Virtualization, Cloud Computing & Containerization

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Agenda

- Virtualization Introduction & History
- Types of Virtualization
- Introduction to Cloud Computing
- Benefits of Cloud Computing
- Basics of Containerization

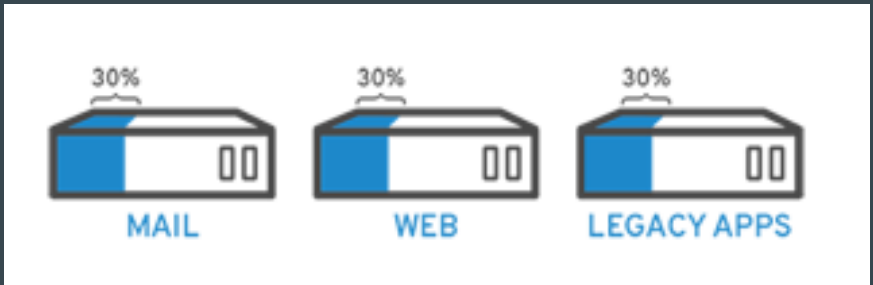
Virtualization Introduction

History of Virtualization Development

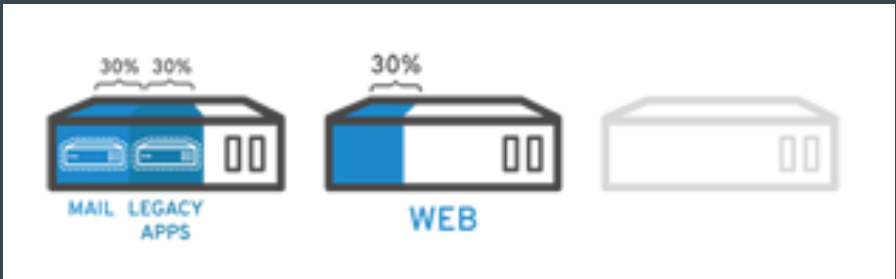
- 1965 IBM M44/44X paging system
- 1965 IBM System/360-67 virtual memory hardware
- 1967 IBM CP-40 (January) and CP-67 (April) time-sharing
- 1972 IBM VM/370 run VM under VM
- 1997 Connectix First version of Virtual PC
- 1998 VMWare U.S. Patent 6,397,242
- 1999 VMware Virtual Platform for the Intel IA-32 architecture
- 2000 IBM z/VM
- 2001 Connectix Virtual PC for Windows
- 2003 Microsoft acquired Connectix
- 2003 EMC acquired Vmware
- 2003 VERITAS acquired Ejascent
- 2005 HP Integrity Virtual Machines
- 2005 Intel VT
- 2006 AMD VT
- 2005 XEN
- 2006 VMWare Server
- 2006 Virtual PC 2006
- 2006 HP IVM Version 2.0
- 2006 Virtual Iron 3.1
- 2007 InnoTek VirtualBox
- 2007 KVM in Linux Kernel
- 2007 XEN in Linux Kernel

Virtualization

Virtualization is technology that lets you create useful IT services using resources that are traditionally bound to hardware. It allows you to use a physical machine's full capacity by distributing its capabilities among many users or environments.



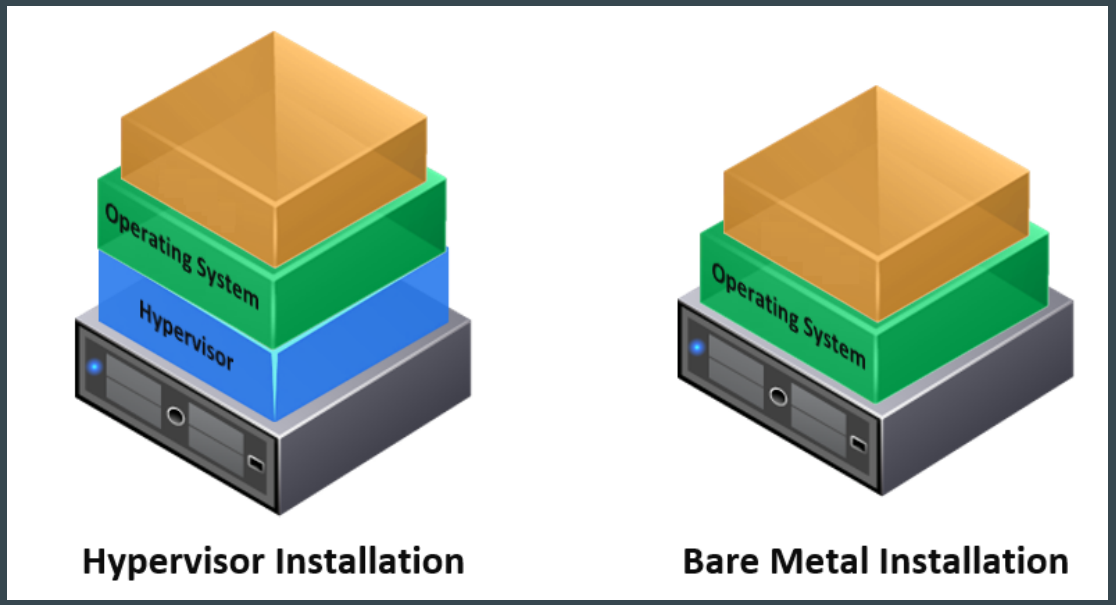
Non Virtualization / Legacy Environment



Virtualized Environment

Hypervisor

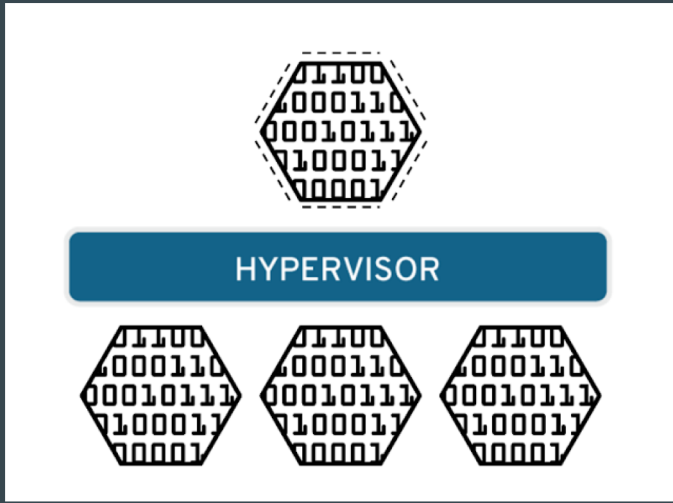
A Hypervisor or Virtual Machine Monitor(VMM) is computer software, firmware or hardware that creates and runs virtual machines. A computer on which a hypervisor runs one or more virtual machines is called a host machine, and each virtual machine is called *"guest"*



