Virtualization

Aula Teórica nº7

2020/2021

Definition

Virtualization is the technology used to run multiple operating systems (OSs) or applications on top of a single physical infrastructure by providing each of them an abstract view of the network

History

- **1964** IBM CP-40
- **1972** IBM VM/370
- **1988** SoftPC (x86 emulator)
- **1997** VirtualPC for Mac
- **1999** VMWare Workstation
- **2003** Xen
- **2005** Intel VT-x, AMD-V
- **2007** VirtualBox, KVM
- **2008** Microsoft Hyper-V
- **2014** Linux Containers

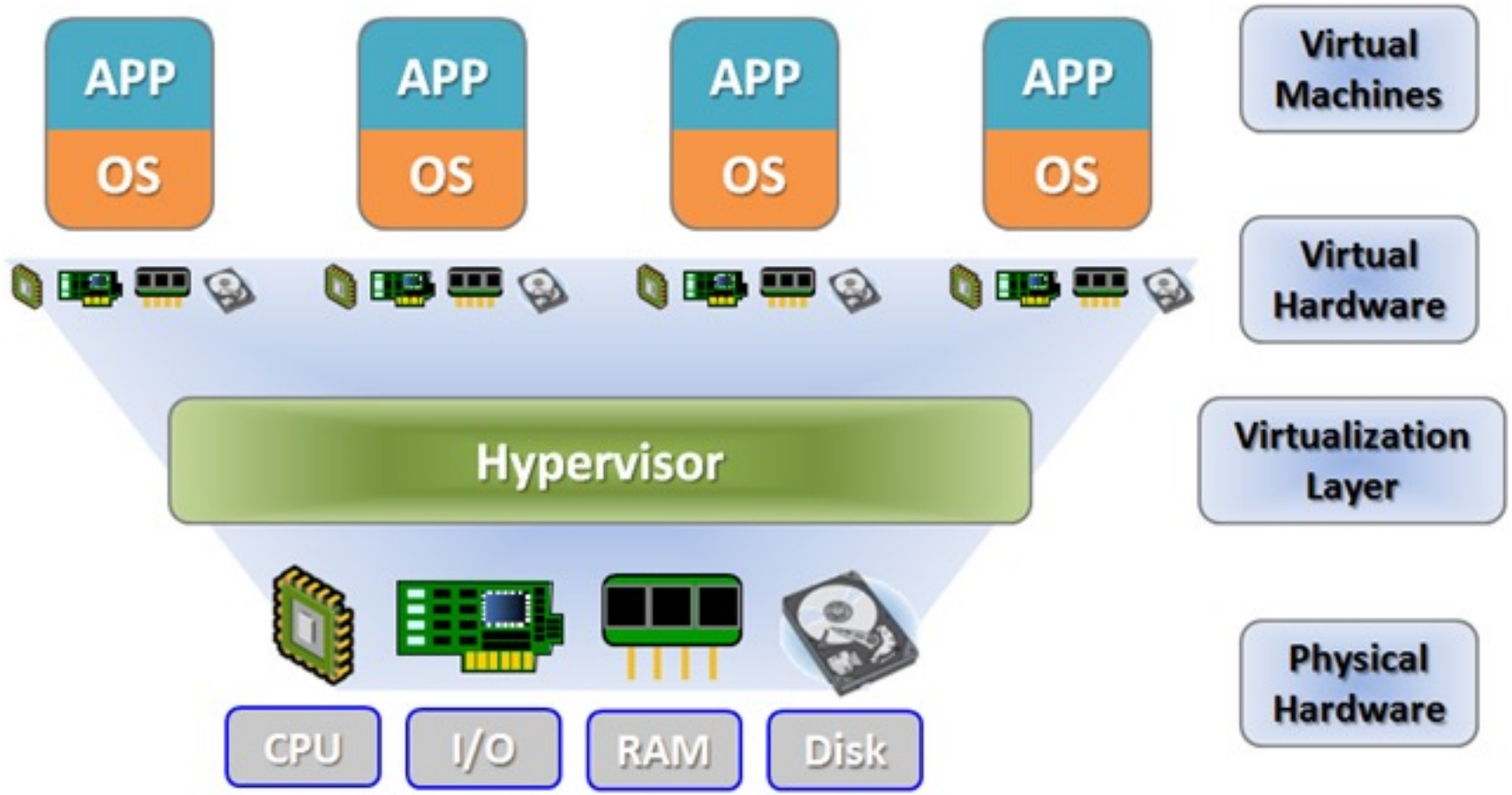
Virtualization Benefits

- Improve server utilization
- Flexible growth
- Reduced space requirement
- Quick provisioning
- Lower operational overhead and cost
- Higher availability

Areas of Virtualization

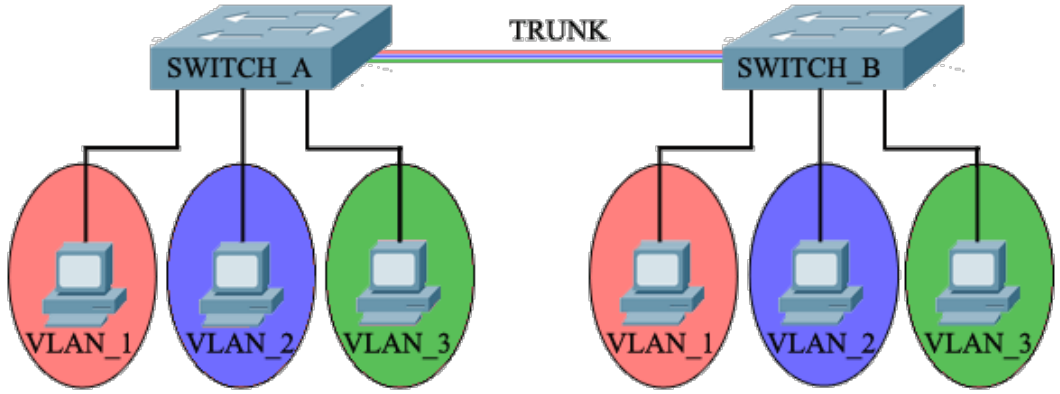
- Server virtualization
- Network virtualization
- Network functions virtualization

