Solution of Exercise Sheet 9

Exercise 1 (Virtualization and Emulation)

1. What component of a computer distributes the physical resources to the virtual machines in the partitioning virtualization concept?

2. What is the difference between emulation and virtualization?

   Virtualization allows to split the resources of a computer system and to execute multiple independent operating system instances.

   Emulation allow the execution of an unmodified operating system, which is designed for a different hardware architecture (CPU).

3. Name a drawback of emulation against virtualization.

4. How works partitioning?

5. Which component of a computer system implements the partitioning functionality?

6. Which sort of computer systems usually implement partitioning?

   ☐ Mobile phones ☐ Desktop PCs ☐ Mainframes ☐ Workstations

7. How works application virtualization?

   Applications are locally executed inside a virtual environment, which uses local resources and provides all the components, which are required by the application. The VM is located between the executed application and the operating system.

8. Name an example for application virtualization.

   Examples are the Java Virtual Machine and VMware ThinApp.

9. How works full virtualization?

10. What is the function of the Virtual Machine Monitor (VMM)?

    The VMM distributes hardware resources to VMs.

11. Where runs the Virtual Machine Monitor (VMM)?

    ☒ The VMM runs *hosted* as an application in the host operating system.
    ☐ The VMM runs *bare metal* and replaces this way the host operating system.

12. Can all physical hardware resources be virtualized when full virtualization is used? If this is not possible, give an example where it does not work and explain your answer.

    Some hardware components are emulated, because they are not designed for the concurrent access from multiple operating systems. Example: Network adapters.

13. How many privilege levels contain x86-compatible CPUs?

14. In which privilege level runs the VMM?

15. In which privilege level run the VMs?

16. How get VMs access to hardware resources when full virtualization is used?

17. Name an example of a full virtualization implementation.

18. How works paravirtualization?

19. Where runs the hypervisor when paravirtualization is used?

    ☐ The hypervisor runs *hosted* as an application in the host operating system.
    ☒ The hypervisor runs *bare metal* and replaces the host operating system.

20. In which privilege level runs the hypervisor when paravirtualization is used?

21. Why is for paravirtualization a host operating system required?

    A host operating system is required because of the device drivers.

22. What is an unprivileged domain (Dom0) of Xen?

23. What is a Domain 0 (Dom0) of Xen?

24. Name a drawback of paravirtualization.

25. In which way have the privilege levels of x86-compatible CPUs been modified to implement hardware virtualization?

26. Name an advantage of hardware virtualization.

27. How works storage operating system-level virtualization (containers/jails)?

28. Name a drawback of operating system-level virtualization (containers/jails).

    Only independent instances of the same operating system are started. It is impossible to start different operating systems at the same time because all virtual environments use the same kernel.

29. Name an example of an operating system-level virtualization (containers/jails) implementation.

30. How works storage virtualization?
31. How works network virtualization via Virtual Local Area Networks (VLAN)?