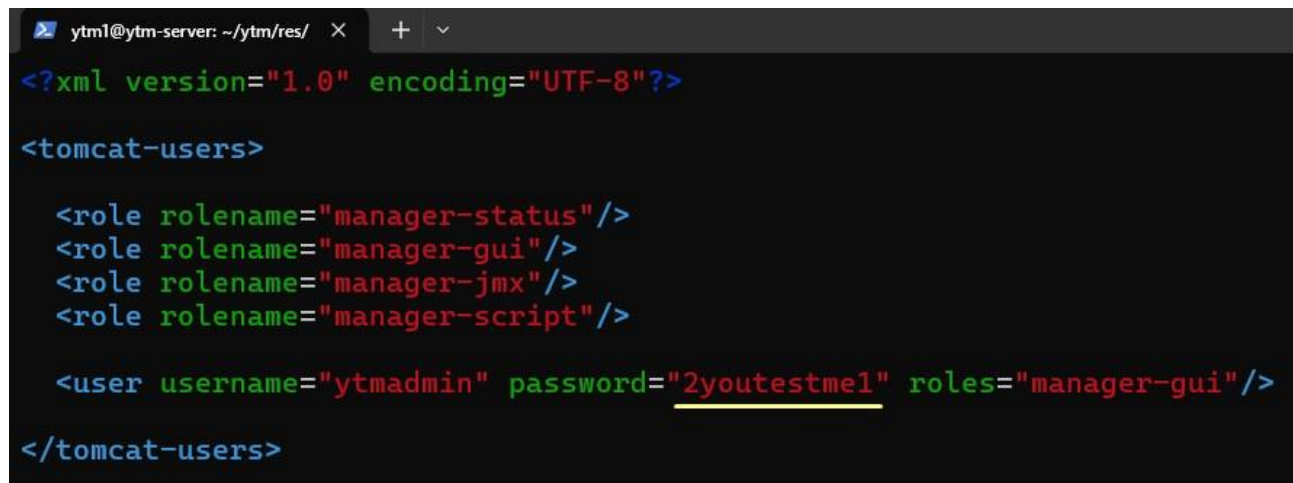
Note: Check the [official documentation](#) for more details about Tomcat Manager functionality.

11.1 Change Login Credentials

To change Tomcat Manager login credentials, perform the following operation:

1. Login to YouTestMe Virtual Machine as **ytm1** user
2. Edit the following configuration file and set up your username and password values.

```
$ vim /home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-  
{TOMCAT_VERSION}/conf/tomcat-users.xml
```



```
<?xml version="1.0" encoding="UTF-8"?>  
  
<tomcat-users>  
  
  <role rolename="manager-status"/>  
  <role rolename="manager-gui"/>  
  <role rolename="manager-jmx"/>  
  <role rolename="manager-script"/>  
  
  <user username="ytmadmin" password="2youtestme1" roles="manager-gui"/>  
  
</tomcat-users>
```

3. **Reboot** the YouTestMe Virtual machine or restart the Tomcat Server explicitly by executing the following command:
 - `$ tstop`
 - *wait 10 seconds for Tomcat gracefully shutdown*
 - `$ tstart`

11.2 Security Considerations

The Tomcat Manager application provides a convenient web-based interface for managing, deploying, and monitoring web applications on a Tomcat server. Still, it can pose security risks if used in a production environment without proper precautions. Key security risks include:

1. **Unauthorized Access:** The Manager app introduces an additional attack surface, which may expose sensitive controls like deployment and configuration management to unauthorized users if not properly secured.
2. **Weak Access Controls:** Tomcat Manager has limited built-in support for role-based access control, which can make it difficult to restrict specific management actions to authorized personnel only, increasing the risk of accidental or malicious changes.

3. **Sensitive Data Exposure:** Tomcat Manager can display server information (like memory usage, sessions, and threads), which can be valuable to attackers for understanding server load and potential vulnerabilities.
4. **Increased Attack Vector:** Running the Manager application may expose Tomcat to potential exploits targeting the management interface, mainly if the server is accessible from the Internet.

To mitigate these risks, consider the following security recommendations:

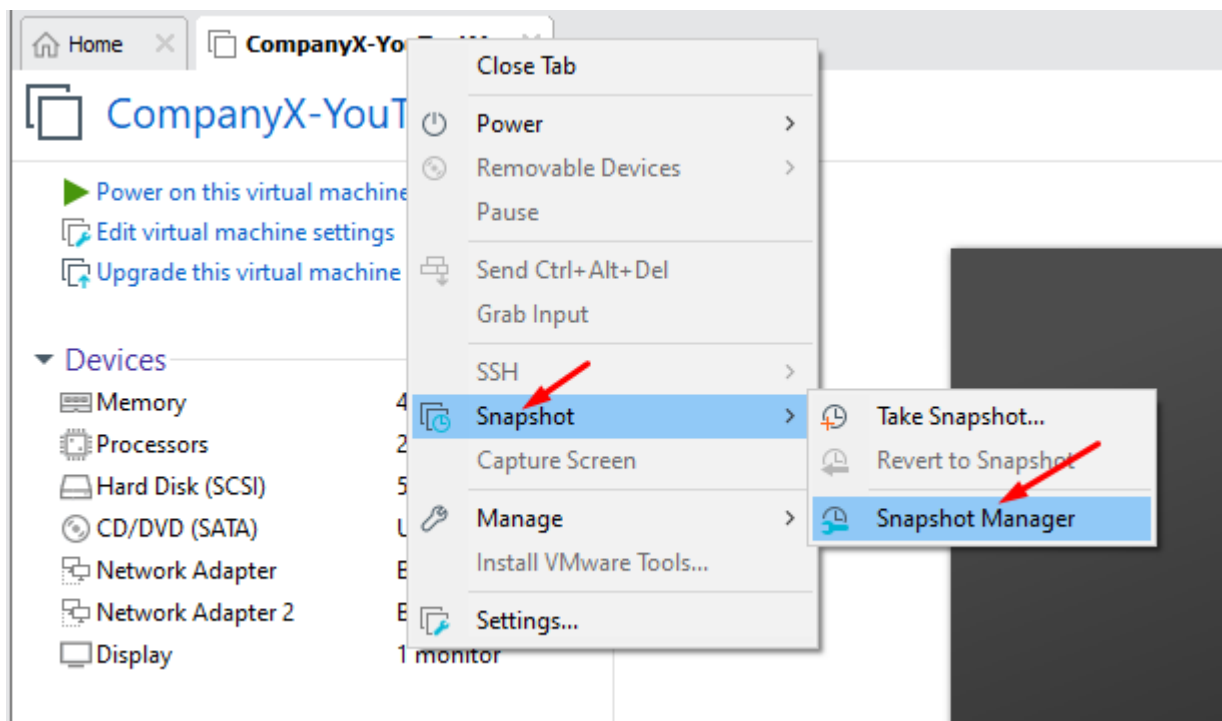
1. **Restrict Network Access:** Limit access to the Manager application by setting up firewalls, using IP safelists, or allowing access only through a VPN to prevent exposure to the public Internet.
2. **Enforce Strong Authentication:** Use robust credentials with unique usernames and complex passwords. Configure SSL/TLS for encrypted communications to prevent credential interception.
3. **Limit Access to Essential Personnel:** Assign the Manager role only to essential administrators and developers and avoid using shared credentials.
4. **Disable in Production:** For high-security environments, consider turning off the Manager application in production or replacing it with automated CI/CD tools (such as Jenkins or Ansible) for secure, controlled deployments.
5. **Regularly Update Tomcat:** Keep Tomcat updated to ensure any known vulnerabilities in the Manager application or Tomcat are patched.

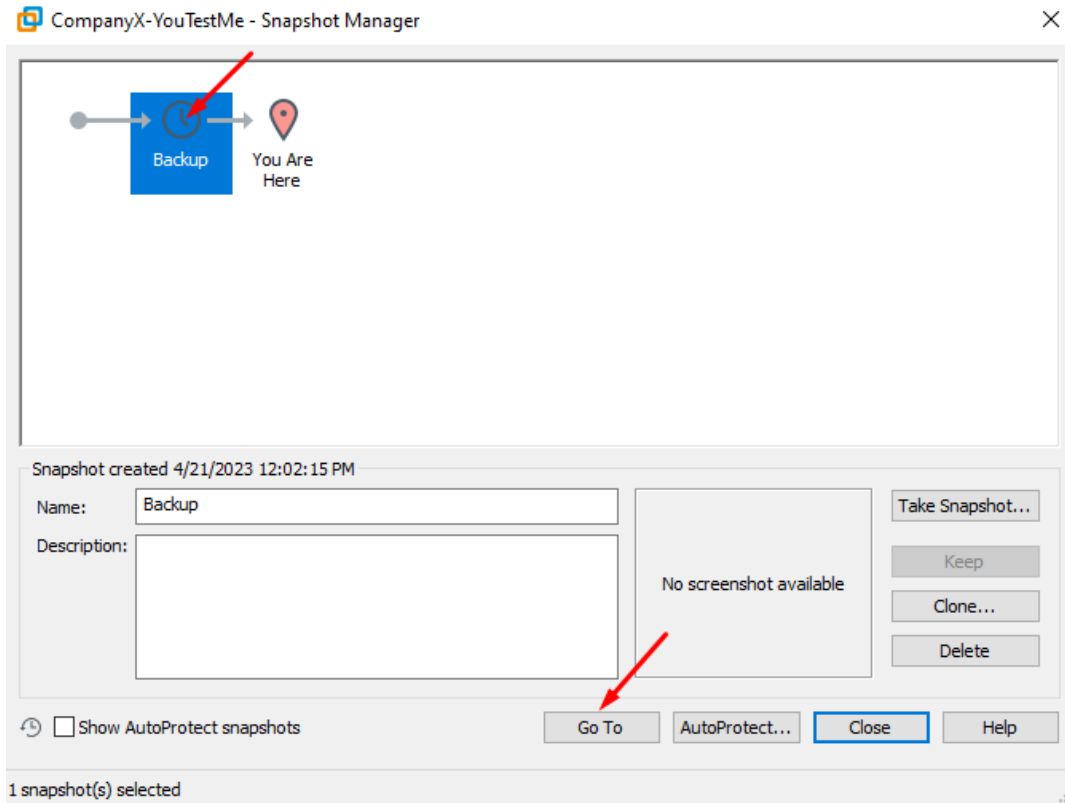
12 Restore VM State from Snapshot

Snapshot is a convenient way of creating a light backup of the Virtual Machine so we can easily roll back to a specific point in time. The restore procedure for three major virtualization software will be shown below.

