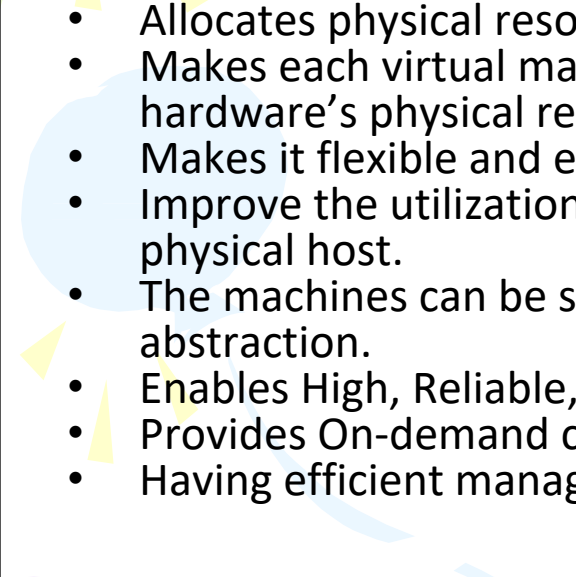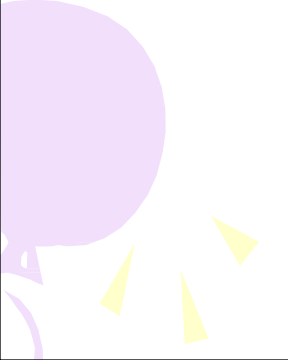# VM Provisioning & VM Migration

- The virtualization layer partitions the physical resource of the underlying physical server into multiple virtual machines with different workloads.

Role of the virtualization layer:
- Schedules resources,
- Allocates physical resources,
- Makes each virtual machine think that it totally owns the whole underlying hardware's physical resource (Preprocessor, disks, etc.)
- Makes it flexible and easy to manage resources.
- Improve the utilization of resources by multiplexing many virtual machines on one physical host.
- The machines can be scale up and down on demand with a high level of resources' abstraction.
- Enables High, Reliable, and agile deployment mechanism.
- Provides On-demand cloning and live migration.
- Having efficient management suite for managing virtual machines

- **VM Provisioning Process**

- The common and normal steps of provisioning a virtual server are as follows:
- Firstly, you need to select a server from a pool of available servers (physical servers with enough capacity) along with the appropriate OS template you need to provision the virtual machine.
- Secondly, you need to load the appropriate software (operating System you selected in the previous step, device drivers, middleware, and the needed applications for the service required).
- Thirdly, you need to customize and configure the machine (e.g., IP address, Gateway) to configure an associated network and storage resources.
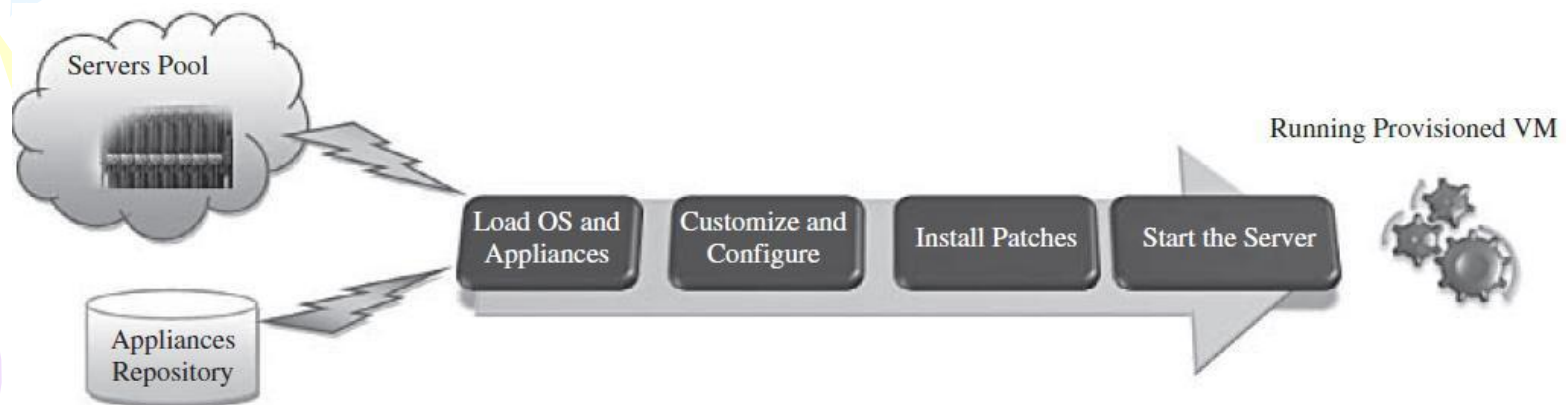- Finally, the virtual server is ready to start with its newly loaded software.

