MIGRATION OF SERVICE AT RUNTIME IN CLUSTER

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Our Objective:

To speed up the process of instance migration by just migrating container and not the whole virtual machine. Which will further help in efficient bandwidth usage and less wastage of memory resources.

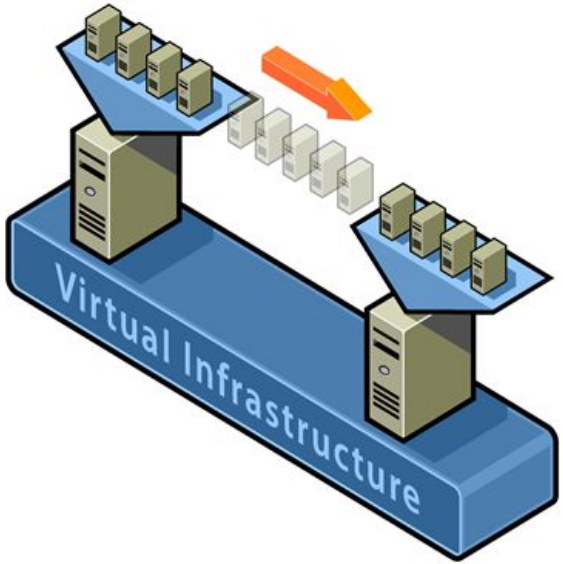
Outline

- Introduction
- Motivation
- Background Study
- Challenges
- Real life advantages
- References

Introduction

What’s live migration?

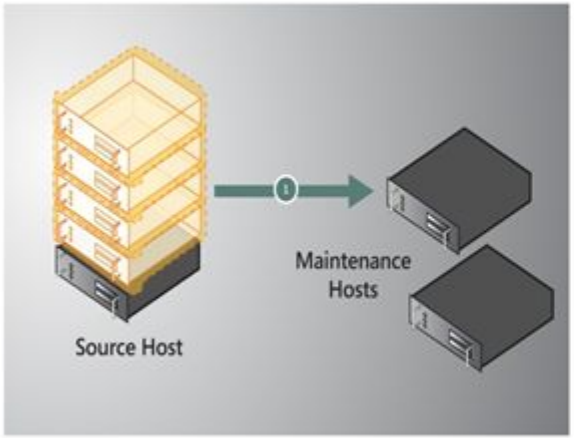
- Live migration means moving instances across different hosts with little or no downtime for running services.
  - User of Services are unaware of the migration.
  - Services are seamlessly resumed from the same instance as before migration .



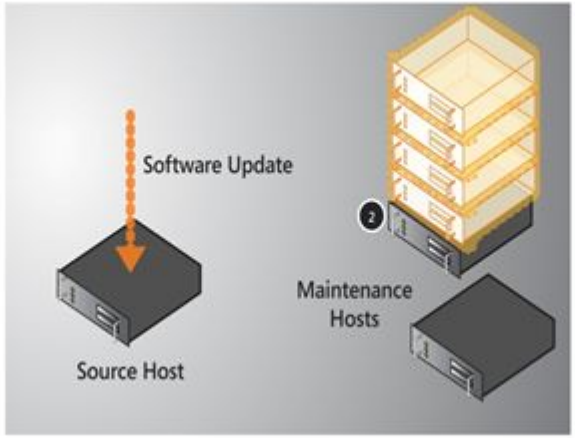
Motivation

- Live migration can be a extremely powerful tool for cluster administrators.
  - Hardware / Software maintenance / upgrades
  - Load balancing / resource management
  - Distributed power management

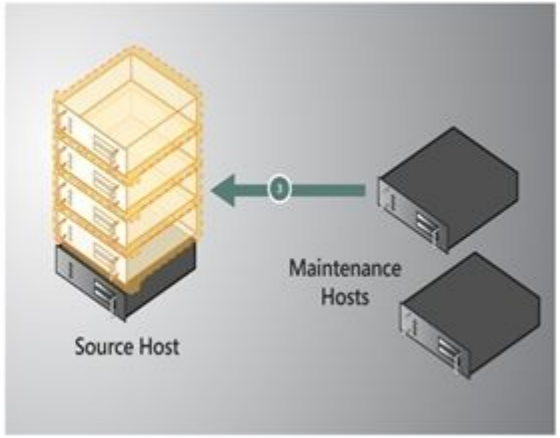
Scenario 1: Host servicing / Hardware Maintenance



