Virtualization and the Cloud

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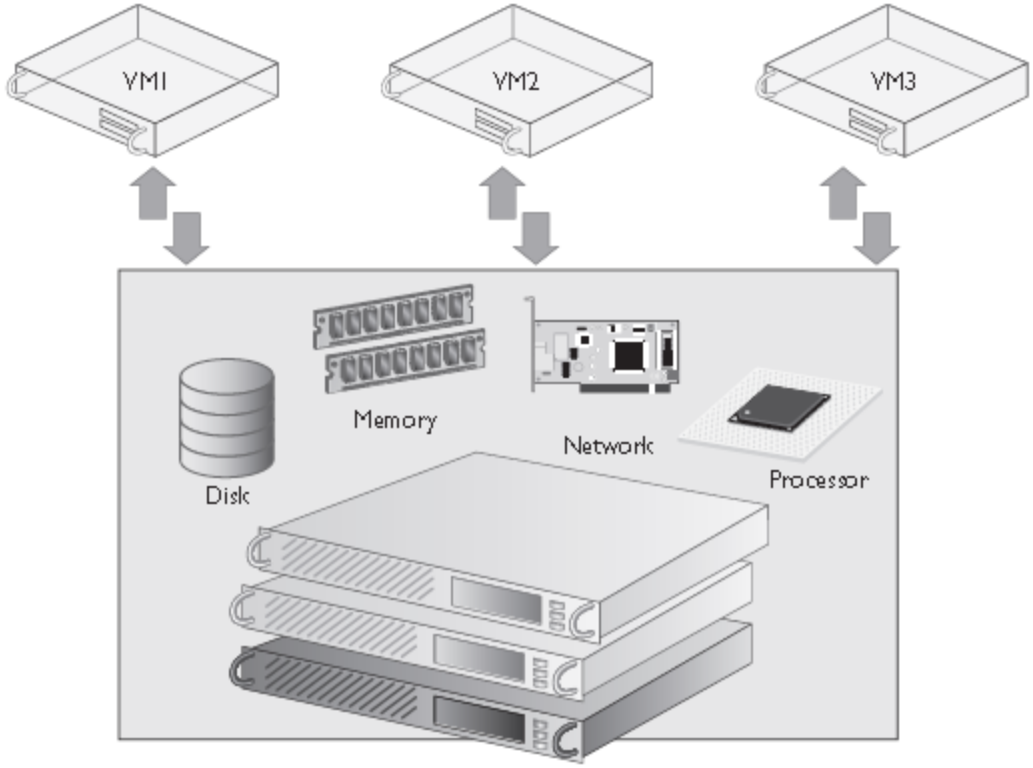
Ch 6

Virtualization

- Makes cloud computing more efficient and easier to manage.
- Facilitates consolidation of servers.
  - Reduces number of servers
  - Lessens rack space
  - Lessens power consumption
  - Reduces administration.
- Enables organization to view compute resources as a centralized resource.
  - Allows on demand elasticity while still maintaining control.
- Provides compute resources as a centralized resource by using shared resources.
- Shared resources allow the distribution of resources on an as-needed basis.



- Virtualization helps simplify sharing of compute resources.
- Cloud management layer allows a virtual machine to be created quickly and scaled to meet the demand.

Elasticity

- Elastic computing allows compute resources to vary dynamically with workload.
  - Primary reason organizations implement a cloud computing model.
- Elasticity supported by resource pooling.
- With cloud computing and elasticity, the time to service and the time it takes to implement an application can both be drastically reduced.

Implementation

- When an organization implements cloud computing and virtualization, they can quickly provision a new server to host an application and then provision that application.
- Reduces time to implement new applications and services.
- Elasticity allows an organization to scale resources up and down as required.
  - Organization becomes a cloud consumer.
- Cloud resources appear to the consumer to be infinite, allowing organization to consume as much or as few resources as required.

Migration

- Organization can also migrate applications and data between cloud providers, making the applications portable.
- With the cloud, an organization has the ability to deploy applications to any cloud provider, making all of the applications portable and scalable.

