



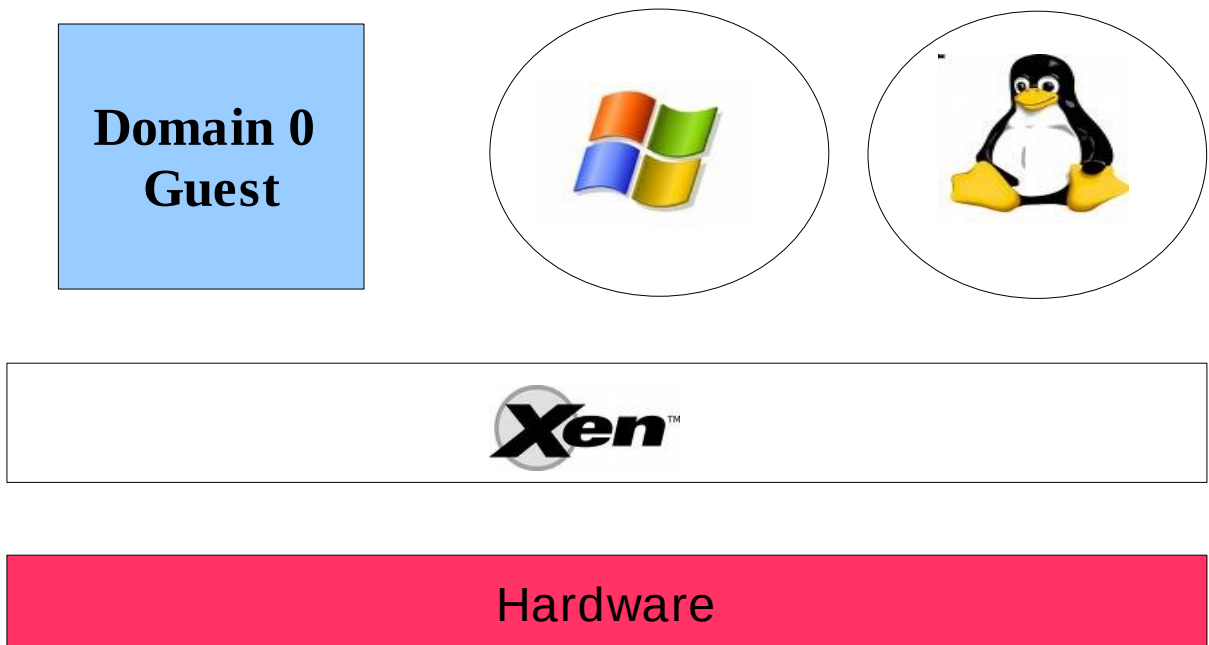
How are Hypervisors Classified?

A hypervisor is a piece of software that allows multiple operating systems to run concurrently on the same computer. Hypervisor's have been categorized into two main types:

- Type 1 Hypervisor (Native or Bare-Metal)
- Type 2 Hypervisor (Hosted)

