Technology Example of Virtualization

Citrix XEN

What is XEN ???

- XEN is open source Type1 Bare metal Hypervisor.
- XEN is a is a virtual machine monitor (VMM) that allows multiple guest operating systems to run on the same computer hardware
- XEN uses Paravirtualization as virtualization technique.
- Allows for the increase of server utilization and consolidation.
  - ❖ More processes can be run on less hardware

Paravirtualization

- It is a type of Virtualization which uses hypercalls for direct communication between Guest OS and hypervisor.

- In this type, the guest OS is not completely isolated but it is partially isolated from virtualization layer.

- Due to partial virtualization, it provides more security as it does not send the calls to host hardware directly.

- Benefit : Better performance than binary translation.

- Disadvantage: Modification in the guest OS is required.

Design Principles

- Allows user-level applications to be run without being modified

- Support for multiple full multi-application OS
  - ❑ Each guest can contain a complex server configuration

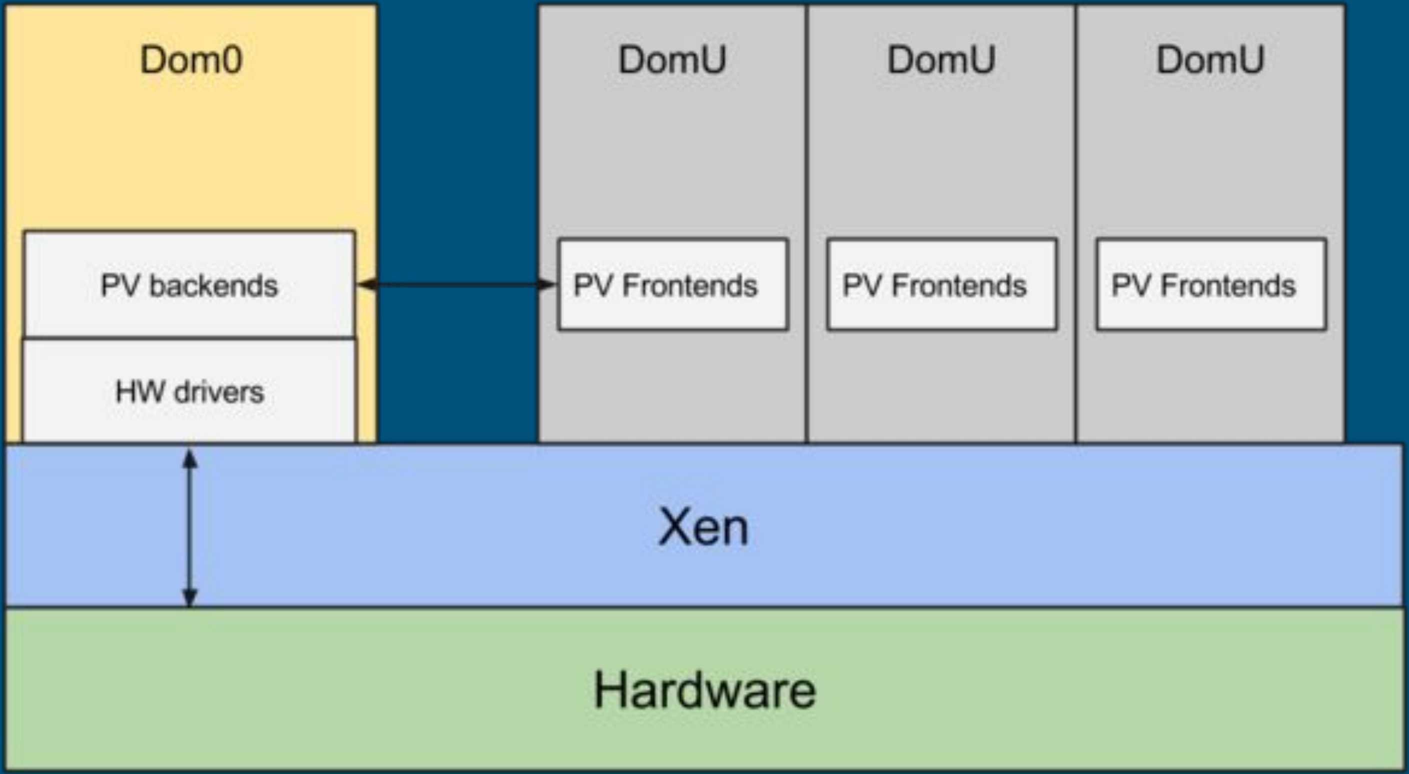
- Hide effects of virtualization from guests
  - ❑ Each guest OS does not know about other guests

Architecture of XEN System

1. The Xen hypervisor provides an abstraction layer that sits between system hardware and one or more guest operating systems