Type of Virtualization

Data/Storage virtualization

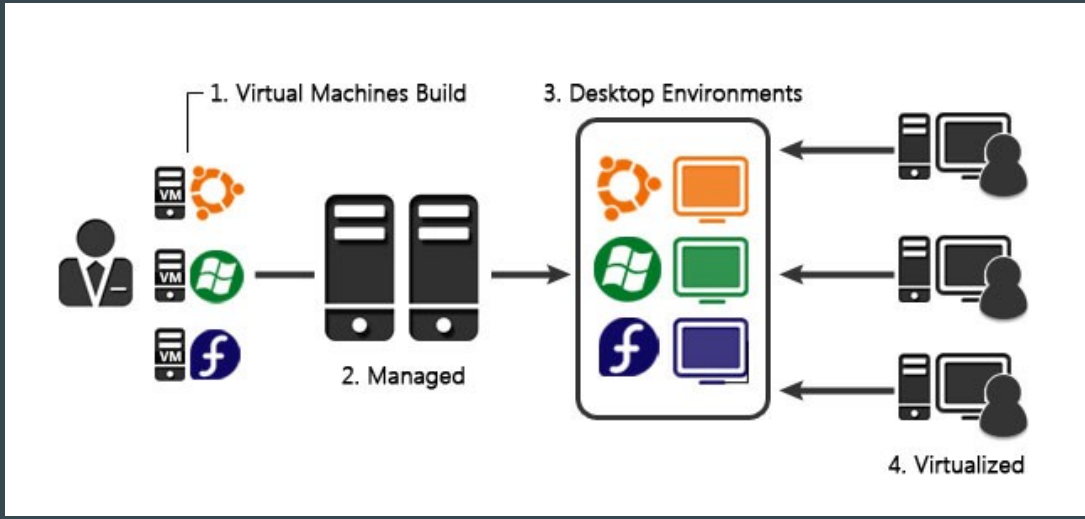
Data that’s spread all over can be consolidated into a single source. Data virtualization allows companies to treat data as a dynamic supply



Type of Virtualization

Desktop virtualization

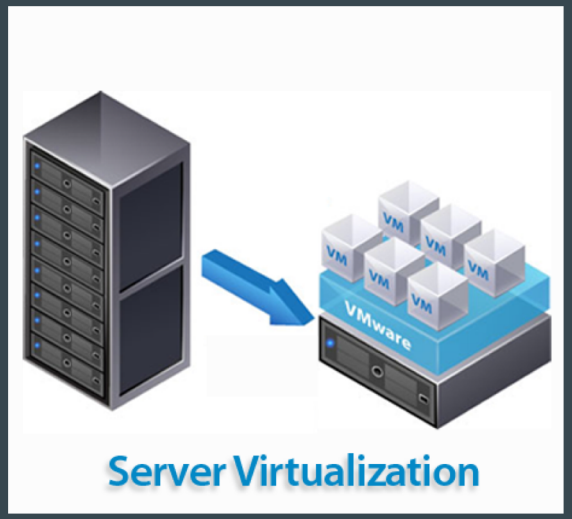
Desktop virtualization allows a central administrator (or automated administration tool) to deploy simulated desktop environments to hundreds of physical machines at once



Type of Virtualization

Server virtualization

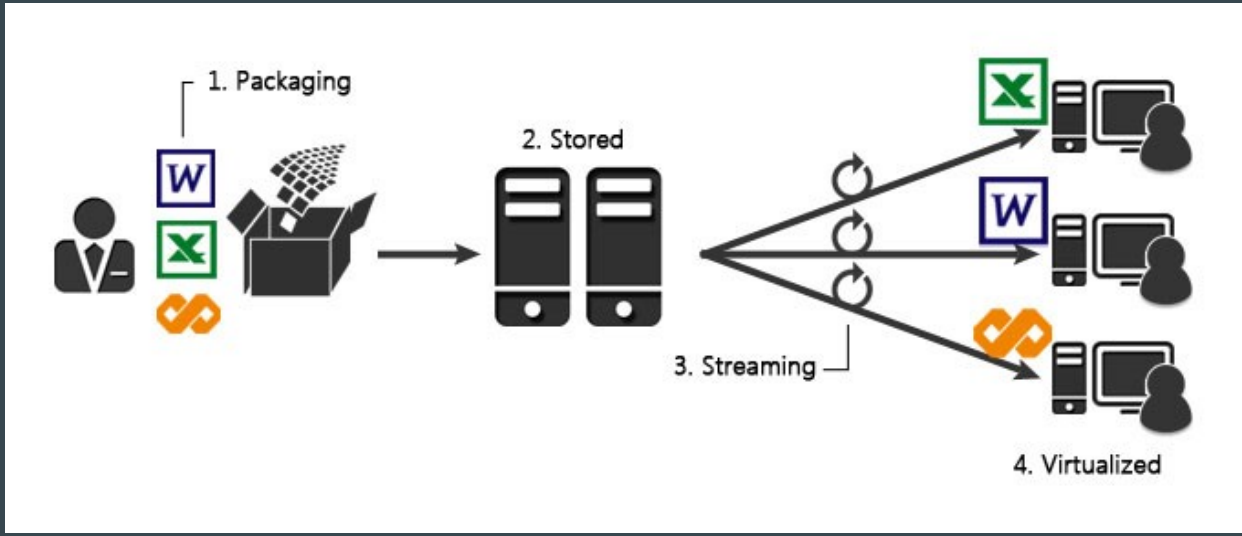
Virtualizing a server lets it to do more of those specific functions and involves partitioning it so that the components can be used to serve multiple functions



Type of Virtualization

Operating system Or Application virtualization

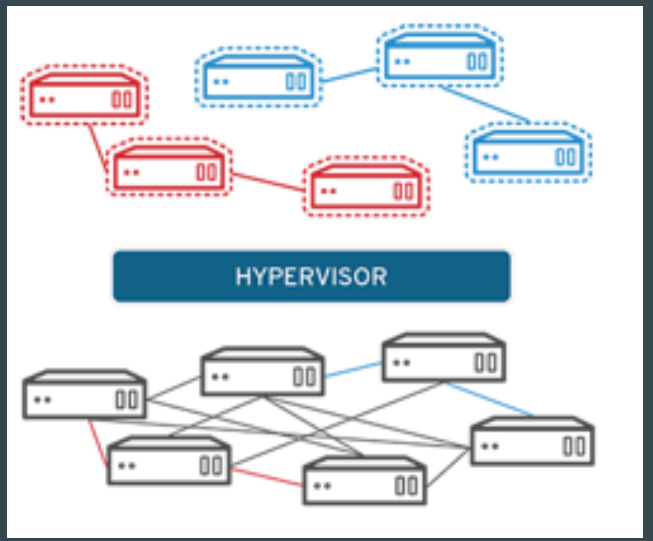
Operating system virtualization happens at the kernel—the central task managers of operating systems. It's a useful way to run Linux and Windows environments side-by-side



