Rise of Virtualization

Virtualization is not new

- Mainframe virtualization in the 1960s

- Codified in 1970s by Popek and Goldberg's three properties

- Fidelity – virtual environment should be identical to physical

- Isolation or Safety – VMM must have control of system resources

- Performance – little or no difference in performance

- An efficient VMM has all three properties

Rise of Windows

- Companies began using technology to achieve competitive advantages and save money (1970s)

- Proprietary solutions were expensive and inflexible

- Windows provided commodity platforms that drove down costs and defeated platform lock-in (1980s)

- Windows limitations often forced a 'one server, one application' policy.

Moore's Law

- Processing power doubles roughly every eighteen months.

- Originally, was coined around processing power.

- Today applies to many technologies
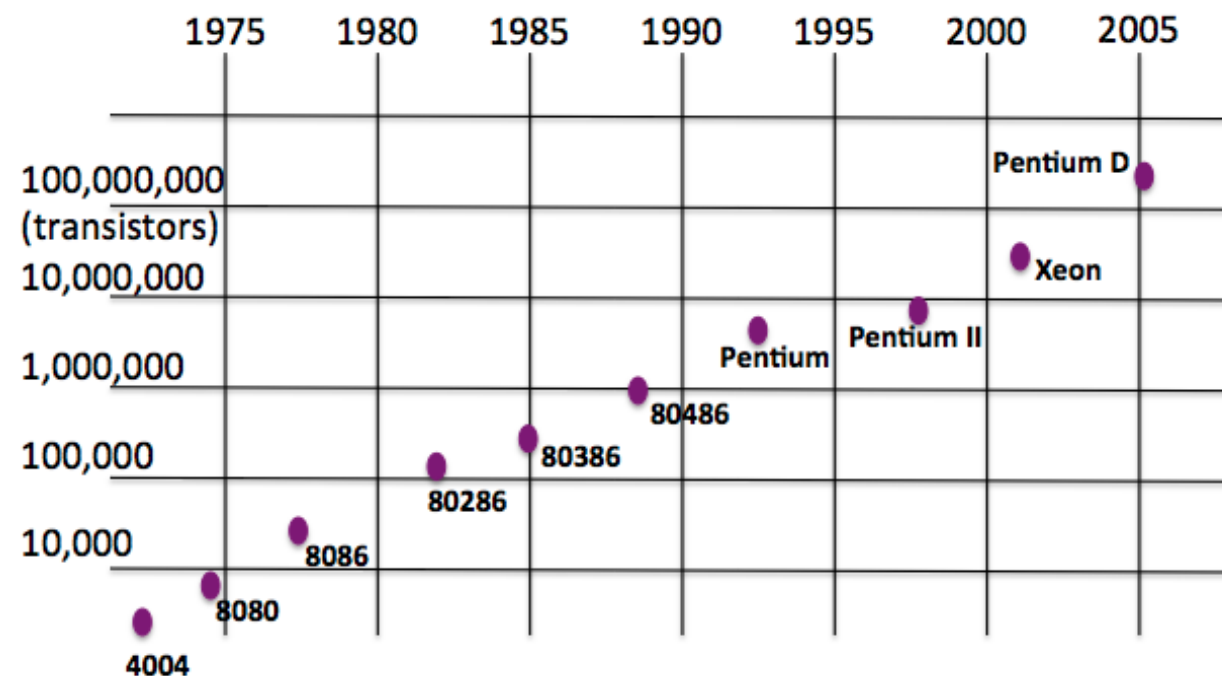
Rapid Data Center Growth

- Windows server growth drove datacenter growth

- Datacenter growth drove resource utilization

- Power, cooling, cables, square footage, staff, security

- Moore's Law made servers more powerful, but less efficient due to application deployment practices

Trends that accelerated virtualization

- Consolidation

- Running multiple workloads on a single host

- Containment

- Faster server provisioning

- Dynamic Load Balancing

- Faster development and test environment.