Advantages

- While virtualization alone could provide elasticity and scalability, it would rely on compute resources being purchased and owned by the organization rather than leased from a seemingly infinite resource like a cloud provider.
- Another benefit of combining cloud computing and virtualization is the ability to self-provision virtual systems.
- An IT department in a cloud computing model can grant permissions that give users in other departments the ability to self-provision virtual machines.
  - The IT department still controls how the virtual machine is created and what resources are provided to that virtual machine without actually having to create it.

Network and Application Isolation

- Cloud computing and virtualization can
  - Enhance network security
  - Increase application agility
  - Improve scalability and availability.
  - Help create network and application isolation.
- Without network isolation it might be possible for a cloud consumer to intentionally or unintentionally consume a large share of the network fabric or see another tenant's data in a multitenant environment.

Configuration

- Proper configuration of the network to include resource control and security using network isolation helps mitigate this.
- There are also circumstances where certain network traffic needs to be isolated to its own network to provide an initial layer of security, to afford higher bandwidth for specific applications, to enforce chargeback policies, or for use in tiered networks.

Virtualization and Isolation

- Virtualization and cloud computing provide organizations with a means to isolate an application without having to deploy a single application to a single physical server.
- By combining virtualization and network isolation, it is possible to isolate an application just by correctly configuring a virtual network.
- Organizations now have the ability to install multiple applications on one physical server and then isolate a given application so that it can communicate only with the network devices it is configured to.

Infrastructure Consolidation

- Virtualization allows an organization to consolidate its servers and infrastructure by allowing multiple virtual machines to run on a single host computer while providing a way to isolate a given application from other applications that are installed on other virtual machines on the same host computer.
- Cloud computing can take it a step further by allowing an organization not only to take advantage of virtualization but also to purchase compute resources from a cloud provider.
- Consolidating the infrastructure means lower costs since it no longer needs to provide the same power, cooling, administration, and hardware that would be required without virtualization and cloud computing.
- The network environment becomes easier to manage and maintain as an organization moves to a consolidated infrastructure

Virtual Data Center Creation

- A virtual data center offers compute resources, network infrastructure, external storage, backups, and security just like a physical data center.
- Virtual data center also offers virtualization, pay-as-you-grow billing, elasticity, and scalability.
- An administrator can control the virtual resources by using quotas and security profiles.
- A cloud user would then have the ability to create virtual servers and host applications on those virtual servers based on the security permissions assigned to the user's account.
- Multiple virtual data centers based on either geographic or application isolation requirements.

Virtual Resource Migrations

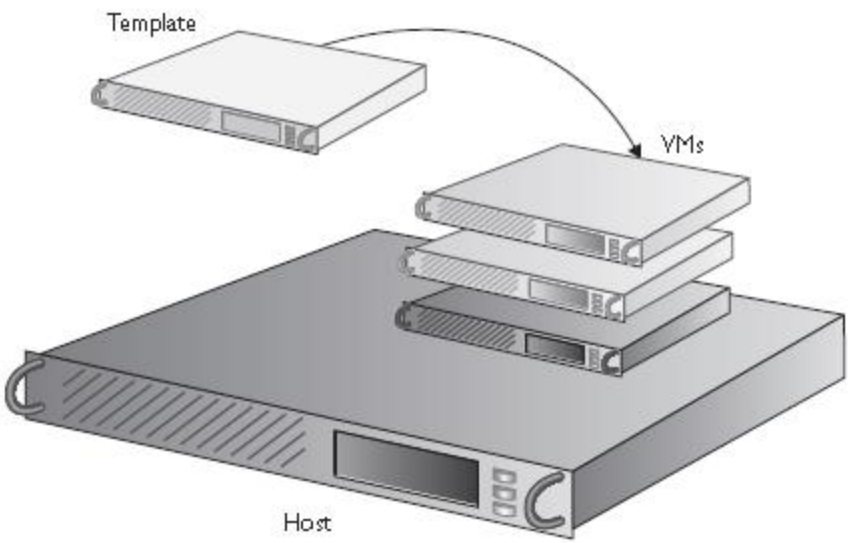
- Migrating servers to a virtual or cloud environment is one of the first steps in adopting a cloud computing model.
- Organizations want the ability to migrate their current data center to a cloud environment.
- With the advancements in virtualization and consolidated infrastructures, organizations now see IT resources as a pool of resources that can be managed centrally, not as a single resource.
- IT administrators now have the ability to easily move resources across the network from server to server, from data center to data center, or into a private or public cloud, giving them the ability to balance resource and compute loads more efficiently across multiple, even global, environments.