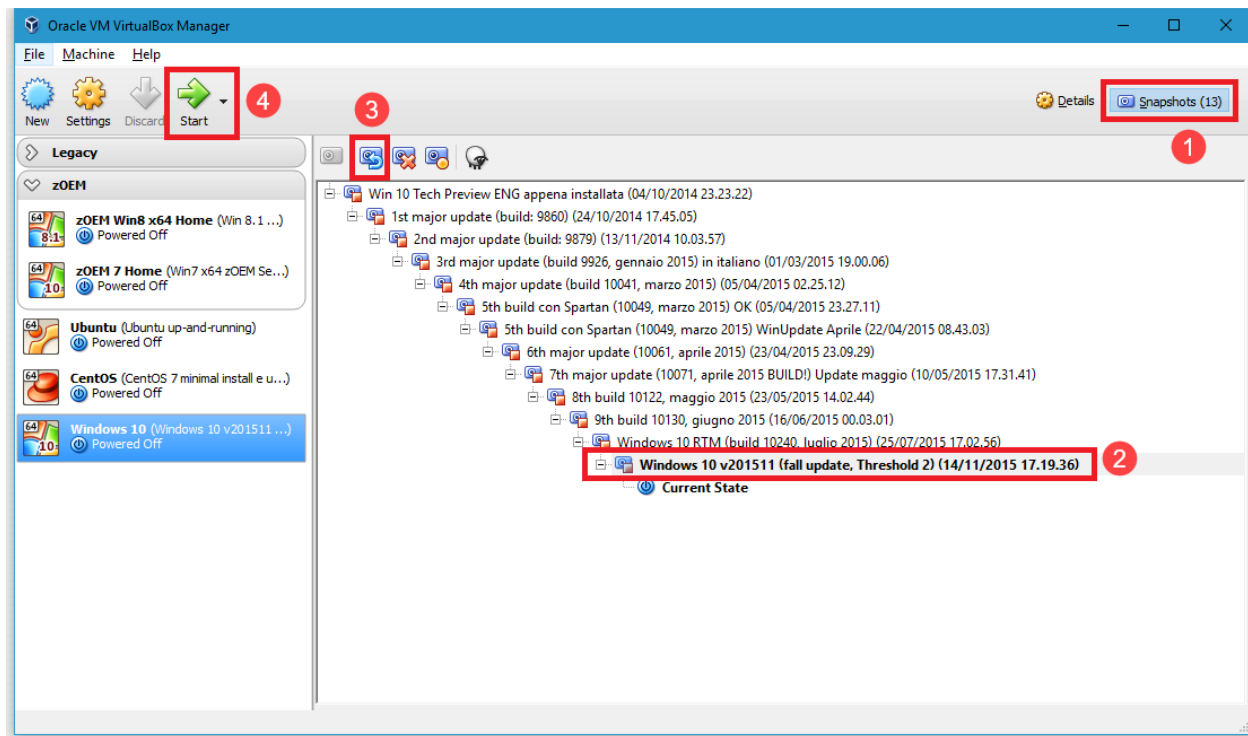
We highly recommend powering off the YTM Virtual Machine before reverting to one of the previous states.

12.1 VMware Workstation





12.2 VirtualBox



13 Protecting Your System and Data - Good Practices

Protecting your system and data is of extreme importance. Several easy-to-follow procedures and best practices should be used to protect your system and data from various events, such as hardware failure.

Company system administrators usually do these tasks regularly, and end-users don't need to worry about them. However, YouTestMe can run even on desktop computers in small departments. In that case, the person responsible for the application should use the best practices written below to ensure that the system can be recovered in case of hardware failure or accidental damage.

13.1 Create Virtual Machine Snapshots

A virtual machine snapshot is a one-click backup of the current state of your Virtual machine. Everything on the Virtual Machine is preserved at the time of the snapshot, and you can revert to that state at any time. Snapshots should be created as often as possible; however, it is generally recommended to do it:

- whenever you have a significant change in data or system settings or
- every few days

13.2 Export Virtual Machine File to another computer or disk

It is necessary because if the Virtual Machine file gets corrupted for some reason (i.e., hardware failure), even previously created snapshots may become unusable. It is less likely to happen if the Virtual Machine is hosted in the data center with various redundancy systems such as RAID disks, redundant power supply, etc. However, it is strongly recommended that this type of backup is regularly created.

Once a week is recommended, but generally, more often is better.

13.3 Manage Important Passwords

Please write down your administrative passwords and store them in a secure place. If they are lost, it is impossible to recover UNIX administrative passwords.

The most critical administrative passwords are listed in the table below.

Account	Description
root	administrative account for the Operating System (Linux)
postgres	administrative user for the database management (PostgreSQL)
ytmadmin	sudo user with administrative privileges (Linux)

13.4 Use Administrative Accounts with Caution

You should never log in to the system using administrative accounts unless you know what you are doing. These accounts are there to be used by system administrators to troubleshoot problems with the system.

The YouTestMe system is designed to do maintenance automatically through scheduled jobs; however, it may require manual intervention under exceptional and rare circumstances. An example would be installing patches or recovering the system after hardware failure where a backup does not exist.

Note that accidentally deleting or changing some critical files may damage the system or data, and the only way to recover may be to revert to the previous VM snapshot or backup.

13.5 Shut down the YTM system gracefully before turning off the Server computer

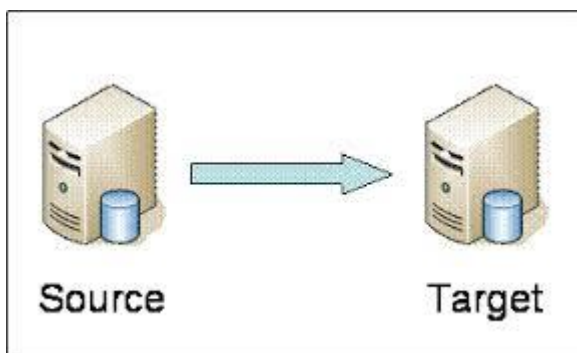
If the server computer needs to be turned off or restarted, the YouTestMe system should be [shut down gracefully](#).

14 Creating a YouTestMe Standby Site

For the maximum protection of your data and system availability, you can create the YouTestMe standby (mirror) site used as a failover system if the primary system gets unavailable (due to hardware failure or similar).

It can be accomplished by installing two YTM Virtual machines on two servers. One would be the "Primary" server used in your production process, and the other would be the "Standby" server.

The standby server will always run, but users will not access it. The data copy process will run periodically on the standby server, and all data will be copied from the primary server. The user can set this copy's frequency to be, for example, several times per day, once per day, or a week. More frequent data copying may impose a load on the source system and network, so scheduling it for "quiet" time is best.



14.1 Scheduling data copy process

Log in to YouTestMe Virtual Appliance as application user "ytm1" and open the Terminal:

Execute:

```
crontab -e
```

Add to crontab file:

```
#####  
  
#  
  
# WARNING! USE THE OPTION BELOW ONLY IF THIS IS STANDBY SERVER!  
  
# Activating this option will delete data on this server, and it  
# will refresh it with data from the Primary server.  
  
# Below setting will run data copy every day at midnight  
  
#  
  
#####  
  
0 0 * * * * ${HOME}/ytm/res/Scripts/Unix/ytm/system_upgrade/ytm_copy_db_to_new_vm.sh  
79.127.105.146 5432 ytm123pw ytm1
```

Save file exit with "vi" command: ":wq" + ENTER

Parameters in the command line are:

1. The IP address of the source VM from where we are copying data
2. port of the source database (usually "5432")
3. source database schema where the original data resides

Note that log files and target database backup are stored in the following directory:

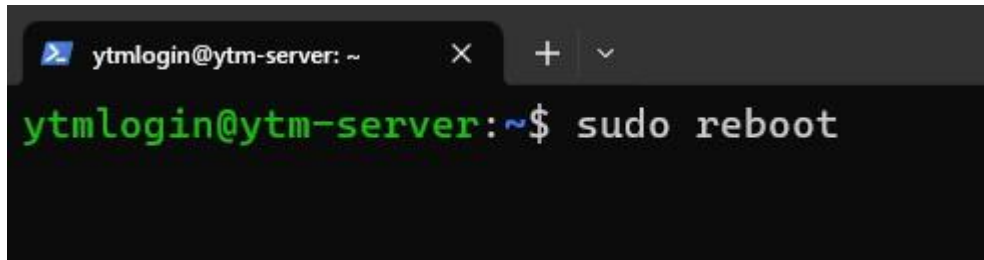
```
/ytmdata/ytm_data_pump_dir/
```

15 YouTestMe System Maintenance

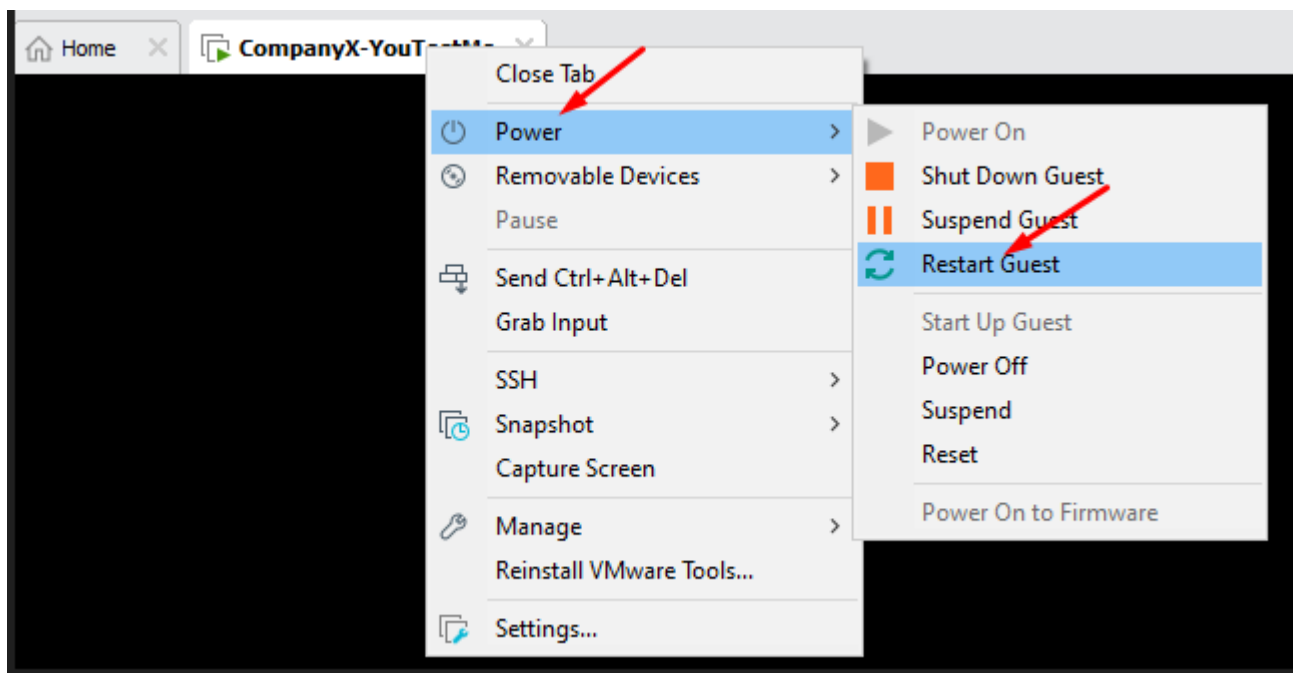
15.1 Restarting the YouTestMe Virtual Machine

To complete this procedure, you must be logged in as a sudo user.

1. Using a terminal, execute the command "sudo reboot"



2. From VMware Workstation, select the virtual machine from the inventory, right-click on it, and choose "Power" -> "Restart guest"

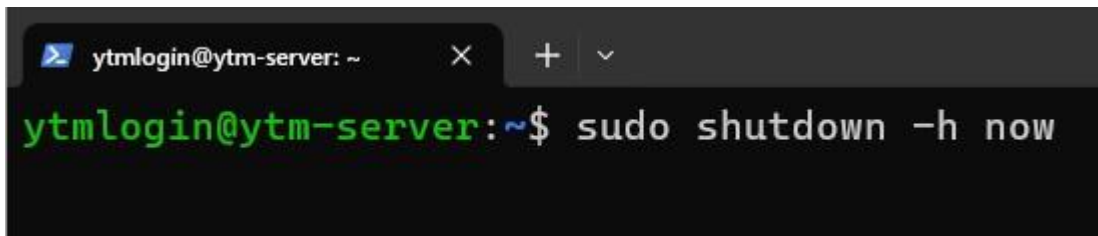


15.2 Shutting down the YouTestMe Virtual Machine

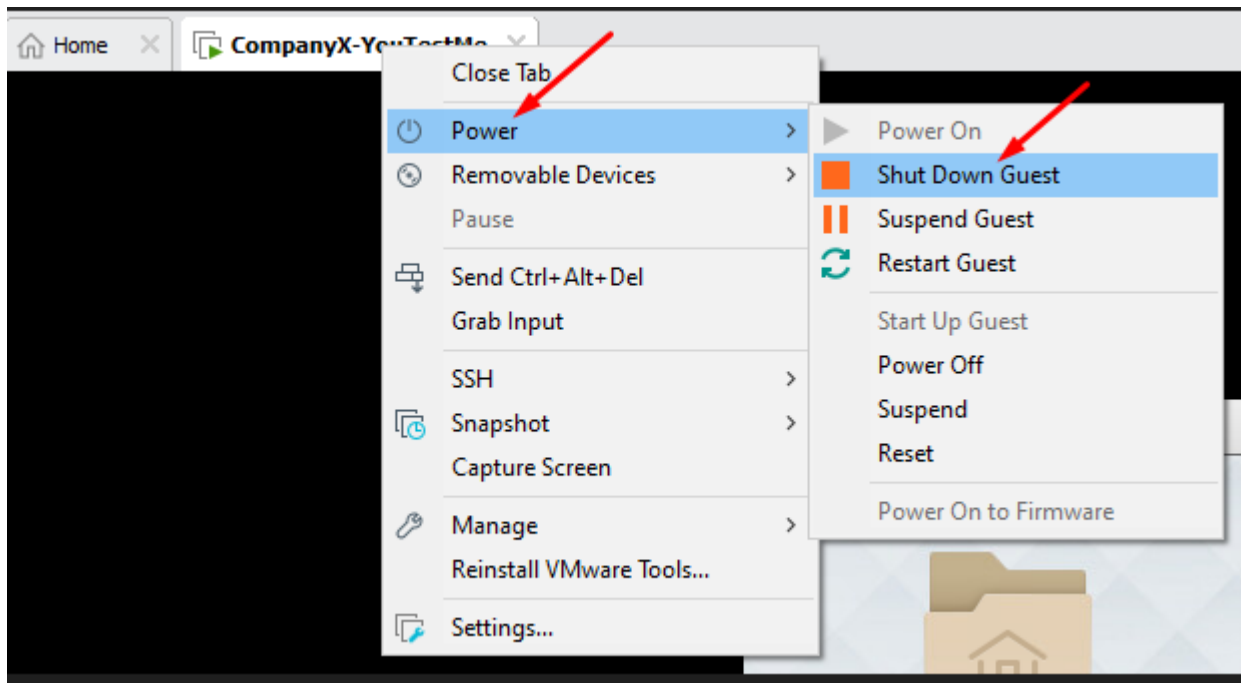
To complete this procedure, you must be logged in as a sudo user.

Before powering off the physical server, the Virtual Machine should be shut down gracefully so server files and data are not corrupted.

1. Using a terminal, execute the command "sudo shutdown -h now":



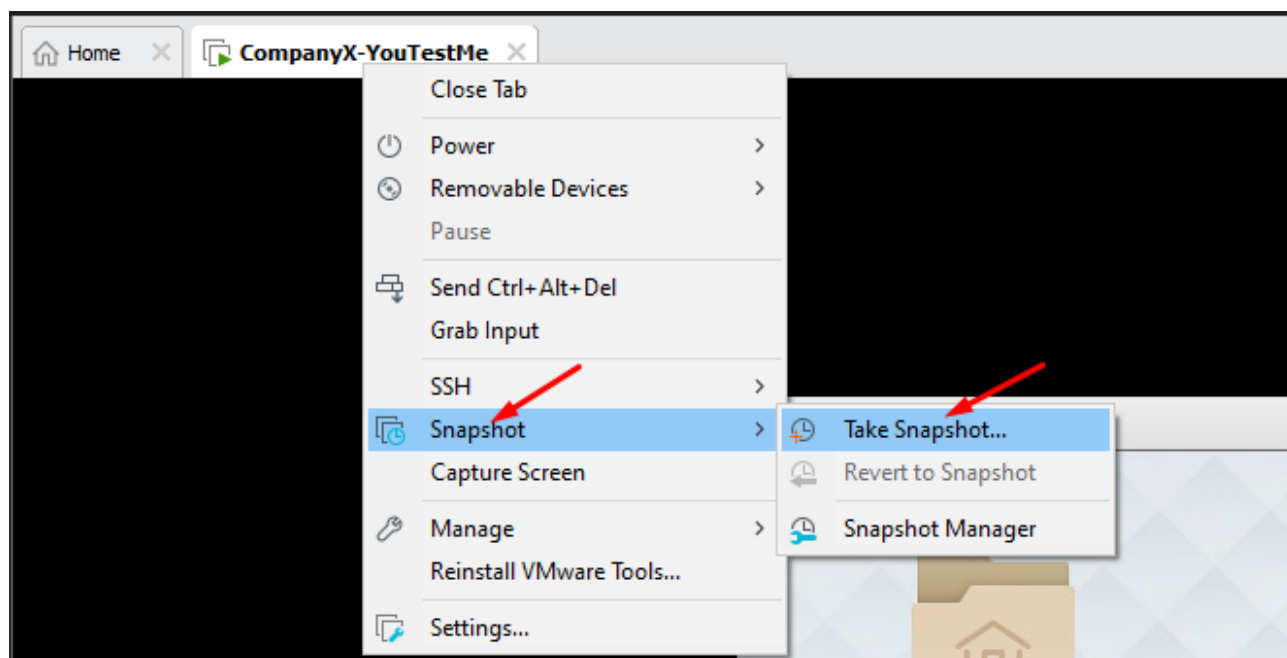
2. From VMware Workstation, select the virtual machine from inventory, right-click on it, and choose "Power" -> "Shut Down Guest"



15.3 Creating a Snapshot of the Virtual Machine

Snapshot is a convenient way of creating virtual machine backups. With snapshots, we can roll back to a specific point in time.

From VMware Workstation, select a virtual machine from inventory, right-click on it, and choose "Snapshot" -> "Take Snapshot"