Live Migrate Containers from Source to Destination

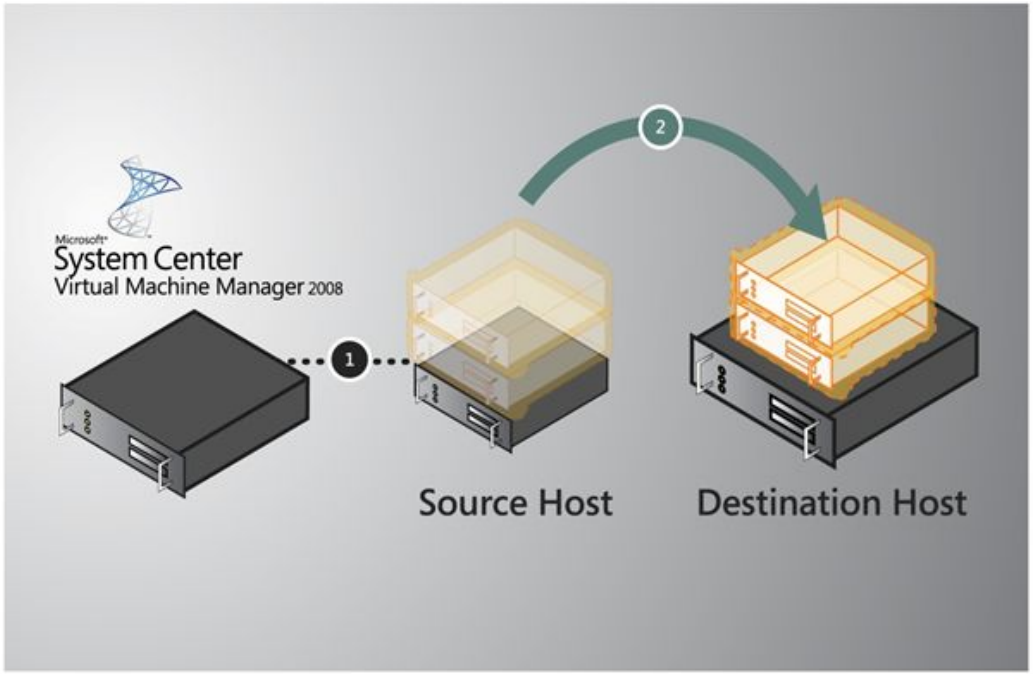


Hardware Servicing, no downtime seen by services on Destination



Live Migrate containers from back from Destination to Source

Scenario 2: Load Balancing

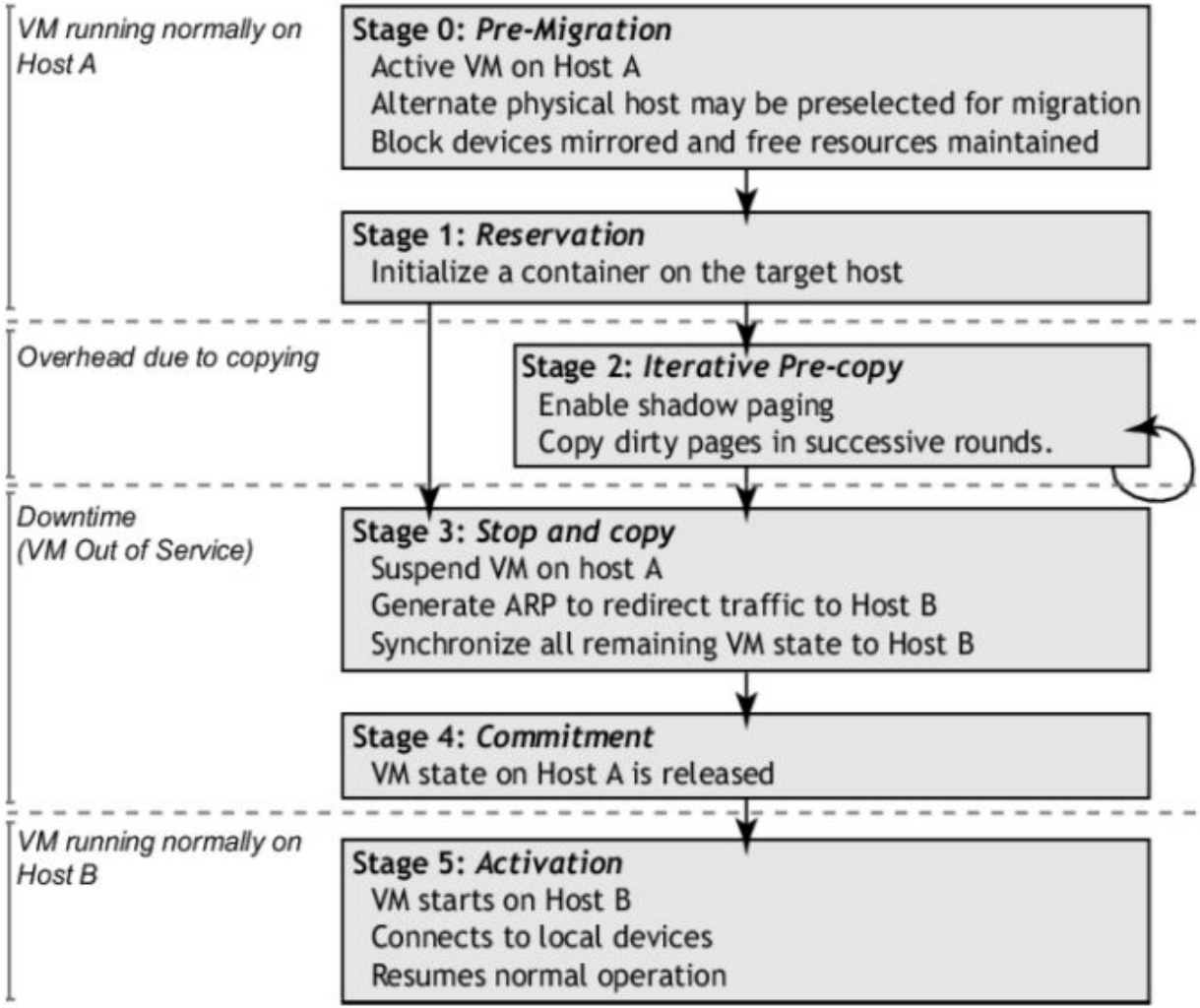


- Load Balancer can move containers at run time for balancing the load among nodes.

Background Study

Earlier the Migration of services has been achieved using the Virtual Machine.

- VM is a guest OS which provides isolation from host and host can emulate different operating system and hardware platforms with it.
- VM migration uses shared memory storage to take care of file dependencies.
- VM Live migration basically follows this steps-
  - Pre-migration
  - Reservation
  - Iterative pre-copy
  - Stop and copy
  - Commitment
  - Activation