Virtual Machine Templates

- When an organization is migrating to the cloud, it is important for them to have a standardized installation policy or profile for their virtual servers.
- All the machines need to have the same security patches, service packs, and base applications.
- Virtual machine templates provide a streamlined approach to deploying a fully configured base server image
  - Or even a fully configured application server.
- Virtual machine templates help decrease the installation and configuration costs when deploying virtual machines and lower ongoing maintenance costs.
  - Allowing for faster deploy times and lower operational costs.

Templates

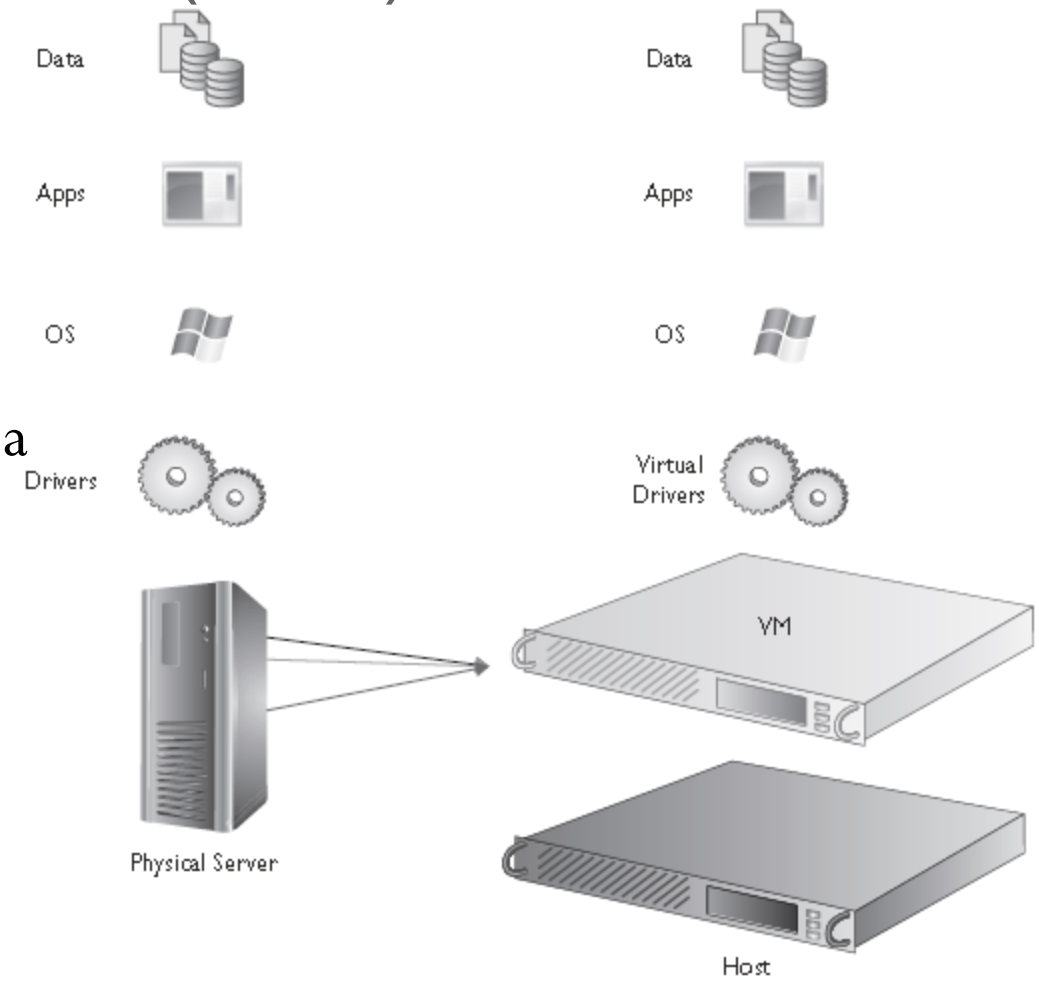
- A virtual machine template can be exported from one virtualization host, and then imported on another virtualization host and be used as a master virtual machine template for all virtualization hosts.
- Virtual machine templates provide a standardized group of hardware and software settings that can be reused repeatedly to create new virtual machines that are configured with those specified settings.
- For example, a virtual machine template can be defined to create a virtual machine with 1024 MB of memory, one vCPU, and three virtual hard disks.
- Or a virtual machine template can be created based on an existing, fully configured virtual machine.
- In essence a virtual machine template acts as a master image that an organization can use to quickly and efficiently deploy similar virtual machine instances in their environment