- **VM Provisioning Process contd.**

To summarize, server provisioning is **defining server's configuration** based on the organization requirements, a hardware, and software component (processor, RAM, storage, networking, operating system, applications, etc.).

- Normally, virtual machines can be provisioned by manually installing an operating system, by using a preconfigured VM template, by cloning an existing VM, or by importing a physical server or a virtual server from another hosting platform.

- Physical servers can also be virtualized and provisioned using P2V (Physical to Virtual) tools and techniques (e.g., virt-p2v).

- After creating a virtual machine by virtualizing a physical server, or by building a new virtual server in the virtual environment, a template can be created out of it.

- Most virtualization management vendors (VMware, XenServer, etc.) provide the data center's administration with the ability to do such tasks in an easy way.

- **VM Provisioning Process contd.**

- Provisioning from a template is an invaluable feature, because it reduces the time required to create a new virtual machine.

- •Administrators can create different templates for different purposes. For example, you can create a Windows 2003 Server template for the finance department, or a Red Hat Linux template for the engineering department. This enables the administrator to quickly provision a correctly configured virtual server on demand.

FIGURE   Virtual machine provision process.

Release Ms
- End of service
- Compute resources deallocated to other VMs

IT Service Request
- Infrastructure Requirements Analysis
- IT request

VMs In Operation
- Serving web requests
- Migration services
- Seal on-demand
- Compute Resource

VM Provision
- Load OS + Appliances
- Customize and Configure
- Start the server

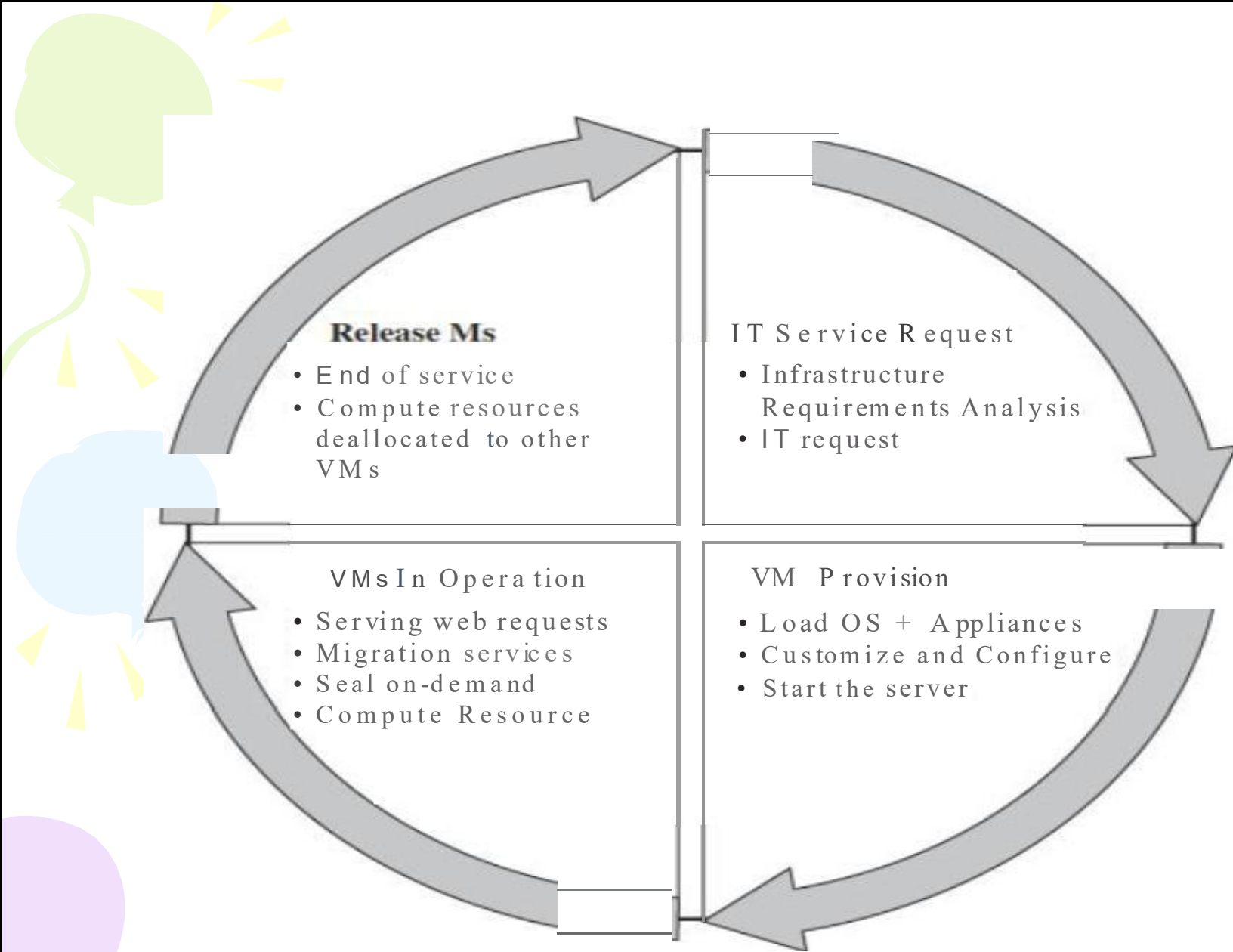FIGURE 53. Virtual machine life cycle.

