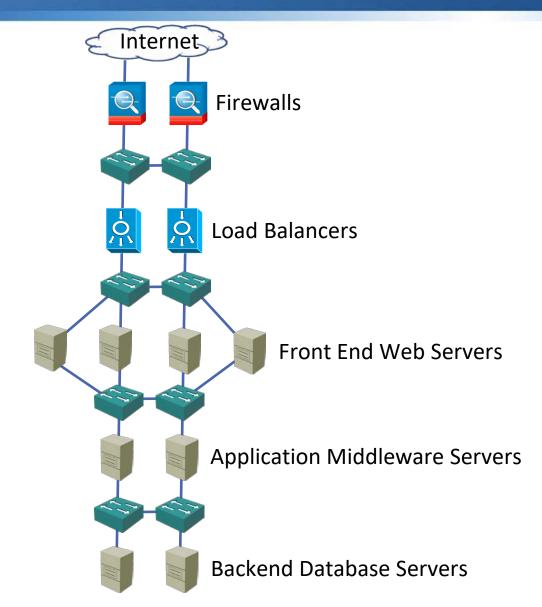
Virtualization

- Virtualization is one of the main enablers of Cloud Computing
- It allows for resource pooling where multiple customers share the underlying hardware
- Virtualization has been around a lot longer than Cloud Computing though
- This lecture focuses on server virtualization because it was the first type available, but the same principles can be applied to virtualize network infrastructure equipment

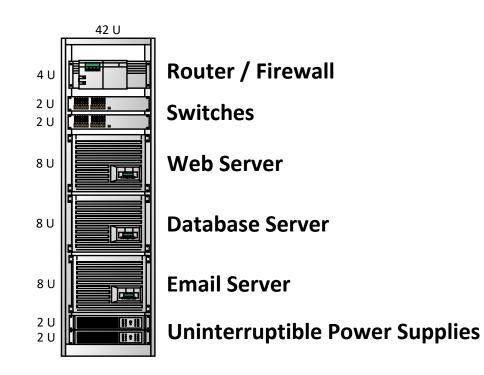


Virtualization



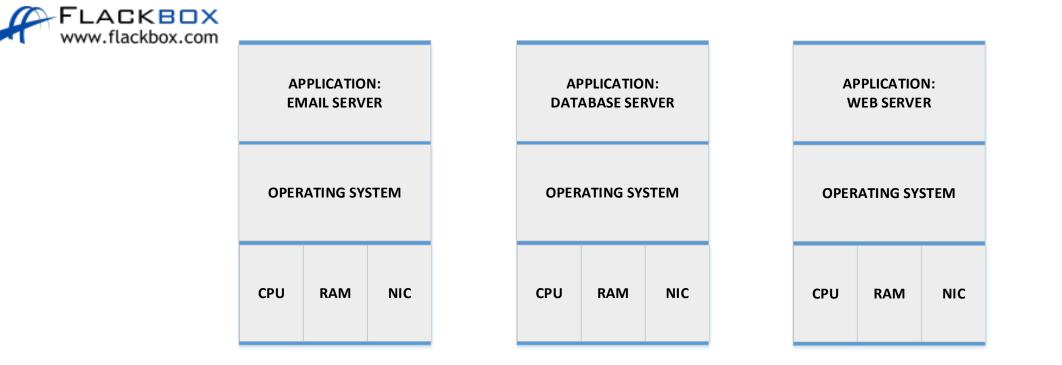
- The cloud provider does not provision
 separate physical hardware for every
 customer
- A customer can sometimes deploy
 selected dedicated hardware devices at additional cost.

Before Virtualization





Before Virtualization



- Server utilization (CPU, RAM, NIC etc.) around 15%
- You have to pay for each separate server, and they're all using power, space and cooling

Multiple Applications on Same Server

- Putting multiple applications on the same server would improve utilization
- But it is very bad practice, because if you have a problem with any of your applications they will all be affected

APPLICATION: EMAIL SERVER	APPLICATION: DATABASE SERVER	APPLICATION: WEB SERVER		
OPERATING SYSTEM				
CPU	RAM	NIC		



Server Virtualization

VIRTUAL MACHINE 1	VIRTUAL MACHINE 2	VIRTUAL MACHINE 3		
APPLICATION: EMAIL SERVER	APPLICATION: DATABASE SERVER	APPLICATION: WEB SERVER		
OPERATING SYSTEM: WINDOWS	OPERATING SYSTEM: WINDOWS	OPERATING SYSTEM: LINUX		
HYPERVISOR				
CPU	RAM	NIC		



Popular Type 1 (Bare Metal) Hypervisors

Type 1 Hypervisors run directly on the system hardware

- VMware ESXi (part of the vSphere suite)
- Microsoft Hyper-V
- Red Hat KVM
- Oracle VM Server
- Citrix XenServer



Popular Type 2 Hypervisors

Type 2 Hypervisors run on top of a host operating system

- VMware Workstation, Player and Fusion
- VirtualBox
- QEMU
- Parallels



Type 2 Hypervisor

VIRTUAL MACHINE 1 **VIRTUAL MACHINE 2 APPLICATION: APPLICATION: EMAIL SERVER** DATABASE SERVER APPLICATIONS **OPERATING SYSTEM: OPERATING SYSTEM:** WINDOWS WINDOWS HYPERVISOR DESKTOP OPERATING SYSTEM NIC CPU RAM



Type 1 vs Type 2 Hypervisor

CPU	RAM	NIC	
HYPERVISOR			
OPERATING SYSTEM: WINDOWS	OPERATING SYSTEM: WINDOWS	OPERATING SYSTEM: LINUX	
APPLICATION: EMAIL SERVER	APPLICATION: DATABASE SERVER	APPLICATION: WEB SERVER	
VIRTUAL MACHINE 1	VIRTUAL MACHINE 2	VIRTUAL MACHINE 3	



