



Cyber Security and Forensics - I

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CHAPTER-8

Concept of Virtualization

Topics

- Software Virtualization
- Hardware Virtualization
- OS Partitioning
- VMWare Windows, Linux



Software Virtualization

- What is Software Virtualization?
- Software Visualization in Cloud Computing allows the single computer server to run one or more virtual environments. It is quite similar to virtualizations but here it abstracts the software installation procedure and creates a virtual software out of it.
- In software virtualizations, an application will be installed which will perform the further task. One software is physical while others are virtual as it allows 2 or more operating system using only one computer.

Software Virtualization

- Benefits of Software Virtualization
- Testing
- It is easier to test the new operating system and software on VMs as it does not require any additional hardware and the testing can do within the same software. After the testing, the VM can move or delete for the further testing.
- Utilization
- In software virtualization, there is higher efficiency in resource utilization if it tunes correctly. The VM can modify as per the requirement such as the user can modify ram, drive space, etc. It requires very less amount of hardware as compared to the equivalent number of physical machines.



Software Virtualization

- Efficient
- It is efficient in a way such that it can run 12 virtual machines and eliminates the use of 12 physical boxes. This is the power cost as well as the cost of maintaining the server.
- Less Downtime
- The software is upgrading and the upgrade in the VMs can do when the VM is working. VM can modify when it is working or it is not working which means that the downtime of it is very less.
- Flexible
- It provides flexibility to the user so that the user can modify the software as per their demand. The modification can do within minutes and can adjust easily when the workload changes.



Software Virtualization

- Secure
- It can protect with many hantaviruses. Moreover, there are several firewalls which prevent hacking and virus. The data in the software virtualization is safe as it stores in several different places so if the disaster takes place the data can retrieve easily.

Software Virtualization

- Types of Software Virtualization
- Operating System Virtualization
- Application Virtualization
- Service Virtualization
- i. Operating System Virtualization
- In operating system virtualization, the hardware is used which consists of software on which different operating systems work. Here, the operating system does not interfere with each other so that each one of them works efficiently.



Software Virtualization

- ii. Application Virtualization
- Application virtualization is a technology, encapsulates the computer program within the operating system. It can say that application virtualizations refer to running an application on a thin client. This thin client runs an environment, which is different from what refer to as encapsulating from the operating system which is the location of it.
- iii. Service Virtualization
- In the service virtualization, the DevOps team can use the virtual servers rather than the physical one. It emulates the behaviour of essential components which will be present in the final production environment.
- With the help of service virtualization, the complex application can go through testing much earlier in the development process. It can say that service visualization is a technique to simulate the behaviour of some components in a mixture of component-based applications



Hardware Virtualization

- It is the abstraction of computing resources from the software that uses cloud resources. It involves embedding virtual machine software into the server's hardware components.
- That software is called the hypervisor. The hypervisor manages the shared physical hardware resources between the guest OS & the host OS. The abstracted hardware is represented as actual hardware. Virtualization means abstraction & hardware virtualization is achieved by abstracting the physical hardware part using Virtual Machine Monitor (VMM) or hypervisor.
- Hypervisors rely on command set extensions in the processors to accelerate common virtualization activities for boosting the performance.



Hardware Virtualization

- The term hardware virtualization is used when VMM or virtual machine software or any hypervisor gets directly installed on the hardware system. The primary task of the hypervisor is to process monitoring, memory & hardware controlling. After hardware virtualization is done, different operating systems can be installed, and various applications can run on it. Hardware virtualization, when done for server platforms, is also called server virtualization.



Hardware Virtualization

- The benefits of hardware virtualization decrease the overall cost of cloud users and increase flexibility.
- The advantages are:
- Lower Cost: Because of server consolidation, the cost decreases; now, multiple OS can exist together in a single hardware. This minimizes the quantity of rack space, reduces the number of servers, and eventually drops the power consumption.
- Efficient resource utilization: Physical resources can be shared among virtual machines. Another virtual machine can use the unused resources allocated by one virtual machine in case of any need.



Hardware Virtualization

- Increase IT flexibility: The quick development of hardware resources became possible using virtualization, and the resources can be managed consistently also.
- Advanced Hardware Virtualization features: With the advancement of modern hypervisors, highly complex operations maximize the abstraction of hardware & ensure maximum uptime. This technique helps to migrate an ongoing virtual machine from one host to another host dynamically.