Type of Virtualization

Network functions virtualization

Network functions virtualization (NFV) separates a network's key functions (like directory services, file sharing, and IP configuration) so they can be distributed among environments



Virtualization vs Emulation

- Virtualization

  The concept of dividing available resources into smaller, independent units

- Emulation

  Using software to simulate hardware you do not have

- Complementary concepts

  Virtualize a Server, making it appear as multiple smaller virtual machines

  Use Emulation to simulate individual hard drives, network card, displays, on each virtual machine

Benefits

- Consolidation

  Most systems are under-utilized, especially the CPU is idle for much of the time Do more work with less hardware
  Reduced space and power requirements

- Management

  Less hardware inventory to manage

  Concentrate your resilience efforts

  Increased isolation between services

  Abstract away (hide) differences in hardware

Benefits

- Flexibility
  - Grow systems on demand (e.g. allocate more CPU or RAM where it is needed)
  - Create new services quickly without having to install new hardware every time
  - Dynamically create and destroy instances for testing and development
- New Capabilities
  - Snapshot/restore, cloning, migration
  - Run different OSes on the same machine at once

Emulation

- In software, you can simulate the behavior of a device which doesn't exist

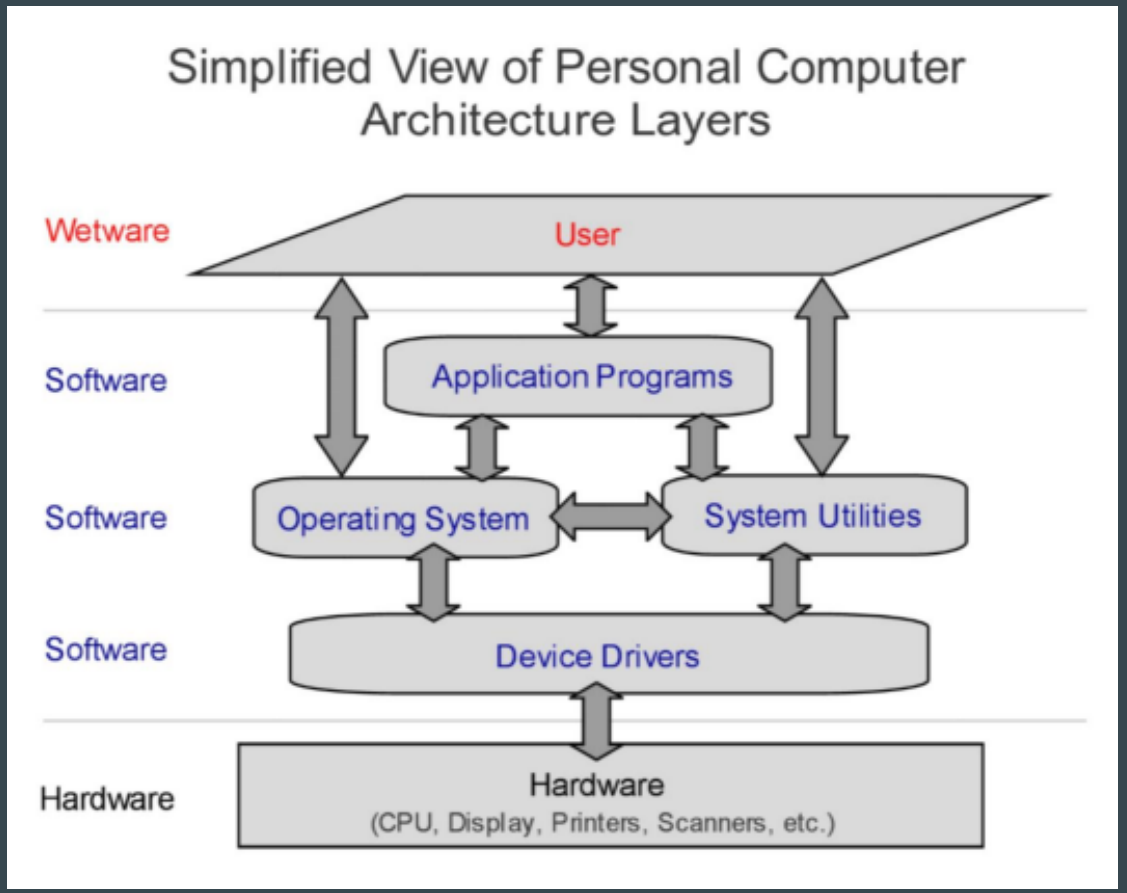
  Example: emulation of a CD-ROM drive using an ISO file

  A request to read block N of the (virtual) CD-ROM drive instead reads block N of the ISO file

  Similar to partition mapping

- You can simulate any hardware - including the CPU or an entire system!