- How virtual machine templates work.
- Virtual machine templates can be maintained by applying operating system updates and application patches so that any new virtual machine instances created with the template are updated and ready to use instantly.

Physical to Virtual (P2V)

- Process of creating a virtual machine from a physical server is called physical to virtual (P2V).
- P2V enables the migration of a physical server's operating system, applications, and data to a newly created guest virtual machine on a host computer.



P2V Methods

- Manually, you can create a new virtual machine on a host computer and copy all the files from the OS, applications, and data from the source physical server.
  - Time consuming
  - Not very effective.
- Semi-automated P2V uses a software tool to assist in the migration from a physical server to a virtual server.
  - Simplifies process.
  - Gives administrator some guidance when migrating the physical server.
  - Free software tools available that help migrate a physical server from a virtual server.

Fully Automated P2V.

- Uses a software utility that can migrate a physical server over the network without any assistance from an administrator.
  - Either online or offline.
- With an online migration the physical computer or source computer remains running and operational during the migration.
  - An advantage of the online option is that the source computer is still available during the migration process.
  - May not be a big advantage, however, depending on the application that is running on the source computer.

Offline P2V

- When doing an offline P2V, the source computer is taken offline during the migration process.
  - Provides for a more reliable transition since the source computer is not being utilized.
- For example, if you are doing a migration of a database server or a domain controller, it would be better to do the migration offline since the system is constantly being utilized.
- Always advisable to check with the application vendor to make sure they support their application in a virtual environment.

Virtual to Virtual (V2V)

- Process of migrating an operating system, applications, and data, but instead of migrating them from a physical server you are migrating them from a virtual server.
  - Software tools available to fully automate a V2V migration.
- V2Vcan be used to copy or restore files and programs from one virtual machine to another.
  - Can also be used to convert a VMware virtual machine to a Hyper-V-supported virtual machine or vice versa.
  - If the conversion is from VMware to Hyper-V, the process creates a .vhd file and copies the contents of the .vmdk to the new .vhd file so that the virtual machine can be supported in Hyper-V.

Open Virtualization Format

- Open virtualization format (OVF) is a platform-independent extensible open packaging and distribution format for virtual machines.
- OVF allows for efficient and flexible distribution of applications, making virtual machines mobile between vendors because the application is vendor and platform neutral.
- An OVF virtual machine can be deployed on any virtualization platform

Virtual to Physical (V2P)

- Not as simple as a P2V.
- A variety of tools are needed to convert a virtual machine back to a physical machine.
  - First, Microsoft Sysprep would need to be installed on the virtual machine to prepare the image for transfer and allow for hardware configuration changes.
  - Next, all the drivers for the target physical server need to be installed before doing the migration.
  - Finally, a software tool such as Symantec Ghost is needed to facilitate the virtual-to-physical migration..
- Unlike the P2V process, which requires only the software tool to do the migration, the V2P process involves more planning and utilities and is much more complex.

V2P

- While a V2P conversion is not something that is done often, it is sometimes required.
  - One reasons is to test how the application performs on physical hardware.
- Some applications may perform better on physical hardware than on virtual hardware.
- This is not a common circumstance, however, and it is fairly easy to increase the compute resources for a virtual machine to improve the performance of an application that is hosted there.
- The more common reason to perform a V2P is that some application vendors do not support their product running a virtual environment.

Virtual Machine Cloning

- Virtual machine cloning makes it possible to create one or multiple copies of a virtual machine or a virtual machine template.
  - A virtual machine clone is an exact copy of an existing virtual machine.
  - The existing virtual machine then becomes the parent virtual machine of the virtual machine clone.
- After the clone is created, it is a separate virtual machine that has the ability to share virtual disks with the parent virtual machine or create its own separate virtual disks.
- Once the virtual machine clone is created, any changes made to the clone do not impact the parent virtual machine and vice versa.