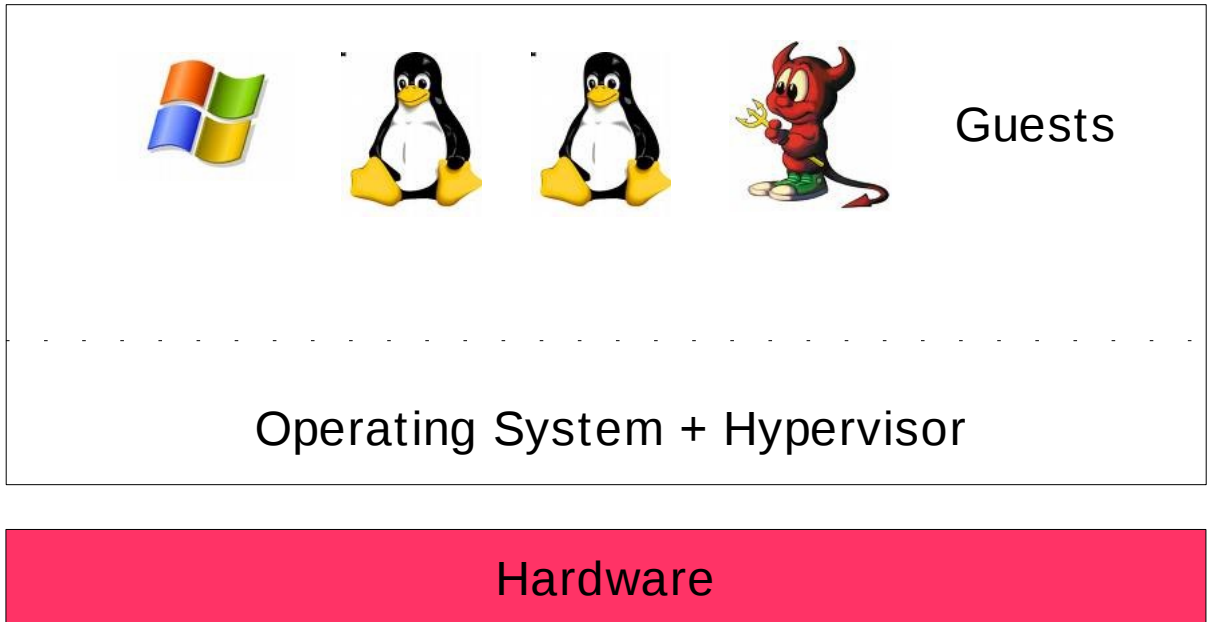
Type 1 Hypervisor

A type 1 hypervisor runs directly on the computer hardware and manages all operating systems running as guests above it. The following diagram illustrates the Type 1 hypervisor from the Xen.org community – it contains the Xen hypervisor running directly on the hardware with three guests running above the hypervisor (Domain 0 Guest, Windows Guest, and Linux Guest).



Type 2 Hypervisor

A type 2 hypervisor is a software application that runs within an operating system and allows multiple operating systems to run above it. The diagram below shows a typical type 2 hypervisor setup; the hypervisor is located within the operating system running on the hardware and contains four guests running above it:



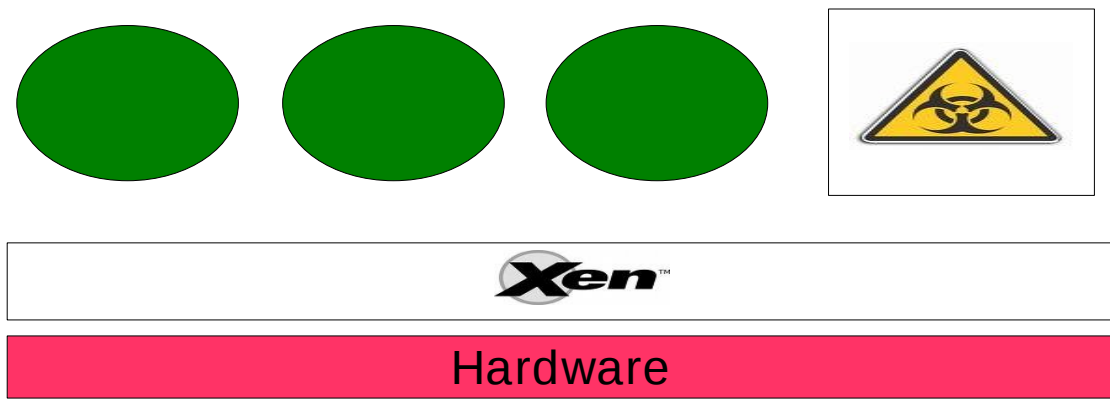
Type 1 vs Type 2 Hypervisors

The hypervisor design does make a significant difference in the following features:

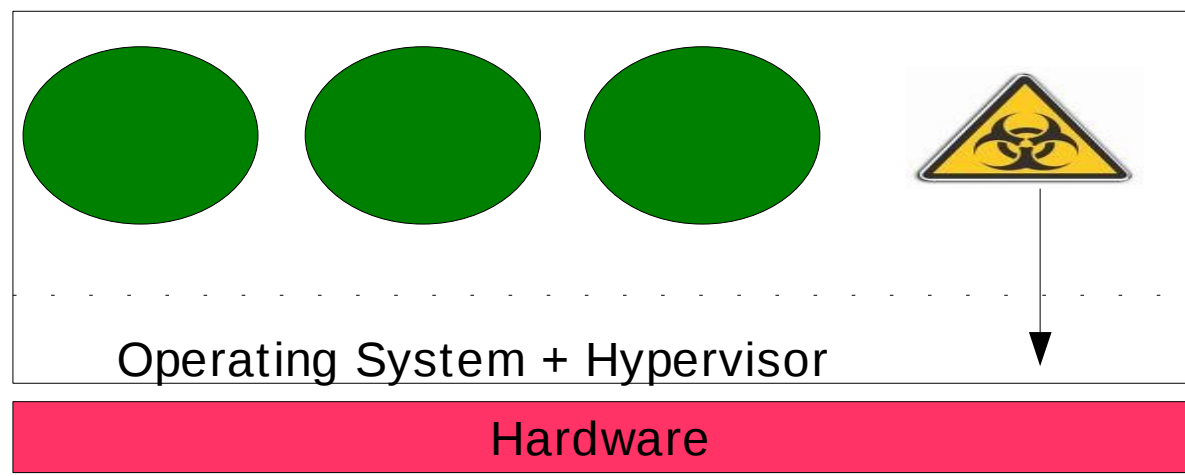
- Security – Guest Isolation
- Performance – Pass-Thru, Hypervisor Overhead
- Scalability – Guest Failure

