

# SEG4135 - Lecture 5

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# Midterm

- We won't be writing any code
- Code may be presented and asked for analysis

## IaaS

- Obtain computing resources on-demand
  - No need for planning in advance
- No commitment for future needs
  - Your virtual infrastructure can scale up
- Pay as you go
- Maintenance costs are eliminated

## Resources

- Images
  - Create/remove
- Storage
  - Create/remove
  - Attach/Detach
- Networking
  - Create/remove
  - Establish/delete
- Virtual Devices
  - Monitor
  - Get monitoring information
- Management (events)
  - Create/remove
  - deploy/undeploy
- Management (physical)
  - Discover resources

## Communication Modes

- Unicast, point to point (s,d)
- Multicast, point to predefined set of points (s,d' is a subset of N, s is not in {d'})
- Anycast, point to anywhere (s, d' in D', D' is a subset of N, s is not d')
- Multicast, point to many (s, D'' is a subset of D', D' is a subset of N, s is not in D'')

# VM Migrations

## Non-live migration

- Take a snapshot of your workload and move that workload somewhere else
- Very basic and not hard to do
- Has the con of interruption of service

## Partial Migration

- Only part of the VM image is copied to the destination machine
- Useful when the VM will be migrated back to the source machine in the near future

## Local Area Live VM Migration

- The mode common type of VM Migration
- Maintain high availability of the running vm during the migration process, while reducing as much as possible the total transfer time.

# Storage Migration

## Snapshotting

- No atomicity
- Similar to non-live VM migration

## Dirty Block Tracking

- Keep track of the dirty blocks
- No guaranteed coverage
- If the I/O speed of the destination machine is slower than that of the source machine, dirty block tracker can lead to scenarios where the disk content is never synchronized.

## I/O Monitoring

- Traps the IO write access at the source VM, and is mirrored at the destination VM

# Network Connection Migrations

- VM may engage in multiple connections simultaneously
- Usually not an issue if both the source and destination machines are located in the same broadcast domain
- In large data center networks or wide-area networks, maintaining active network connections during live Vm migration requires support from the underlying network architecture

## Migration Benefits

### Server Consolidation

We consolidate virtual machines on a set of virtual machines. Instead of having 100 little servers running 100 little VMs, have one running all of the VMs

### Load Balancing

It becomes very easy to balance the load of VMs among physical servers so that none become overloaded.

### Improved Data and Network Locality

If we have multiple VMs that exchange traffic, we want to place them close together in the network so they can communicate easily.

### Reduced Energy Costs and Carbon Footprint

By keeping VM performance low, we keep our need for cooling lower.

### Reduced host costs

### Facilitated Maintenance Costs

If we schedule maintenance on a physical server, we can migrate the VMs off it.

# VM Migration Costs

## CPU Overhead

Can be up to 20/30 percent

## Network overhead

Network resources will be used to transfer VMs

## Solutions

CPU Thresholds

Rate Limiters

Memory Compression

## Server Downtime

~3 Seconds of downtime over 44 seconds of downgraded performance

SLA Violations in terms of 90th and 99th percentile service response time up to 300 seconds

## Security Vulnerabilities

Control plane: Malicious users can issue false migration commands that cause victim VMs to be migrated to undesired locations

Data Plane: Malicious users can eavesdrop or actively manipulate the content of the virtual machine that is being transferred.

Migration Module: The migration module must be protected to avoid users from gaining full access to the virtual machine being migrated.

# Migration Schemes

## Sandpaper

- VM Migration scheme for data center environments designed to avoid machine overloading conditions.

## Entropy

- Relied on the VM Migration to dynamically consolidate servers on the machine.
- Two phases
  - Packing problem
  - Vm replacement problem.

## Multi-Objective Approach

- Motivated by the fact that heat imbalance within a data center can lead to higher coolings costs
- VMM in data centers that aims not only to improve the performance of Vms. But also to take into account power consumption and thermal properties.

## Midterm Format

- Multiple choice questions
- Expect to see some short description questions, definitions.
  - E.g. what is VM migration
  - List the benefits of VM Migration
- "Find the problem with this code"
  - Moto tree and Modelsim
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