Virtual Machine Provisioning and Manageability Virtual Machine Life Cycle

- Virtual Machine Provisioning and Manageability Virtual Machine Life Cycle
- The cycle starts by a request delivered to the IT department, stating the requirement for creating a new server for a particular service.
- This request is being processed by the IT administration to start seeing the servers' resource pool, matching these resources with requirements
- Starting the provision of the needed virtual machine.
- Once it provisioned and started, it is ready to provide the required service according to an SLA.
- Virtual is being released; and free resources.

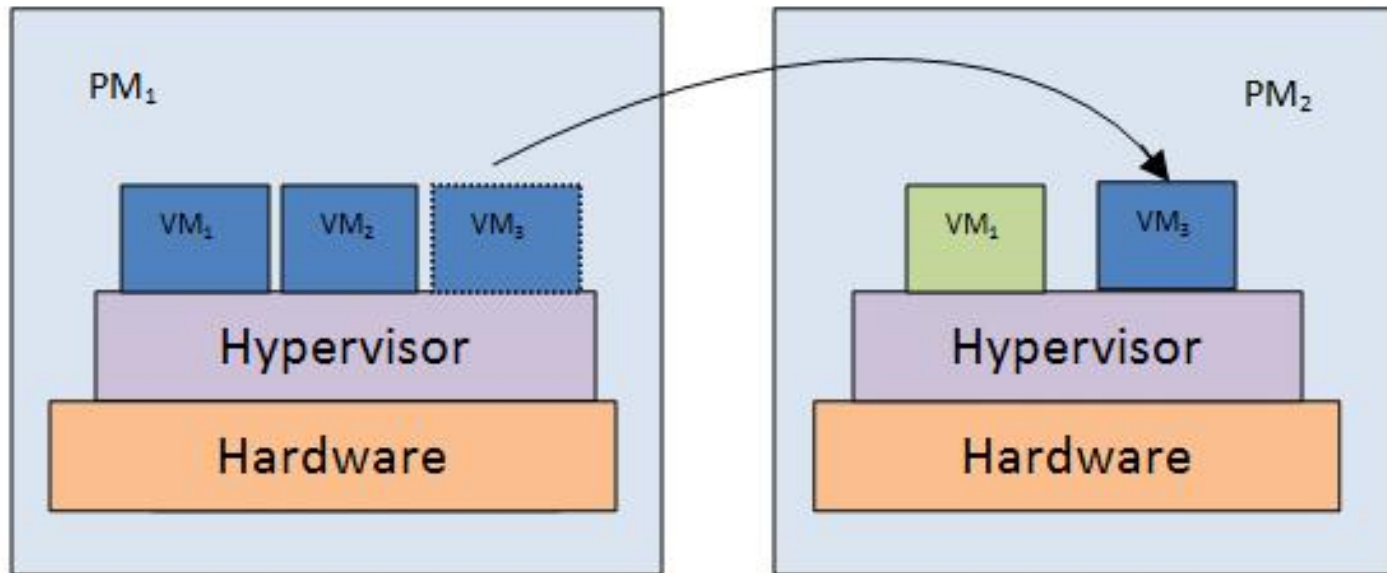- **VIRTUAL MACHINE MIGRATION SERVICES (Live Migration and High Availability)**