2. Each guest OS is executed within its own virtual machine, called a domain.
   - ❑ **Domain0:** has special management privileges and is used to create the other domains
   - ❑ **DomainU:** contains one guest OS

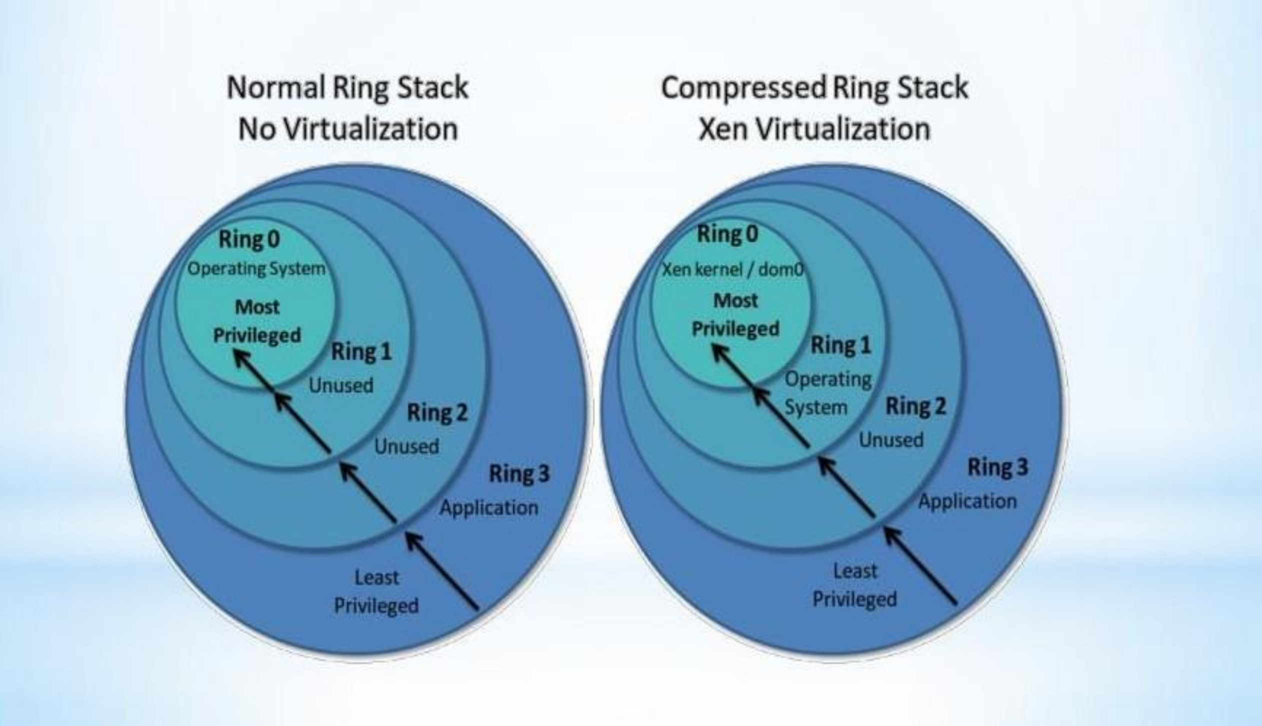
Architecture of XEN System



Ring Stack of XEN hypervisor

1. Xen runs in ring 0, the most privileged ring

2. Guest runs in a ring higher than 0 is called "ring deprivileging".



Virtual Machine Interface: Memory

- New page tables are allocated from a guest OS memory reservation and registers it with Xen