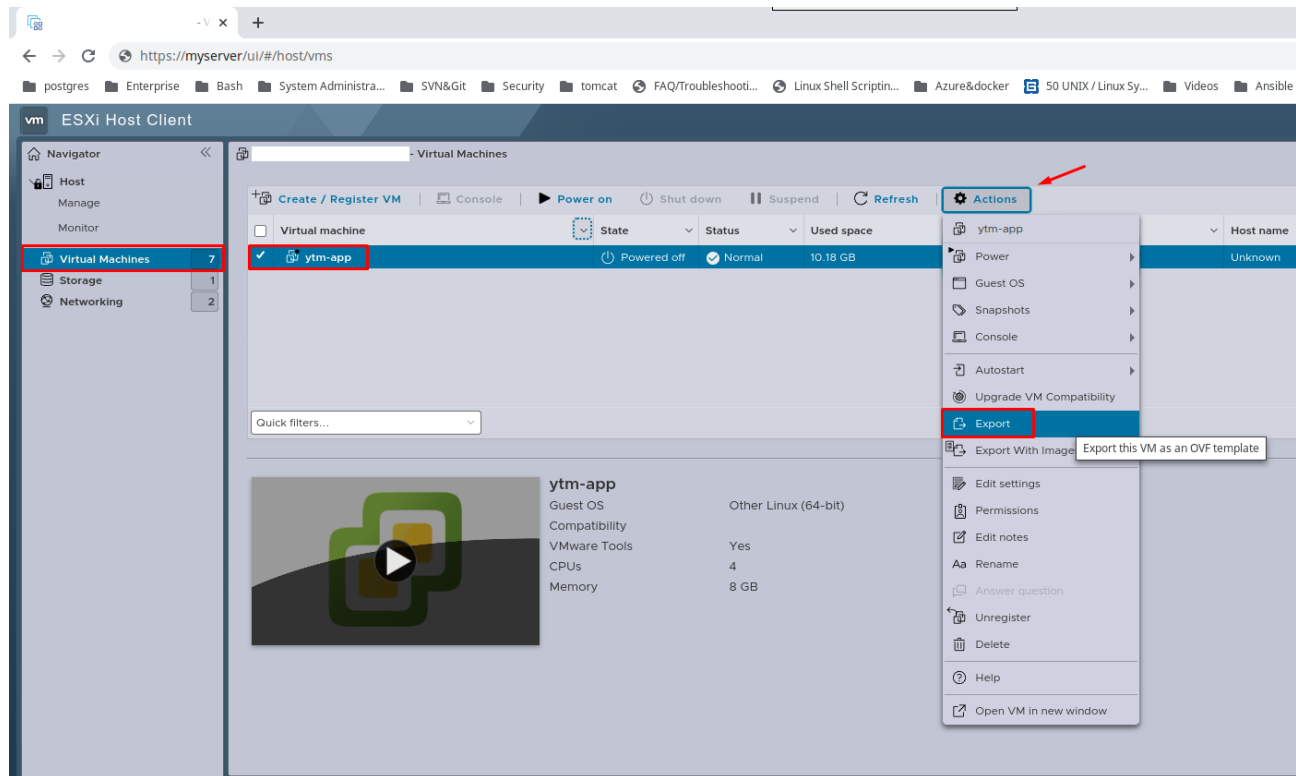
15.4 Creating Export (Physical Backup) Of Virtual Machine

Virtual Machine Export is the ultimate physical backup. It should be done regularly and kept in a safe place.

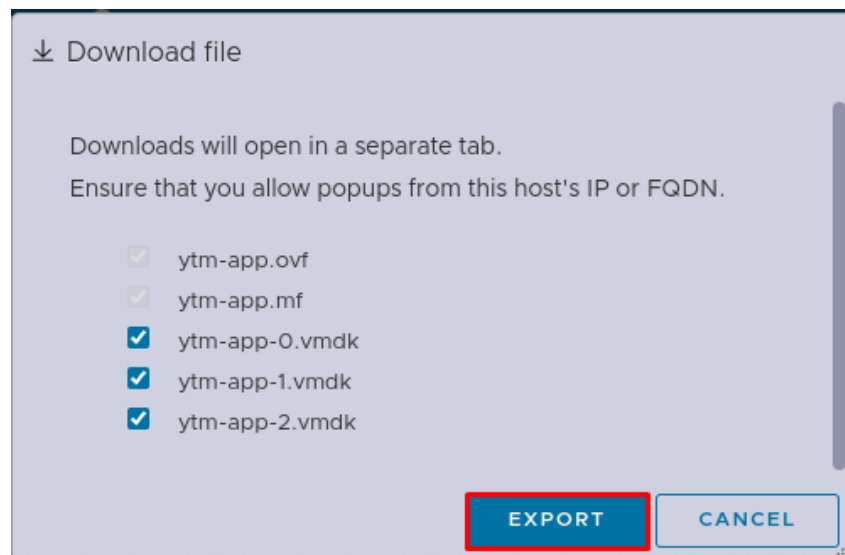
If Virtual Machine files get corrupted, it may not be possible to roll back to previous snapshots, so it is essential to make these backups regularly.

Using this type of export, you can also move or clone YouTestMe virtual machines. Cloning should be done only for backup. Backup files can be used to import Virtual Machine at the same or different location using the procedure explained in installing the YouTestMe Virtual Machine chapter.

1. From the vSphere web client (VMware), select the virtual machine from the list and navigate to Actions -> Export:



2. Confirm the operation by clicking the "EXPORT" button:

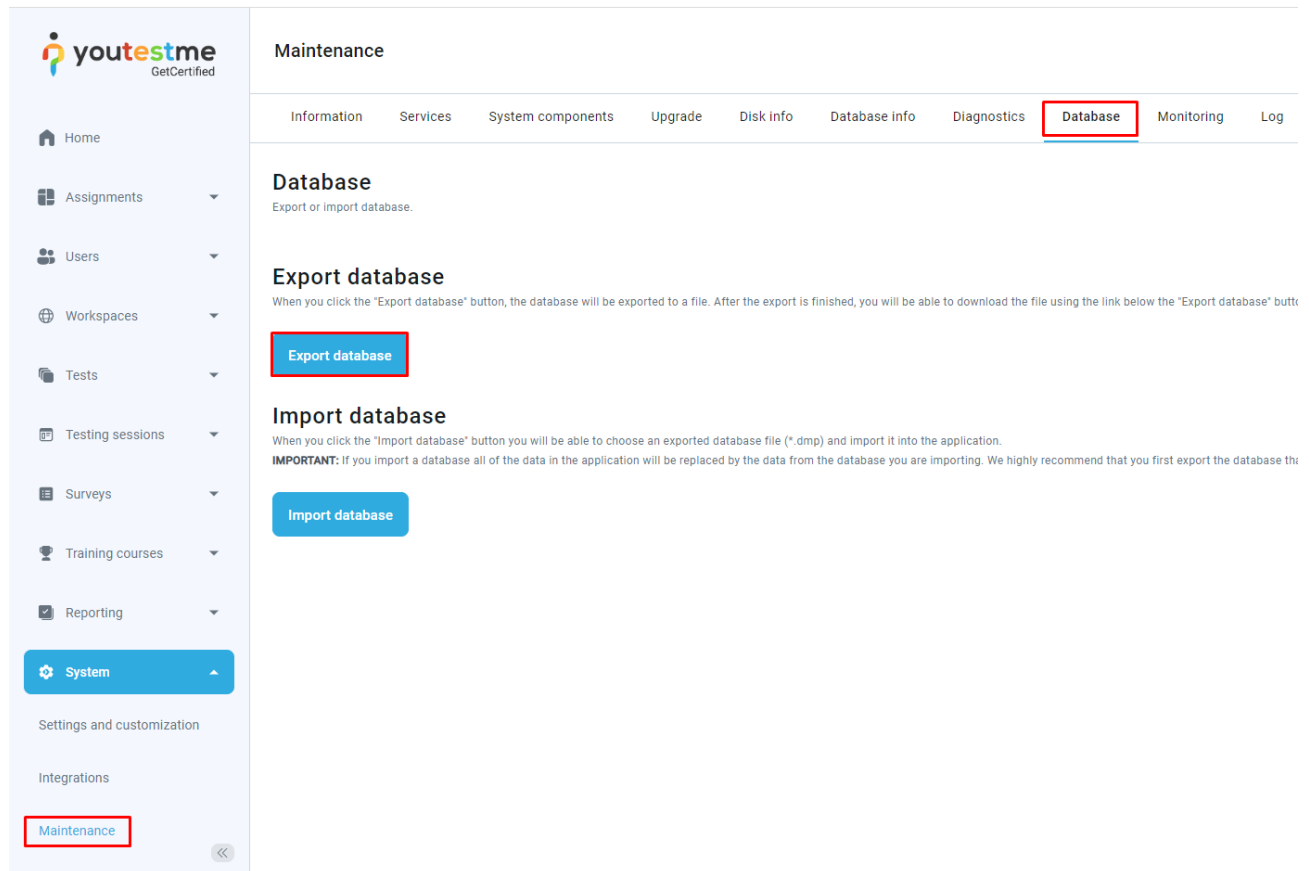


3. To turn off pop-up blocking or to exclude the host's IP or FQDN from being blocked, follow the instructions for your web browser: [Chrome](#) or [Firefox](#)

15.5 Export Database Data to a File

It is a good practice to back up your data occasionally by exporting them into a file. Then, the file can be downloaded and stored in a safe place. In addition, it can be helpful in data loss because the saved user data can be imported into the database (check the picture below).

Navigate to the **System -> Maintenance** page to execute database data export to a file within the application.



The screenshot shows the YouTestMe application interface. On the left is a sidebar with a menu including Home, Assignments, Users, Workspaces, Tests, Testing sessions, Surveys, Training courses, Reporting, System, Settings and customization, Integrations, and Maintenance (highlighted with a red box). The main content area is titled 'Maintenance' and contains a sub-menu with Information, Services, System components, Upgrade, Disk Info, Database Info, Diagnostics, Database (highlighted with a red box), Monitoring, and Log. The 'Database' section is active, showing options to 'Export or import database'. Under 'Export database', there is a blue button labeled 'Export database' (highlighted with a red box) and explanatory text. Under 'Import database', there is a blue button labeled 'Import database' and a warning note: 'IMPORTANT: If you import a database all of the data in the application will be replaced by the data from the database you are importing. We highly recommend that you first export the database th'.

15.6 Import Database Data from a File

The PostgreSQL data file can be restored from the backup via CLI (command-line interface) by performing the following procedure:

1. Copy your data file (**ytm1-backup.dmp**, for example) to YTM Virtual Machine and place it in the following directory:

```
/ytmdata/ytm_data_pump_dir/
```

The file can be migrated using any SFTP client software like WinSCP or FileZilla.

2. Log in to YTM Virtual Machine as user "**postgres**" and navigate to the directory where you transferred the database backup file :

```
$ cd /ytmdata/ytm_data_pump_dir/
```

3. Backup your current database data (schema):

```
pg_dump -v -U ytm1 -n ytm1 -b -Fc ytmdb1 > ytm1-backup2.dmp
```

4. Drop database schema "**ytm1**":

```
psql -U ytmadmin -d ytmdb1 -c 'drop schema ytm1 cascade';
```

5. Restore user data from the backup file "**ytm1-backup.dmp**":

```
pg_restore -U ytmadmin -d ytmdb1 < ytm1-backup.dmp
```

15.7 Database Parameters

Table showing default database parameters:

Setting	Value
Statistics gathering	automatic
Database Name	ytmdb1
YTM database administrative user	ytmadmin
YTM database schema (user data)	ytm1
Character Set	UTF8
Time Zone	UTC
Database Port	5432
Log Rotation	automatic

16 Securing network access to the YouTestMe system

This section describes ensuring that only specific computers on your network can access the YouTestMe system.

