Processes

Overview

- Threads vs Processes
- Clients
- Servers
- Virtualization
- Code Migration

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- Light-Weight Processes (LWP): Hybrid model. Multiple LWP/threads run inside a single (heavy-weight) process. In addition, the system offers a user-level threads package.

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- Characteristics of server implementations.

Model	**Characteristics**
Single-threaded	No parallelism, blocking system calls
Multi-threaded	Parallelism, blocking system calls
Finite state machine	Parallelism, nonblocking system calls

- See example LargerHttpd.java in folder `sockets` in package `tcp.largerhttpd`.

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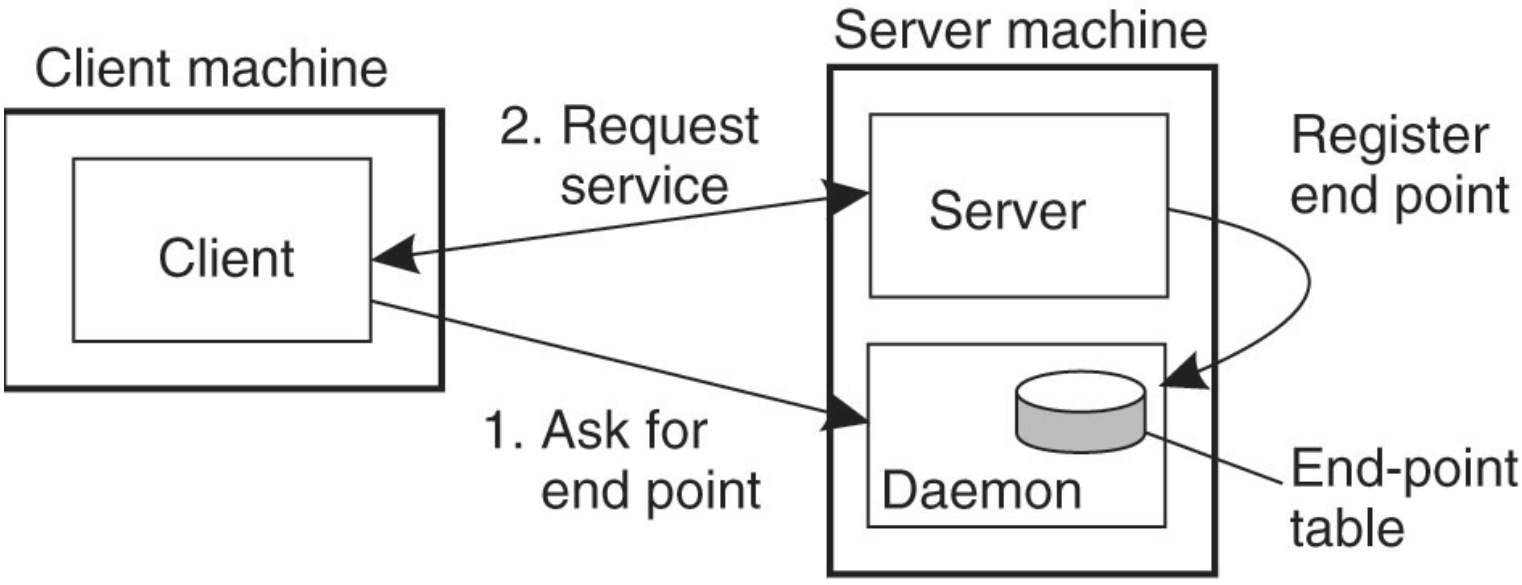
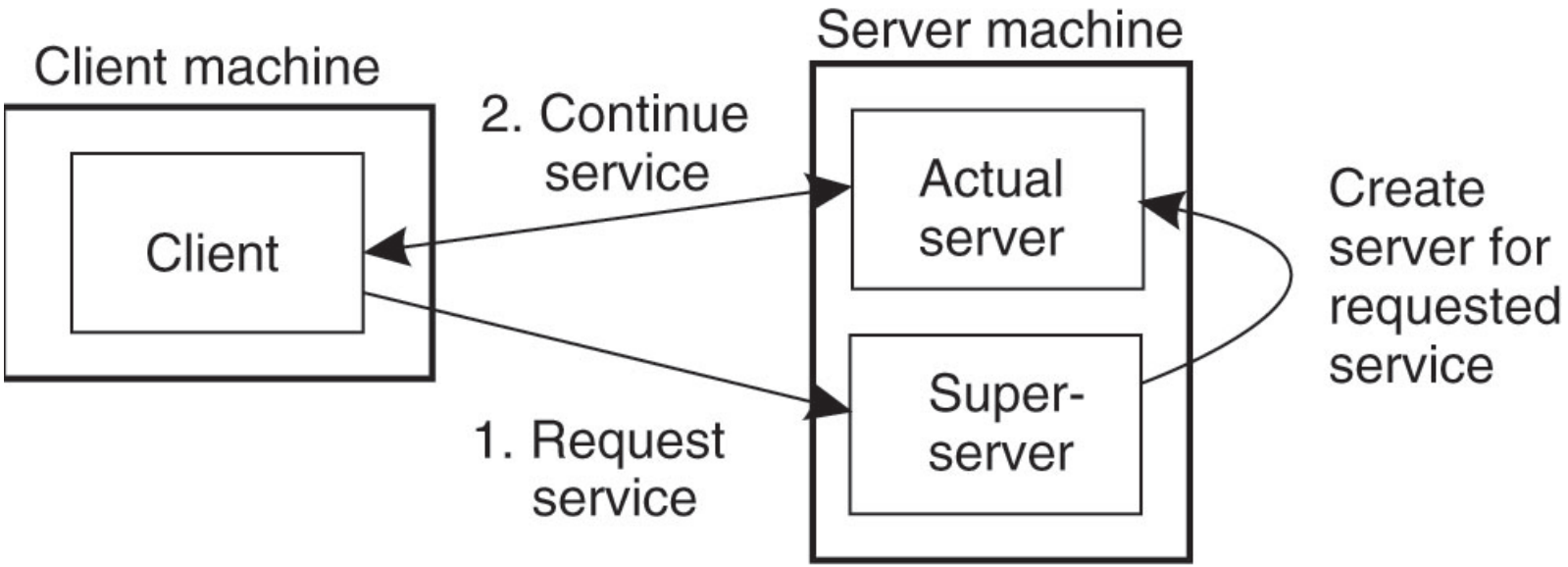
  - Look-up service provided by a special directory/registry server.
  - Using a superserver that selects on multiple ports and forks off the appropriate server when a request comes in.