Computer Arch Overview



What we need

- To emulate a PC we must emulate all the components of the PC

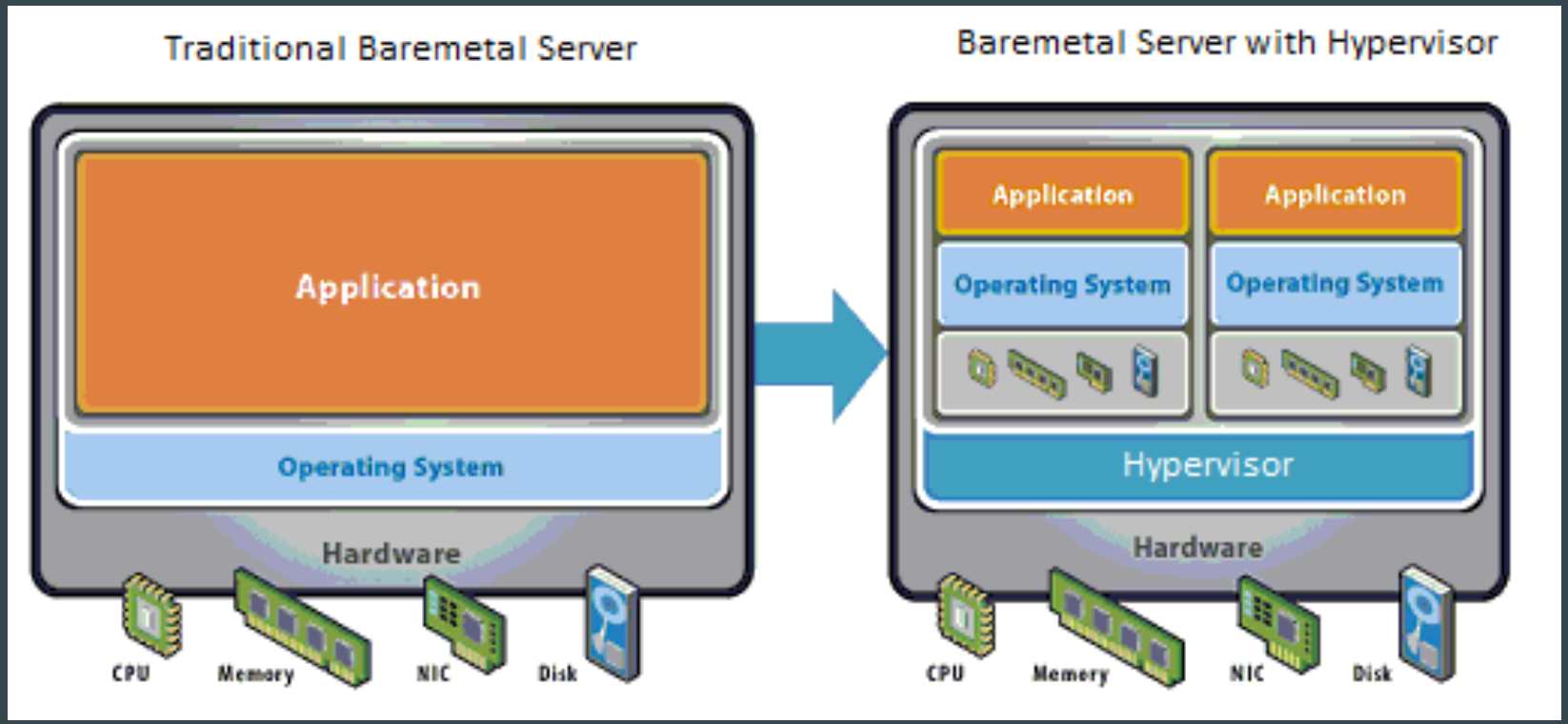
✓Hard disk interface, network card

✓Graphics card, keyboard, mouse

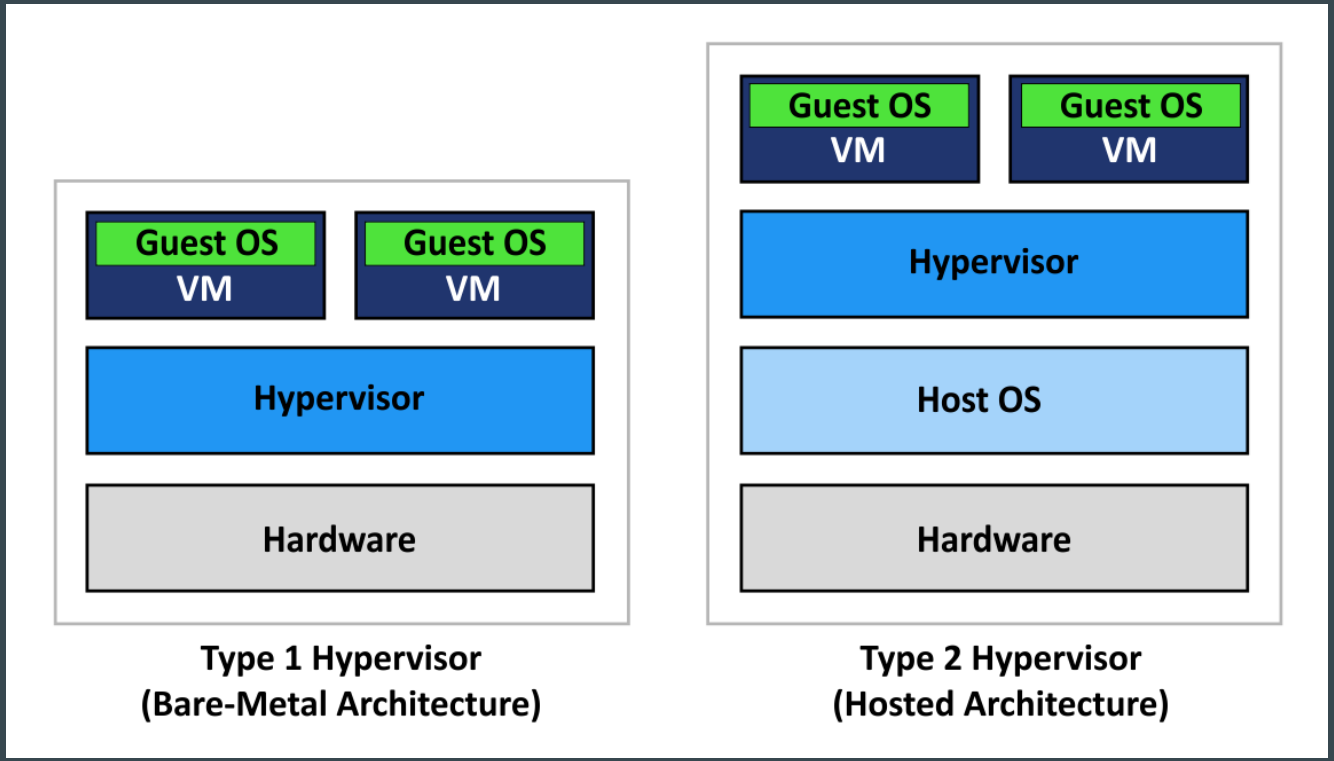
✓Clock, memory management unit etc.

- We want multiple instances to co-exist and not be able to interfere with each other – access to memory must also be controlled
- The software to do this is called a hypervisor

Virtualization



Types of Hypervisors



EXAMPLE:
VMware ESX and ESXi
Microsoft Hyper-V
Citrix XenServer

EXAMPLE:
VMware Workstation/Fusion/Player
Oracle VM VirtualBox
KVM

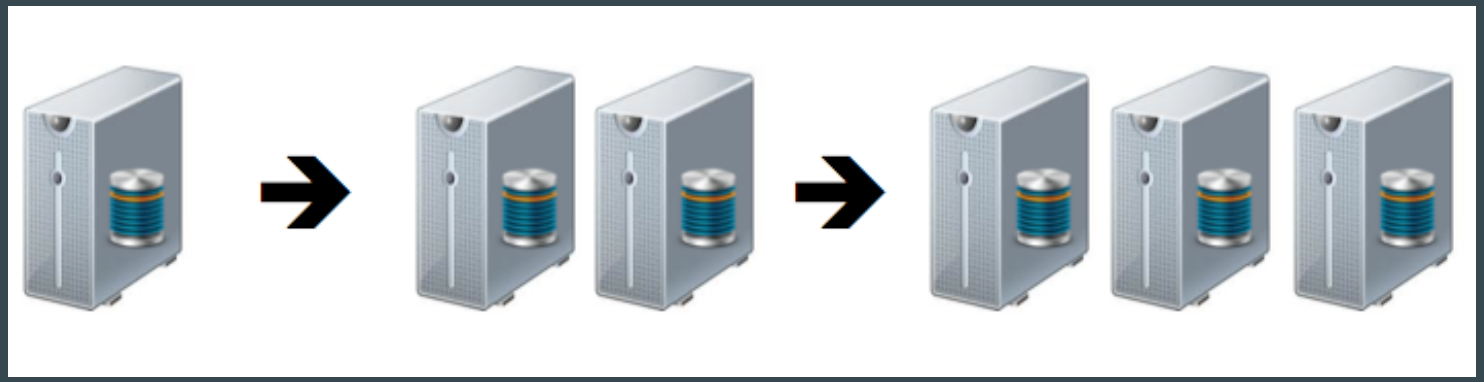
Virtual Machine Creation Demo

Scale-up or Vertical Scaling

Scale-up is done by adding more resources to an existing system to reach a desired state of performance. For example, a database or web server needs additional resources to continue performance at a certain level to meet SLAs. More compute, memory, storage, or network can be added to that system to keep the performance at desired levels.