16.1 YouTestMe Virtual Machine Active Ports

Port	Protocol	Purpose
22	SSH	System support
5432	TCP	Access to the PostgreSQL database
8080	HTTP	Access to the YouTestMe Web Application through a web browser

Linux bash commands that can be used to determine listening ports:

1. `netstat -tulnp`
2. `ss -nutlp`
3. `lsof -i`

16.2 Assumptions

All computers are on the local network.

16.3 Step #1 - Determine a set of IP addresses with Access to the YouTestMe System

Determine the range of IP addresses permanently assigned to computers (devices) that will have access to the YouTestMe System. For example, suppose you have 30 computers (workstations) used for doing tests and for the application's administration. In that case, you could specify a range of related IP addresses from 192.168.1.100 to 192.168.1.129.

16.4 Step #1 - Collect MAC addresses

Collect MAC addresses from all computers (devices) that need access to the YouTestMe system.

Type "ipconfig /all" inside the DOS Window and search for Physical Address (picture below).

```
Wireless LAN adapter Local Area Connection* 4:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . . . . . : 
    Description . . . . . : Microsoft Hosted Network Virtual Adapter
    Physical Address. . . . . : 26-77-03-8A-1B-74
    DHCP Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . . : Yes

Wireless LAN adapter Wi-Fi:
    Connection-specific DNS Suffix . . . . . : 
    Description . . . . . : Intel(R) Centrino(R) Ultimate-N 6300 AGN
    Physical Address. . . . . : 24-77-03-8A-1B-74
    DHCP Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . . : Yes
    Link-local IPv6 Address . . . . . : fe80::3d7c:b3a9:c9c6:6651%12(Preferred)
    IPv4 Address. . . . . : 192.168.1.20(Preferred)
    Subnet Mask . . . . . : 255.255.255.0
    Lease Obtained. . . . . : March 9, 2018 10:15:01 AM
    Lease Expires . . . . . : March 10, 2018 10:15:00 AM
    Default Gateway . . . . . : 192.168.1.2
    DHCP Server . . . . . : 192.168.1.2
    DHCPv6 IAID . . . . . : 103053059
    DHCPv6 Client DUID. . . . . : 00-01-00-01-20-30-30-E1-00-21-CC-CE-02-15
    DNS Servers . . . . . : 192.168.1.2
    NetBIOS over Tcpip. . . . . : Enabled

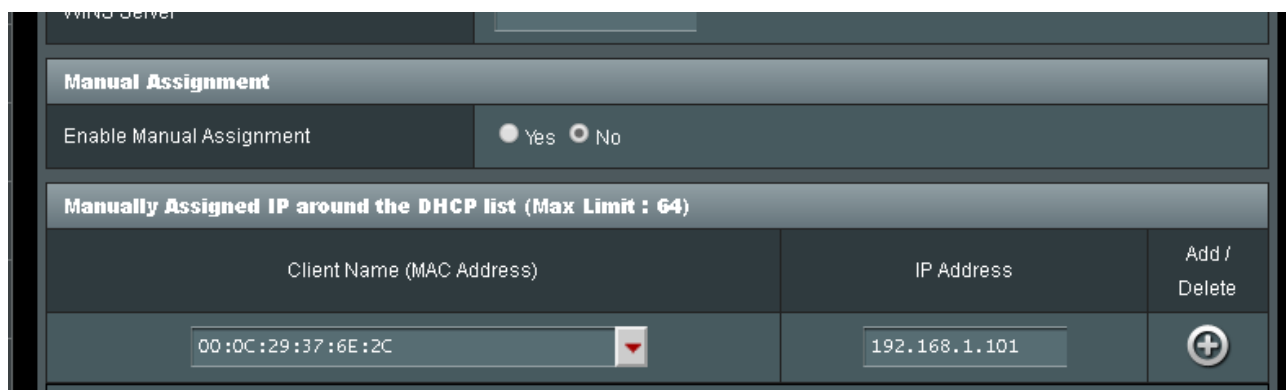
Ethernet adapter Bluetooth Network Connection:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . . . . . : 
    Description . . . . . : Bluetooth Device (Personal Area Network)
    Physical Address. . . . . : 40-2C-F4-E2-BA-44
    DHCP Enabled. . . . . : Yes
    Autoconfiguration Enabled . . . . . : Yes

Tunnel adapter Local Area Connection* 15:
```

16.5 Step #3 - Set up your network (DHCP server)

Set up your DHCP server to reserve specific IP addresses to specific MAC addresses.

An example of one particular router (Asus RT-AC66U) is shown below:



The screenshot shows a web-based configuration interface for a DHCP server. The 'Manual Assignment' section is active, with 'Enable Manual Assignment' set to 'Yes'. Below this, a table titled 'Manually Assigned IP around the DHCP list (Max Limit : 64)' is displayed. The table has three columns: 'Client Name (MAC Address)', 'IP Address', and 'Add / Delete'. A single entry is shown with the MAC address '00:0C:29:37:6E:2C' and the IP address '192.168.1.101'. An 'Add' button (represented by a plus sign in a circle) is visible next to the entry.

Client Name (MAC Address)	IP Address	Add / Delete
00:0C:29:37:6E:2C	192.168.1.101	+

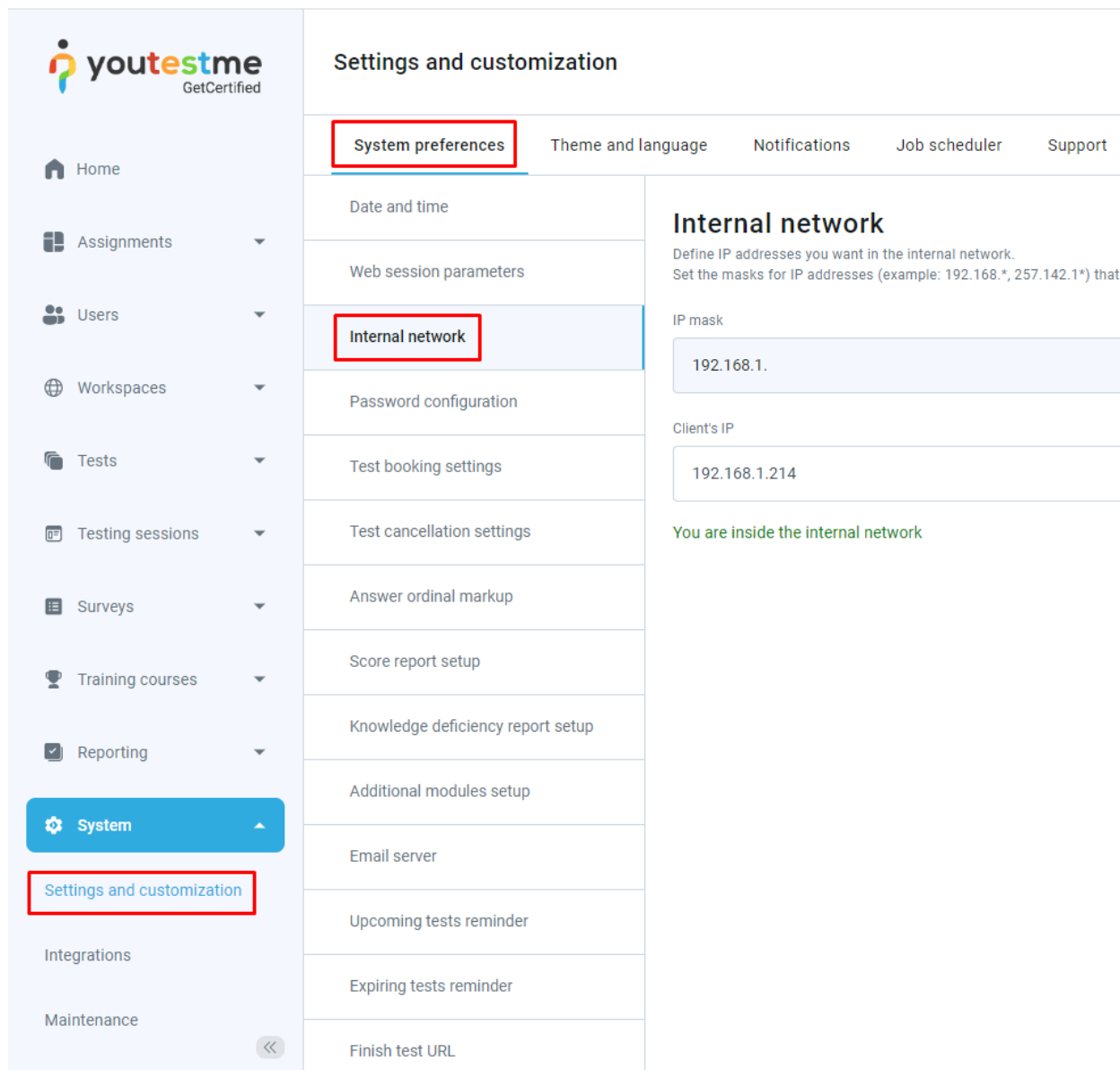
16.6 Step 4 - Verify your devices

Reboot your devices and make sure they are assigned IP addresses as set up in Step #3

16.7 Set up networking in the YouTestMe application

Set up access to the YouTestMe application to be allowed for IP ranges from 192.168.1.100 to 192.168.1.129.

Navigate to "System -> Settings and customization -> System preferences" tab, and locate the "Internal network" settings, where you can set a range of your local IP addresses.



The screenshot displays the 'Settings and customization' section of the YouTestMe application. The left sidebar contains a navigation menu with options like Home, Assignments, Users, Workspaces, Tests, Testing sessions, Surveys, Training courses, Reporting, System, Settings and customization, Integrations, and Maintenance. The 'System' menu item is highlighted with a blue bar, and 'Settings and customization' is further highlighted with a red box. The main content area shows the 'System preferences' tab selected, with a red box around the 'Internal network' option in the left sidebar. The 'Internal network' settings are displayed on the right, including a description, IP mask (192.168.1.), Client's IP (192.168.1.214), and a green status message: 'You are inside the internal network'.