Cloning

- A virtual machine clone's MAC address and universally unique identifier (UUID) are different from those of the parent virtual machine..
- If they are looking to save the current state of a virtual machine so that they can revert back to that state in case of a software installation failure or an administrative mistake, they should create a snapshot, not a virtual machine clone.
- Virtual machine cloning allows for deploying multiple identical virtual machines to a group.
  - For example, the IT department might create a clone of a virtual machine for each employee, and that clone would contain a group of preconfigured applications.
  - Or they might want to use virtual machine cloning to create a development environment.
  - A virtual machine could be configured with a complete development environment and cloned multiple times to create a baseline configuration for testing new software and applications.

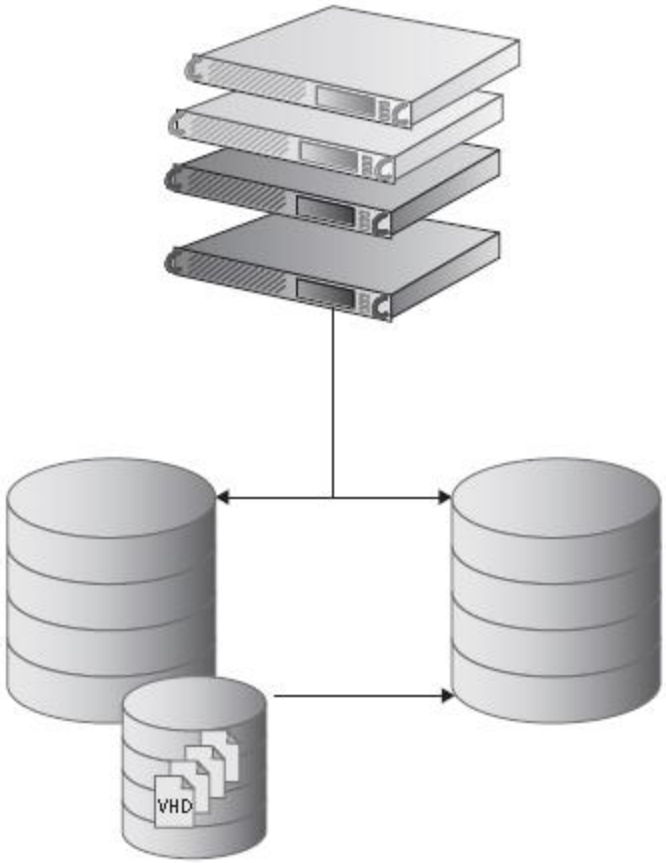
Storage Migration

- Process of transferring data between storage devices.
  - Automated or manual.
- Storage migration makes it possible to migrate a virtual machine's storage or disks to a new location and across storage arrays while maintaining continuous availability and service to the virtual machine.
- Also allows for migrating a virtual machine to a different storage array without any downtime to the virtual machine.
- Storage migration eliminates service disruptions to a virtual machine and provides a live and automated way to migrate the virtual machine's disk files from the existing storage location to a new storage destination.

Storage Migration

- Migrating virtual machine storage to different classes of storage is a cost-effective way to manage virtual machine disks based on usage, priority, and need.
  - Provides a way to take advantage of tiered storage.
- Allows a virtual machine to be moved from SAN-based storage to NAS- or DAS-based storage according to the current needs of the virtual machine.

Storage Migration Virtual Environment



Migration Considerations

- Among the most important of those considerations are the compute resources:
  - CPU
  - Memory
  - Disk I/O
  - Storage requirements
- IT administrator plans the migration of physical servers to the virtual environment.
  - Critical that they perform their due diligence and discover all the necessary information about both the server and the application that the server is hosting.

Requirements Gathering

- Helps define which servers to migrate first and which servers are good candidates for migration.
  - During evaluation, important to monitor that server over a period of time.
- A monitoring tool such as the Microsoft Performance Monitor or other comparable tools in the Linux environment can be used to get an accurate assessment.
  - The longer the trends of the physical server are monitored, the more accurate the assessment of resource usage will be.
  - Time spent monitoring the system also varies depending on the applications the physical server is hosting.
  - For example, it would make sense to monitor a database server for a longer period of time than a print server.
- In the end the organization needs to have an accurate picture of memory and CPU usage under various conditions so they can use that information to plan the resources the physical server might need after it is converted to a virtual machine.