Directory/Registry Server Setup



SuperServer Setup



`xinetd` is an example of a superserver

Design Issues for Servers (3)

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- Soft State servers: The server promises to maintain state on behalf of the client, but only for a limited time.

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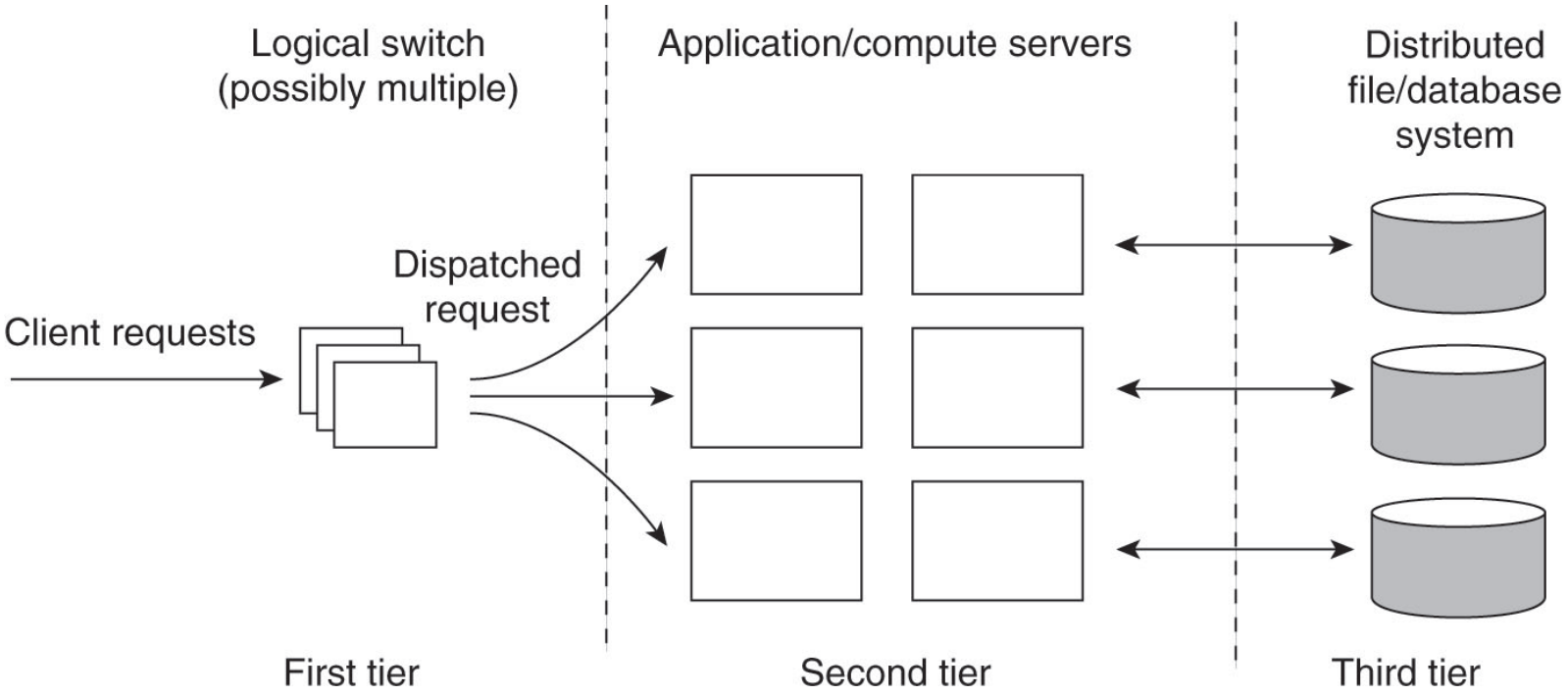