17 Configure HTTPS Using Apache HTTPD (Ubuntu)

Requirements:

1. Apache HTTPD
2. Apache module **mod_ssl**
3. SSL certificate for your domain/subdomain

17.1 Copy Your SSL Certificate to the Apache Server

1. SSH to your web server
2. Switch to sudo/root user
3. Copy your certificate file, the certificate key, and the certificate of the CA that signed the SSL certificate to the following directory: **/etc/ssl/certs**

17.2 Add Virtual Host to Apache HTTPD

1. Navigate to the following directory:
`$ cd /etc/apache2/sites-enabled`
2. Create a **"httpd-vhosts.conf"** file with a **Virtual Hosts** (your domain/subdomain should replace **getcertified.example.com**). The "secret" value should be the same as it is specified

```
<VirtualHost *:80>
    ServerName          getcertified.example.com
    Redirect             /      https://getcertified.example.com/
</VirtualHost>

<VirtualHost *:443>

    ServerName          getcertified.example.com

    SSLEngine on
    SSLCertificateFile /etc/ssl/certs/YOUR_CERTIFICATE.crt
    SSLCertificateKeyFile /etc/ssl/certs/YOUR_key.key
    SSLCACertificateFile /etc/ssl/certs/YOUR_CA.ca-bundle

    ProxyPreserveHost on

    RewriteEngine on
    RewriteCond %{REQUEST_URI} ^/$
    RewriteRule (.*) /ytm1/ [R=301]

    RewriteCond %{HTTP:Upgrade} websocket [NC]
    RewriteCond %{HTTP:CONNECTION} Upgrade$ [NC]
    RewriteRule /(.* ) ws://YTM_VM_IP:8080/$1 [P,L]

    ProxyPass            /ytm1/ ajp://YTM_VM_IP:9101/ytm1/ secret=your_secret
    ProxyPassReverse     /ytm1/ ajp://YTM_VM_IP:9101/ytm1/
```

```
</VirtualHost>
```

3. Check HTTPD for syntax errors:

```
$ apachectl configtest
```

4. Reload HTTPD:

```
$ apachectl graceful
```

5. Edit the Tomcat configuration file "server.xml" and **change the default value** for the "secret" parameter within the AJP connector settings. The new secret value should match the value specified in the Apache virtual host. Restart the Tomcat server to apply the changes.

```
$ vim /home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/conf/server.xml
```

```
<Connector protocol="AJP/1.3"
    address="0.0.0.0"
    port="9101"
    secretRequired="true"
    secret="your_secret"
    redirectPort="8443"
    maxParameterCount="1000"
/>
```

18 Ensuring Stability and Reliability of the System

You can do several things to ensure that the system is running without interruptions:

1. Monitor disk space usage and memory usage on the host server
2. Monitor disk space usage and memory within the YouTestMe Virtual Machine
3. Install the latest patches for your host operating system and hypervisor software; however, ensure you can revert to previous versions in case of compatibility issues.

19 Getting YouTestMe System Support

Basic and Advanced support services are included for free in the first year, and after that, they are based on a chosen support plan.

19.1 Without Remote Access

In case our technical support team doesn't have access to your infrastructure, you can use the following support:

1. User Manuals (Basic)
2. Technical Documentation (Basic)
3. Email (Basic)
4. Video Tutorials (Basic)
5. Phone (Advanced)
6. Personal, on-demand video tutorials (Advanced)

19.2 With Remote Access

1. Crisis management (Basic)
2. On-site training (Advanced)
3. On-site maintenance (Advanced)
4. Personnel Administrators (Advanced)
5. Troubleshooting by our technical support team (Advanced)

19.2.1 Webex Support

Our support team can help you using the Cisco Webex meeting platform if remote access is possible. With Webex, you can share the screen with our support team, and they can guide you on which actions to take, leaving you complete control over your system.

19.2.2 About Webex Meetings

- Cisco Webex is a web-based application used for conference calls and video presentations. Multiple people from different locations can participate in a ring.
- You will need a web browser, speakers or headphones, and an Internet connection to participate in the call.
- A microphone is optional, depending on whether you will listen to the presentation or participate in the discussion.
- If you are unfamiliar with this tool, watch our [video tutorial](#) (linked here).

20 Troubleshooting

20.1 Virtual Machine Freezes

When a virtual machine freezes, the reason is usually that the host server is running out of memory or disk space. The solution is to shut down some processes on your host server or add more memory. If the cause runs out of disk space on the host server, adding disk space or cleaning unnecessary files will solve it.

20.2 Checking Tomcat Log

To complete this procedure, you must be logged in as a "ytm1" user.

In most cases, there will be a problem with the YTM application. There are two aliases set up to make checking the Tomcat log easier and faster:

1. **tlog ytm1** (the command will open the log with the vim text editor, and you can examine the entire log)
2. **tlogt ytm1** (the command will open the log tail and monitor the changes in real-time - default ten lines)

Aliases are defined as:

```
alias tlog='vim /home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/logs/ytm1.log'
alias tlogt='tail -f /home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/logs/ytm1.log'
```

20.3 Tomcat could not be stopped

To complete this procedure, you must be logged in as a "ytm1" user.

Use the command "**istomcat**" to see if Tomcat is running.

Sample output:

```
ytm1 6341 1 2 Jan06 ? 17:07:31 /usr/lib/jvm/adoptopenjdk-8-hotspot/bin/java -
Djava.util.logging.config.file=/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/conf/logging.properties -
Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -Xms6144M -Xmx6144M -Xmn1024M -Djdk.tls.ephemeralDHKeySize=2048 -
Djava.protocol.handler.pkgs=org.apache.catalina.webresources -Dorg.apache.catalina.security.SecurityListener.UMASK=0027 -
Dignore.endorsed.dirs=/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/bin/bootstrap.jar:/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/bin/tomcat-juli.jar -
Dcatalina.base=/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION} -
Dcatalina.home=/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION} -
Djava.io.tmpdir=/home/ytm1/ytm/res/ProgramFiles/tomcat/apache-tomcat-{TOMCAT_VERSION}/temp org.apache.catalina.startup.Bootstrap start
```

Use the command "**tstop**" to stop the Tomcat server.

After issuing the **tstop**, check if Tomcat is still running. If it is still running after several minutes, use the "**kill**" command to kill the process: **kill -9 6341**

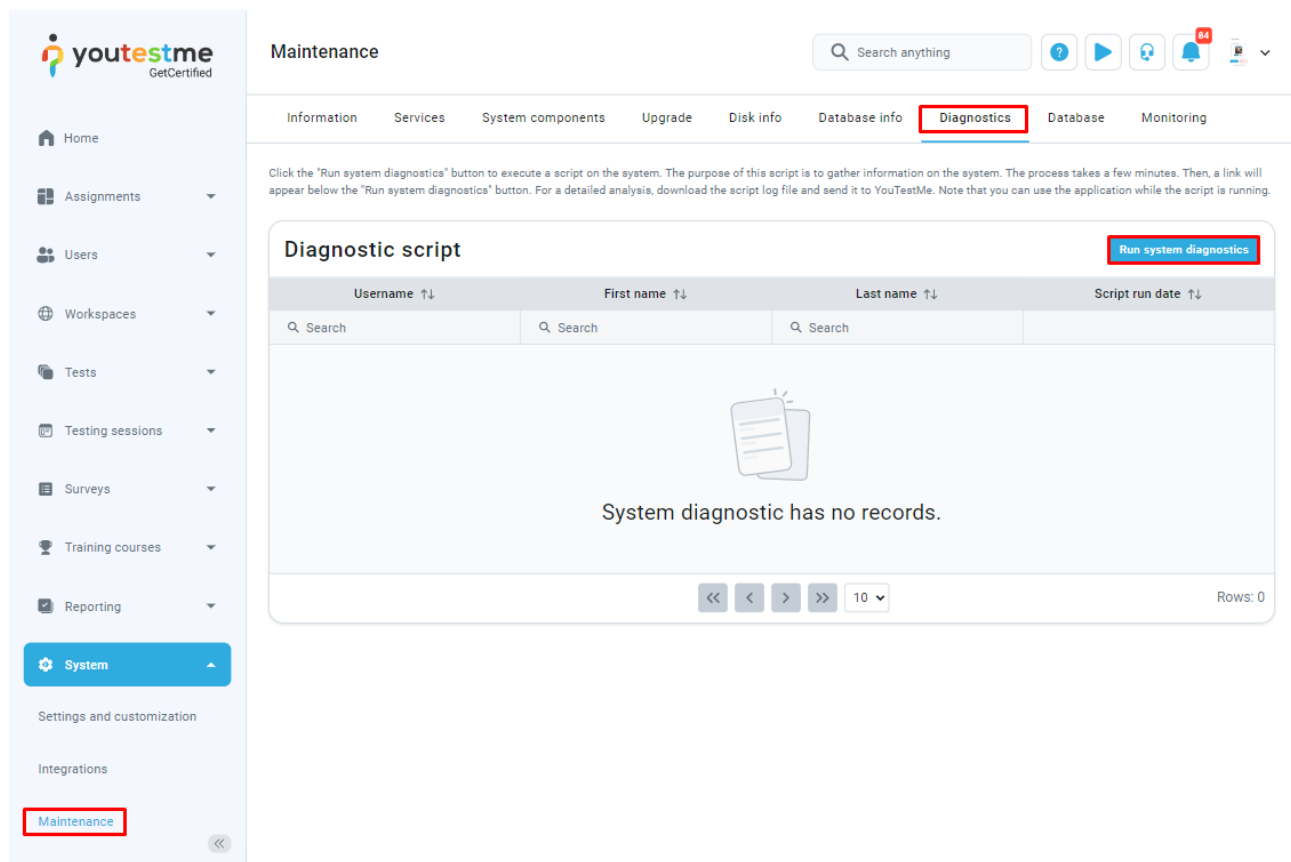
Note that "6341" is a Unix process ID in the command "istomcat" output.