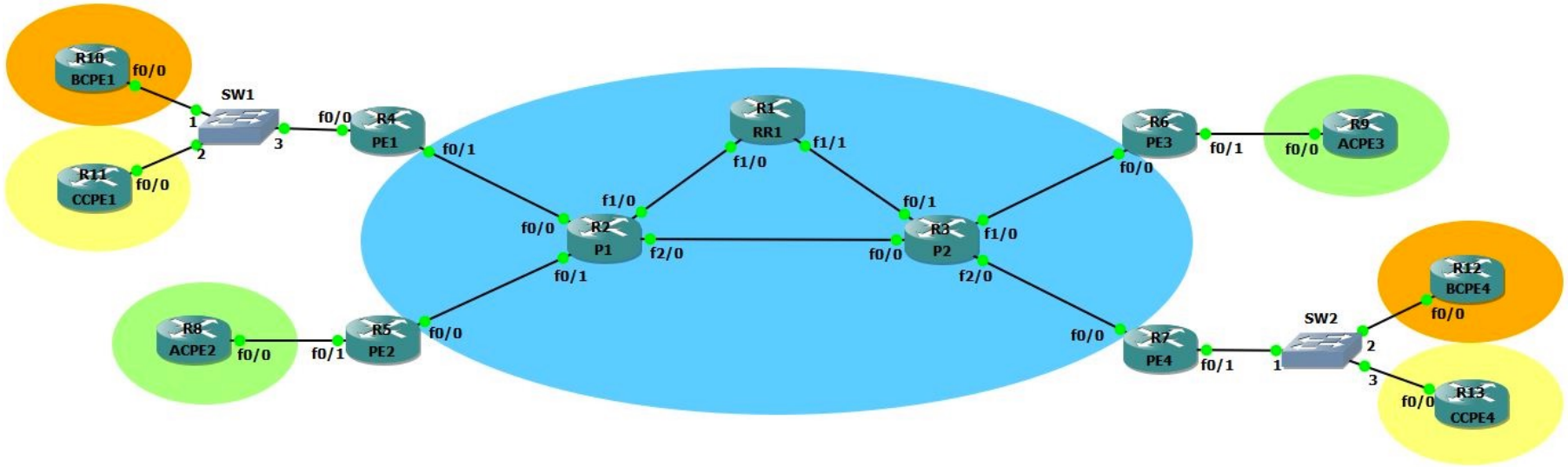
Server Virtualization



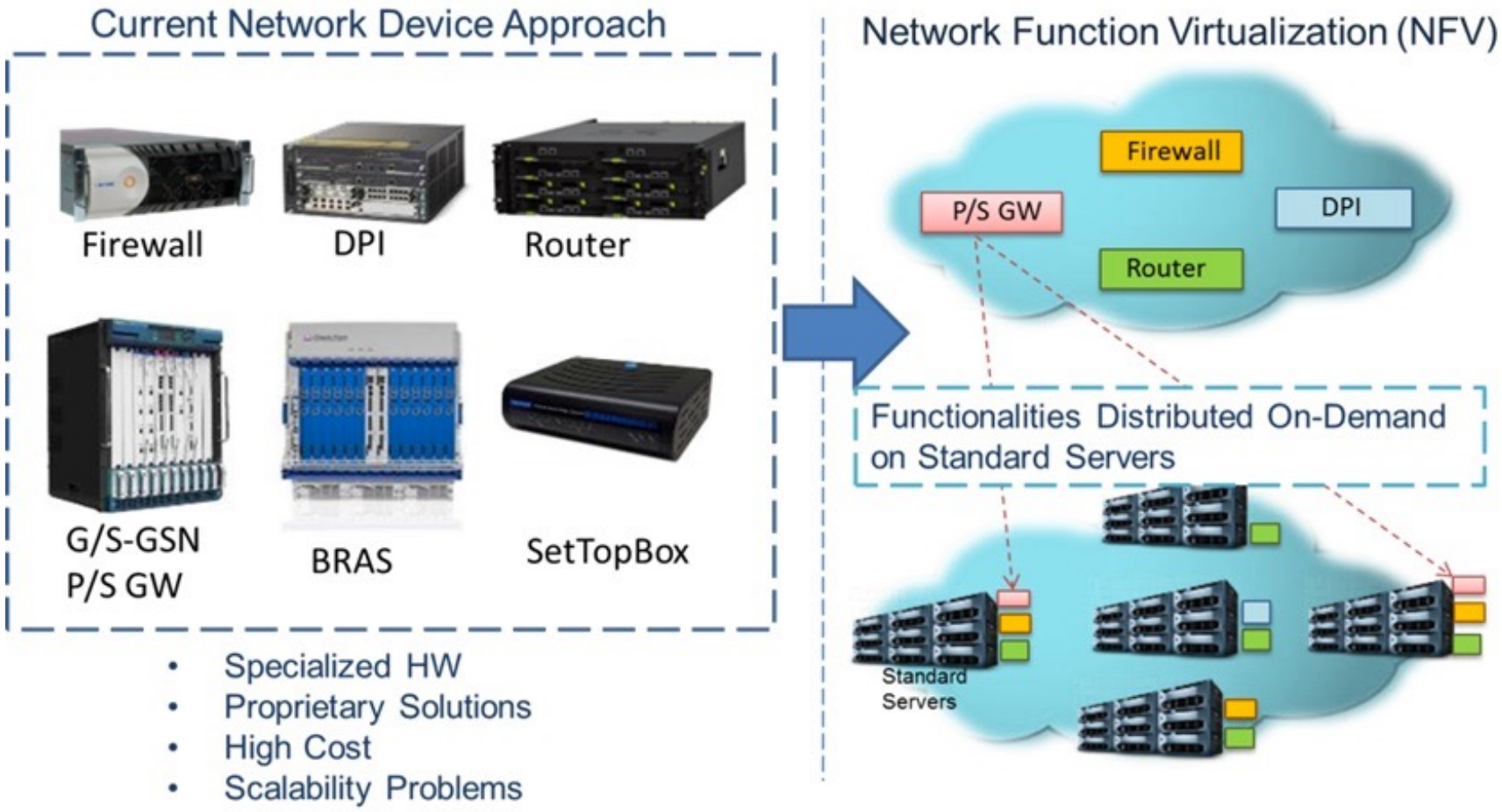
Network Virtualization

- VLANs
- L3VPNs/L2VPNs
- VXLANs



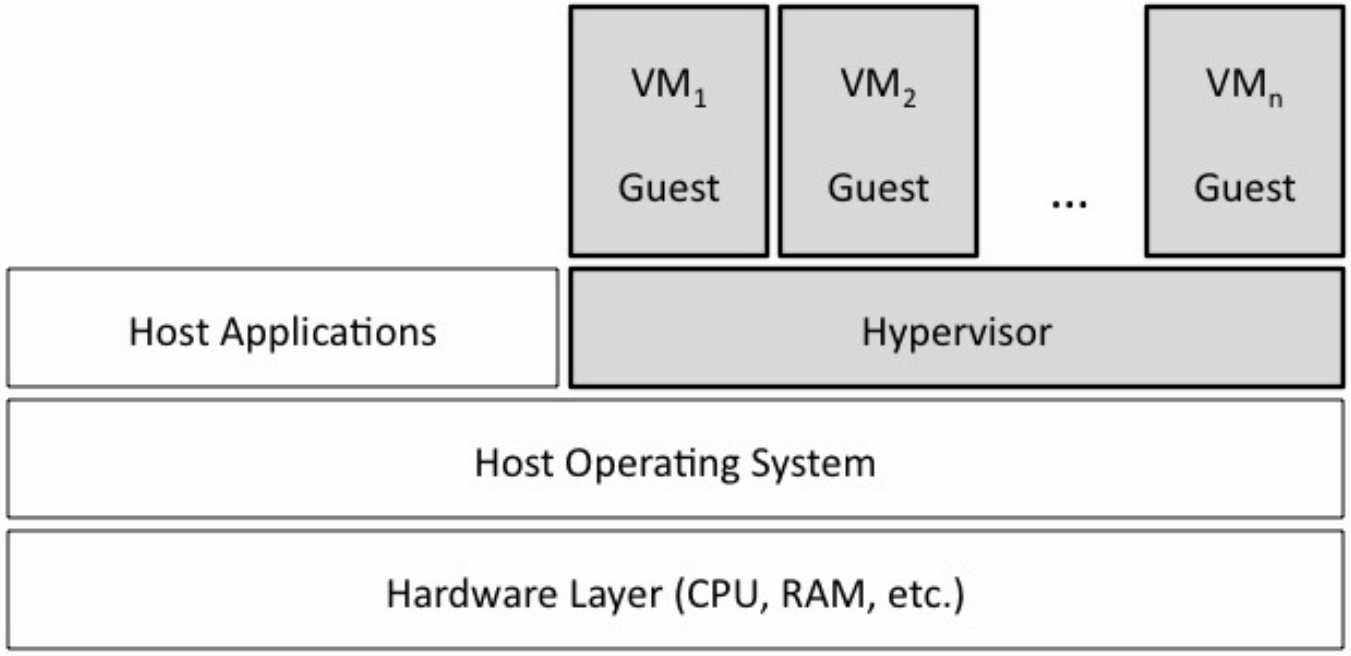


Network Functions Virtualization



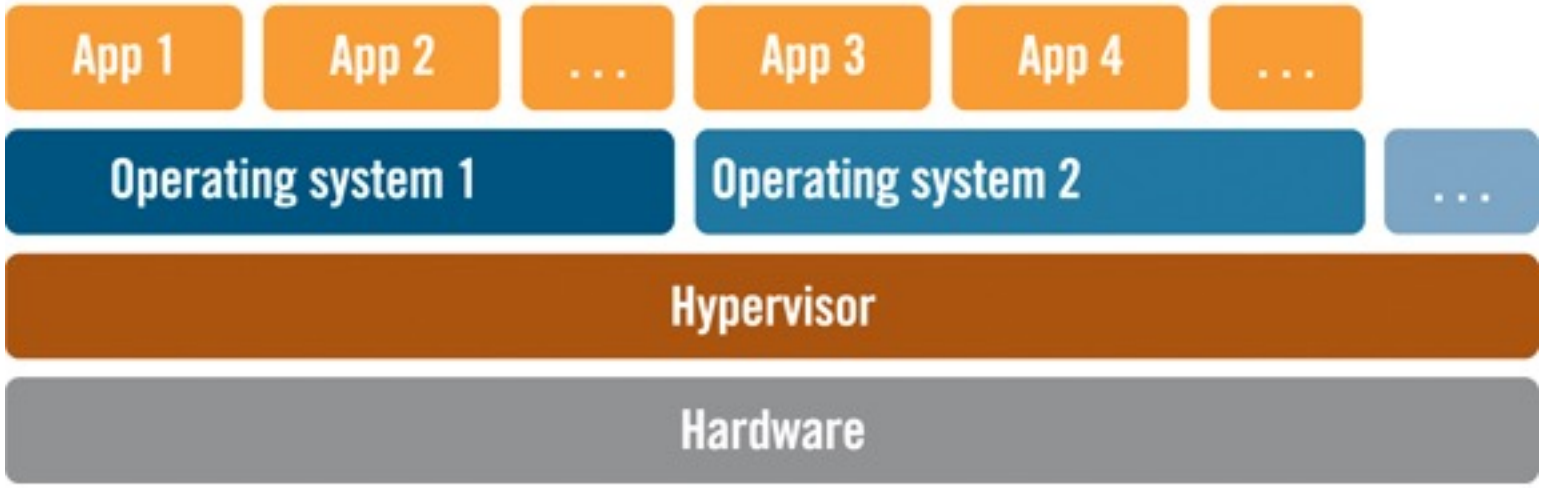
Virtual Machines Components

- Host Operating System
- Virtual Machine Manager (VMM or hypervisor)
- Guest Operating System