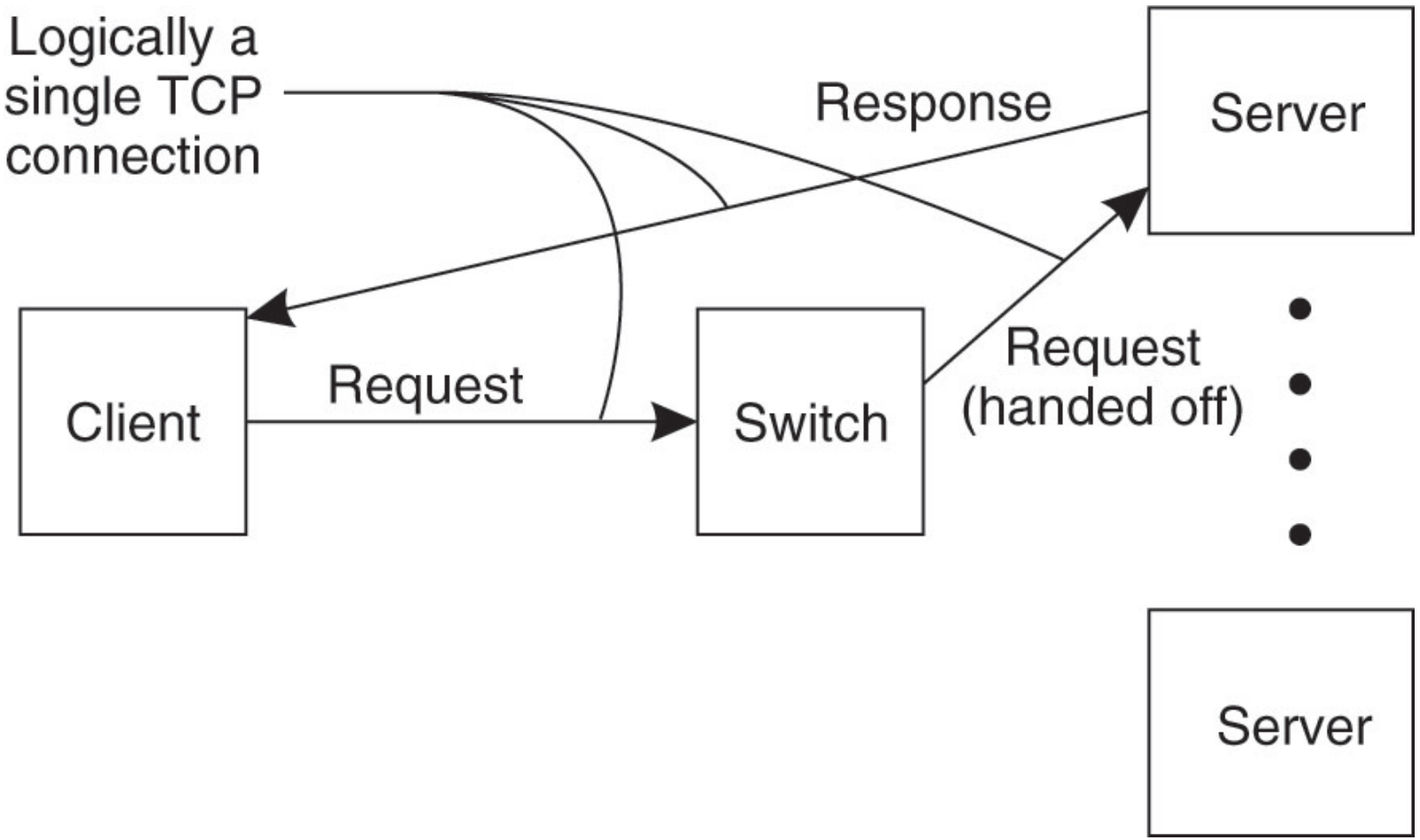
  - Server listens to separate endpoint, which has higher priority, while also listening to the normal endpoint (with lower priority).
  - Send urgent data on the same connection. Can be done with TCP, where the server gets a signal (`SIGURG`) on receiving urgent data.