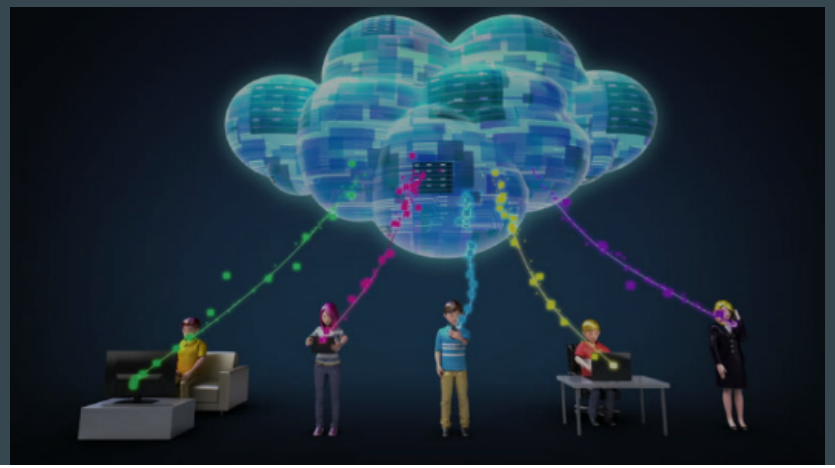
Scale-out or Horizontal Scaling

Scale-out is usually associated with distributed architectures. There are two basic forms of scaling out: Adding additional infrastructure capacity in pre-packaged blocks of infrastructure or nodes (i.e. hyper-converged) or use a distributed service that can retrieve customer information but be independent of applications or services.



Cloud Computing

Cloud Computing is a set of principles and approaches to deliver compute, network, and storage infrastructure resources, services, platforms, and applications to users on-demand across any network. These infrastructure resources, services, and applications are sourced from clouds, which are pools of virtual resources orchestrated by management and automation software so they can be accessed by users on-demand through self-service portals supported by automatic scaling and dynamic resource allocation.



Virtualization vs Cloud

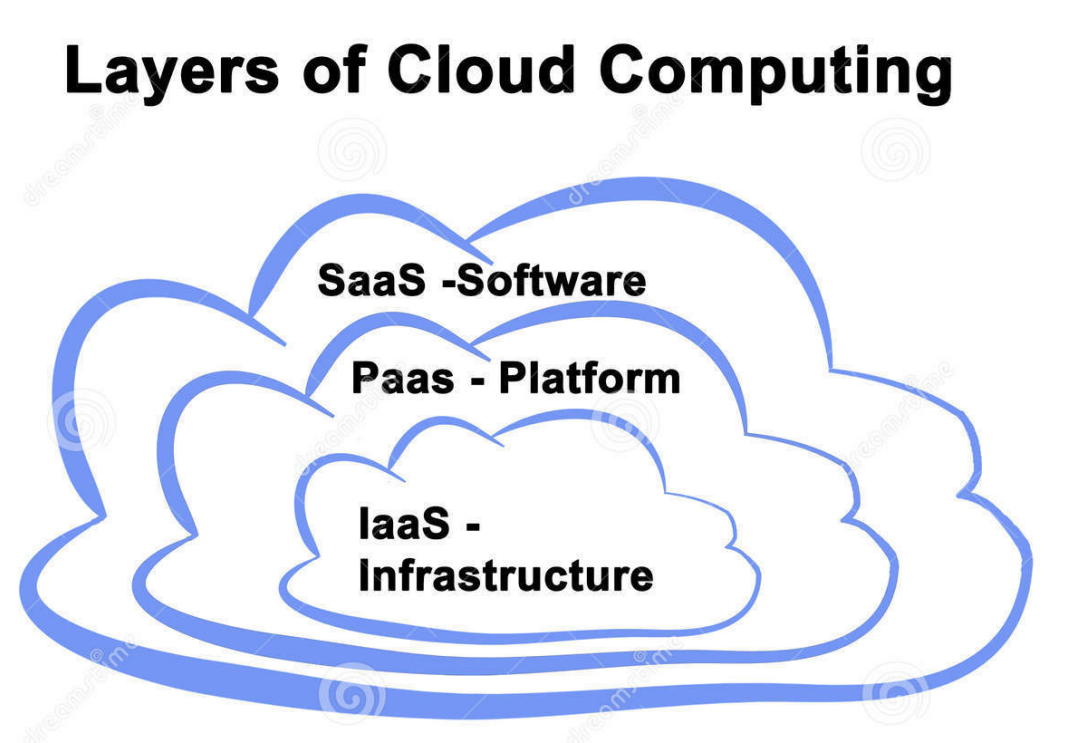
	Virtualization	Cloud
Definition	Technology	Methodology
Purpose	Create multiple simulated environments from 1 physical hardware system	Pool and automate virtual resources for on-demand use
Use	Deliver packaged resources to specific users for a specific purpose	Deliver variable resources to groups of users for a variety of purposes
Configuration	Image-based	Template-based

Virtualization vs Cloud

	Virtualization	Cloud
Cost	High capital expenditures (CAPEX), low operating expenses (OPEX)	Private cloud: High CAPEX, low OPEX Public cloud: Low CAPEX, high OPEX
Scalability	Scale up	Scale out
Workload	Stateful	Stateless
Tenancy	Single tenant	Multiple tenants

Cloud services

- Infrastructure-as-a-Service (IaaS)
- Platform-as-a-Service (PaaS)
- Software-as-a-Service (SaaS)



Infrastructure-as-a-Service (IaaS)