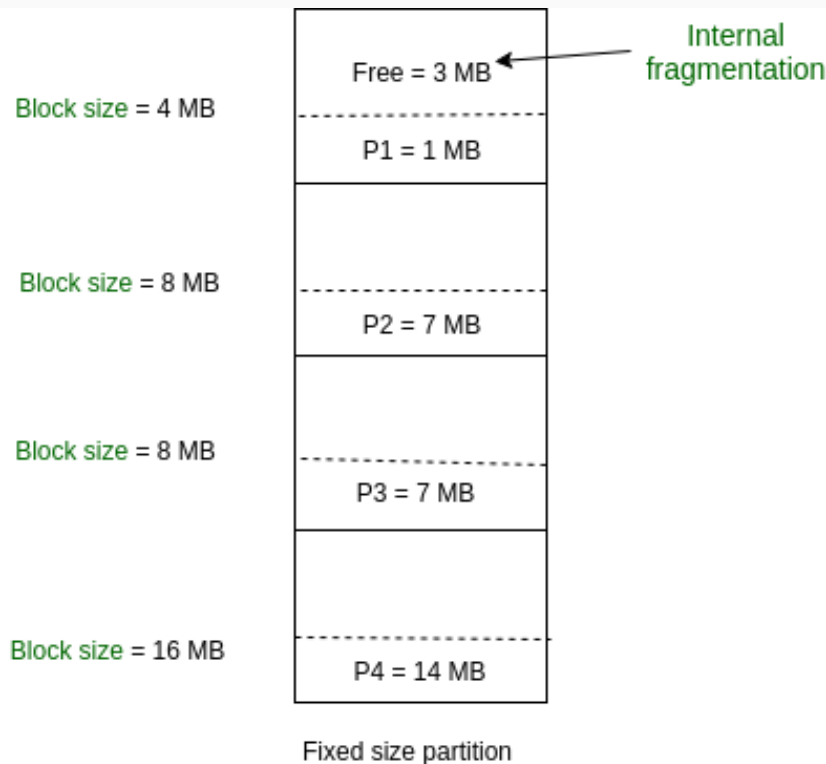
Hardware Virtualization

- Type of Hardware virtualization is of three kinds.
- These are:
- Full Virtualization: Here, the hardware architecture is completely simulated. Guest software doesn't need any modification to run any applications.
- Emulation Virtualization: Here, the virtual machine simulates the hardware & is independent. Furthermore, the guest OS doesn't require any modification.
- Para-Virtualization: Here, the hardware is not simulated; instead, the guest software runs its isolated system.

OS Partitioning

- Fixed (or static) partitioning
- Variable (or dynamic) partitioning
- Fixed Partitioning:
- This is the oldest and simplest technique used to put more than one process in the main memory. In this partitioning, the number of partitions (non-overlapping) in RAM is fixed but the size of each partition may or may not be the same. As it is a contiguous allocation, hence no spanning is allowed. Here partitions are made before execution or during system configure.

OS Partitioning



- As illustrated in figure, first process is only consuming 1MB out of 4MB in the main memory. Hence, Internal Fragmentation in first block is $(4-1) = 3\text{MB}$.
Sum of Internal Fragmentation in every block = $(4-1) + (8-7) + (8-7) + (16-14) = 3+1+1+2 = 7\text{MB}$.
- Suppose process P5 of size 7MB comes. But this process cannot be accommodated in spite of available free space because of contiguous allocation (as spanning is not allowed). Hence, 7MB becomes part of External Fragmentation.

OS Partitioning

- There are some advantages and disadvantages of fixed partitioning.
- Advantages of Fixed Partitioning –
- Easy to implement:
- Algorithms needed to implement Fixed Partitioning are easy to implement. It simply requires putting a process into a certain partition without focusing on the emergence of Internal and External Fragmentation.
- Little OS overhead:
- Processing of Fixed Partitioning requires lesser excess and indirect computational power.

OS Partitioning

- Disadvantages of Fixed Partitioning –
- Internal Fragmentation:
- Main memory use is inefficient. Any program, no matter how small, occupies an entire partition. This can cause internal fragmentation.
- External Fragmentation:
- The total unused space (as stated above) of various partitions cannot be used to load the processes even though there is space available but not in the contiguous form (as spanning is not allowed).
- Limit process size:
- Process of size greater than the size of the partition in Main Memory cannot be accommodated. The partition size cannot be varied according to the size of the incoming process size. Hence, the process size of 32MB in the above-stated example is invalid.