Server Clusters (1)



Design of a Three-tiered Server Cluster

Server Clusters (2)



TCP Handoff (uses IP forwarding and IP spoofing)

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- Switch can handoff request by being aware of the content
- Single point of access can be made better using DNS to map one hostname to several servers. But the client still has to try multiple servers in case some are down.

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  - route optimization from MPIv6 is used to make different clients believe they are communicating with a single server where, in fact, each is communicating with a different member node of the distributed server

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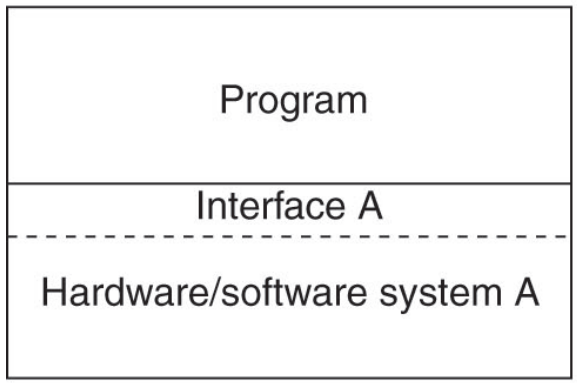
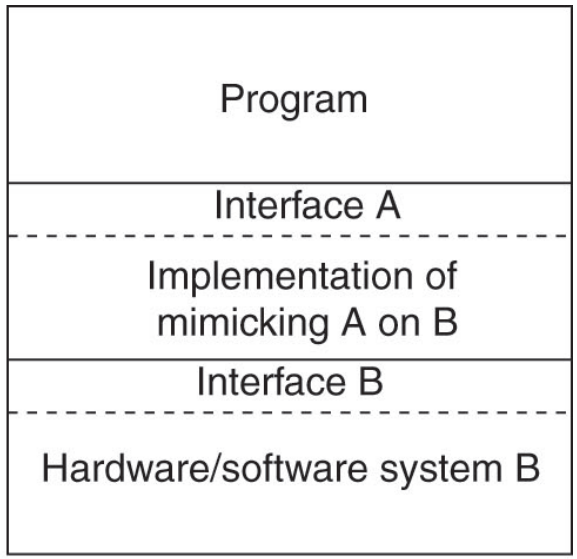


(a)



(b)

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- The main driver behind the growth in cloud computing and utility computing.