- **Live migration** (which is also called **hot or real-time migration**) can be defined as the movement of a virtual machine from one physical host to another while being powered on.

- When it is properly carried out, this process takes place without any noticeable effect from the end user's point of view **(a matter of milliseconds).**

- One of the most significant advantages of live migration is the fact that **it facilitates proactive maintenance in case of failure,** because the potential problem can be resolved before the disruption of service occurs.

- Live migration can also be used for **load balancing** in which work is shared among computers in order to optimize the utilization of available CPU resources.

Live Migration Anatomy, Xen Hypervisor Algorithm.

- How to live migration's mechanism and memory and virtual machine states are being transferred, through the network, from one host A to another host B:

- the Xen hypervisor is an example for this mechanism. The logical steps that are executed when migrating an OS.

- In this research, the migration process has been viewed as a transactional interaction between the two hosts involved:

VM MIGRATION
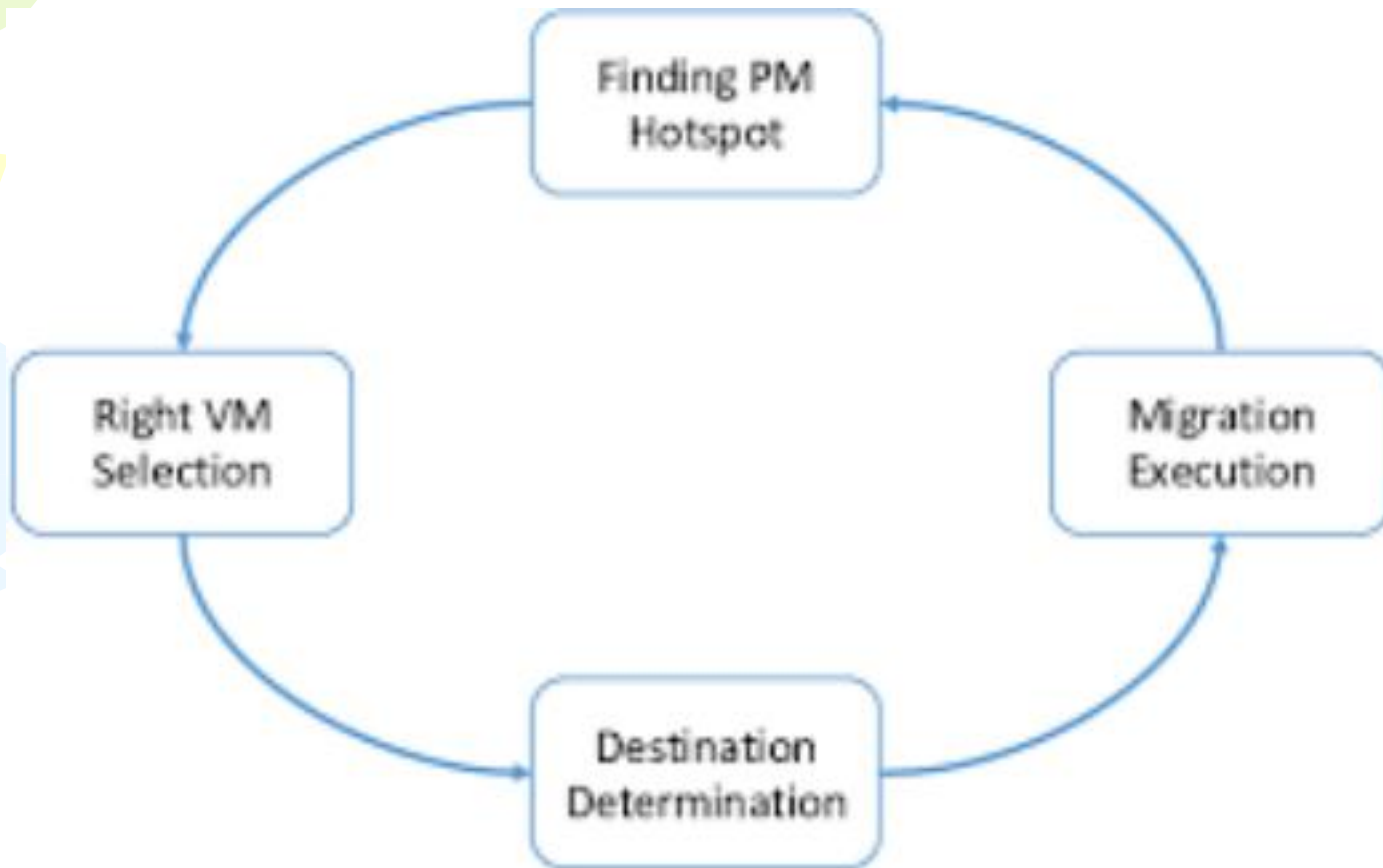
- **LIVE MIGRATION STAGES**