OS Partitioning

- Variable Partitioning –
- It is a part of Contiguous allocation technique. It is used to alleviate the problem faced by Fixed Partitioning. In contrast with fixed partitioning, partitions are not made before the execution or during system configure. Various features associated with variable Partitioning-
- Initially RAM is empty and partitions are made during the run-time according to process's need instead of partitioning during system configure.
- The size of partition will be equal to incoming process.
- The partition size varies according to the need of the process so that the internal fragmentation can be avoided to ensure efficient utilization of RAM.

OS Partitioning

- Advantages of Variable Partitioning –
- No Internal Fragmentation:
- In variable Partitioning, space in main memory is allocated strictly according to the need of process, hence there is no case of internal fragmentation. There will be no unused space left in the partition.
- No restriction on Degree of Multiprogramming:
- More number of processes can be accommodated due to absence of internal fragmentation. A process can be loaded until the memory is empty.
- No Limitation on the size of the process:
- In Fixed partitioning, the process with the size greater than the size of the largest partition could not be loaded and process can not be divided as it is invalid in contiguous allocation technique.

OS Partitioning

- Disadvantages of Variable Partitioning –Difficult Implementation:
- Implementing variable Partitioning is difficult as compared to Fixed Partitioning as it involves allocation of memory during run-time rather than during system configure.
- External Fragmentation:
- There will be external fragmentation inspite of absence of internal fragmentation.
- For example, suppose in above example- process P1(2MB) and process P3(1MB) completed their execution. Hence two spaces are left i.e. 2MB and 1MB. Let's suppose process P5 of size 3MB comes. The empty space in memory cannot be allocated as no spanning is allowed in contiguous allocation. The rule says that process must be contiguously present in main memory to get executed.

VMWare Windows, Linux

Setting up an Lab Environment(Installation of Kali Linux in VM).
Requirement :-

- 1) Need software Vmware or Virtual box
 - Download Link of Vmware :- <https://my.vmware.com/en/web/vmware/downloads/details?downloadGroup=WKST-1610-WIN&productId=1038&rPId=55777>
- 1) Need ISO File of Kali linux.
 - Download Link of Kali linux ISO file :-
<https://cdimage.kali.org/kali-2021.1/kali-linux-2021.1-installer-amd64.iso>

VMWare Windows, Linux

Step 1:-

Install VMware workstation into System. Step 2:-

Start VMware and Click on “Create a New Virtual Machine”

VMWare Windows, Linux

- Step 3:-
- Select “Typical” and click on Next Button.



VMWare Windows, Linux

- Step 4: -
- Click on “Browse...” button and select ISO which is downloaded from Kali linux website.

New Virtual Machine Wizard

Guest Operating System Installation

A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?

Install from:

☐ Installer disc:

No drives available

☒ Installer disc image file (iso):

F:\ISO\kali-linux-2021.1-installer-amd64.iso

Browse...



Could not detect which operating system is in this disc image.
You will need to specify which operating system will be installed.

☐ I will install the operating system later.

The virtual machine will be created with a blank hard disk.