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- An interface consisting of library calls generally forming what is known as an application programming interface (API). In many cases, the aforementioned system calls are hidden by an API.

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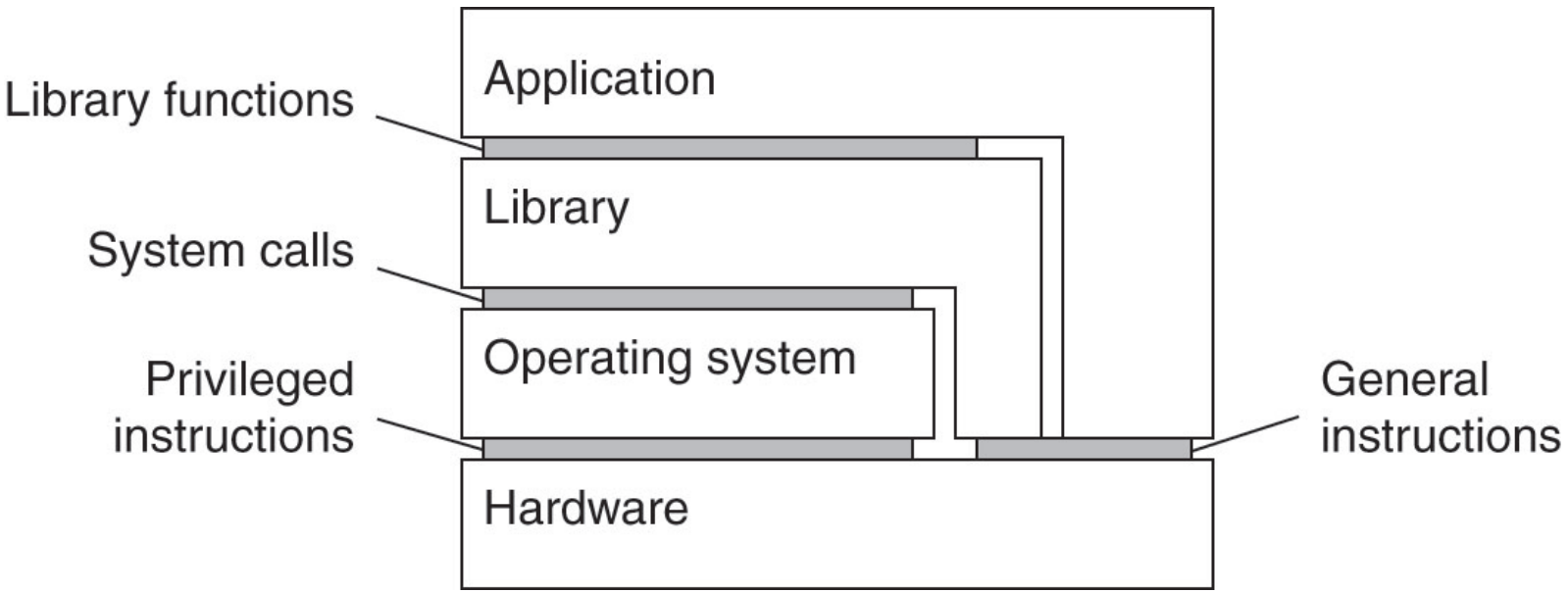