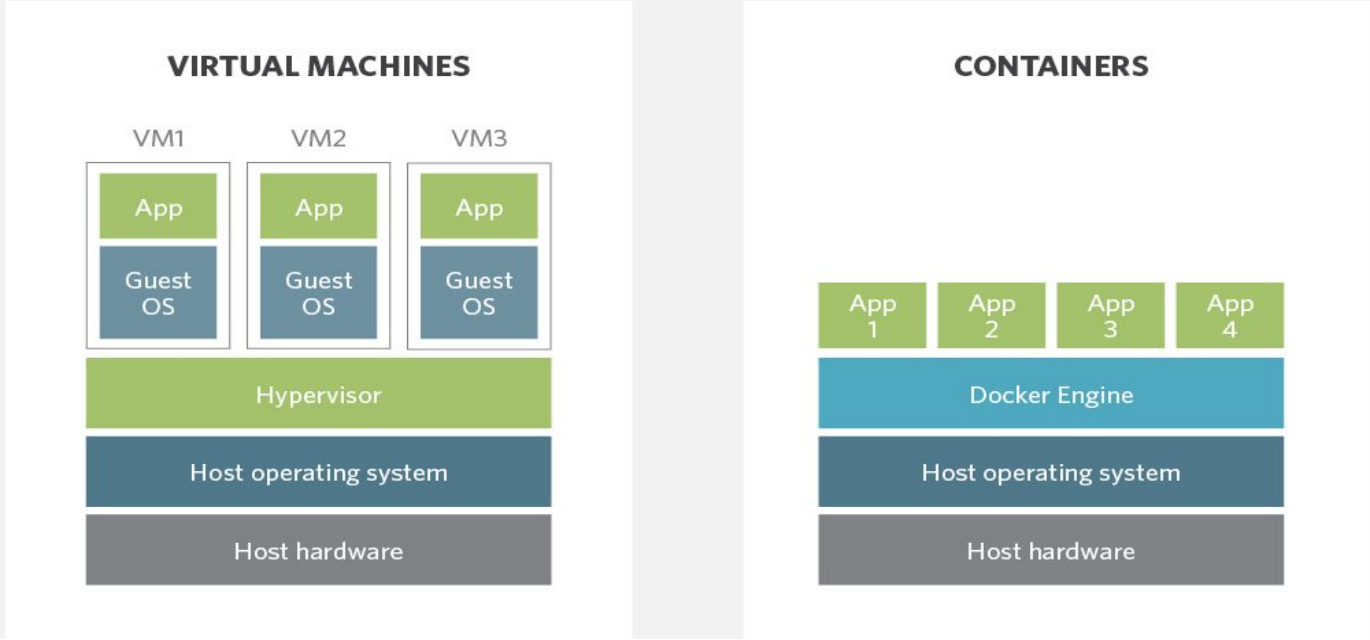

VM running normally on Host A
Stage 0: Pre-Migration
Active VM on Host A
Alternate physical host may be preselected for migration
Block devices mirrored and free resources maintained
Stage 1: Reservation
Initialize a container on the target host
Overhead due to copying
Stage 2: Iterative Pre-copy
Enable 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
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

What is a Container ?

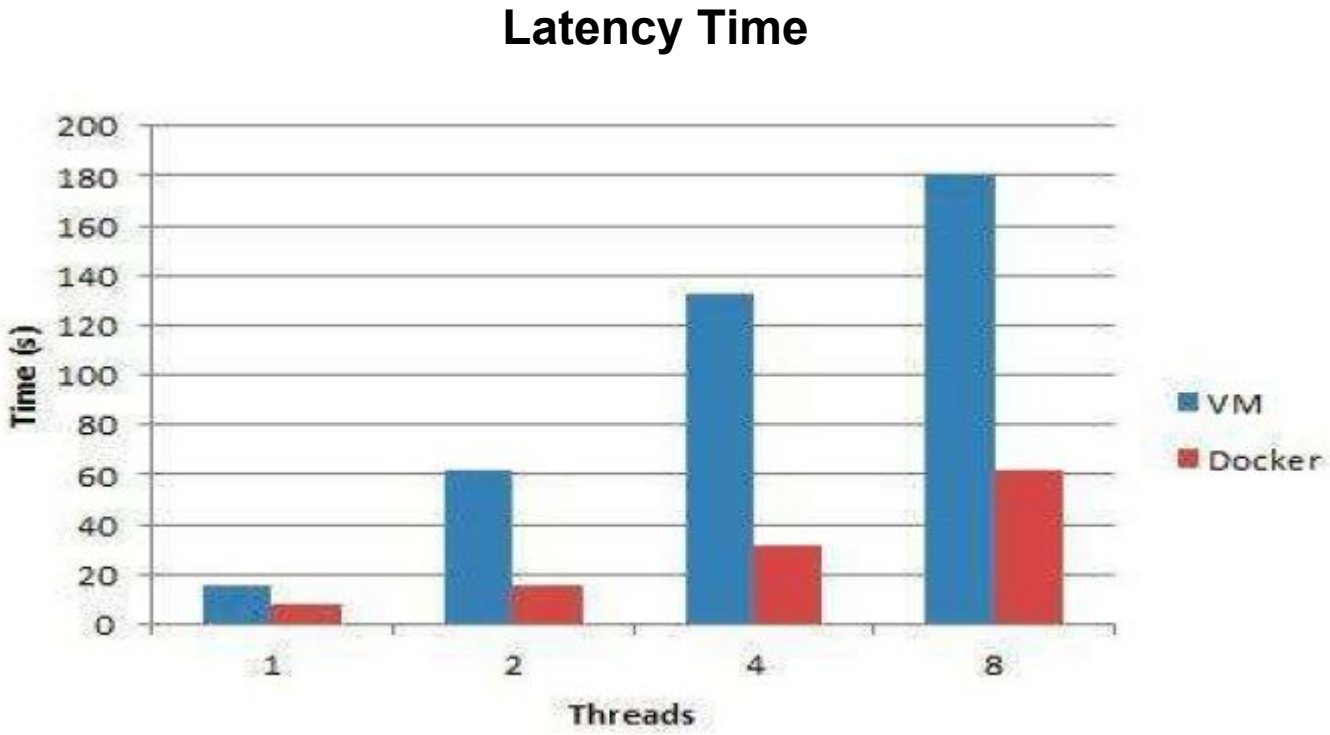
Containers are packages that rely on virtual isolation to deploy and run applications that access a shared operating system (OS) kernel without the need for virtual machines (VMs).