Help

< Back

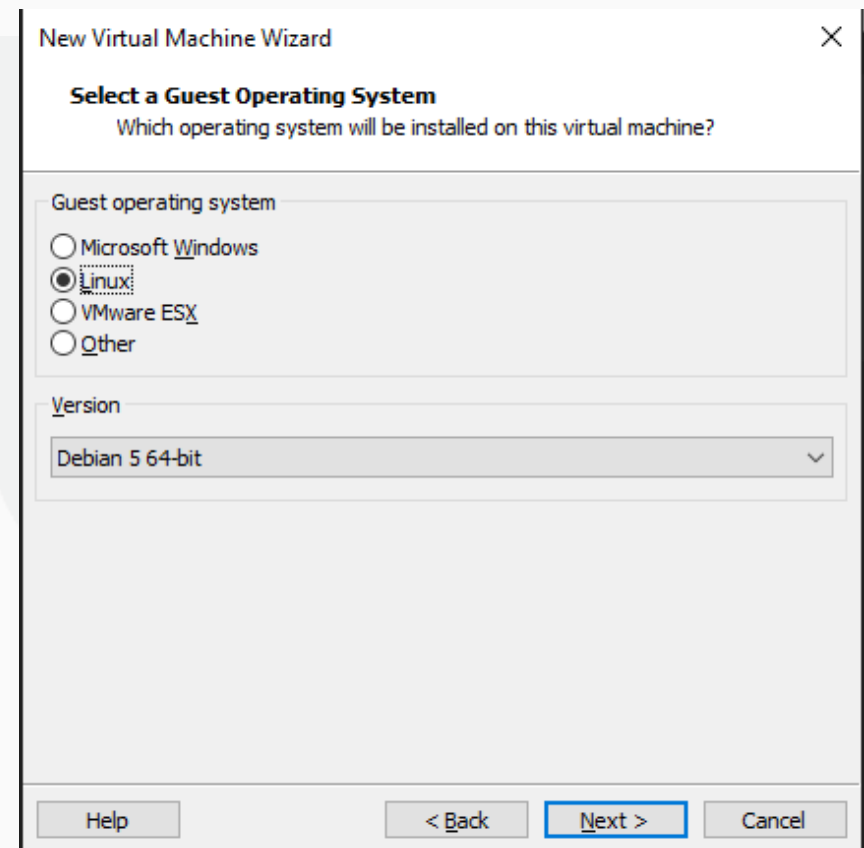
Next >

Cancel



VMWare Windows, Linux

- Step 5: -
- Select “Linux” in Guest operating system option and select version of Linux.



VMWare Windows, Linux

- Step 6: -
- Add virtual machine name and select location where you wanted to store VMware file for operating system.

New Virtual Machine Wizard

Name the Virtual Machine
What name would you like to use for this virtual machine?

Virtual machine name:

Location:
 [Browse...](#)

The default location can be changed at Edit > Preferences.

< Back Next > Cancel



VMWare Windows, Linux

- Step 7: -
- Assign virtual space for the operating system in my case I have assigned 40 GB storage for my operating system.
- Select “Split virtual disk into multiple files” option it will help us it will create operating system files into
- multiple files and when we wanted move this file to another computer it will be easy to move files.

New Virtual Machine Wizard

Specify Disk Capacity
How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB):

Recommended size for Debian 5 64-bit: 20 GB

☐ Store virtual disk as a single file

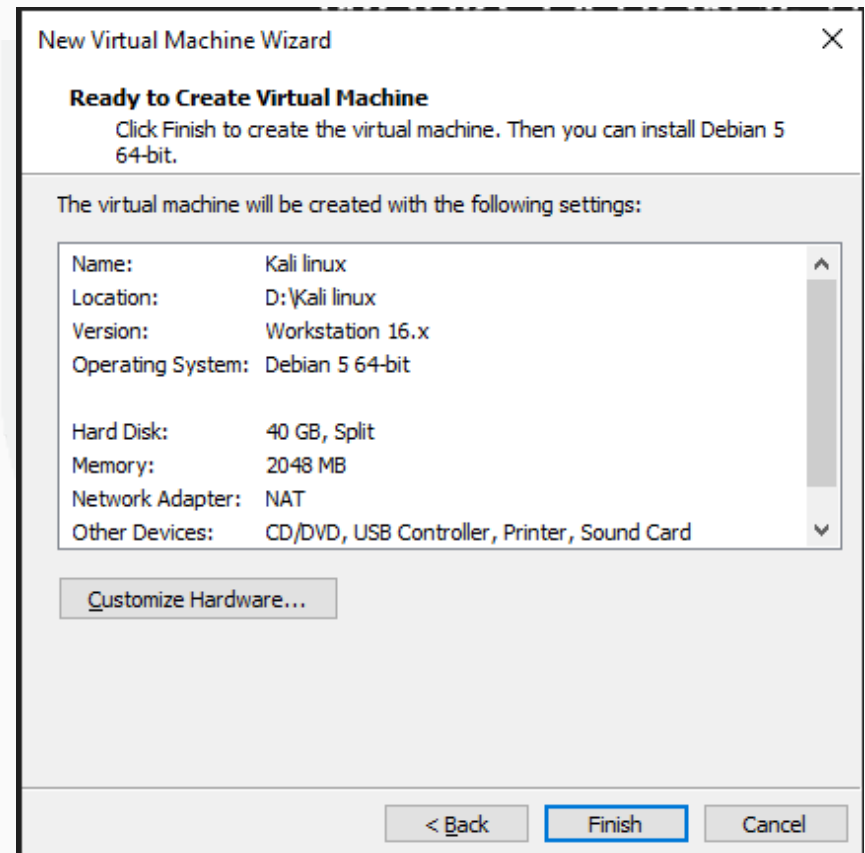
☒ Split virtual disk into multiple files

Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.