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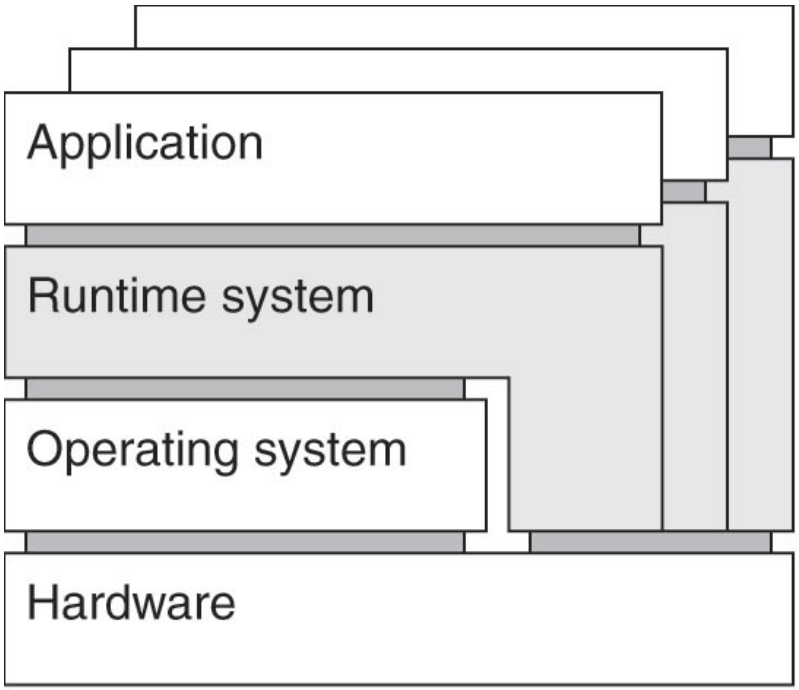

- Process Virtual Machine: An abstract instruction set that is to be used for executing applications. For example: Java Virtual Machine.

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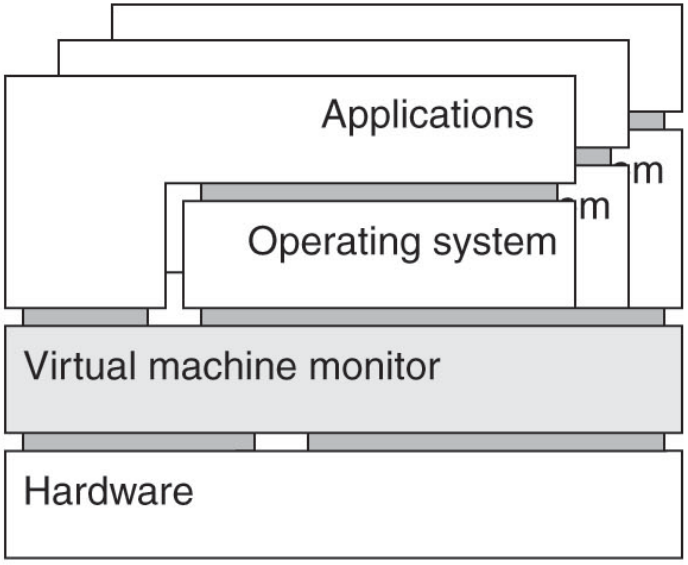

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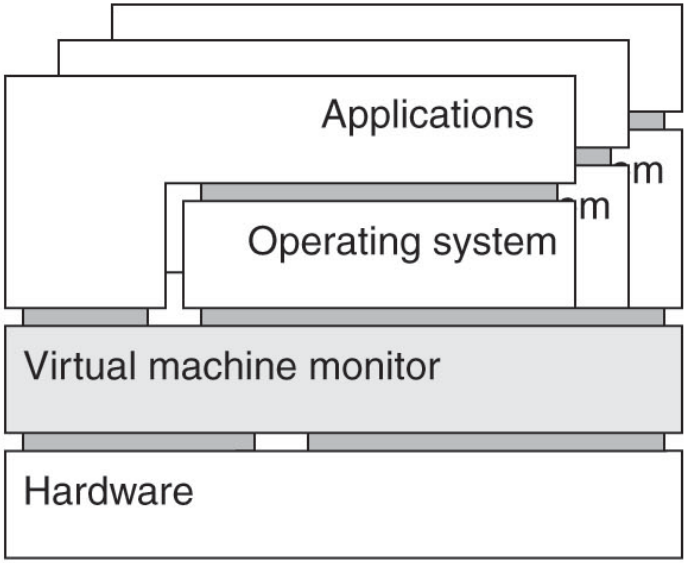