Stage-0: Pre-Migration. An active virtual machine exists on the physical host A.

Stage-1: Reservation. A request is issued to migrate an OS from host A to host B (a precondition is that the necessary resources exist on B and a VM container of that size)

Stage-3: Stop-and-Copy. Running OS instance at A is suspended, and its network traffic is redirected to **B**. As described in reference 21, CPU state and remaining inconsistent memory pages are then transferred. At the end of this stage, there is a consistent suspended copy of the VM at both A and B. The copy at A is considered primary and is resumed in case of failure.
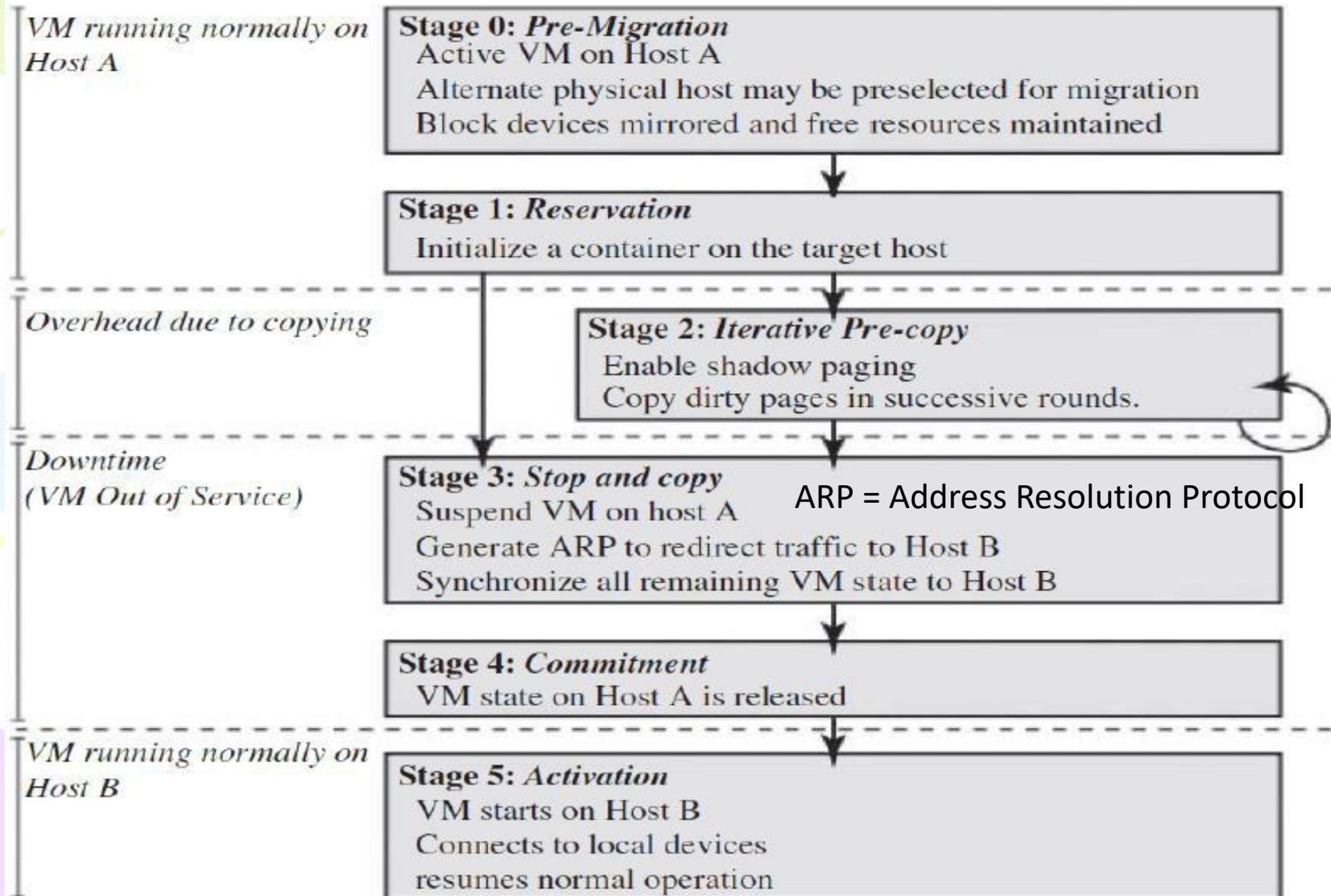
Stage-4: Commitment. Host B indicates to A that is has successfully received a consistent OS image. Host A acknowledges this message as a commitment of migration transaction.