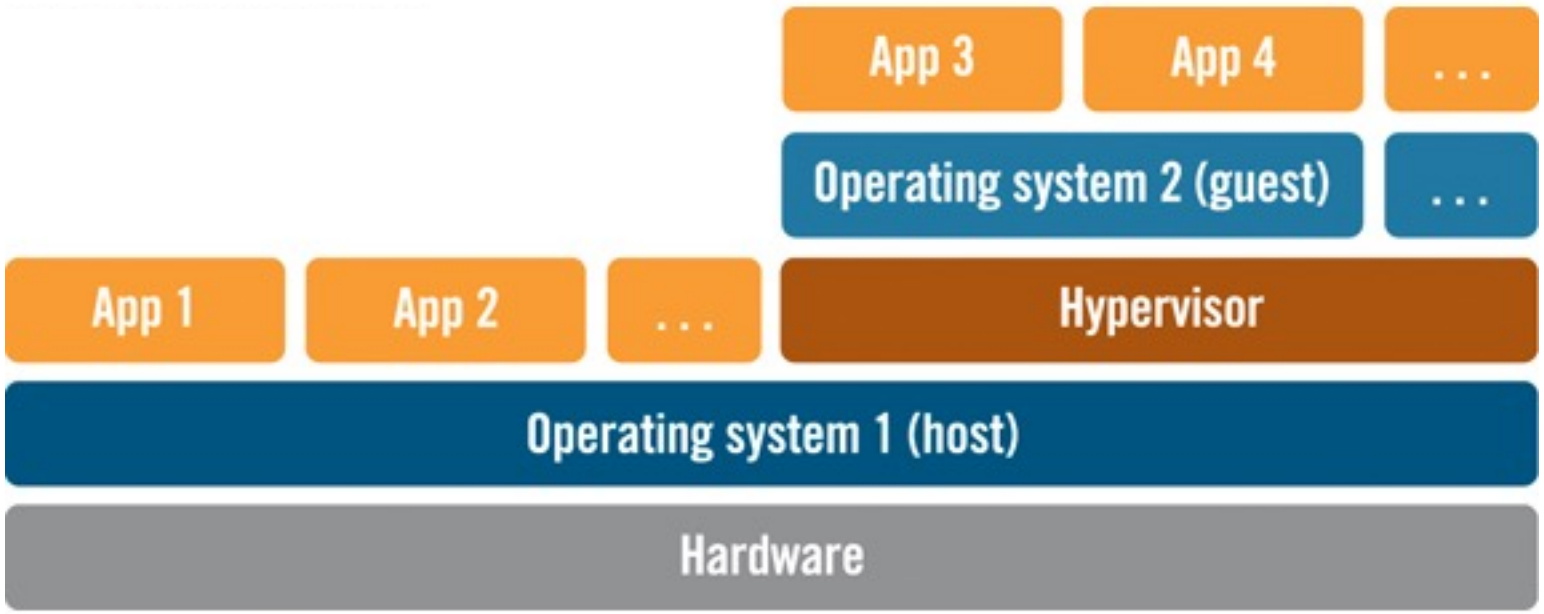
Type-1 Hypervisor

- Also called a bare-metal implementation



- VMWare ESXi, Xen, Microsoft Hyper-V, KVM

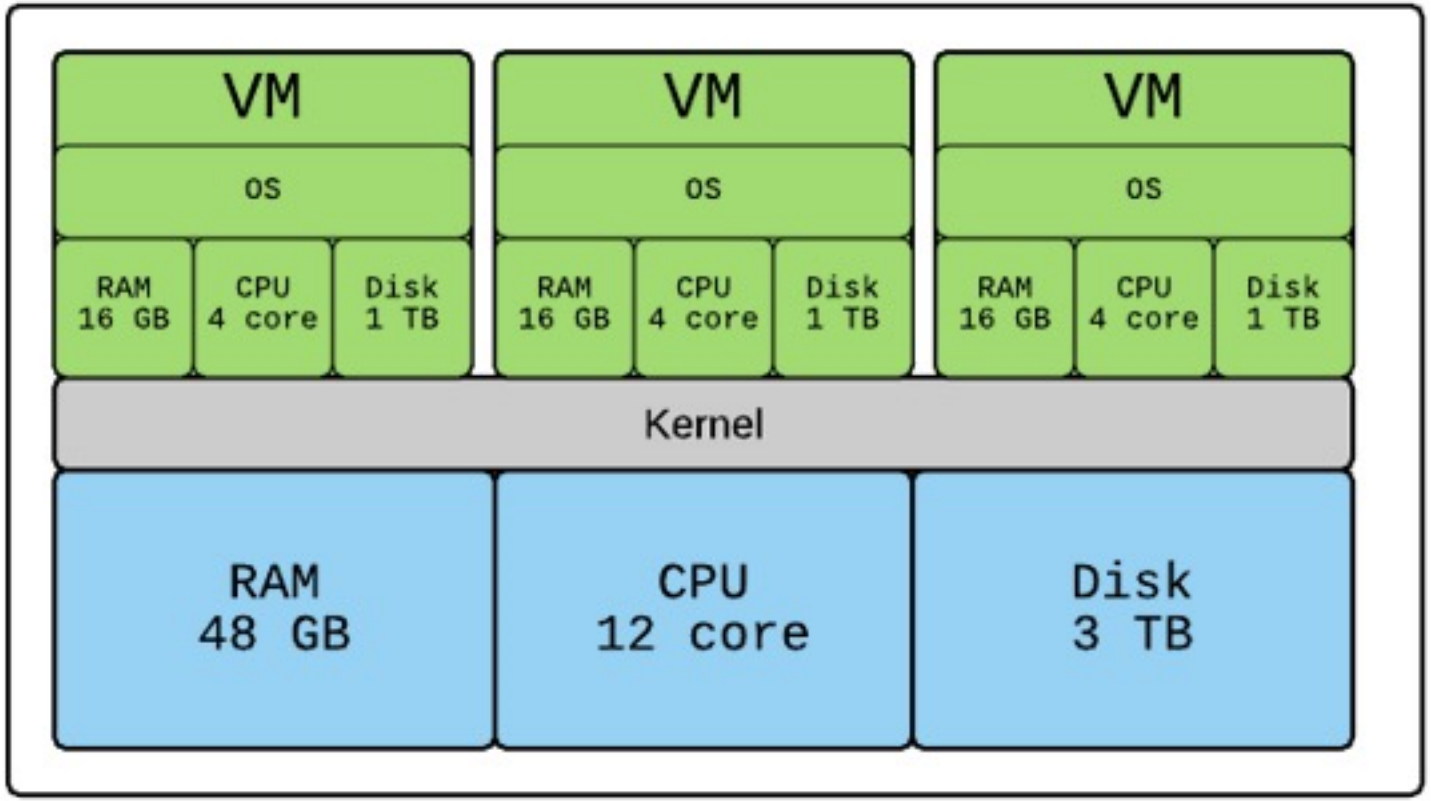
Type-2 Hypervisor



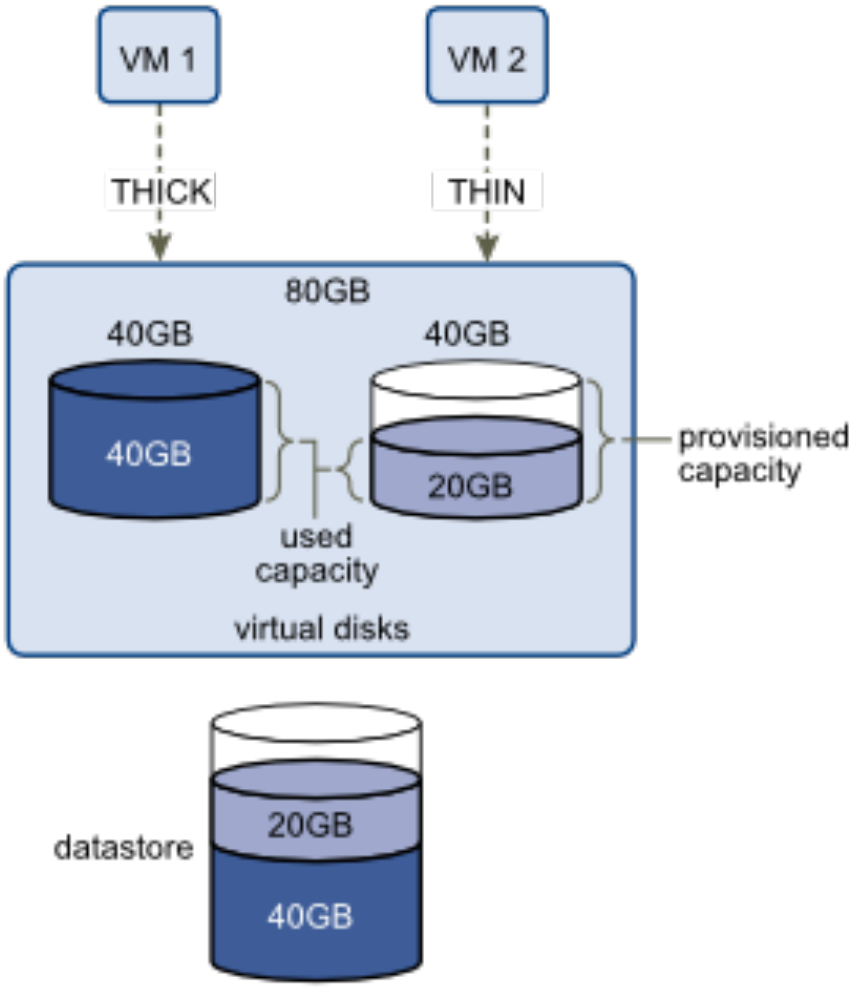
- Qemu, VMWare Workstation/Fusion, Oracle VirtualBox

Resource Allocation for VMs

- CPU, memory, Disk, I/O

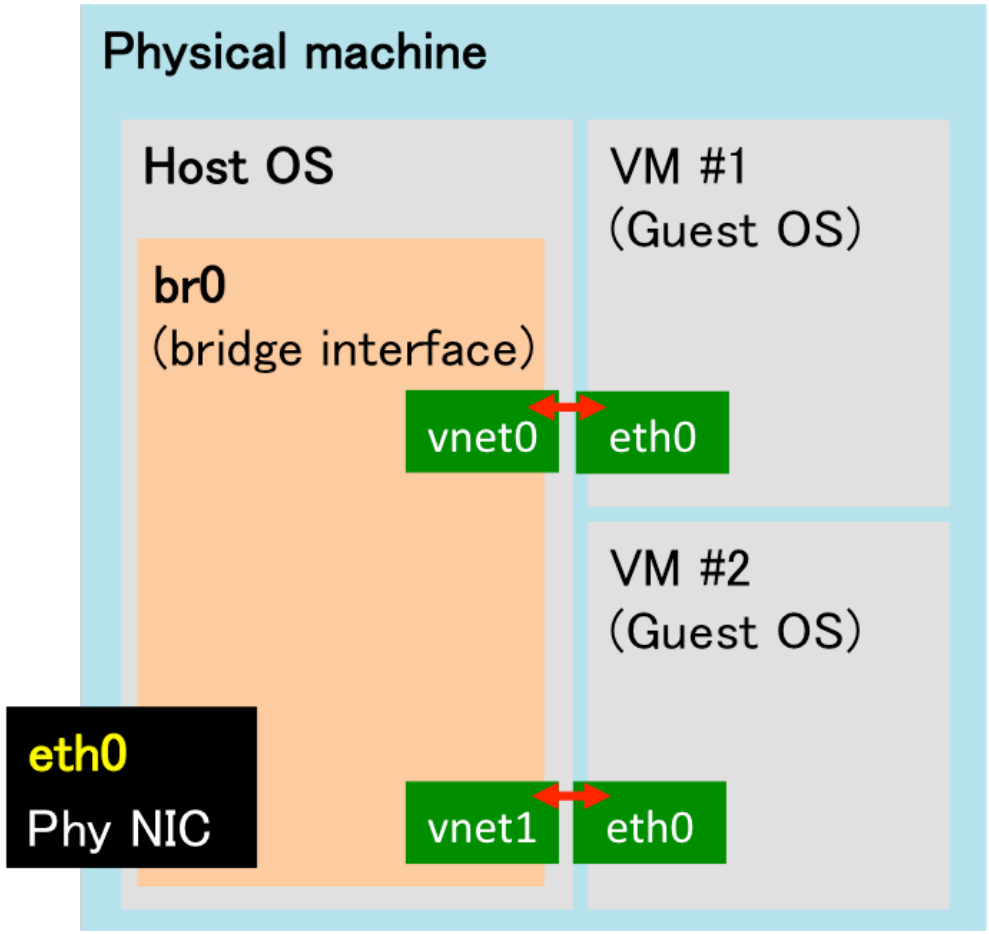


