Unit two is about the components for cloud computing.
Please study this unit's learning objectives.
The diagram illustrates the virtual machine (VM) evolutions from bare metal server to a running process. The quest is for a better place to run computing applications continues. Applications come in disarrays of features and functionalities. For simplicity, applications might be presented as boxes or squares that look the same. Computing applications do not have physical dimensions.
Similarly, you might draw a virtual machine (VM) as a square, which is a place to run your applications. What to put in the VM is dependent upon the applications’ requirements. First, consider the compatibility for the application. If the application is a binary file, then the VM has to come from a compatible server. Not one VM can run binary code with different formats yet. If the application is a collection of scripts, then the VM has to have compatible script language interpreters. Other VM requirements include networks and storages, which are discussed in other units of this course.
It does not matter how small a virtual machine is, it has to come from a bare metal server, which is called a computing host. The host has to have the virtualization capacity: to allocate virtual resources from hardware. Hypervisor is the firmware or software piece that does the work. For example, the visual shows two Power Systems computing hosts: S822 and S822L. Both server models provide low-end scale-out solutions. They look the same from outside. However, S822L is only compatible with Linux on Power Operating Systems. S822 is compatible with Linux and AIX, which in turn requires the Hardware Management Console (HMC) and Virtual I/O Server (VIOS) to enable virtualization. These components are parts of the hypervisor. However, S822L uses Kernel-based Virtualization Machine (KVM, also known as PowerKVM) as the hypervisor.

Additional information is available at:

http://www.ibm.com/systems/power/hardware/

and..

IBM Redbooks:
http://www.redbooks.ibm.com/

• IBM Power System S822 Technical Overview and Introduction, Redpaper REDP-5102-00

• IBM Power System S812L and S822L Technical Overview and Introduction, Redpaper REDP-5098-00
A square represents a virtual machine as an abstract place to run applications. Therefore, virtual CPU and memory are assigned to the virtual machine (VM). But, the empty square needs to be filled with contents to make it an active virtual machine. A virtual image has the contents for the VM. Although it is called virtual image, it is a physical file that contains at least an operating system for the VM. You can think of a virtual image as a package of pre-built components with configurations. For example, see documents for Open Virtualization Format (OVF).

With one image, you can quickly deploy to multiple VMs. In cloud computing, deploy is an operation that applies an image onto a VM to bring it up into active state. You can use software tools to build virtual images offline. Some of the tools can customize the images or create image templates that are ready for deploying. Another cloud operation is to capture an active VM and save all its data and configurations into a new image. You do not need to build the image from scratch. However, you have limited choices in customization or configuration of the new VM, which is a duplicate of the original VM.

For more information on Open Virtualization Format (OVF):

http://www.dmtf.org/standards/ovf
When you create a virtual image from scratch or captured snapshot, you estimate the needed processors and memory amount. Then, you create a virtual machine for a place to deploy the selected image. To accommodate the image, the VM’s processors and memory have to be equal or larger than figures in the image. For example:

\[ C \geq c \]
\[ M \geq m \]

Although \( C, c, M, m \) might be virtual figures, in many ways, they are mapped into the physical processors and memory that the hardware host has. As a rule, the sum of processors and memory of all VMs on a host should be equal or less than what available on the host. The variable \( p \) represents a multiple factor. From performance analysis point of views, it is possible to overload or oversubscribe the physical resources. As an administrator, you might have done analyses and understood that VMs do not use all of the virtual resources at the same time. Demands for resources are usually dynamic at discrete time.
A VM is created from a specific hypervisor, which accepts only compatible virtual image file formats. The visual shows some of the popular hypervisors and the format each supports. Therefore, knowing the virtual image file format is important in deploying it to a VM. A hypervisor might be able to support more than one file format. The Open Virtualization Format (OVF) is a standard for packaging the virtual image files that might be used across different hypervisors.
HMC is a hardware server that might come with a Power System order. It has all the necessary hardware and software components for connecting to the Power System. As the name implies, HMC has all the tools for managing Power Systems. These tools work with the hypervisor software in Power Systems. Plug in the HMC and turn it on.