Security

When running multiple guest operating systems on a single system, it is critical that none of the activities of one guest interfere with another guest. Having guest isolation is a significant tool to prevent one guest from attaching another for malicious purposes. A type 1 hypervisor is designed with isolation in mind as the hypervisor controls each guests' memory in separate partitions and only schedules guest CPU time therefore it isolates the guests by design. However, a type 2 hypervisor has the base operating system and guests running “together” thereby allowing a guest to take over not just another guest but the underlying operating system as well.



Type 1 Hypervisor – Infected Guest is Isolated from 3 other guests and hypervisor

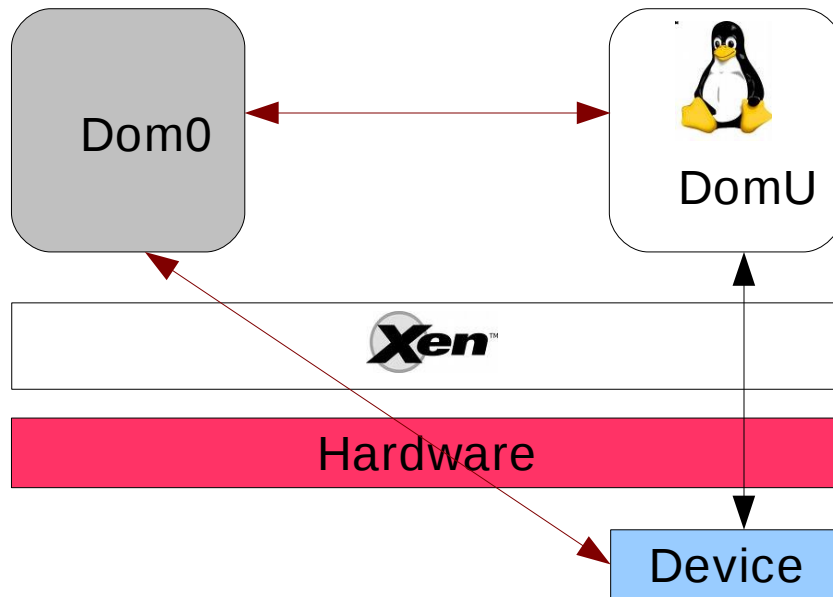


Type 2 Hypervisor – Infected Guest has Direct access to OS and Hypervisor

Performance

A recent feature in type 1 hypervisor development is the introduction of pass-thru; allowing a guest to directly interact with a specific device without any hypervisor overhead. This feature enables various guests to maintain direct hardware connections for fast and efficient data processing. A type 2 hypervisor is not able to provide this feature as all guest hardware requests are required to be processed by the base operating system

In the example below, the DomU is able to talk directly to the hardware without requiring any communication with the Dom0 thereby reducing the load on the Dom0 as well as reducing data transfer from the hardware to the DomU.



Type 1 Hypervisor – Pass-Thru (BLACK) vs Dom0 Controlled (RED)

Another important component in performance is the amount of overhead required by the hypervisor to manage the entire virtualized system. A type 1 hypervisor is able to minimize overhead as it handles CPU scheduling, hardware access, and memory access for the various guests running. A type 2 hypervisor is responsible for all these components but must also provide compute cycles for the base operating system running the entire virtualized environment.

Scalability

An important aspect of virtualization is what happens when a guest fails? In a type 1 hypervisor situation the failure of a single guest does not impact the entire machine as the hypervisor is able to un-schedule that guest and either restart it or “kill” it. Due to guest isolation, the failure of a guest does not impact the entire system. However, on a type 2 hypervisor, the failure of a guest could easily cascade within the system and bring down not just the other guests but also the primary operating system.

For more information on Type1 vs Type 2 Hypervisors:

- Wikipedia – Hypervisors - <http://en.wikipedia.org/wiki/Hypervisor>
- YouTube Video – Type 1 vs Type 2 Hypervisors - <http://www.youtube.com/watch?v=1YtRukUeg04>
- Webopedia – All About Hypervisors - http://www.webopedia.com/quick_ref/hypervisor.asp