Disk Thick versus Thin Provisioning



Network Communication

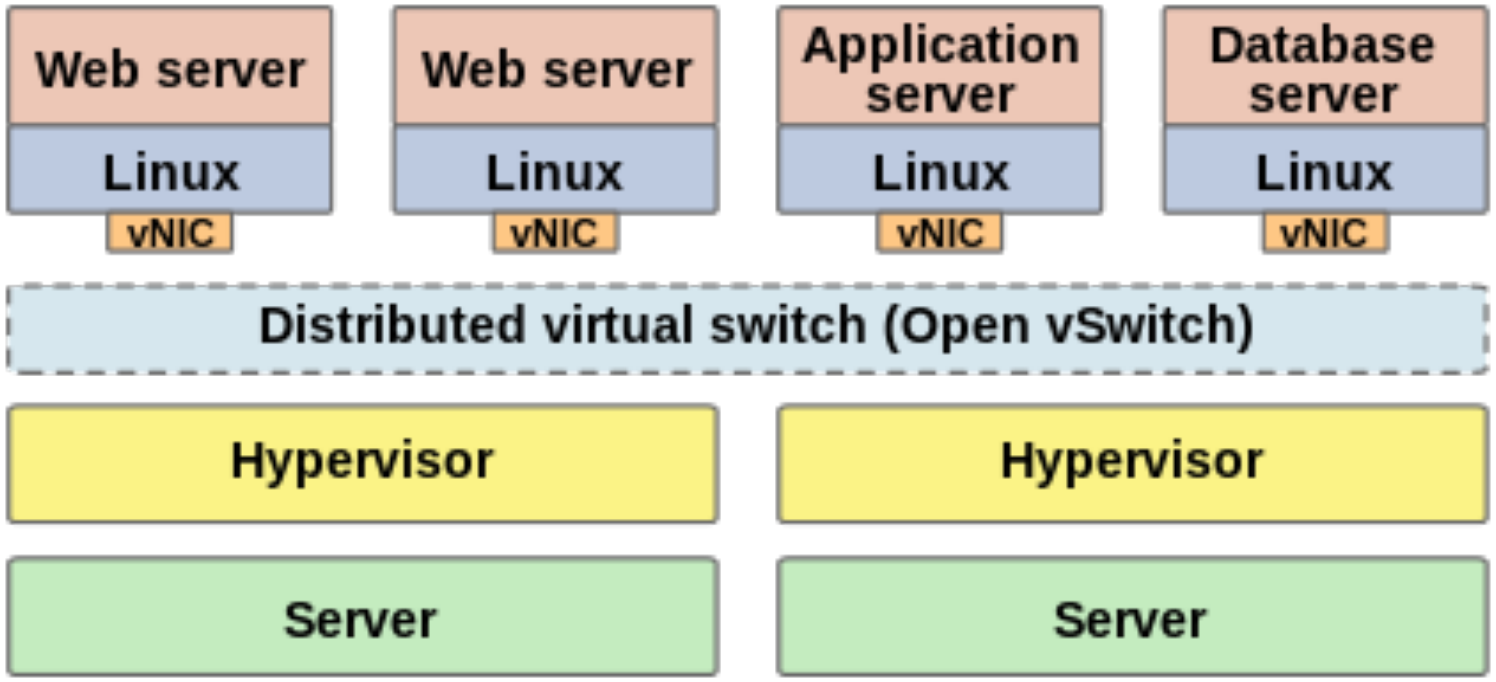
- Create virtual NIC (vNIC) instances and present those as NICs to the guest OS
- A vSwitch is used to achieve the vNIC to NIC connectivity (managed using *brctl* command in Linux)
- For a separate set of vNIC to NIC mappings, an additional virtual bridge or vSwitch can be defined