The virtual HMC is now available as a virtual image, which is called a virtual appliance. You download the image file from IBM site then deploy it to a VM that you created. Users who access the console should not see the differences whether the HMC is a hardware appliance or virtual appliance.
Regardless of being either a hardware or virtual appliance, the Hardware Management Console lets administrators manage Power Systems by using system plans. You can configure resources for the systems: storages, networks, services, and so on. The visual shows the main Hardware Management Console graphical user interface (GUI). You navigate through components on the left panel. The right panel shows detailed information of the selected component from the left.

HMC can also create LPARs as shown in the two screen captures at the bottom of the slide. The snapshot on the left shows the Processing Settings dialog where you specify total usable processing units and virtual processors values to the minimum, desired, and maximum. The snapshot on the right shows the Memory Settings dialog that displays physical or installed memory available. You can specify minimum, desired, and maximum memory in increments of GB or MB.

Reference:
In a single hardware system, a single operating system is the software that manages hardware resources like processors and memory. Running applications get the shares of resources through controls of the operating system. A kernel is the core component of the operating system to prioritize the sharing of resources.

Hypervisor is the firmware component that sits on top of the host hardware to enable multiple guests that run on the same host. In this sense, a hypervisor of the hardware host functions like a kernel for the operating system. Specific hypervisor might have its administrative environment for managing the guest operating systems.
Examples of POWER Hypervisor features

- Provides abstraction between hardware resources and logical partitions (LPARs)
- Enforces partition integrity by providing a security layer between LPARs
- Controls the dispatch of virtual processors to physical processors
- Saves and restores all processor state information during a logical processor context switch
- Controls hardware I/O interrupt management facilities for LPARs
- Provides virtual LAN channels between LPARs for inter-partition communication
- Monitors, resets, or reloads the service processor. Notifies operating system if problem persisted

These features are listed in the Power System S822 Technical Overview and Introduction Redpaper.
Beside virtual cpu and memory, the hypervisor also creates virtual I/O adapters for SCSI, Ethernet, Fibre Channel, and TTY console. In Power System virtualization, the Virtual I/O Server (VIOS) partition is part of the administrative environment. VIOS takes the physical adapters and makes them virtual so that the virtual partitions can share the adapters.
Why virtualized? It makes the most sense with processor and memory resources. A physical processor or memory chip is already virtualized into computing processes or memory. The next step is to divide that process or memory into as smallest units as possible. More importantly, processes are created to match with workloads or demands of data flows.
Keywords 1 of 2

- Virtualization
- Virtual machine (VM)
- Bare metal server
- Kernel-based virtual machine (KVM)
- Logical partition (LPAR)
- Macro partitioning (mPAR)
- Application
- Binary code
- Computing host
- Hypervisor
- Open virtualization format (OVF)
- Deploy
- Capture
- Snapshot

Review the keywords for this unit.
Keywords (2 of 2)

- Hardware Management Console (HMC)
- Integrated Virtualization Manager (IVM)
- Virtual I/O Server (VIOS)
- SCSI (Small Computer System Interface)
- Storage area network (SAN)
- Fibre Channel
- TTY (teletype or device that acts as terminal)
- Terminal emulator
- Adapter
- Raw virtual image
- Qcow2
- AMI / AKI / ARI
- Vdmk
- VHD / VHDX

Additional keywords to review.
Write your answers here:

1. The cloud computing resources are derived from
   a. Hypervisor
   b. Hardware Management Console (HMC)
   c. Bare metal server or host

2. Beside processors and memory, the hypervisor also creates virtual adapters such as
   a. SCSI
   b. Ethernet
   c. Fibre Channel
   d. TTY console
   e. All of the above

3. True or false?
   Oversubscribing virtual resources is not necessarily overloading physical resources because virtual machine resource demands are dynamic at discrete times.
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1. The cloud computing resources are coming from
   a. Hypervisor
   b. Hardware Management Console (HMC)
   c. Bare metal server or host

2. Beside processors and memory, the hypervisor also creates virtual adapters such as
   a. SCSI
   b. Ethernet
   c. Fibre Channel
   d. TTY console
   e. All of the above

3. **True** or false?
   Oversubscribing virtual resources is not necessarily overloading physical resources because virtual machine resource demands are mostly dynamic at discrete times.

Check your responses.

1. C

2. E - All the above

3. True
Review the three steps you will be reviewing through the demo experience.
Please take time to review this unit's objectives.