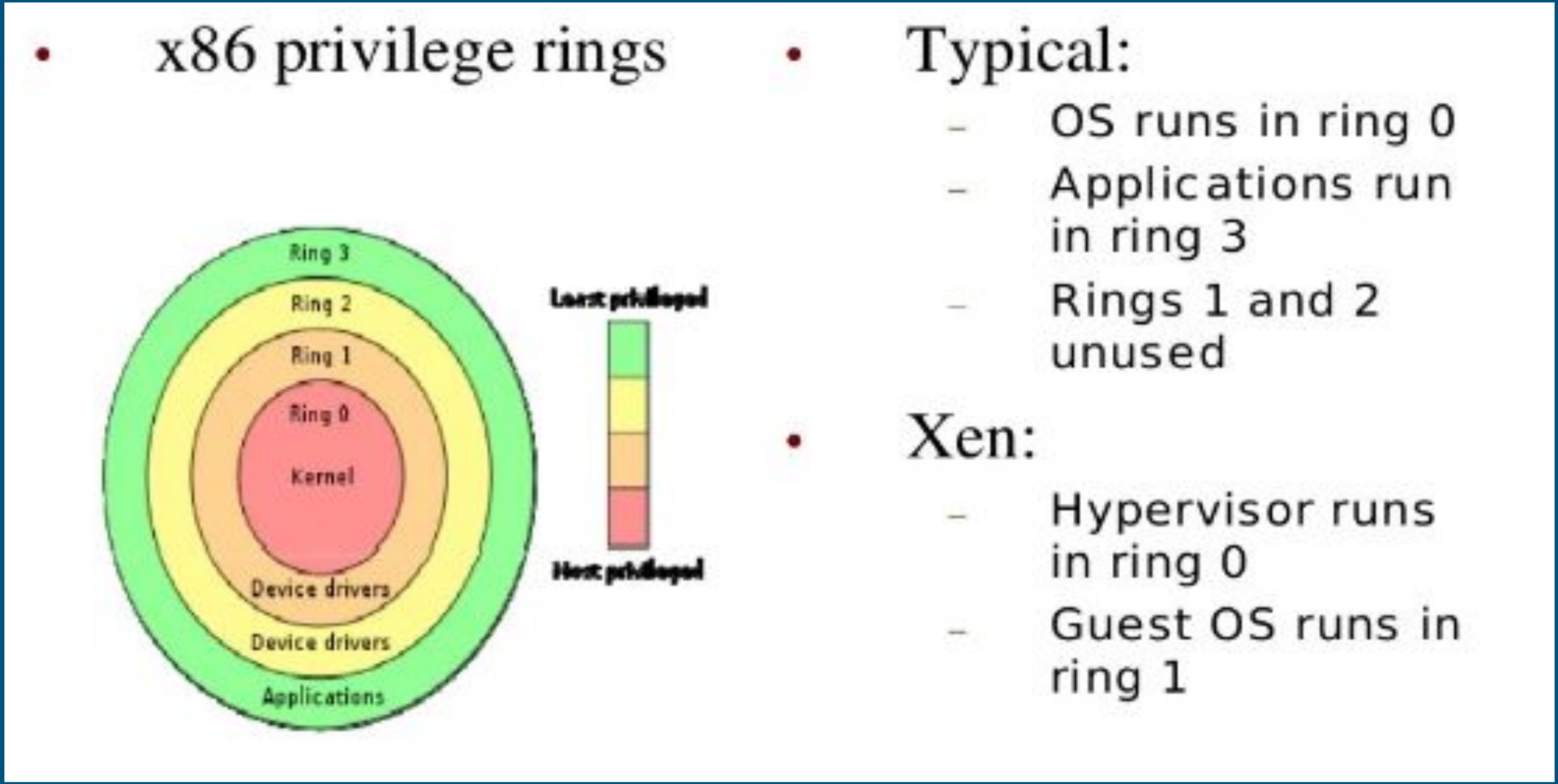
- All subsequent writes to the page table are validated by Xen.

    ❏ This ensures that a guest OS only writes to tables it owns, and is isolated from other guests

Virtual Machine Interface: CPU

- An operating system is typically the most privileged entity of a system
- With Xen, the hypervisor sits between a guest OS and the CPU
- The hypervisor is the most privileged entity in a Xen system
- Xen uses protection rings to allow the hypervisor to be more privileged than a guest OS

Virtual Machine Interface: CPU



Ring 3
Ring 2
Ring 1
Ring 0
Kernel
Device drivers
Device drivers
Applications
Least privileged
Most privileged