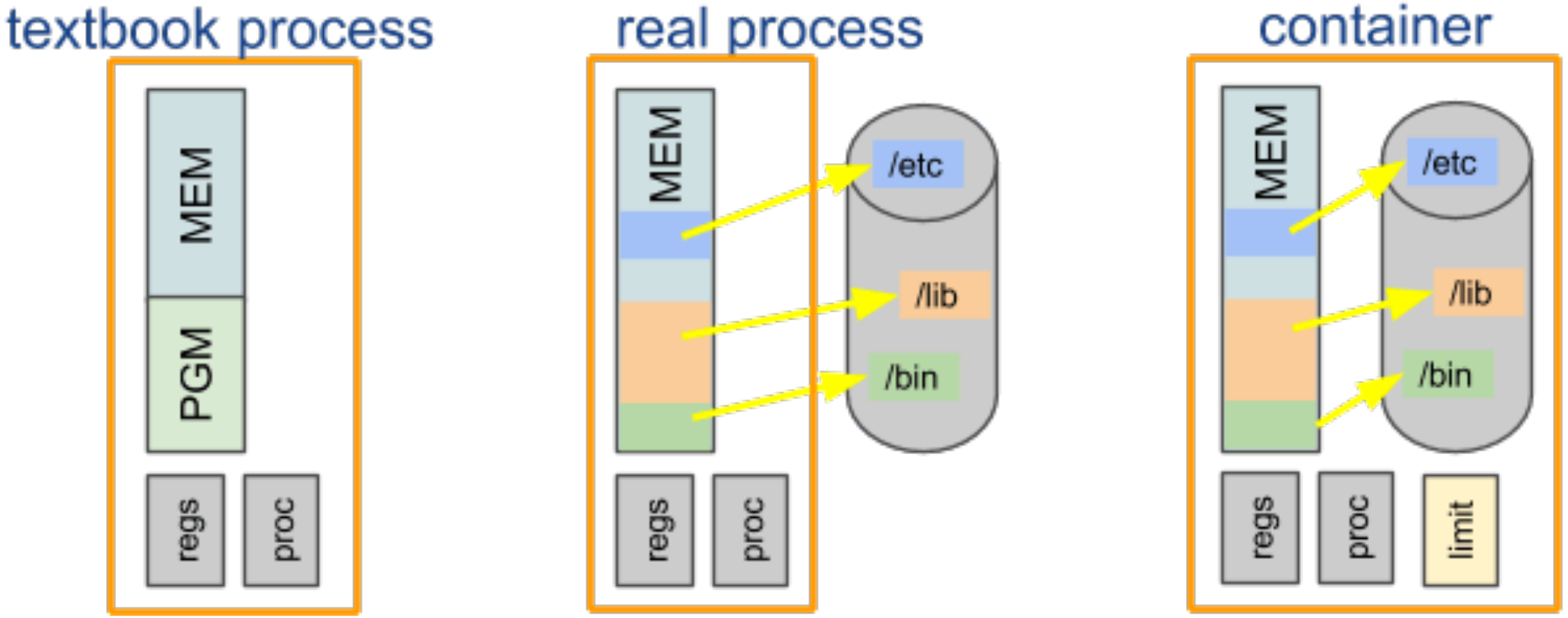
Network Communication

- In a move of a VM from on host to another (load balancing, redundancy, physical proximity) the new virtual port must replicate the config of the original (VLAN, QoS, etc.)
- To ensure consistency, a multi-server environment may require a centralized controller to manage the several switches policies and configs
- The led to the development of Open vSwitch (OVS) in Linux
- OVS supports:
  - OpenFlow for centralized management by a software-defined networking (SDN) controller
  - Optimized switching performance

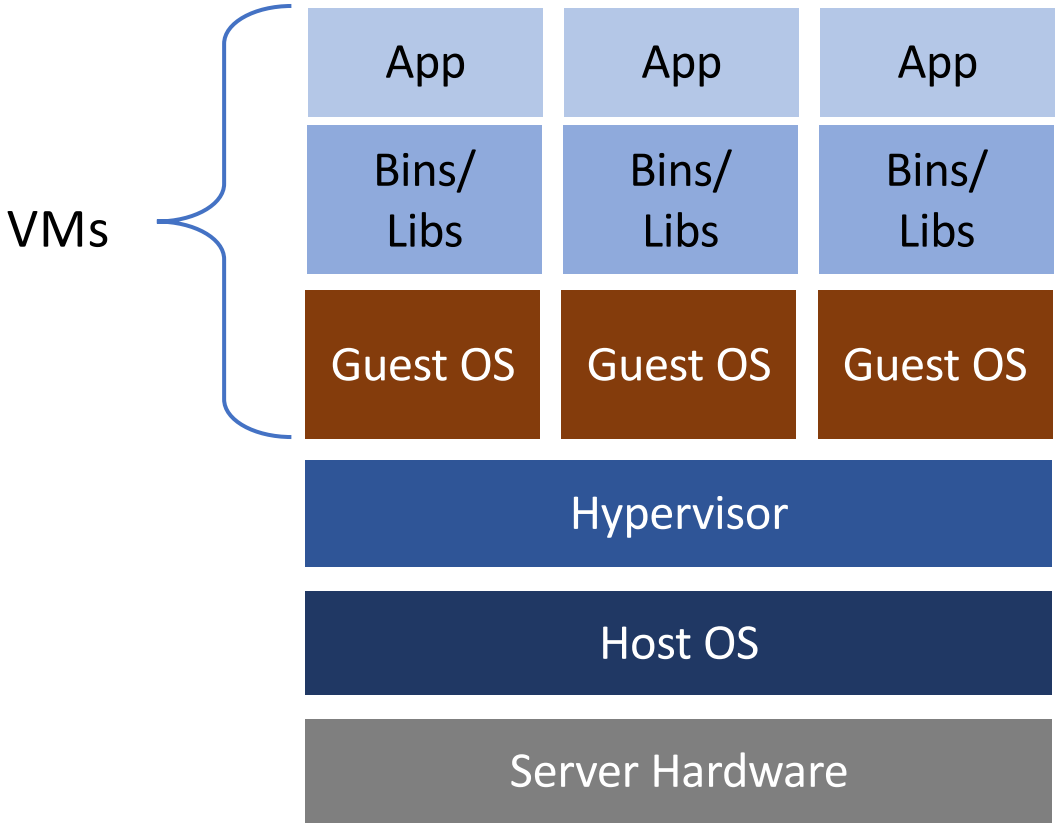
Open vSwitch (OVS)