Help < Back Next > Cancel

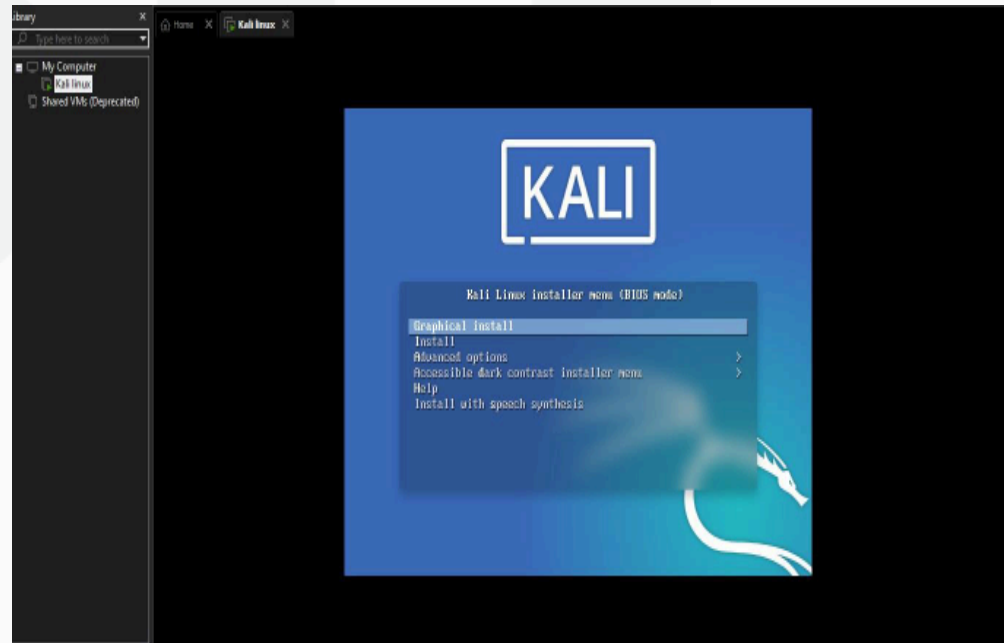
VMWare Windows, Linux

- Step 8: -
- There is option of “Customize hardware” where we can reconfigure hardware configuration for operating system like RAM, STORAGE and OTHER DEVICES configuration.



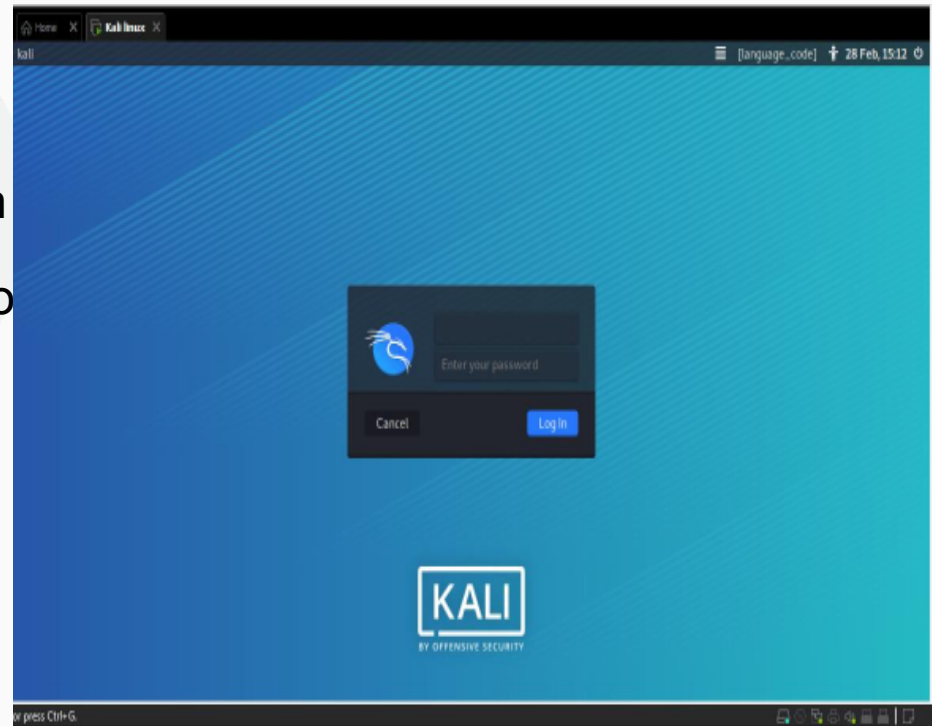
VMWare Windows, Linux

- Step 9: -
- Select “Graphical Install” then hit enter button.



VMWare Windows, Linux

- Enter Username and Password which is you have setup while installing system, and click on login button. System is up and running for the use.



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