- OS Independence (Reduce vendor lock-in)

OS and Application Virtualization

OS Virtualization

- Virtual Workspaces — An abstraction of an execution environment

- Virtualization decouples the application and operating system from HW

  - Allows consolidation

  - Enhances utilization
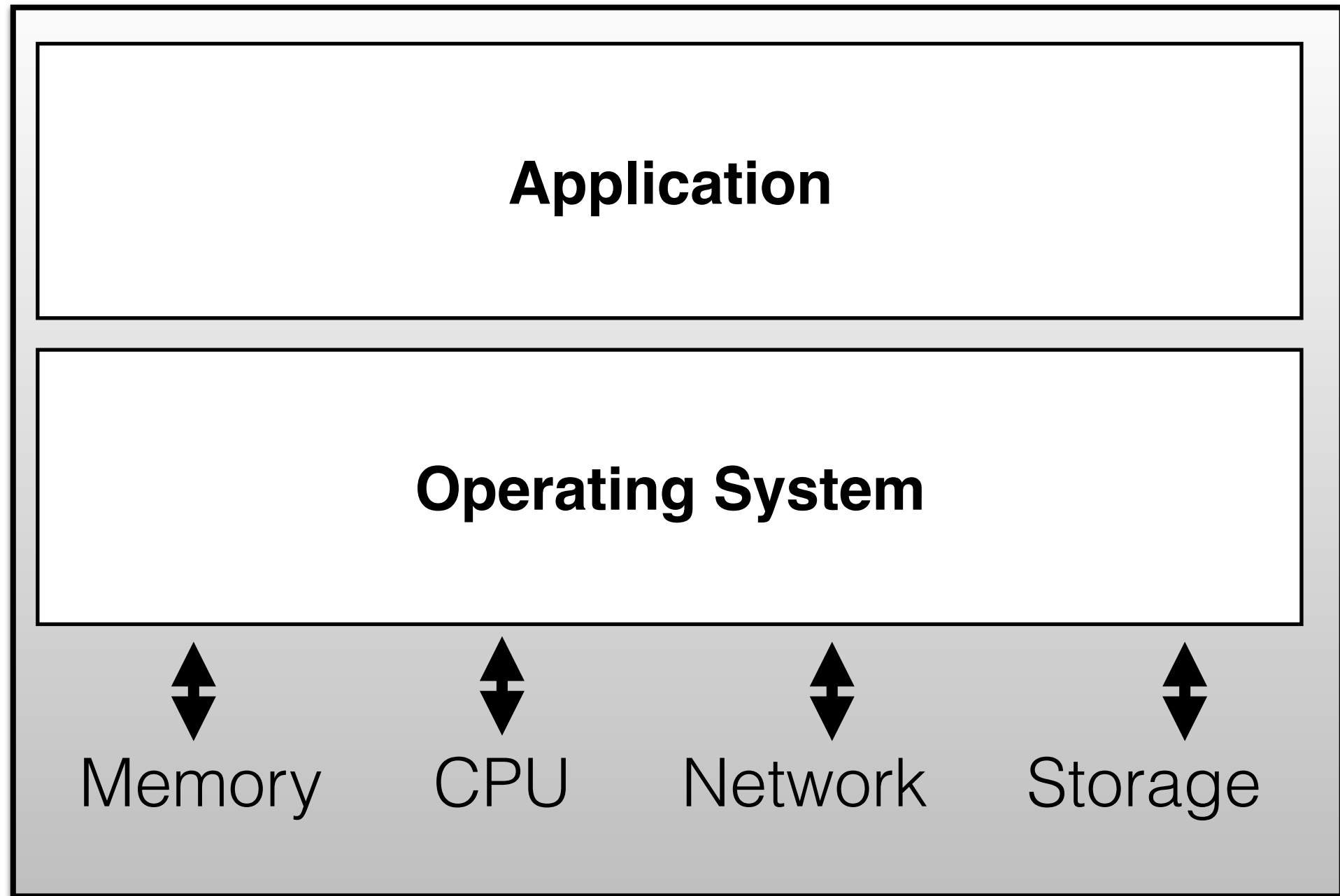
  - Replicated, moved, suspended quickly
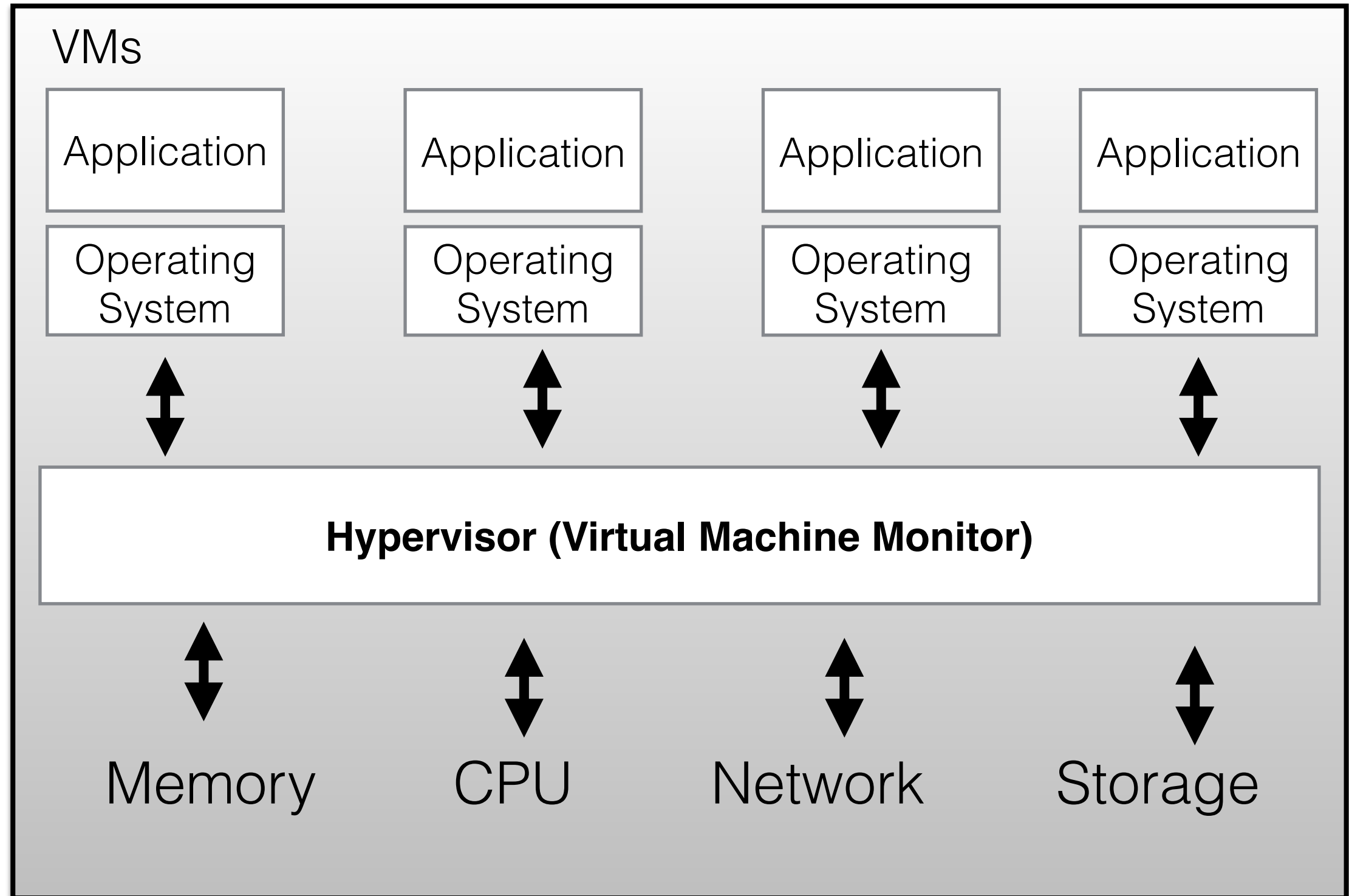
OS Virtualization