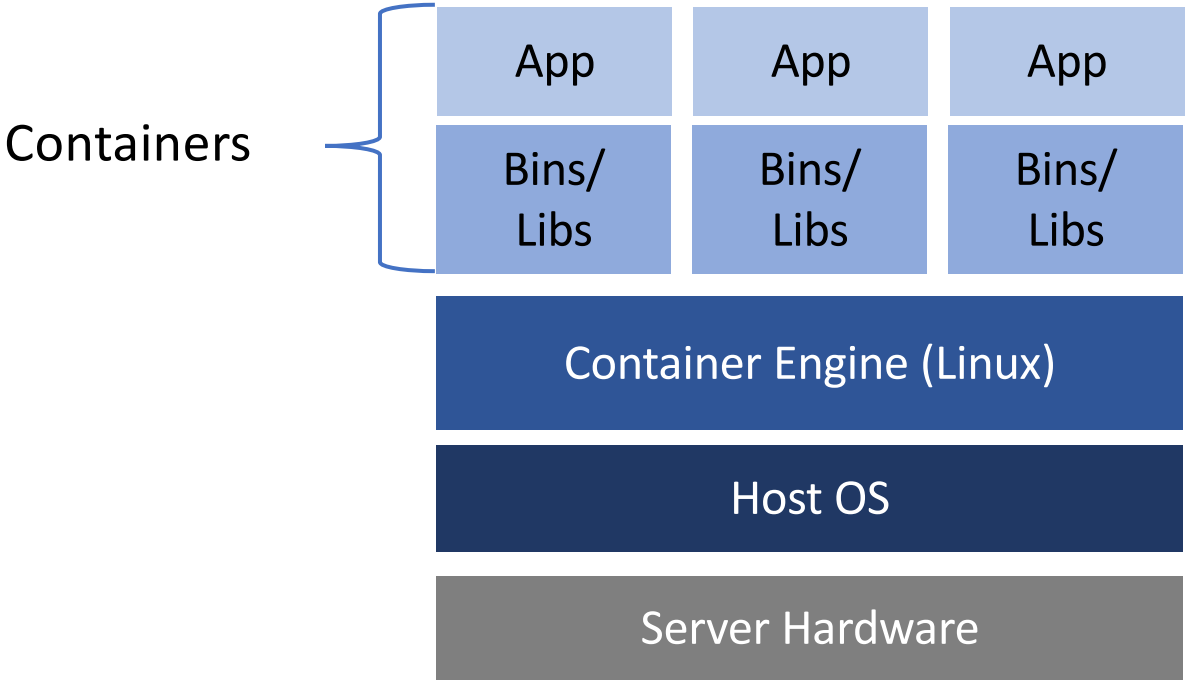
Containers vs Processes



Containers vs. Virtual Machines



Hardware Virtualization



OS Virtualization

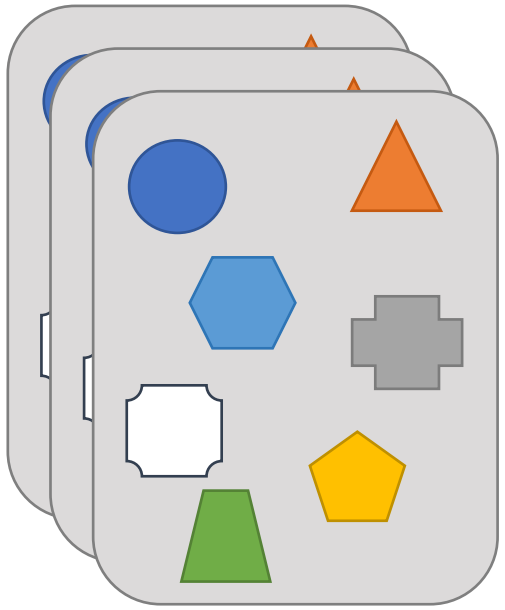
What typically goes in Containers?

BusyBox

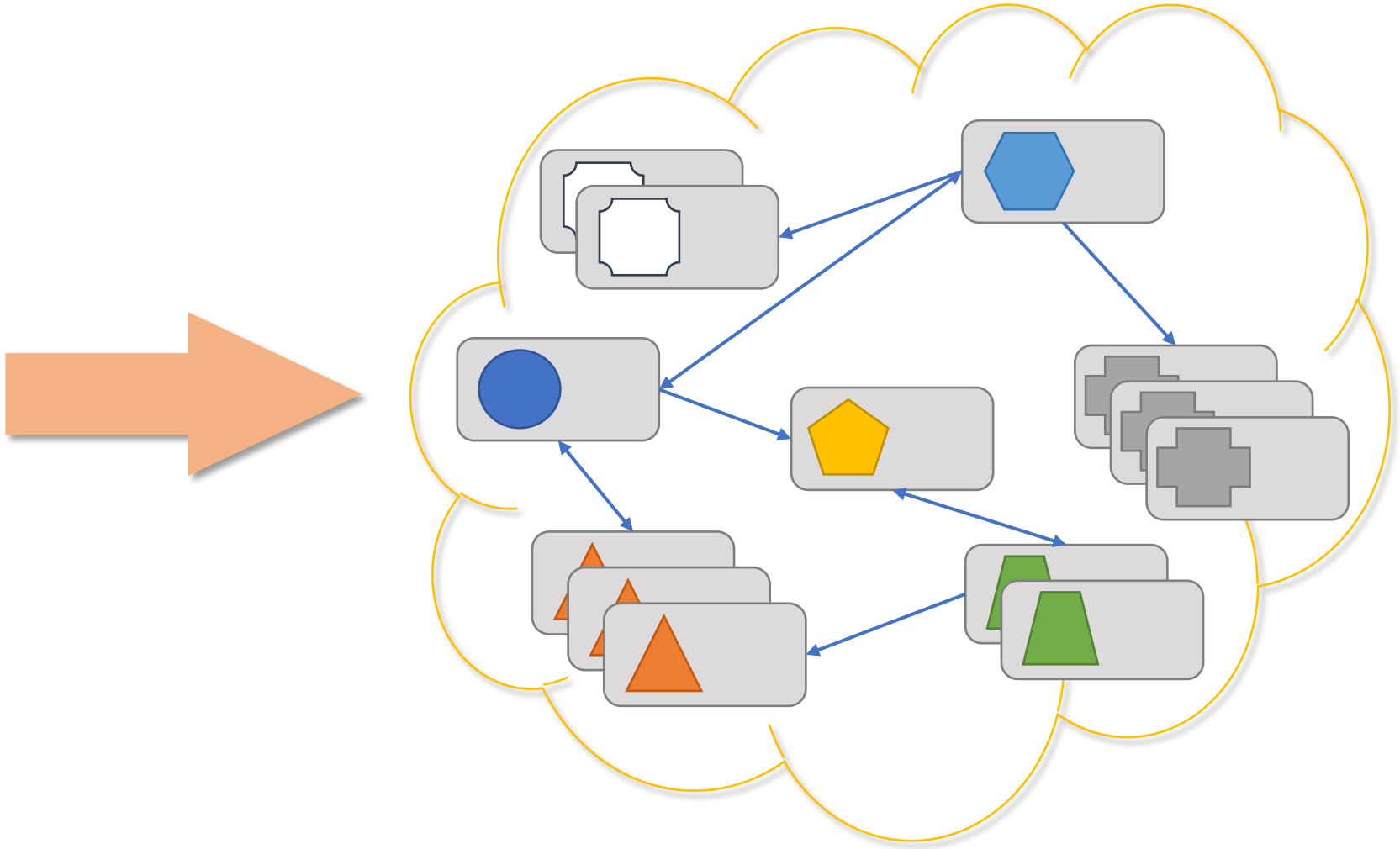
Usually 1 application per container - Microservices