Containers hold the components necessary to run desired software. These components include files, environment variables, dependencies and libraries.

Virtual machines versus containers



Drawbacks of virtual machine based migration



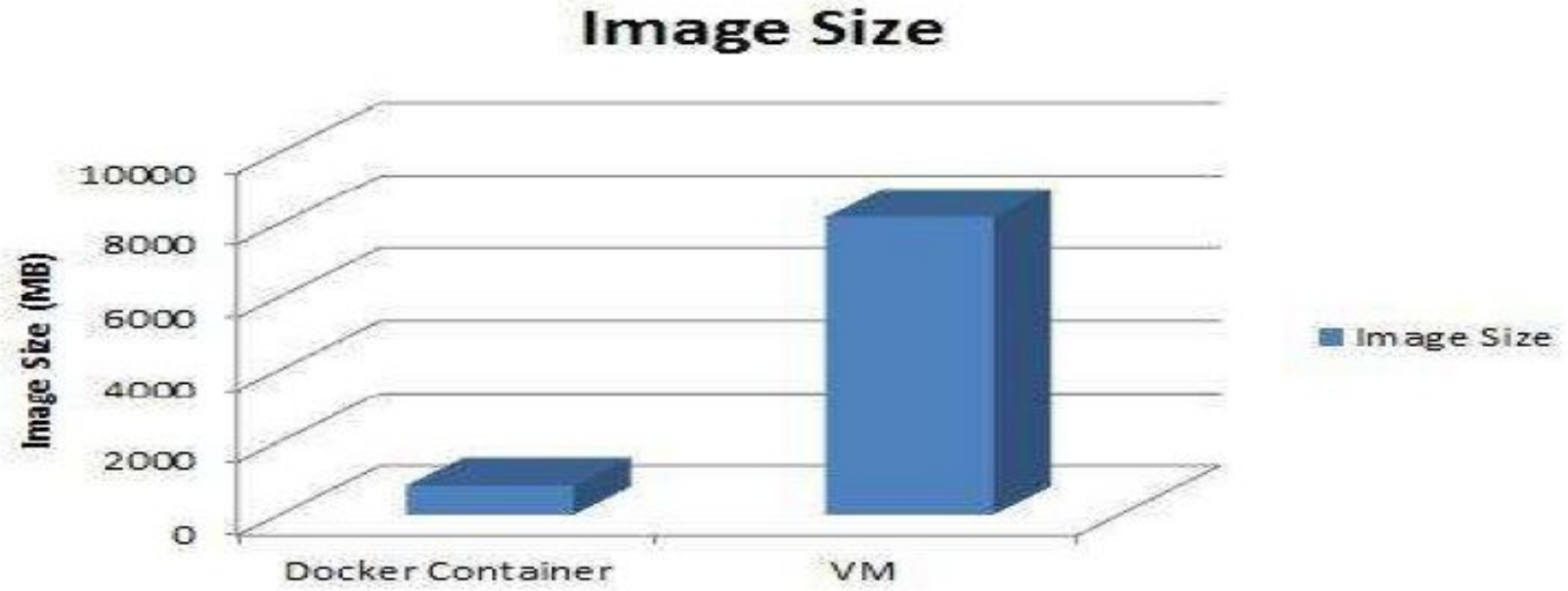
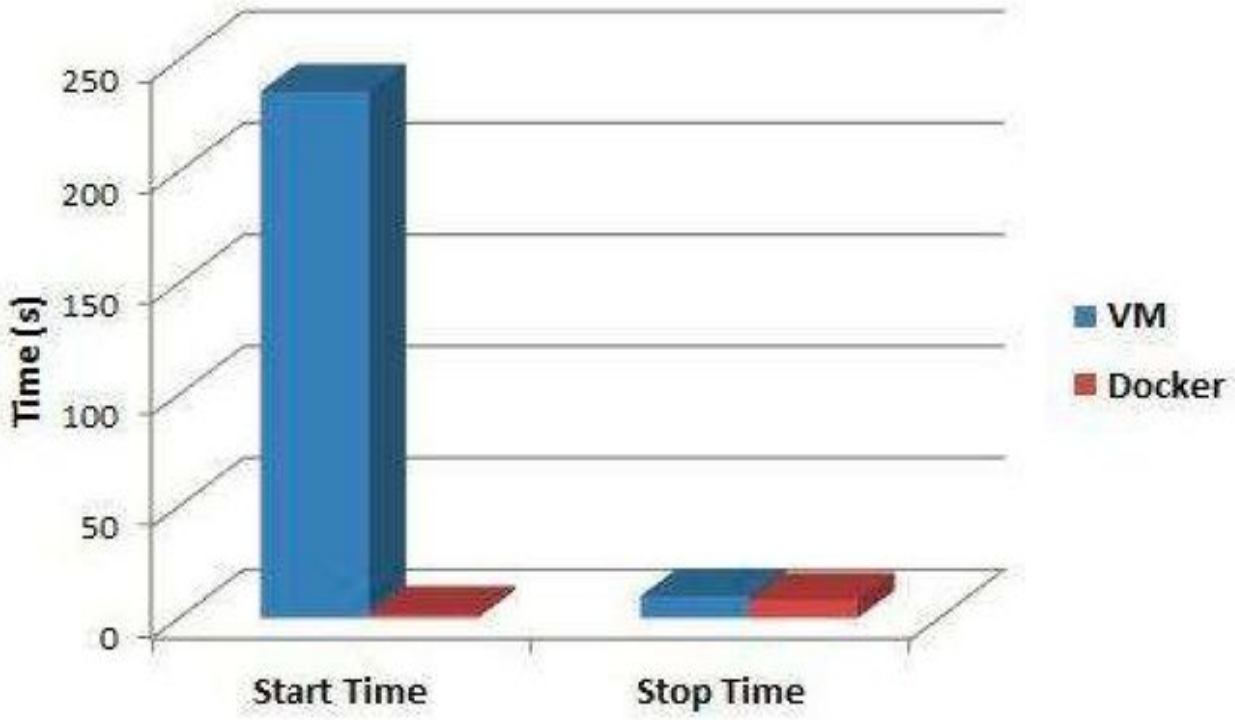