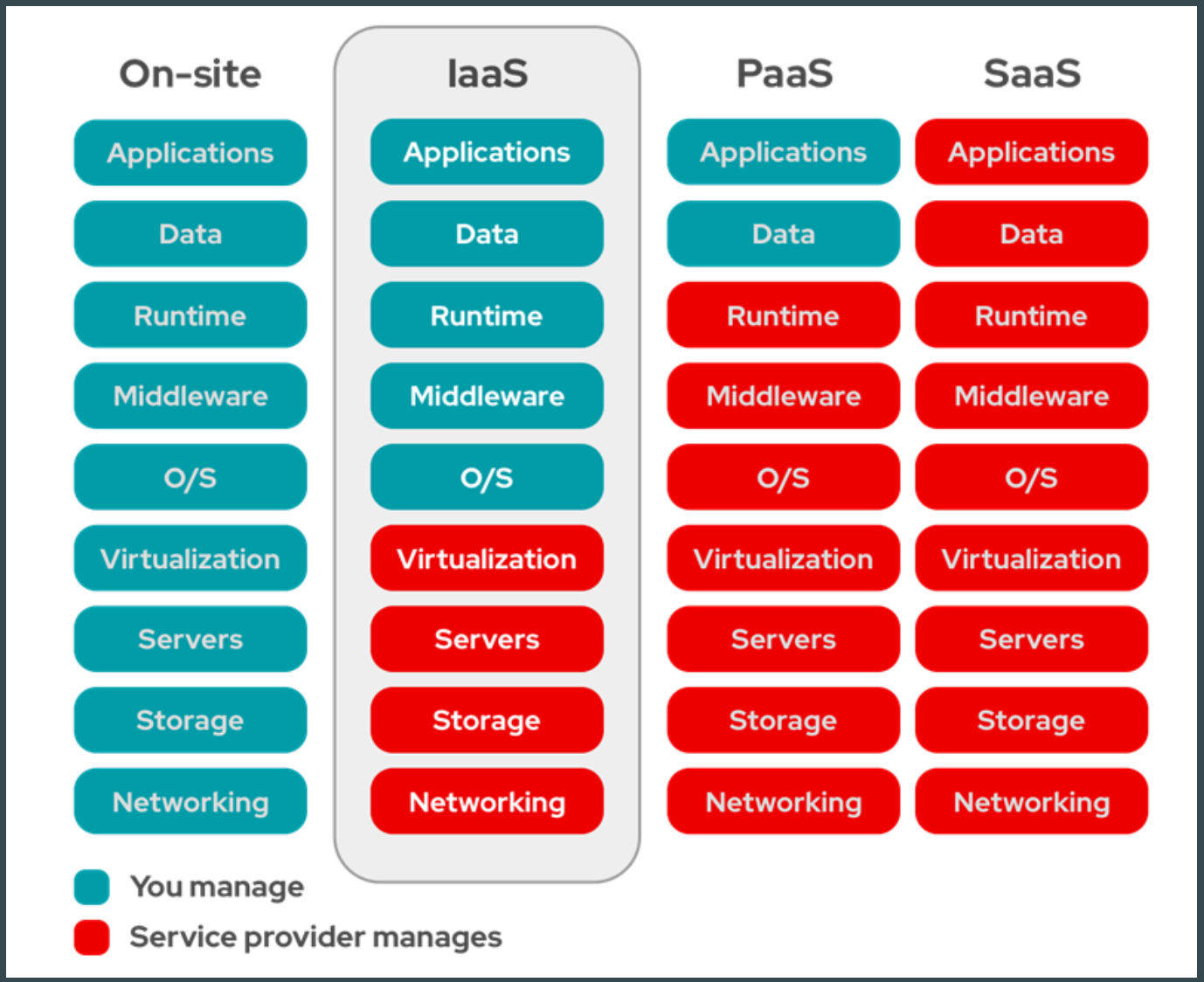
Infrastructure-as-a-service (IaaS), also known as cloud infrastructure services, is a form of cloud computing in which infrastructure services are provided to the user via a cloud, through the internet. The user handles any applications, data, operating system(s) and middleware.

Platform-as-a-Service (PaaS)

Platform-as-a-service (PaaS) is a form of cloud computing where hardware and an application software platform is provided by another party. Primarily for developers and programmers, a PaaS allows the user to develop, run, and manage their own apps without having to build and maintain the infrastructure or platform usually associated with the process.

Software-as-a-Service (SaaS)

Software-as-a-service (SaaS) is a form of cloud computing that delivers an application—and all its underlying IT infrastructure and platforms—to users. It can be an ideal solution for businesses or individuals.


On-site
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
IaaS
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
PaaS
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
SaaS
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
You manage
Service provider manages

Cloud Types

- Public Cloud
- Private Cloud
- Hybrid Cloud

1. Public clouds

Public clouds are cloud environments typically created from IT infrastructure not owned by the end user. Traditional public clouds always ran off-premises, but today's public cloud providers have started offering cloud services on clients' on-premise data centers

2. Private clouds

Private clouds are loosely defined as cloud environments solely dedicated to a single end user, where the environment usually runs behind that user's firewall. All clouds become private clouds when the underlying IT infrastructure is dedicated to a single customer with completely isolated access.

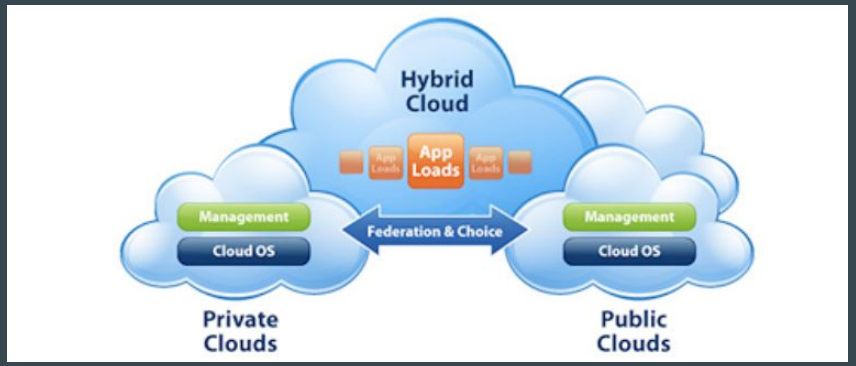
- Managed private clouds
- Dedicated clouds

2. Private clouds

Managed private clouds	Dedicated clouds
Customers create and use a private cloud that's deployed, configured, and managed by a third-party vendor. Managed private clouds are a cloud delivery option that helps enterprises with understaffed or under skilled IT teams provide better private cloud services and infrastructure.	A cloud within another cloud. You can have a dedicated cloud on a public cloud (e.g. Red Hat OpenShift® Dedicated) or on a private cloud. For example, an accounting department could have its own dedicated cloud within the organization's private cloud.

3. Hybrid clouds

A hybrid cloud is a seemingly single IT environment created from multiple other environments. The characteristics of hybrid clouds are complex and the requirements can differ, depending on whom you ask. For example, a hybrid cloud may need to include:



- At least 1 private cloud and at least 1 public cloud
- 2 or more private clouds
- 2 or more public clouds
- A bare-metal or virtual environment connected to at least 1 public cloud or private cloud

Which cloud should I use?

That depends on what you're doing.

- Workloads with high volume or fluctuating demands might be better suited for a public cloud.
- Workloads with predictable use patterns might be better off in a private cloud.
- Hybrid clouds are the catch-all, because any workload can be hosted anywhere.

Which cloud is safest?

That's a loaded question.