Changing landscape

From Monolith to Microservices

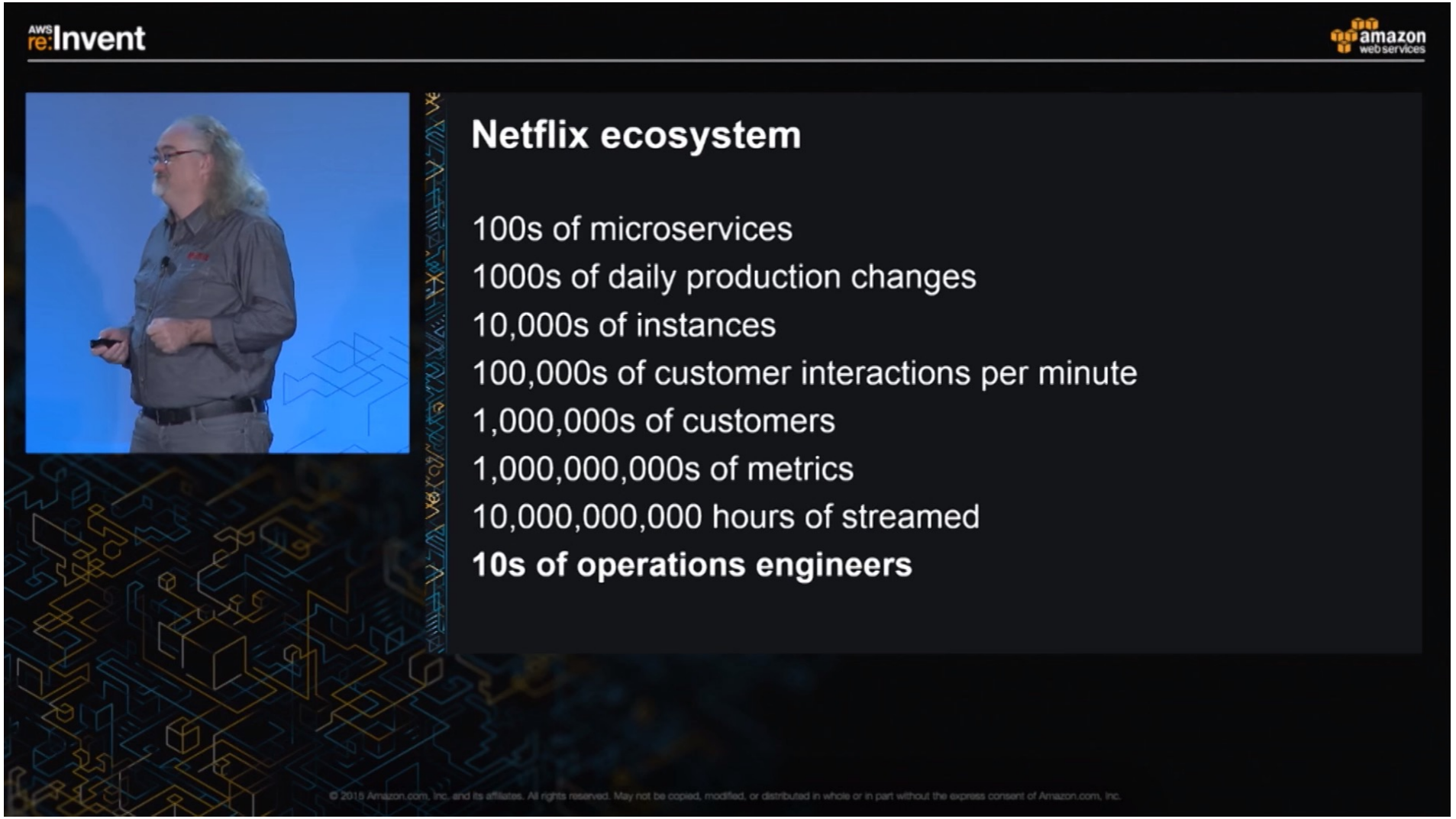


Baremetal/VMs

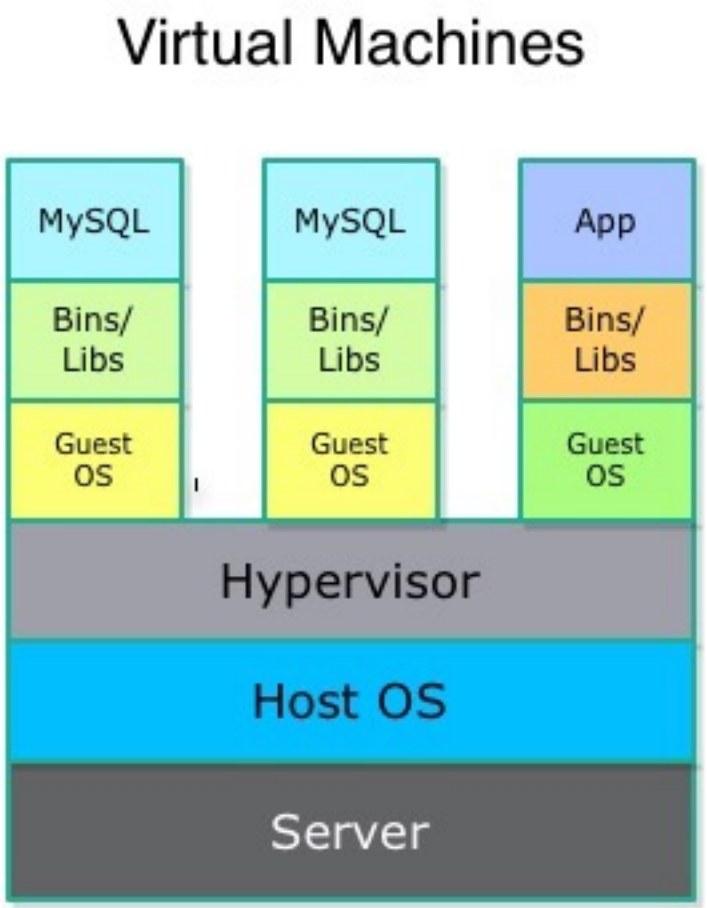


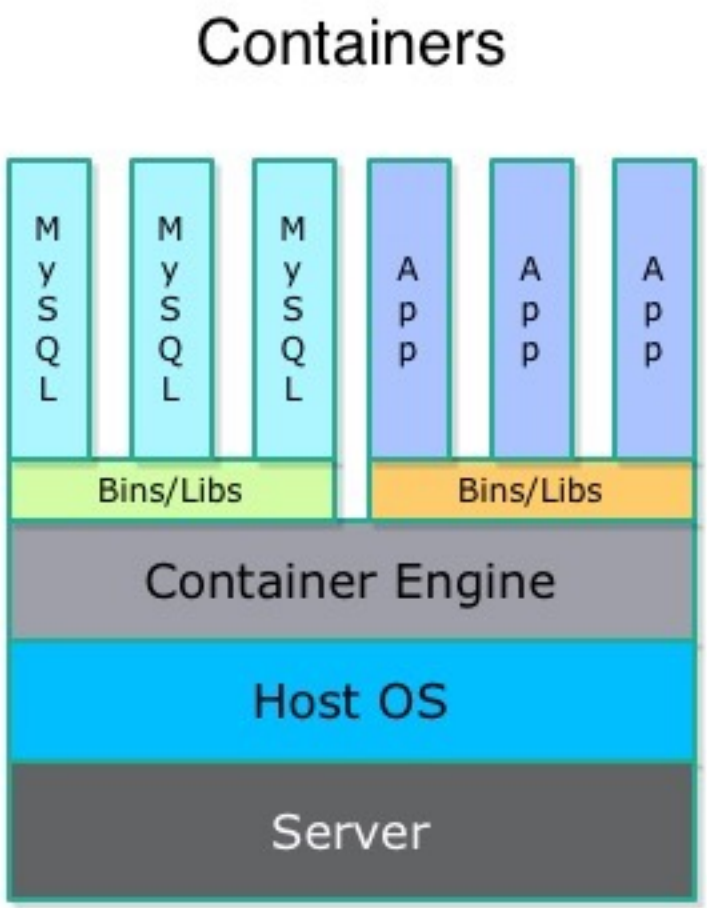
Containers

Some perspective…

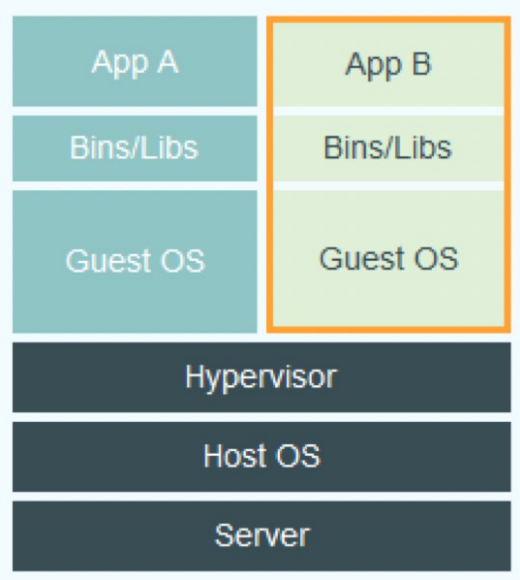


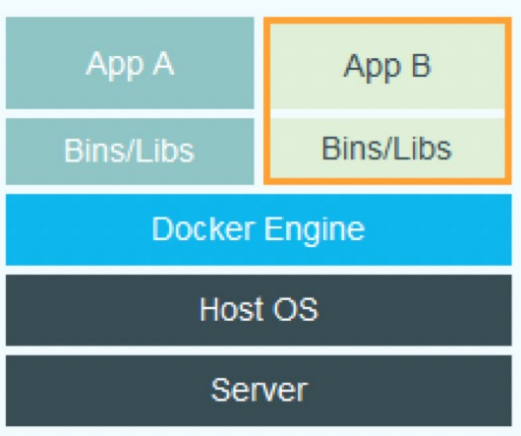
Virtualization vs Containerization





Virtual Machines vs Docker Engine

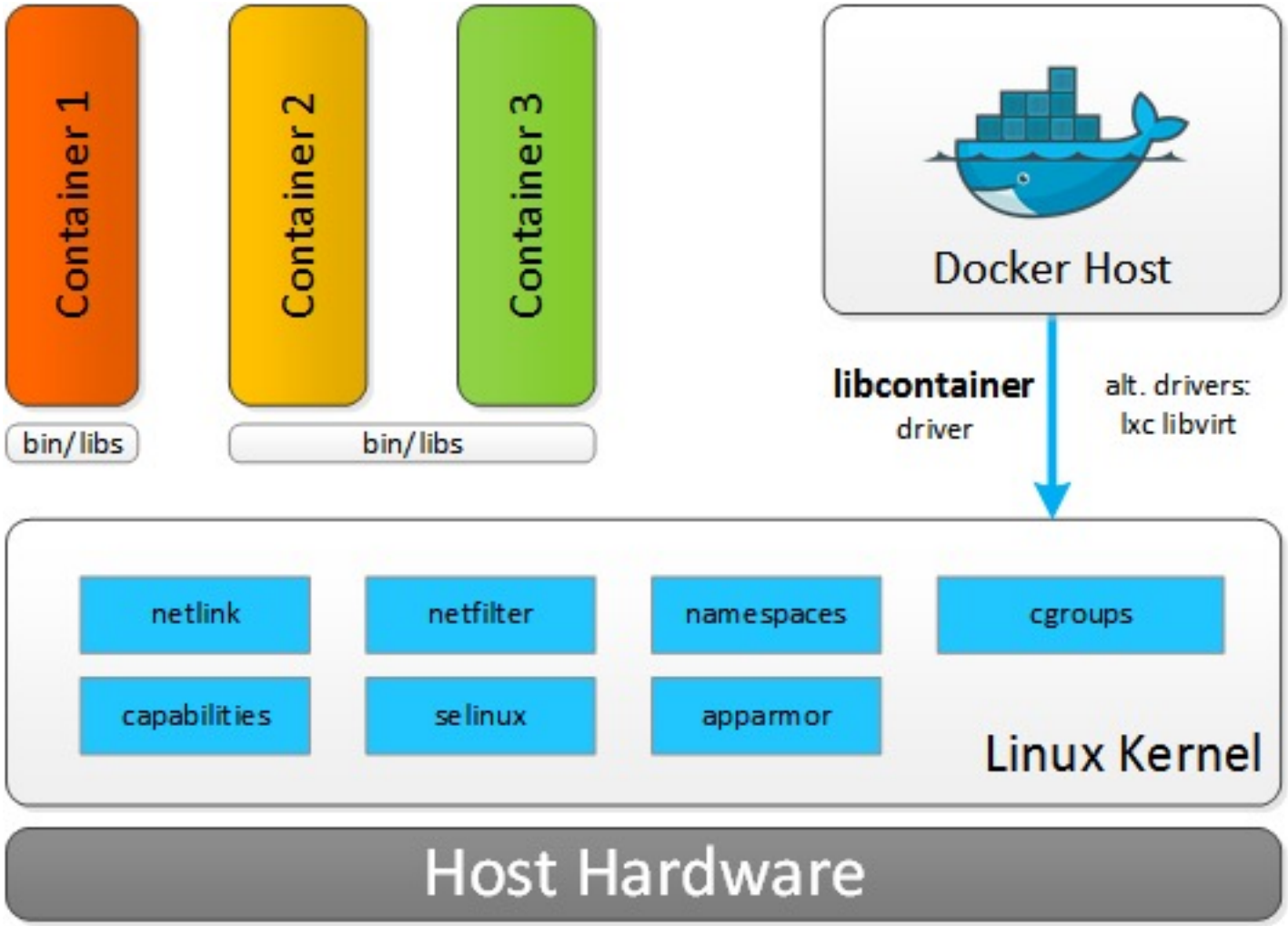




Virtual Machines: Each virtualized application includes not only the application – which may be only 10s of MB – and the necessary binaries and libraries, but also an entire guest OS – which may weigh 10s of GB

Docker Engine: The Docker Engine container comprises just the application and its dependencies. It runs as an isolated process in userspace on the host OS, sharing the kernet with other containers. Thus, it enjoys the resource isolation and allocation benefits of VMs but is much more portable and efficient.