20.4 System Resources

1. check minimal required system resources (RAM, Disk, CPU)
command "free -m -h"
command "cat /proc/meminfo"
2. check free disk space on all file systems
use the command "df -h"

20.5 How to Collect Important System Information from VM

Navigate to the "System -> Maintenance" page in the application and select the "Diagnostics" tab to collect relevant system information:



The screenshot shows the YouTestMe application interface. On the left is a sidebar with navigation options: Home, Assignments, Users, Workspaces, Tests, Testing sessions, Surveys, Training courses, Reporting, System (highlighted with a red box), Settings and customization, and Integrations. The main content area is titled "Maintenance" and contains several tabs: Information, Services, System components, Upgrade, Disk info, Database info, Diagnostics (highlighted with a red box), Database, and Monitoring. Below the tabs, there is a "Diagnostic script" section with a "Run system diagnostics" button (highlighted with a red box). The section contains a table with columns: Username ↑↓, First name ↑↓, Last name ↑↓, and Script run date ↑↓. Each column has a search bar. Below the table, it says "System diagnostic has no records." At the bottom right, it says "Rows: 0".

20.6 How to fix VirtualBox Clipboard not working

To complete this procedure, you must be logged in as "root" user.

Kill VBoxClient:

```
[developer@localhost ~]$ ps -ef|grep clip
503      5140      1  0 14:07 ?        00:00:00 /usr/bin/VBoxClient --clipboard
503      5141    5140  0 14:07 ?        00:00:00 /usr/bin/VBoxClient --clipboard
503      5174    5075  0 14:09 pts/0    00:00:00 grep clip
[developer@localhost ~]$
```

```
kill -9 5140
```

```
kill -9 5141
```

Stat again VBoxClient with:

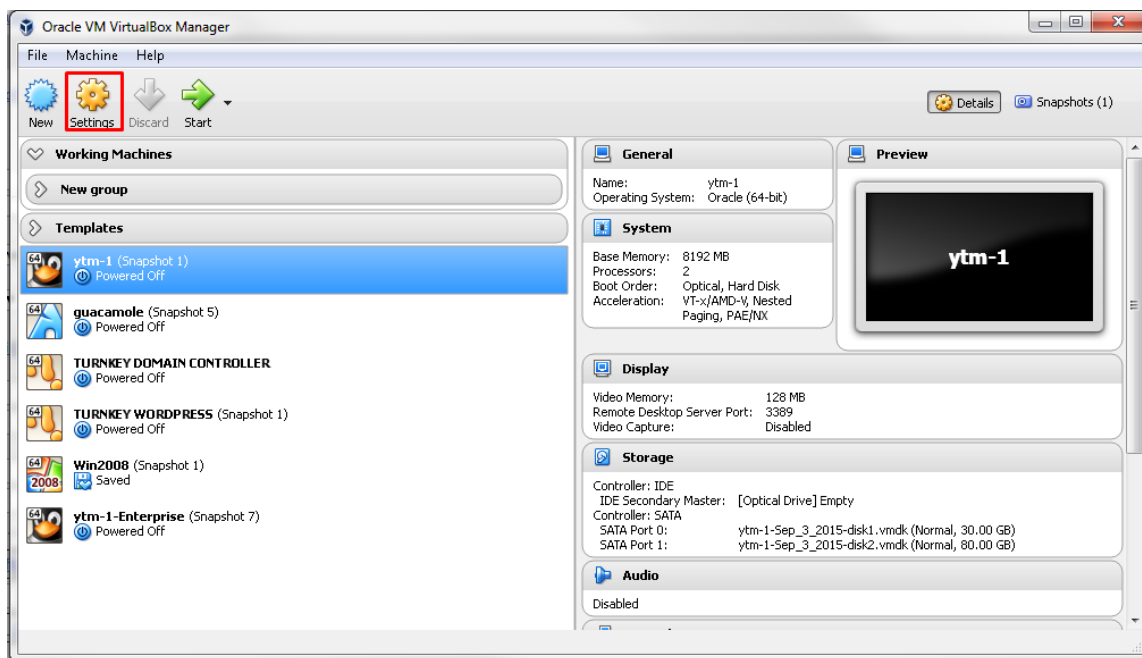
```
/usr/bin/VBoxClient --clipboard
```

The "vboxclient" client runs in the background by default.

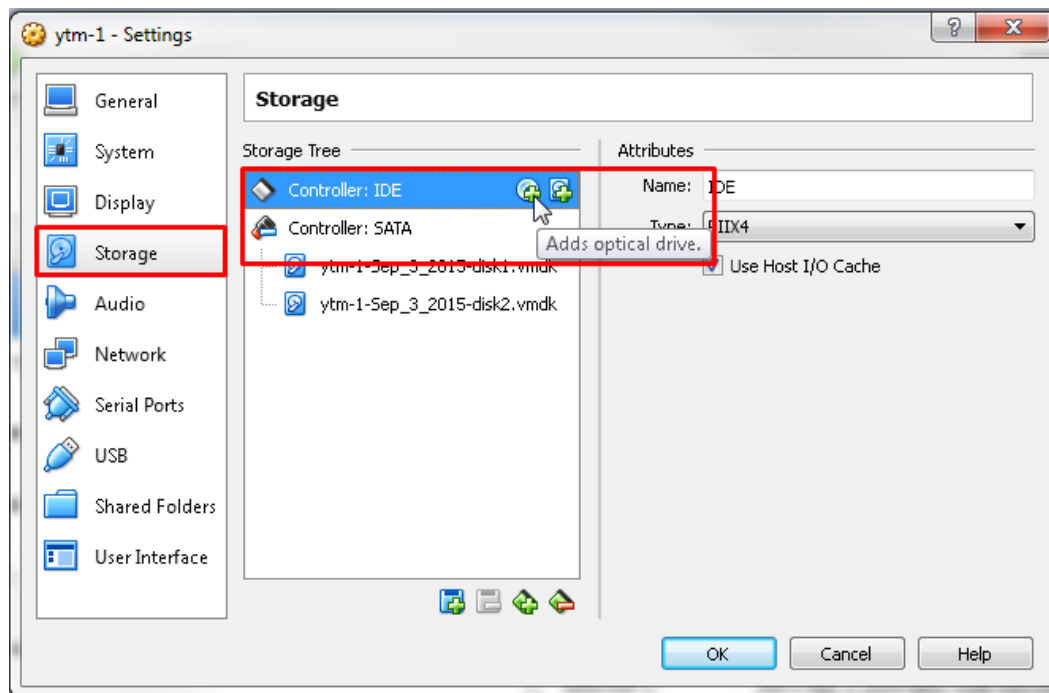
20.7 How to add an optical drive in VirtualBox

In some cases, the optical drive gets detached from the virtual machine. To attach an optical drive, follow the steps:

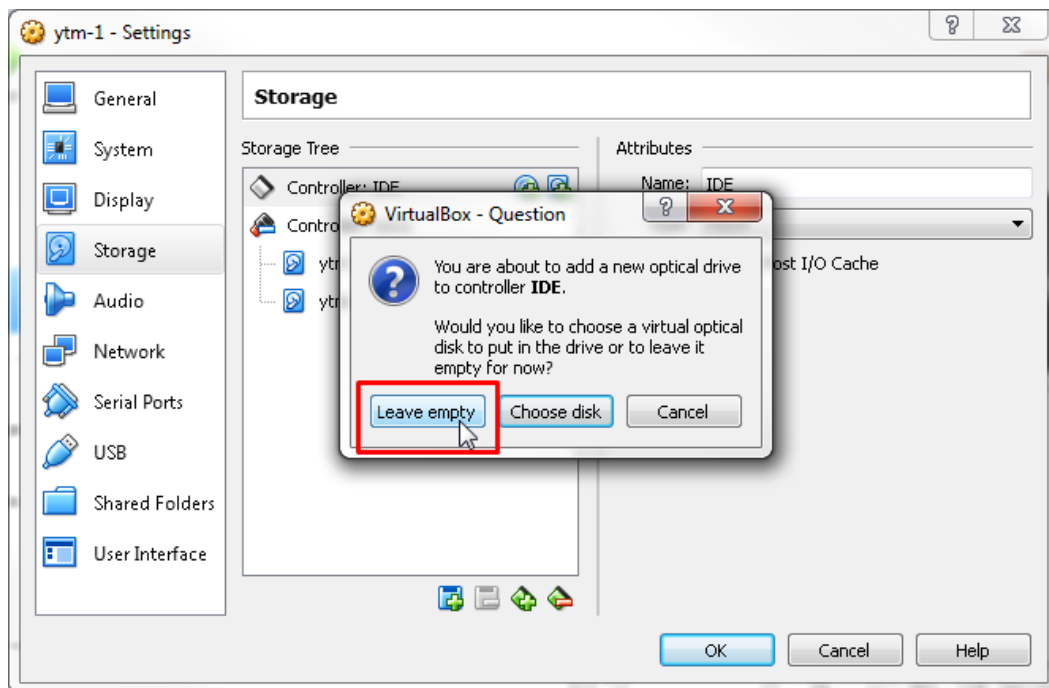
1. Select the virtual machine from the inventory on the left and choose "Settings"



2. Choose "Storage" and choose "Add an optical drive"



3. Choose "Leave empty":



This question often arises when importing a virtual machine into VirtualBox that was previously exported from VMware.

20.8 Antivirus software

20.8.1 The system scanning using ClamAV

To scan the system using ClamAV antivirus software, run the following command, check the "/home" directory, and output only infected files. Then, ring a bell when they are found. The process may take a while.

```
$ clamscan -r --bell -i /home
```

To update the ClamAV antivirus database, run the following command:

```
$ freshclam
```

20.8.2 Automatic Anti Virus Scanning

In the YouTestMe virtual machine, antivirus software is scheduled to run automatically every Sunday at midnight.

Anti Virus log files are located in the following directory:

```
/ytmdata/clamav_logs/
```

20.9 Troubleshooting VMware Workstation

20.9.1 VM shuts down on its own after a period of inactivity

Uncheck the "Keep VMs running after workstation closes" in the **Edit -> Preferences -> Workspace** tab and shut the server down. Once it is back up, re-enable the "Keep VMs running after workstation closes".

20.9.2 Collecting diagnostic information for VMware Workstation

https://kb.vmware.com/selfservice/search.do?cmd=displayKC&docType=kc&docTypeID=DT_KB_1_1&externalId=1346

20.10 Troubleshooting Ubuntu Linux Host

20.10.1 Diagnostic techniques

Examine system logs in	/var/log/
Examine kernel messages	dmesg more
Use "sos report"	sos report -l

21 Configuration Procedures

21.1 Utility Software

List of software used to administer YouTestMe products. Depending on the system, choose the most appropriate of the following:

Software	Description
VMware Workstation	Used to run Virtual Machines and change their settings (i.e., increase memory or disk space)
OpenSSH	Used to open SSH (Secure Shell) session to VM from Windows workstation
Terminal	Used to open SSH (Secure Shell) session to VM from MacOS workstation

21.2 Change Linux User Password

To complete this procedure, you must be logged in as a sudo user.