- Allows same physical host to serve different workload and isolate each workload.

- Host OS runs on the host, with VMs (workloads) running on top

- These workload can run different OS

- Process isolation is provided by Kernel Host

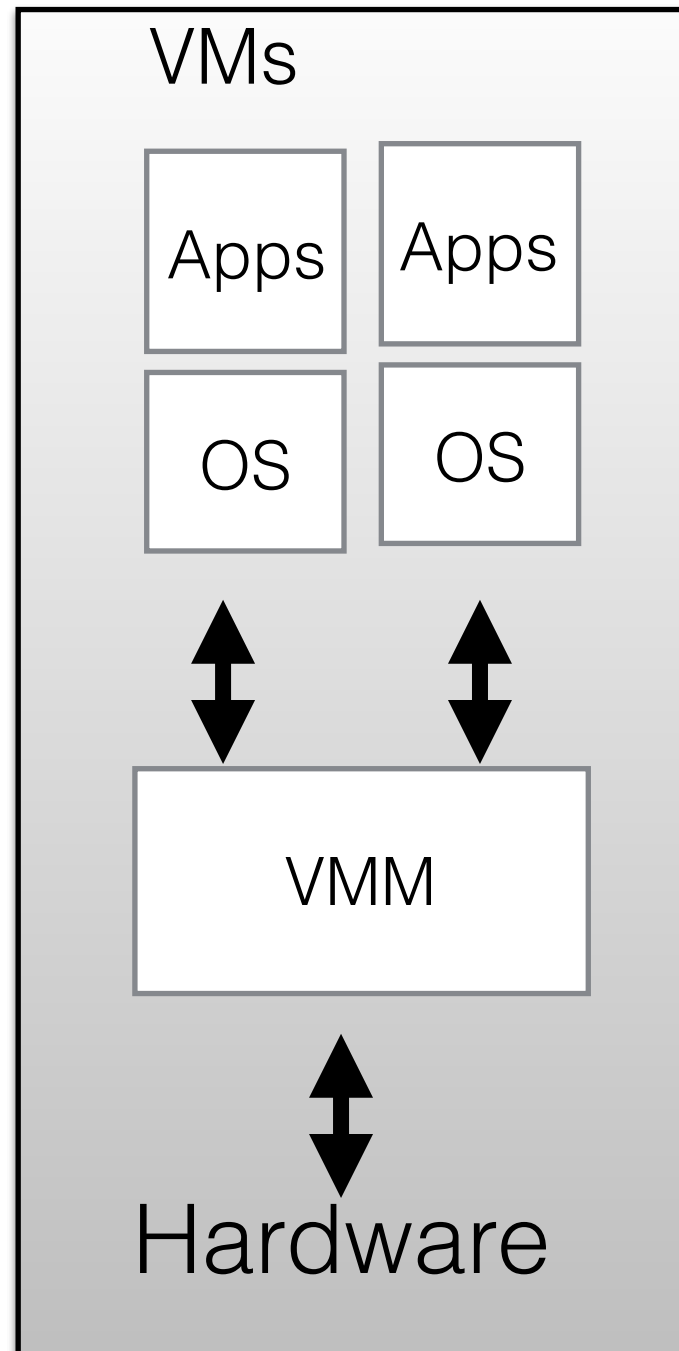- Each process have their own file system, processes memory, devices, etc.

Dedicated Server

Application

Operating System

↕ Memory   ↕ CPU   ↕ Network   ↕ Storage

Virtualized Server

VMs

| Application | Application | Application | Application |
| Operating System | Operating System | Operating System | Operating System |

Hypervisor (Virtual Machine Monitor)

Memory   CPU   Network   Storage
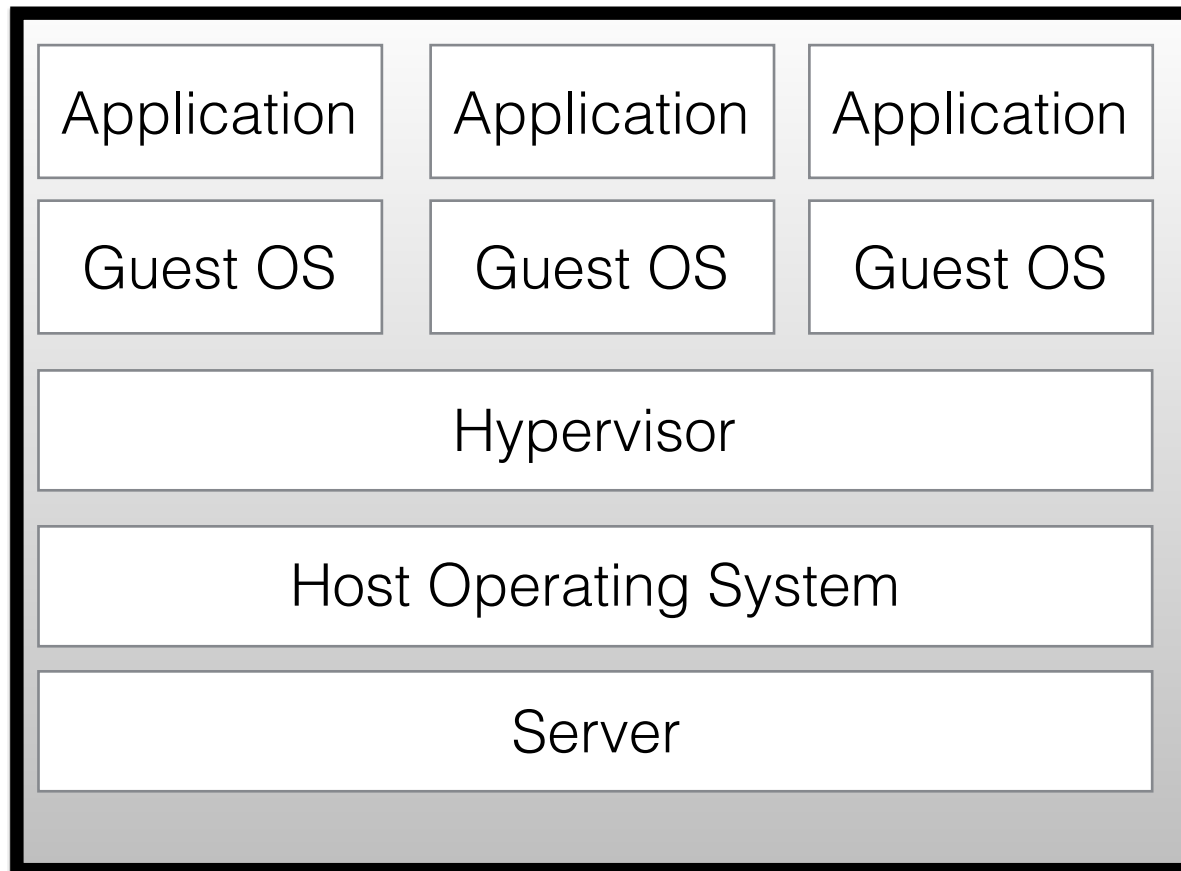
Virtualization