Docker


Container 1
Container 2
Container 3
bin/libs
bin/libs
Docker Host
libcontainer
driver
alt. drivers:
lxc libvirt
netlink
netfilter
namespaces
cgroups
capabilities
selinux
apparmor
Linux Kernel
Host Hardware

Traditional vs Cloud Native

Bins/Libs

Host OS

Server

Bare Metal

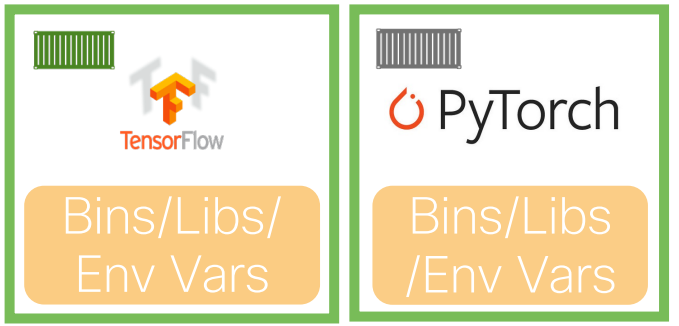
Bins/Libs | Bins/Libs

Host OS | Host OS

Hypervisor

Server

Virtual Machines

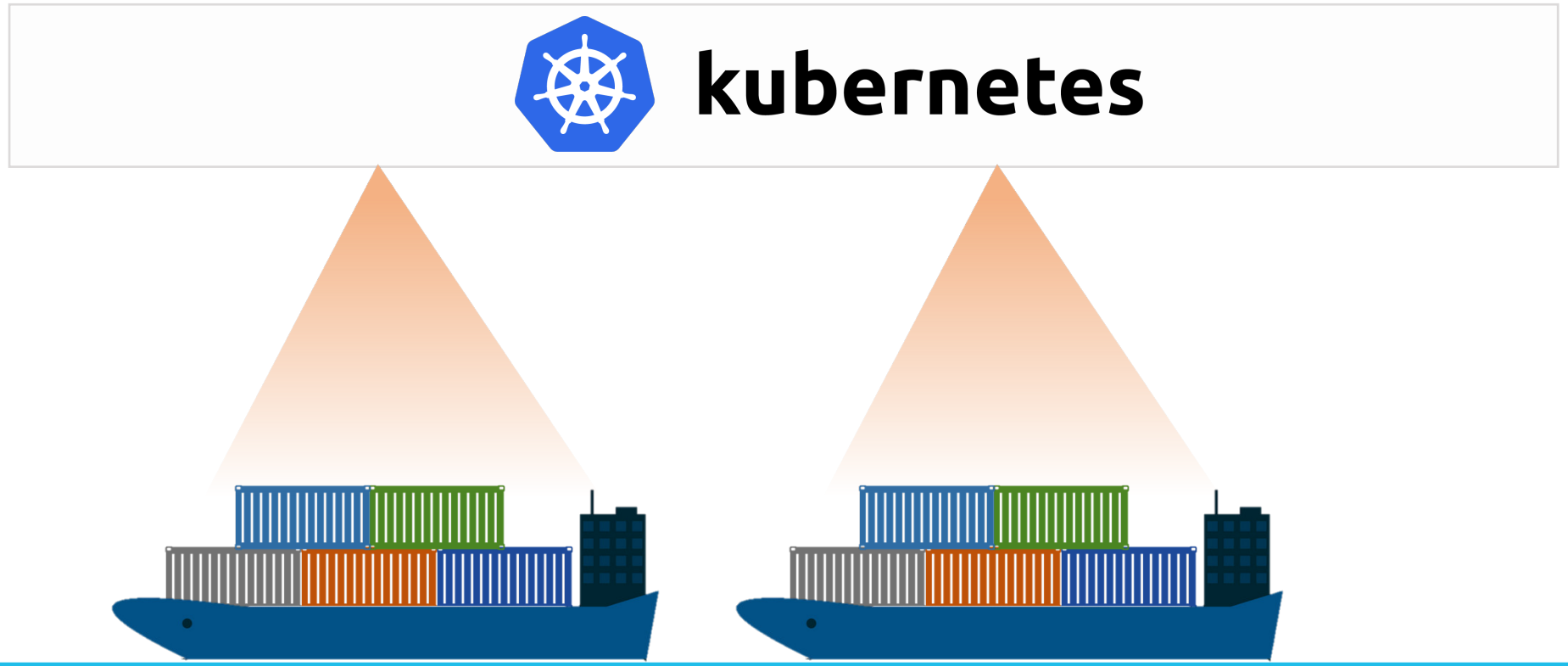


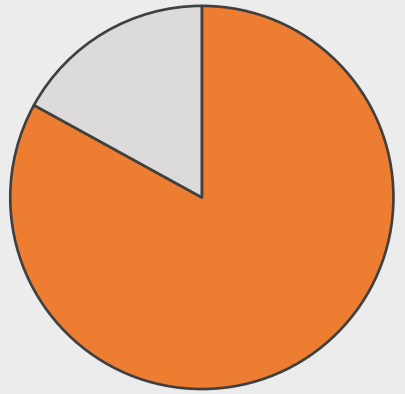
Containers

Container are great, but they need orchestration

Container runtimes are not multi-host aware

Introducing...Kubernetes





Kubernetes is the #1 choice for container orchestration

Container scheduling, scaling, load-balancing, logging,...

Source: Jan 17th 2017 cncf.io blog