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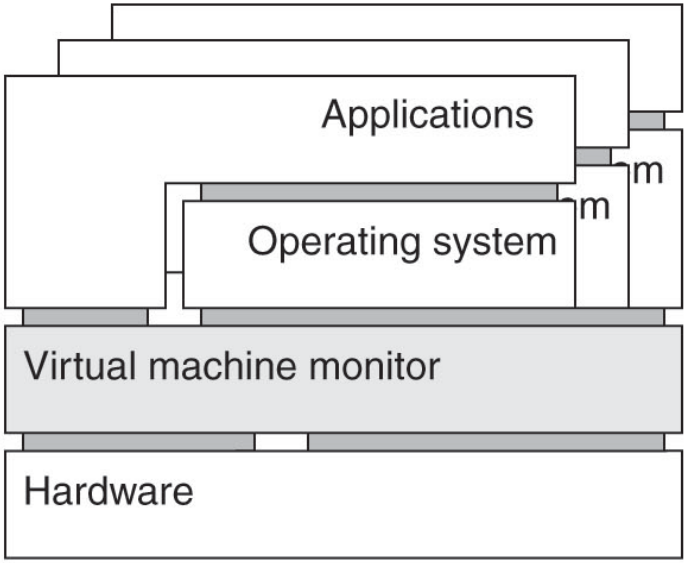

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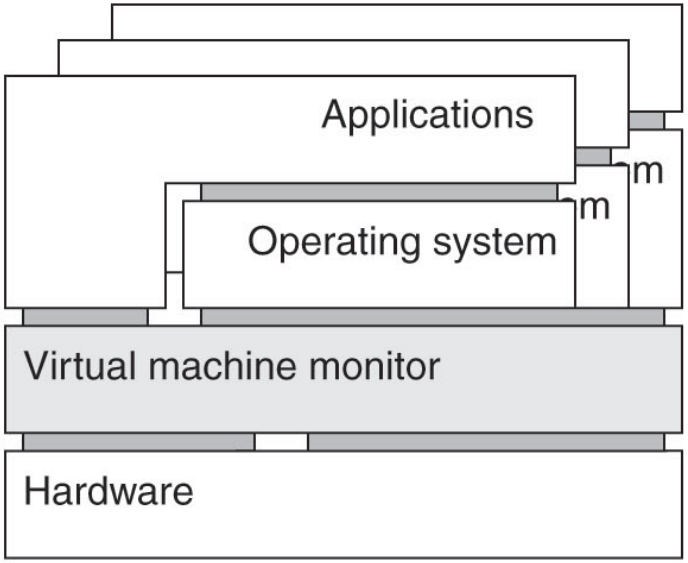

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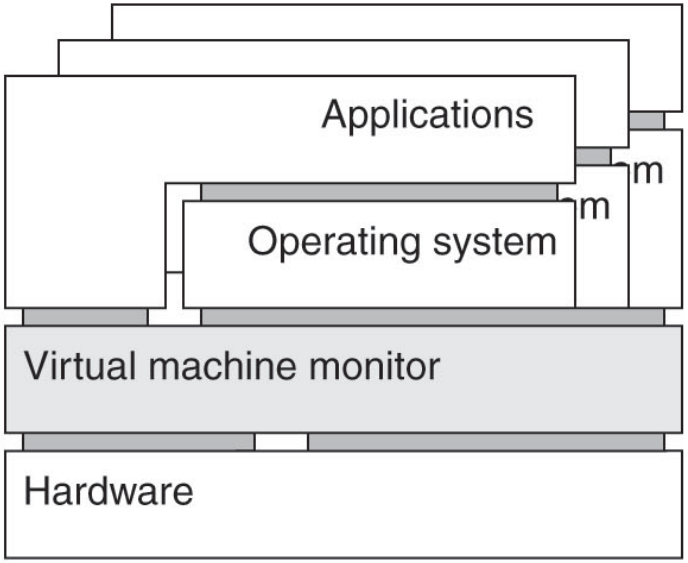

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- Microkernel Examples: Hyper-V, VMWare ESX/ESXi, Xen, z/VM.

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- Containers (Environment-level). Examples: *cgroups*-based Docker and LXC (Linux Containers). Lighter weight compared to Virtual Machine Monitors.

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- Is a server that maintains a TCP/IP connection to a client stateful or stateless?
- Imagine a web server that maintains a table in which client IP addresses are mapped to the most recently accessed web pages. When a client connects to the webserver, the server looks up the client in its table, and if found, returns the registered page. Is the server stateful or stateless?