5. Virtual machine

> An emulation of an existing computer/program/operating system. A computer OS running with another computer's OS.
> Using a software to implement a hardware setup

Host OS

- The operating system that is actually controlling the physical hardware
- The operating system for the physical hardware
- Guest OS is running under the host OS

Guest OS

- An operating system running in the virtual machine
- Controls virtual hardware
- OS being emulated

Hypervisor

> Virtual machine software that creates and runs virtual machine

- Software, not hardware
- Creates/deletes/manages virtual machine
- Translates the instruction used by the guest operating system to that required by the host operating system
- Hardware emulation
- Protects each virtual machine
    - So instances can be tested together

Benefits

- Multiple operating systems can exist simultaneously
- … allow for testing using the same hardware
- Only one set of hardware required
- … reduces cost of producing the app

- No need to set up more than one computer
- `--`
- Software can be tried on different OS using the same hardware
- No need to purchase all sorts of different software
- Easier to recover if the system issue causes the system to crash
- VM provides protection to other software
- `--`
- No need to acquire client hardware for testing
- Reduce set-up time for test system
- Common development system for all developers
- `--`
- They allow modern systems to use programs that run on obsolete or unsupported platform
- They allow platform independent program to run on multiple platforms
- They allow one computer to behave as several computers simultaneously
- They can be easily backed up, copied, and reinstalled.

Limitations

- Time and effort required for implementation
- Implementation would not offer the same level of performance that would be obtained in a normal system
- Expensive, complex to manage and maintain
- Execution of extra code, processing time increased
  - So cannot accurately test speed for real performance
  - Performance is degraded
- May not be able to emulate some hardware
  - So that the hardware cannot be tested using virtual machine
- `--`
- Virtual machine may not be able to emulate some hardware
- Virtual machine cannot directly access some hardware
- Using virtual machine means execution of extra code // processing time increased
- A virtual machine might not be as efficient // performance degraded
- Using a virtual machine increases the maintenance overheads

Role of virtual machine software

1. Create/delete virtual machines
2. translate instruction used by the guest operating system to that required by the host operating system
3. Existing hardware made available to guest OS // hardware emulation
4. Ensure each virtual machine is protected from actions from other virtual machines

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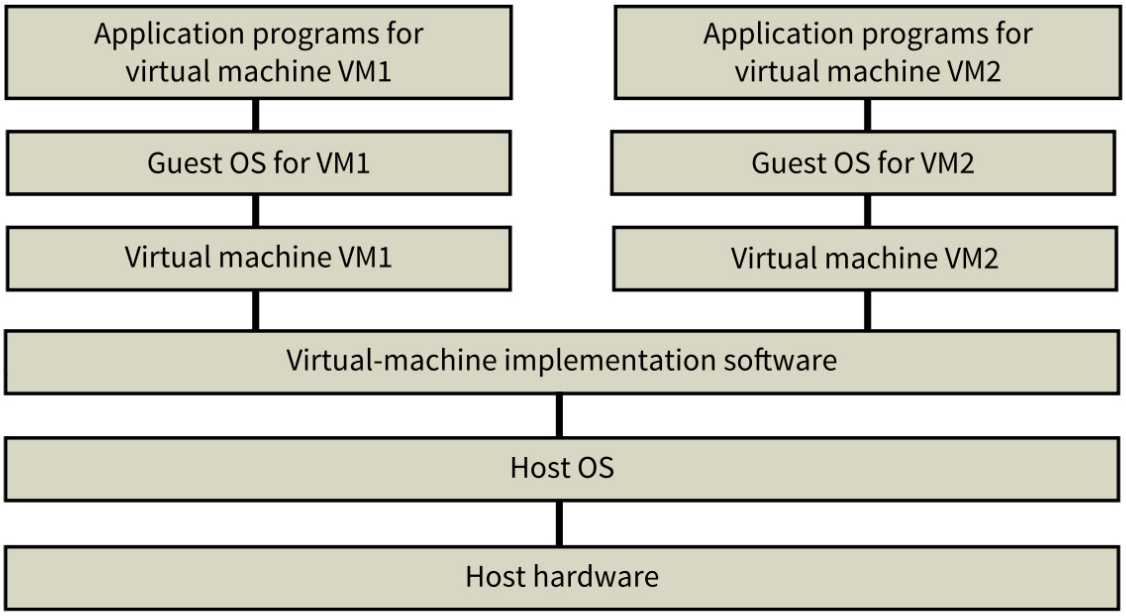

Figure 18.05 Logical structure for a system virtual machine implementation

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Past-paper questions

A virtual machine is a software/program that emulate a physical/different computer system; A virtual machine allow multiple guest operating system to run on one computer using host operating system

Describe what happens after the guest operating system has received the data request from the application:

- Guest OS handles the request as if it were running on its own physical machine
- Guest OS handles the request as usual
- I/O requests are translated by the virtual machine software
- Into instruction executable by the host OS

- Host OS retrieves the data from the file
- Host OS passes the data into virtual machine software
- The virtual machine passes the data to the guest OS
- Guest OS passes the data to the application