Stage-5: Activation. The migrated VM on B is now activated. Post-migration code runs to reattach the device's drivers to the new machine and advertise moved IP addresses.

This approach to failure management ensures that at least on host has a consistent VM image at all times during migration:

1) Original host remains stable until migration commits and that the VM may be suspended and resumed on that host with no risk of failure.

2) A migration request essentially attempts to move the VM to a new host and on any sort of failure, execution is resumed locally, aborting the migration.

LIVE MIGRATION TIMELINE

VM running normally on Host A

Stage 0: *Pre-Migration*
Active VM on Host A
Alternate physical host may be preselected for migration
Block devices mirrored and free resources maintained

Stage 1: *Reservation*
Initialize a container on the target host

Overhead due to copying

Stage 2: *Iterative Pre-copy*
Enable shadow paging
Copy dirty pages in successive rounds.

Downtime (VM Out of Service)

Stage 3: *Stop and copy*
Suspend VM on host A
Generate ARP to redirect traffic to Host B
Synchronize all remaining VM state to Host B

ARP = Address Resolution Protocol

Stage 4: *Commitment*
VM state on Host A is released

VM running normally on Host B

Stage 5: *Activation*
VM starts on Host B
Connects to local devices
resumes normal operation

FIGURE   Live migration timeline

• LIVE MIGRATION VENDOR IMPLEMENTATION EXAMPLE

There are lots of VM management and provisioning tools that provide the live migration of VM facility, two of which are VMware VMotion and Citrix XenServer "XenMotion".

VMware VMotion:

a) Automatically optimize and allocate an entire pool of resources for maximum hardware utilization, flexibility, and availability.

b) Perform hardware's maintenance without scheduled downtime along with migrating virtual machines away from failing or underperforming servers.

Citrix XenServer "XenMotion":

Based on Xen live migrate utility, it provides the IT Administrator the facility to move a running VM from one XenServer to another in the same pool without interrupting the service (hypothetically zero – downtime server maintenance), making it a highly available service and also good feature to balance workloads on the virtualized environments.

- **REGULAR /COLD MIGRATION**

- **Cold migration is the migration of a powered-off virtual machine. With cold migration:**

- You have options of moving the associated disks from one data store to another.

- The virtual machines are not required to be on a shared storage. 1)Live migrations needs to a shared storage for virtual machines in the server's pool, but cold migration does not. 2) In live migration for a virtual machine between two hosts, there should be certain CPU compatibility checks, but in cold migration this checks do not apply.

- Cold migration (VMware product) is easy to implement and is summarized as follows:

- The configuration files, including NVRAM file (BIOS Setting), log files, and the disks of the virtual machines, are moved from the source host to the destination host's associated storage area.

- The virtual machine is registered with the new host.

- After the migration is completed, the old version of the virtual machine is deleted from the source host.