To log in as the **root** user via Terminal, execute the following command and enter the password afterward:

```
$ sudo su
```

Default Linux passwords:

Username	Password	Role
root	not configured	Linux administrator
postgres	2ytm1	YouTestMe database user
ytm1	2ytm1	YouTestMe application user

The "#" sign in front of the command means the **root** user is logged in and will execute the following command.

The "\$" sign in front of the command indicates that the **regular** user is logged in and will execute the following command.

21.2.1 Changing password using SSH Terminal

To change the password for the Linux user:

1. execute the command "passwd *username*"
2. enter a new password
3. confirm by pressing the key "Enter"

Example:

passwd *ytm1*

```
[root@centosse ~]# passwd ytm1
Changing password for user ytm1.
New password:
BAD PASSWORD: The password is shorter than 7 characters
Retype new password:
passwd: all authentication tokens updated successfully.
```

Test new password by logging in as a newly configured user:

su - *ytm1*

21.3 Change PostgreSQL Database Administrator's Passwords

The default password for the database administrative account listed in the table below should be changed.

Username	Role
<i>postgres</i>	PostgreSQL native database administrator
<i>ytmadmin</i>	PostgreSQL YouTestMe database administrator

Essential: write down new passwords and store them in a secure place. Ensure you don't lose them since it may be impossible to recover them except by restoring the backup or snapshot system.

To complete this procedure, you need to be logged in to Linux as the "postgres" user.

Changing passwords for database users "postgres" and "ytmadmin" is highly recommended when installing the system. To do that, you will need to log in as user "postgres" into the Linux system and log into the database as user "psql" (see example below):

```
$ psql
postgres=# ALTER USER ytmadmin WITH PASSWORD 'new_password';
postgres=# ALTER USER postgres WITH PASSWORD 'new_password';
```


21.4 Install VMware Tools

To complete this procedure, you must be logged in as a sudo user.

If YouTestMe Appliance is deployed using VMware products, it is advised to install VMware tools.

1. Go to Virtual Machine > Install VMware Tools (or VM > Install VMware Tools).

Note: If you are running the light version of Fusion, or a version of Workstation without VMware Tools, or VMware Player, you are prompted to download the Tools before they can be installed. Click **Download Now** to begin the download.

2. In the Ubuntu guest, run these commands:

1. Run this command to create a directory to mount the CD-ROM:

```
$ sudo mkdir /mnt/cdrom
```

When prompted for a password, enter your Ubuntu admin user password.

Note: For security reasons, the typed password is not displayed. You do not need to enter your password again for the next five minutes.

2. Run this command to mount the CD-ROM:

```
$ sudo mount /dev/cdrom /mnt/cdrom or sudo mount /dev/sr0 /mnt/cdrom
```

3. The file name of the VMware Tools bundle varies depending on your version of the VMware product. Run this command to find the exact name:

```
$ ls /mnt/cdrom
```

4. Run this command to extract the contents of the VMware Tools bundle:

```
$ tar xzvf /mnt/cdrom/VMwareTools-x.x.x-xxxx.tar.gz -C /tmp/
```

Note: `x.x.x-xxxx` is the version discovered in the previous step.

5. Run this command to change directories in the VMware Tools distribution:

```
$ cd /tmp/vmware-tools-distrib/
```

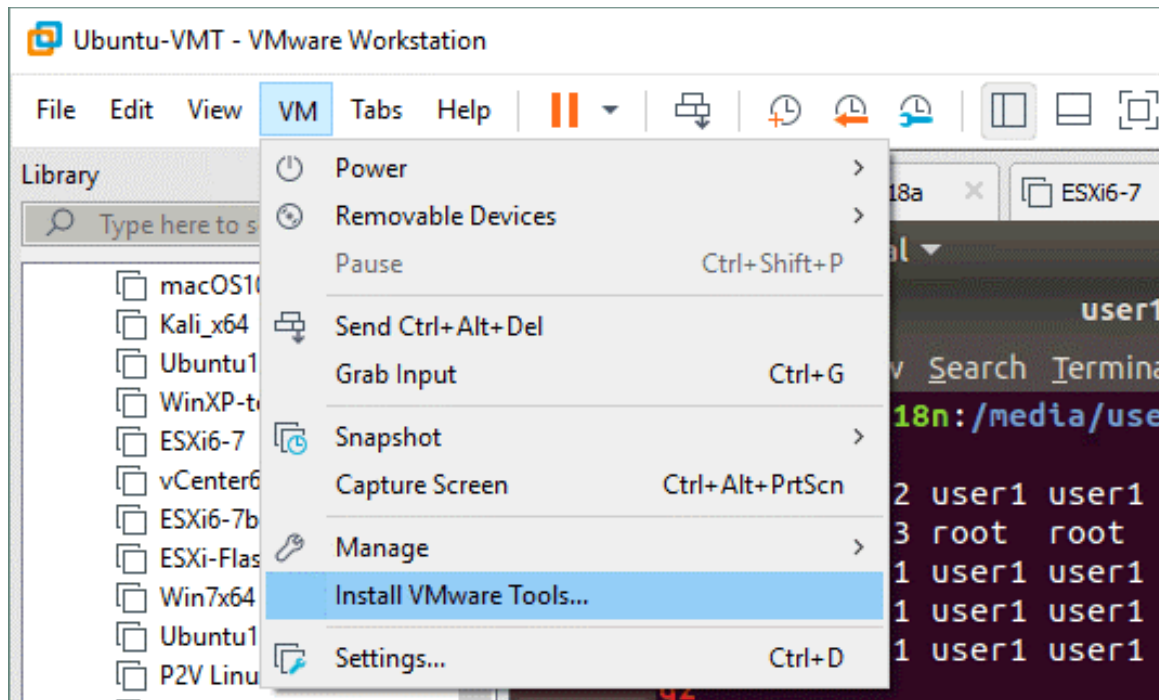
6. Run this command to install VMware Tools:

```
$ sudo ./vmware-install.pl
```

Note: Press **Return** to accept each default or supply your answers.

3. Run this command to reboot the virtual machine after the installation completes:

`$ sudo reboot`



21.5 Upgrading Ubuntu Linux Operating System

To install the latest patches to your operating system, log in as sudo user and execute:

`$ sudo apt update` – updates the list of available packages and their versions but does not install or upgrade any packages.

`$ sudo apt upgrade` – installs newer versions of the packages you have. After updating the lists, the package manager knows about available updates for your installed software.

There are many advantages of using the concept of Virtual Machines:

1. Very complex computer systems are packaged in pre-configured in one VM and hence very easy to install
2. The virtual machine is independent of the underlying operating system
3. It is easy to assign additional virtual memory or virtual disk space to a Virtual Machine
4. Backup and restore of the entire system is straightforward
5. Moving a Virtual Machine from one server to another is fast and convenient



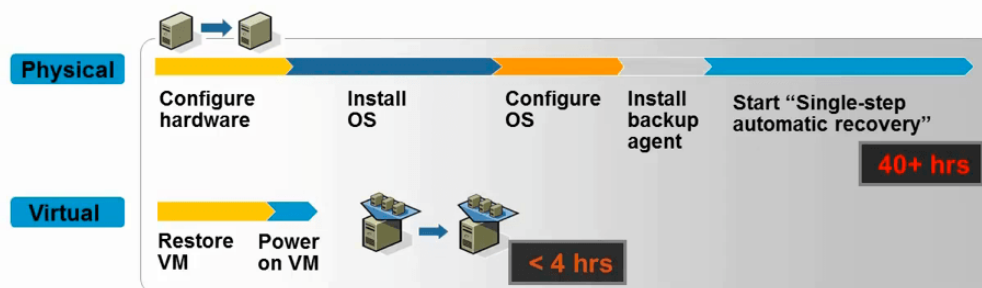
23 VM Advantages



Encapsulation

- Entire state of the virtual machine as a set of files
- Move and copy virtual machines easily

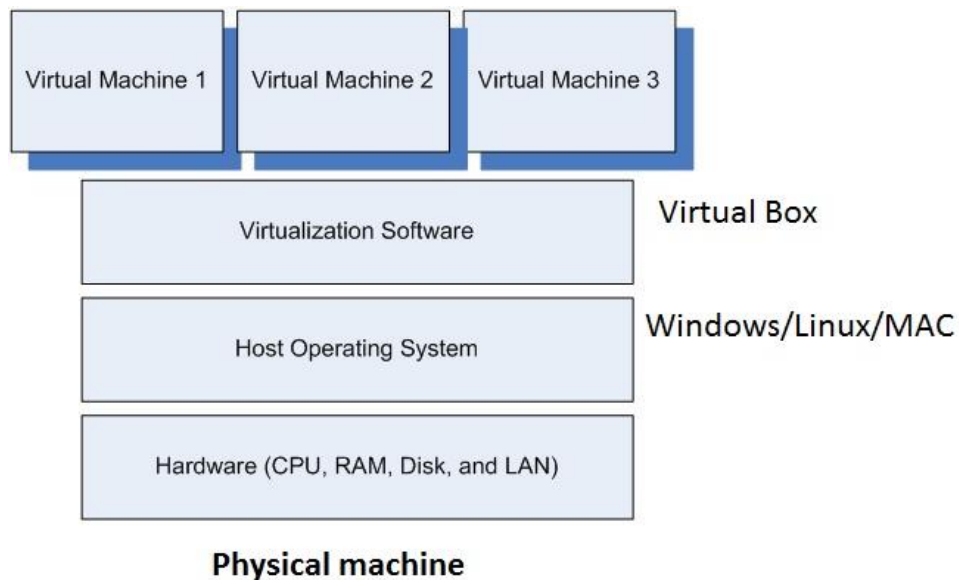
Save Time During Disaster Recovery



- Eliminate recovery steps
- Standardize recovery process

24 VM Concepts

24.1 Physical Server with Operation System



24.2 "Bare Metal" Physical Servers

"Bare Metal" Physical Servers do not have an underlying Operating System. Instead, hypervisor software is installed directly on the hardware platform.