Image Size
Image Size (MB)
10000
8000
6000
4000
2000
0
Docker Container
VM
Image Size

Boot Time



CRIU a useful tool

Checkpoint/Restore In Userspace, or CRIU is a software tool for the Linux operating system. Using this tool, you can freeze a running application (or part of it) and checkpoint it as a collection of files on disk. You can then use the files to restore the application and run it exactly as it was during the time of the freeze.

But, There are a few ongoing attempts to develop a proper method for migration of services at runtime using docker container and CRIU freeze technology but no one has been able to develop a full fledged globally acceptable solution for migration a service keeping in mind that all it’s dependencies are successfully resolved .

Challenges

- Moving container from one host to another host at run time.
- Resuming service with no or very low downtime, user of service even can’t notice.
- Its challenging to preserve all dependencies of service and restore them on another host .
- Moving and mounting back local memory repository would be great challenge.

Approach to Challenges

- Steps We Follow-
  - Executing Service Migration
    - First we have to synchronize file system of the containers.
    - We checkpoint the service and preserve its states in a file.
    - We Again synchronize the target container with source one.
    - Copy the file from source to target.
    - Resume the service back on the target host.
    - Stop and destroy the source hosts container.
  - Migrating Volume Dependencies
    - Local volume directories associated with source container are copied to target local directories.
    - Copied volume directory then mounted back to target host container.

Tools And Technology

- LXC -Linux Containers
  - Virtualization technology lighter in comparison to Virtual Machines.
  - Provides isolation to the service from host system.
- Docker
  - A command line program,manages UNIX virtualization technology container .
  - Docker contains set of remote services for installing, running, publishing, and removing software or service on containers.

Real life advantages :

- One of the most significant advantages of live migration is the fact that it facilitates proactive maintenance. If an imminent failure is suspected, the potential problem can be resolved before 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.

References

- Book - Docker in Action, By Jeff Nickoloff
- Comparative analysis of docker and virtual machine in cloud computing published in international journal of pure and applied mathematics.
- https://searchitoperations.techtarget.com/definition/container-containerization-or-container-based-virtualization
- https://criu.org/ -Checkpoint/Restore in Userspace

Thank You