- Public cloud operates in a shared responsibility model. Public clouds often split security responsibilities. For instance, infrastructural security can be the provider’s responsibility while workload security can be the tenant's responsibility.
- Private clouds are thought to be more secure because workloads usually run behind the user's firewall, but that all depends on how strong your own security is.
- Hybrid cloud security is made up of the best features of every environment, where users and admins can minimize data exposure by moving workloads and data across environments based on compliance, audit, policy, or security requirements.

Introduction of Containerization

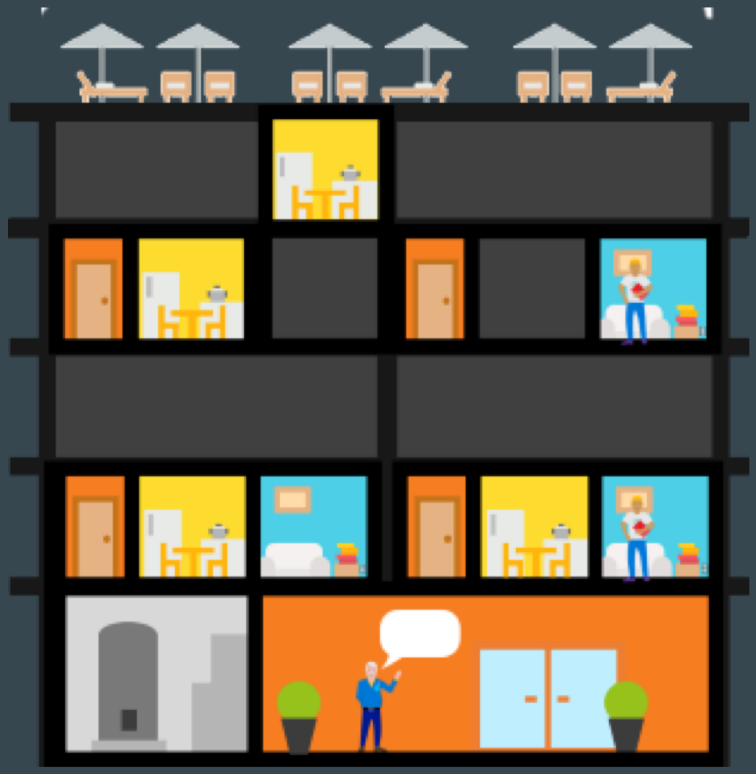
Containerization has become a major trend in software development as an alternative or companion to virtualization. It involves encapsulating or packaging up software code and all its dependencies so that it can run uniformly and consistently on any infrastructure.

Containers

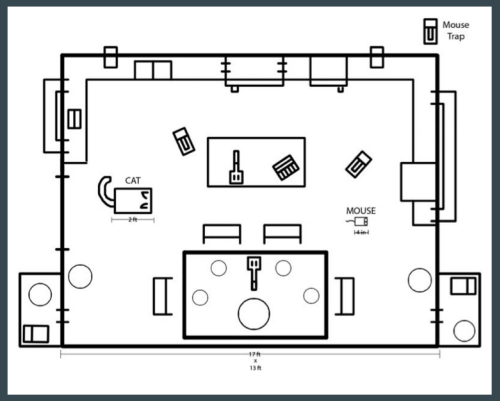
A way to wrap up the application as an isolated box.

Imagine a kitchen with some appliances and furniture. We can drop it anywhere in the building and start cooking because it has everything thing it needs.