- Hypervisor (VMM) abstracts all hardware resources

- Guest OS runs in user mode

- VMM runs in kernel mode

- VMM responsible for controlling physical platform resources and I/O mapping

- Advantage: Run multiple OSs on the same physical platform

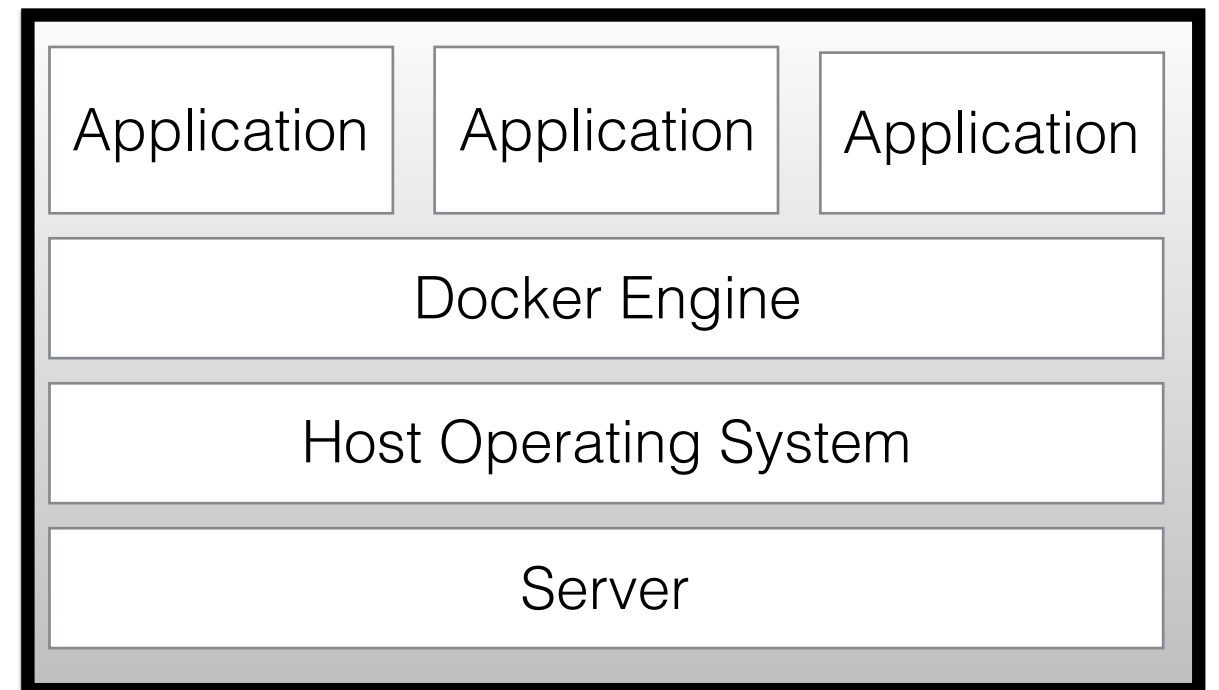- VMM allocate resources based upon the request.

Application Virtualization

Virtualized Servers

Application	Application	Application
Guest OS	Guest OS	Guest OS
Hypervisor		
Host Operating System		
Server		

Containers (Docker)

Application	Application	Application
Docker Engine		
Host Operating System		
Server		

Container

- Container abstracts OS Kernel

  - Hypervisor on abstracts the entire device.

- Container makes it easier to package and move program into different cloud environment

- Container uses shared operating system

  - VM provides more isolation with guaranteed resources