- x86 privilege rings

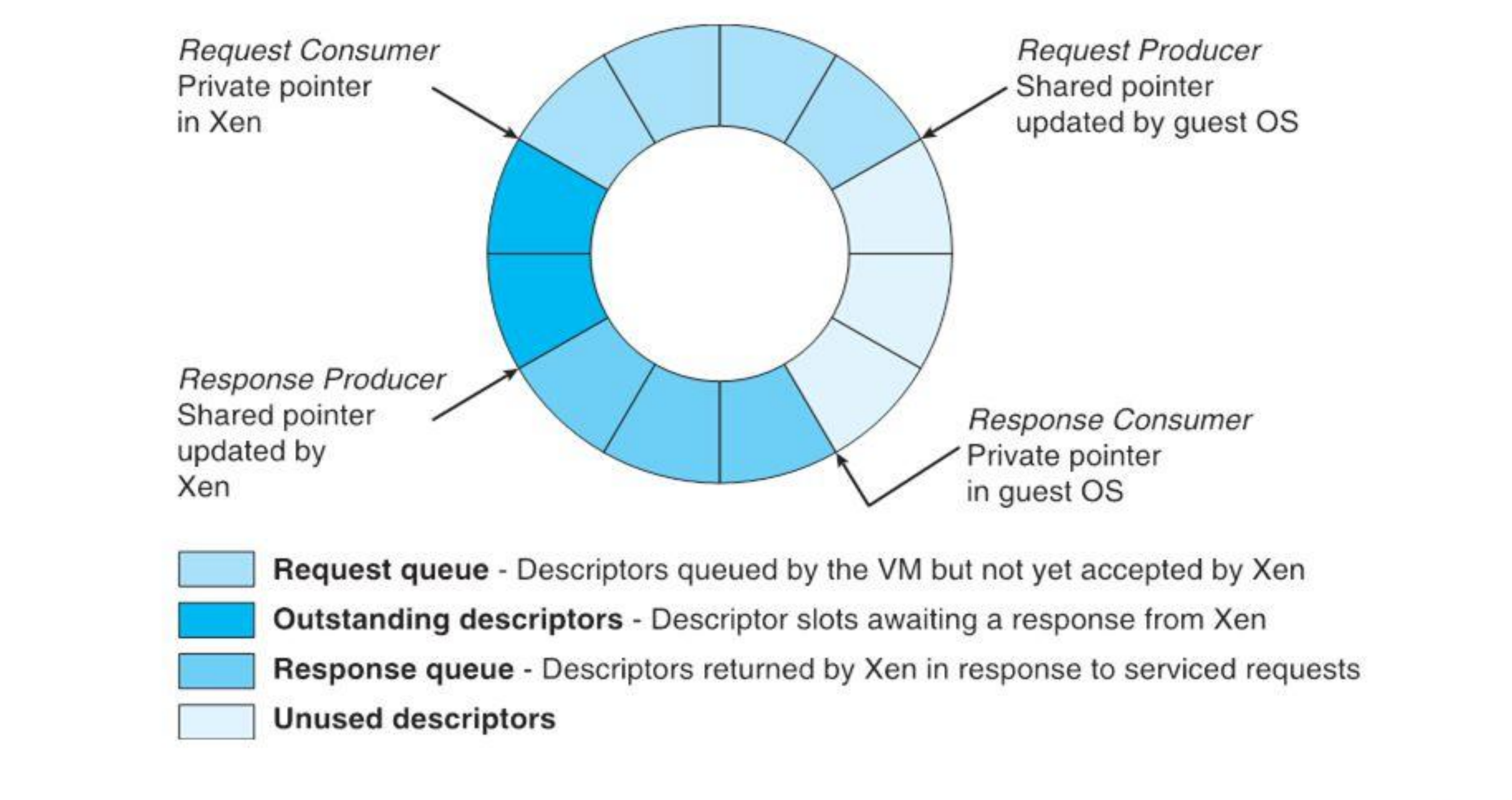
- Typical:
  - OS runs in ring 0
  - Applications run in ring 3
  - Rings 1 and 2 unused

- Xen:
  - Hypervisor runs in ring 0
  - Guest OS runs in ring 1

Virtual Machine Interface: I/O

- Xen provides simple device abstractions
  - This helps realize goal of protection and isolation
- Data sent to and from each domain through the hypervisor
- I/O descriptor rings are used for asynchronous data transfer

XEN I/O via shared circular buffer



Request queue - Descriptors queued by the VM but not yet accepted by Xen

Outstanding descriptors - Descriptor slots awaiting a response from Xen

Response queue - Descriptors returned by Xen in response to serviced requests

Unused descriptors

Performance

- In summary, XEN performs well
    - ❑ Multiple domains can be hosted without any noticeable loss of performance by end user

- XEN and the Art of Virtualization identifies a scalability goal of 100 domains on modern (c. 2003) server-class hardware Tests demonstrate that 128 domains can be run with only 7.5% loss of throughput relative to standalone Linux

Pros:

- XenCenter Management Console :
  It allows IT staff to closely monitor, administer and manage several VMs.
  It allows user to start, stop, migrate, create, copy or make backup VMs in few clicks.

- XenMotion
  This allows VMs to be transferred between physical servers with no interruption call which reduces downtime.

- Easy Virtualization of workload
  Fast running VMs allow the installation and running of softwares.

Cons:

- Xen is more reliable over linux rather than window.
- Xen relies on 3rd-party component to manage the resources like drivers, storage, backup, recovery & fault tolerance.
- Xen deployment could be a burden some on your Linux kernel system as time passes.
- Xen sometimes may cause increase in load on your resources by high input-output rate and and may cause starvation of other Vm’s.

Team 4 Members

2019BTECS00029	Harshal Kodgire	2019BTECS00033	Teknath Jha
2019BTECS00034	Rutikesh Sawant	2019BTECS00036	Nikhil Dhanpgol
2019BTECS00077	Avinash Biradar	2019BTECS00083	Bhargav Kulkarni
2019BTECS00111	Aditya Sanap	2019BTECS00072	Nikhil Khavanekar

THANK YOU