Ref: Windows Containers

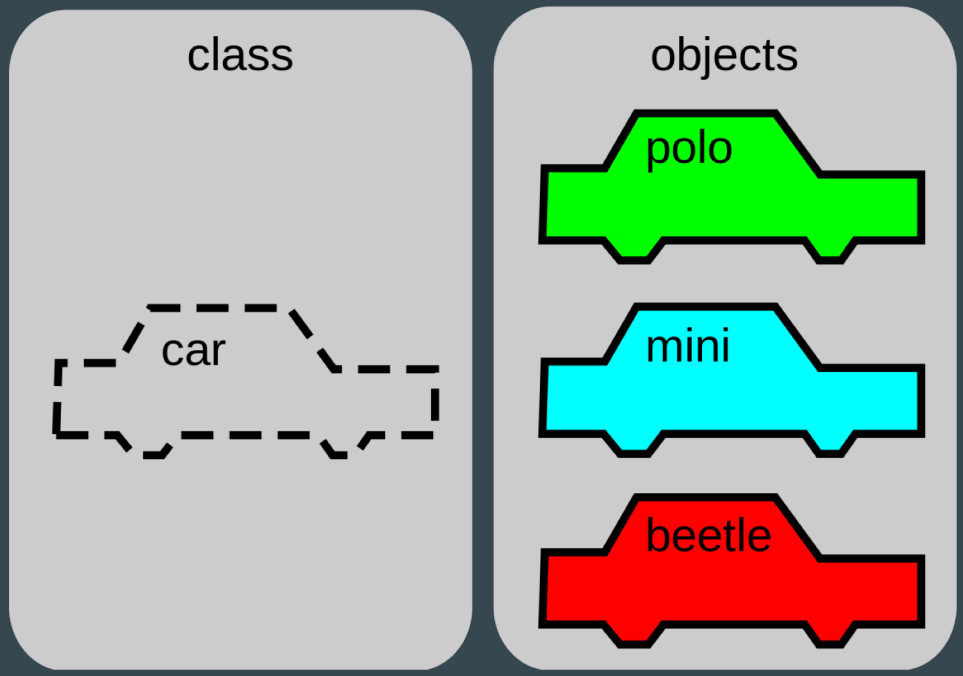


Revisiting Kitchen



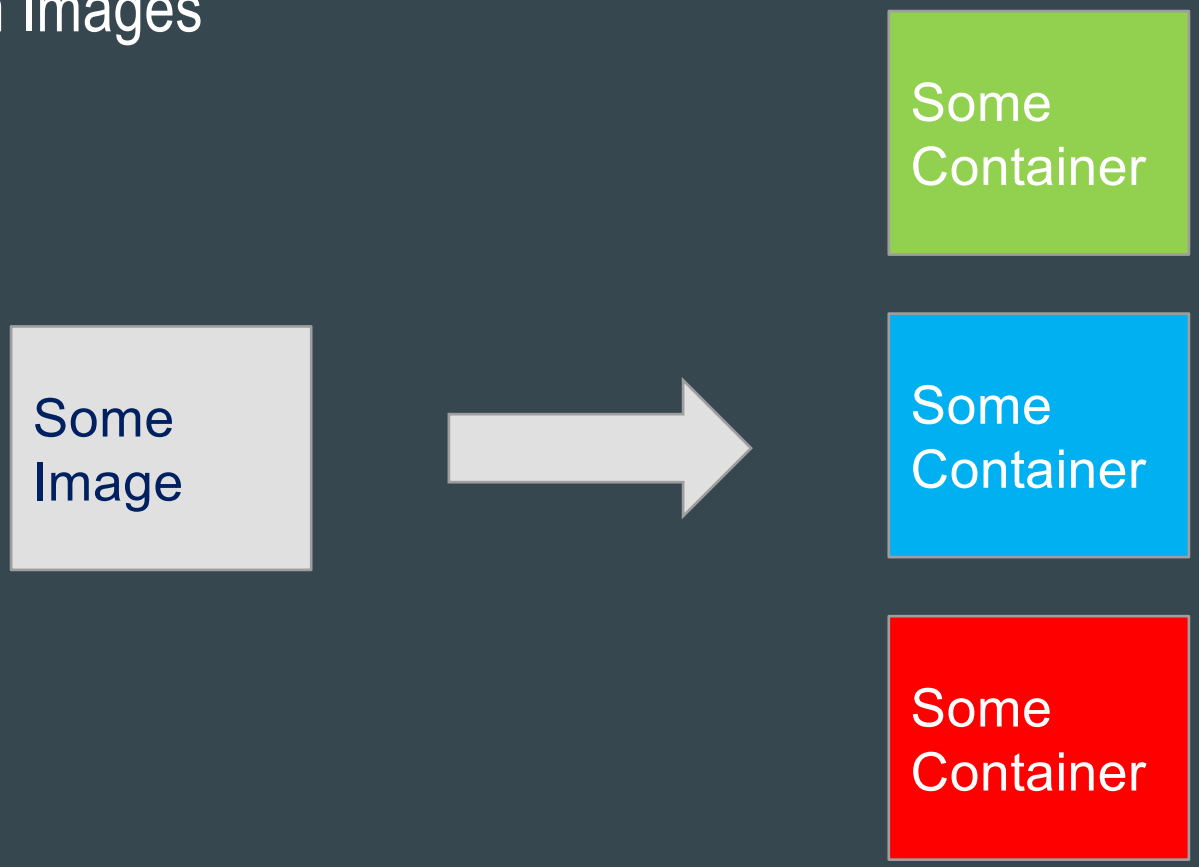
You can make *n* number of Kitchens from the same map. They will all look and behave the same way.

Revisiting OOP



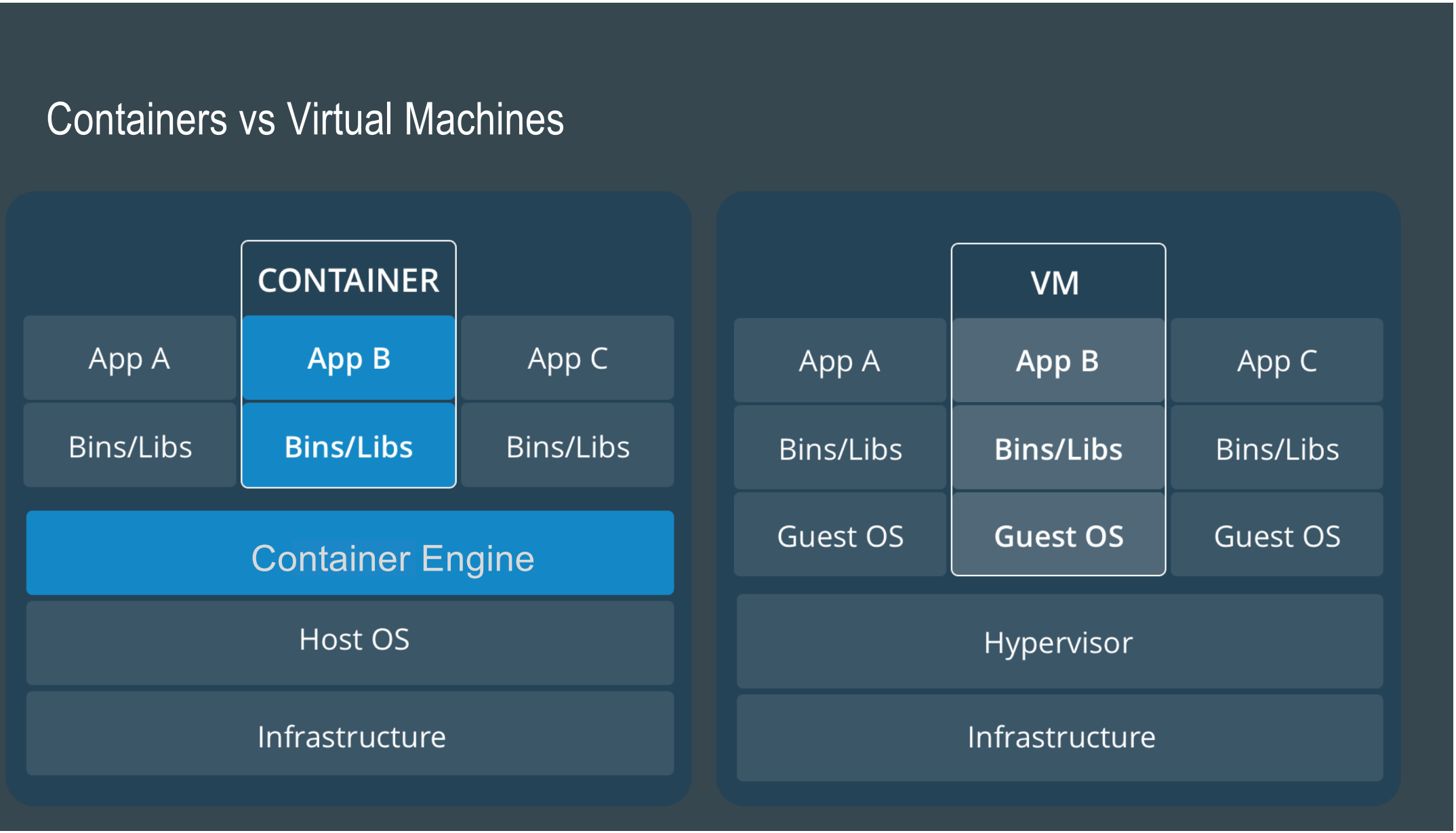
You can make *n* number of Cars from the same class.

Containers from Images



You can make *n* containers from the same image.

Containers vs Virtual Machines



Comparison VM vs Containers

- Heavyweight
- Limited performance
- Each VM run in its own OS
- Hardware level virtualization
- Startup time in minutes
- Allocated required memory
- Fully isolated and hence more secure

- Lightweight
- Native performance
- All container share the same OS
- OS virtualization
- Startup time in milliseconds
- Required less memory space
- Process level isolation, possibly less secure.

Recap

- Virtualization : . It allows you to use a physical machine’s full capacity
- Virtualization types
- Hypervisor : Type 1 and Type 2
- Cloud Architecture : IAAS, SAAS & PAAS
- Types of Cloud
- Benefits of cloud
- Basics of Containerization

Any Questions?