File System Considerations

- Another consideration when determining if a physical server is a good candidate for virtualization is the status of the file system.
- When converting a physical server to a virtual server, all the data from the physical server is copied to the virtual server as part of the P2V process.
  - Sometimes, files and data kept on a server that are not required, and those files do not need to be migrated as part of the P2V process.
- It is important, then, to examine the hard drive of the physical server before performing a migration and to remove all files and data not required for the server to function and provide the application it is hosting.
  - Examples of these files might be WiFi files, or other files meant to be used only by a physical machine.

Maintenance Scheduling

- When migrating a physical server to a virtual server, they should expect some downtime as part of the migration.
- They will at least have to take the time to start the new virtual machine and shut down the old physical server.
- DNS changes may also need to be made and replicated to support the new virtual instance of the physical server.
- Maintenance schedules should also be implemented or taken into consideration when planning the migration of a physical-to-virtual server.
- Most organizations have some type of maintenance schedule set up for routing maintenance on their server infrastructure, and all P2V migrations should take place during that planned maintenance.

Provisioning

- So before an IT administrator embarks on the P2V migration process, they should provide the business case for some downtime of the systems to the change management team.
- Part of that downtime goes back to the resource provisioning discussion earlier in this chapter.
- The IT department does not want to under-provision the new virtual servers from the beginning and cause additional and unnecessary downtime of the virtual server and the application the virtual server is hosting.
- On the other hand, they don't want to overprovision the virtual server either, reserving too many resources to the virtual machine and consuming precious host resources where they are not required or are sometimes detrimental.

Upgrading

- In addition to P2V, V2P, and V2V, an organization also has the option to upgrade an existing virtual machine to the latest virtual hardware or latest host operating system.
- Virtual machine hardware corresponds to the physical hardware available on the host computer.
  - In order for a virtual machine to take advantage of some of the features that the host computer provides, it might be necessary to upgrade the virtual machine hardware or guest tools.
- The host file system or hypervisor may also need to be upgraded to support these upgrades.
- Virtual machine hardware features might include BIOS enhancements, virtual PCI slots, maximum number of CPUs, and maximum memory configuration.

New Host O/S

- Another scenario that might require upgrading a virtual machine is when a new version of the host operating system is released
  - When Microsoft releases a new version of Hyper-V or VMware releases a new version of ESXi.
- In this instance an organization would need to upgrade or migrate their virtual machines to the new host server.
- This can be accomplished with a V2V migration of the virtual machines or by exporting the virtual machines from the previous version and importing them into the new version of the host operating system software.
- Upgrading to a new host operating system and migrating the virtual machines to that new host requires the same planning that would be needed to perform a P2V migration.
- The IT administrator needs to understand the benefits of the new host operating system and how those benefits will impact the virtual machines and, specifically, their compute resources.

Testing

- The process of P2V, or V2V, generally leaves the system in complete working and functional order and the entire system is migrated and left intact.
- That said, any system that is being migrated should be tested both before and after the migration process.
- IT administrator needs to define a series of checks that should be performed after the migration and before the virtual server takes over for the physical server.

Testing Attributes

Some tests that should be completed on the virtual server after migration are as follows:

- Remove all unnecessary hardware from the virtual machine. (If you are migrating from a physical server to a virtual server, you might have some hardware devices that were migrated as part of the P2V process.)
- When first booting the virtual machine, disconnect it from the network.
- Allows the booting without concern about duplicate IP addresses or DNS names.
- Reboot the virtual machine several times to clear the logs and verify that it is functioning as expected during the startup phase.
- Verify network configurations on the virtual server while it is disconnected from the network.
- Make sure the IP address configuration is correct so that the virtual machine does not have any issues connecting to the network once connectivity restored.

Migration Issues

- Performing these post-migration tests will help to ensure a successful migration process and to minimize any errors that might arise after the migration is complete.
- As with anything there could still be issues once the virtual machine is booted on the network, but performing these post-conversion tests will lessen the likelihood of problems.

Questions???