



Operating Systems and Networks

Solutions 11

Assigned on: **9th May 2014**
Due by: **15th May 2014**

Virtual Machines

- a) *List all machine resources that must be virtualized and discuss why. List some uses of virtual machines.*

To a hypervisor, the different guest operating systems are like different untrusted user applications to a normal operating system. So any resource that needs to be protected from untrusted applications must be virtualized by the hypervisor such as memory, CPU, MMU, devices, network.

Virtualization has been used for server consolidation, better performance isolation, running legacy code, building & debugging operating systems, etc.

- b) *What is the difference between Native (type 1) and Hosted (type 2) virtual machines? Which might be more suitable for a data center (cloud provider) and which might be more suitable for your laptop?*

The native type virtual machines run on bare-metal. They are more suited for a cloud provider as there are fewer layers between the hardware and the application. Note that on these types of virtual machines, one guest OS is privileged (it can be used to configure the VM).

The hosted type runs on top of an existing operating system. This is more suited for your laptop. Your native OS is probably the one you use most regularly switching to the guest to run special cased software.

- c) *Discuss the differences between and the (dis)advantages of full- and para-virtualization.*

In full virtualization, guest OSes don't know (or shouldn't know) that they are running on virtual hardware rather than real hardware. In para-virtualization, guest OSes are aware of the virtualization layer.

In full-, guests need not be modified, whereas in para-, guests have to be modified. The modification of guest allows it to run more efficiently on virtual hardware.

- d) *Discuss the functionality of ballooning. What problem is it trying to solve and how does it solve it?*

Ballooning is used reclaim memory from guest OSes. Classical operating systems use the MMU to reclaim memory from applications. When the system runs low of memory, they reclaim paged memory from applications. When applications try to access it, they page fault and the memory is returned. In the absence of such hardware support, virtual machines use ballooning.

A balloon is installed on every guest OS. To reclaim memory from the guest, the balloon expands taking up memory from the guest and returning it to the hypervisor. To return memory to the guest, the balloon contracts.