MODULE 9: Software Systems and Tools

Lecture 9.2
Protected Environments

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Lecture 9.2 Objectives

- Describe the motivation for protected environments in computing systems

- Describe key features of virtual machine environments

- Describe why attention has turned to (returned to) virtual machines and server-based computing

- Describe key features of the use of subsystems and partitions to create protected environments

Protected Environments

- Operating systems need to support protected environments

  - Protect operating system from programs

  - Protect programs from each other

- Resource sharing is also essential

  - Ensure proper authorization

  - Manage contention

- Approaches

  - Virtual machines (VMs)

  - Subsystems

 - Partitions

Virtual Machines

- Virtual machines present a full computer environment for applications or a full operating system

- A controlling program manages the virtual machines

- The controlling program interfaces with the operating system (OS) to manage the VMs and their use of shared resources

- Examples

  - Virtual Machine Manager (VMM) in Microsoft Windows to create a 16-bit x86 environment for MS-DOS

  - Java Virtual Machine (JVM) realized by the Java Runtime Environment (JRE)

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Many Virtual Machines on a Single Host
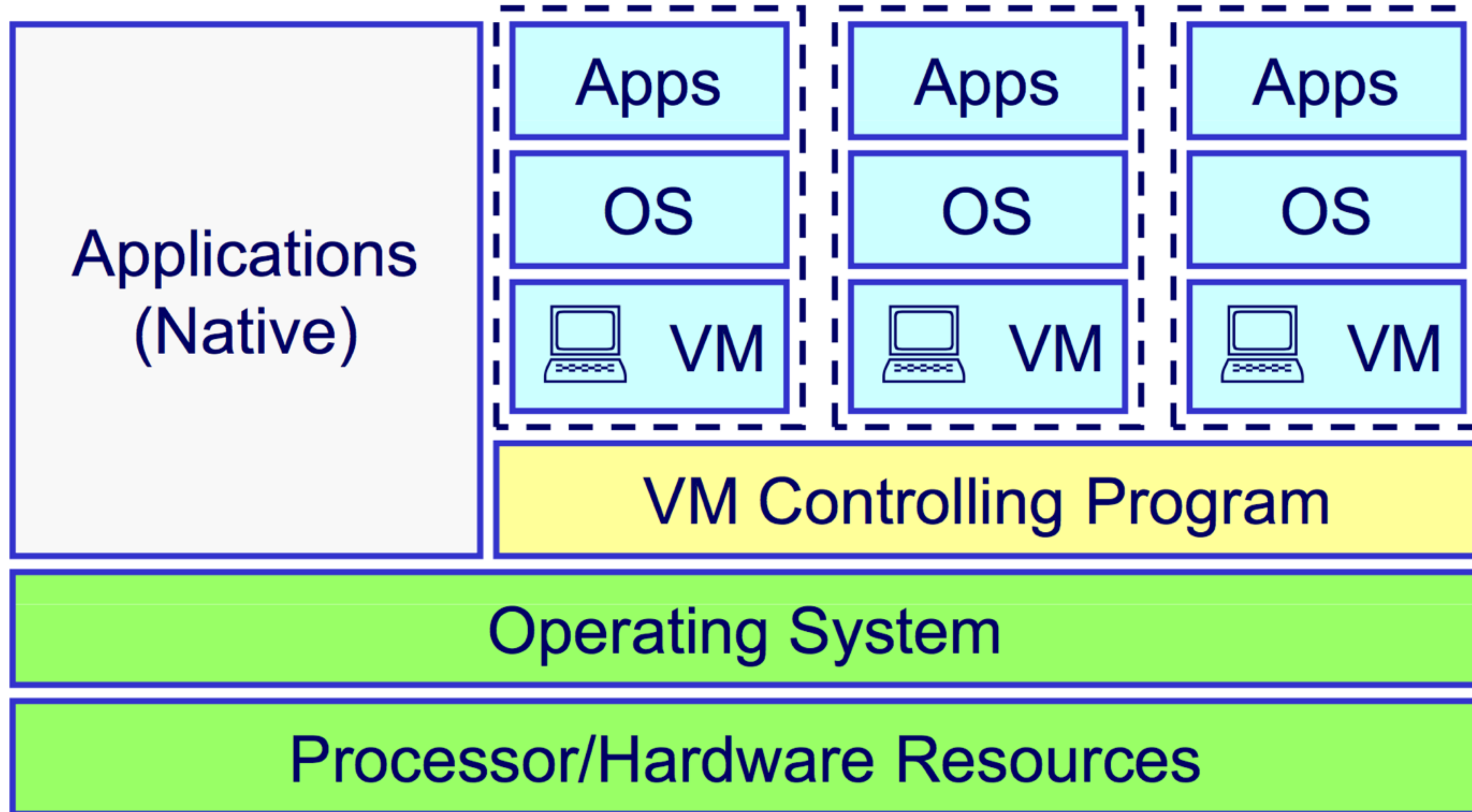
Evolution Leading to Virtual Machines

Early Computing → **Multi-User Computing** → **Personal Computing** → **Virtual Machine Computing**

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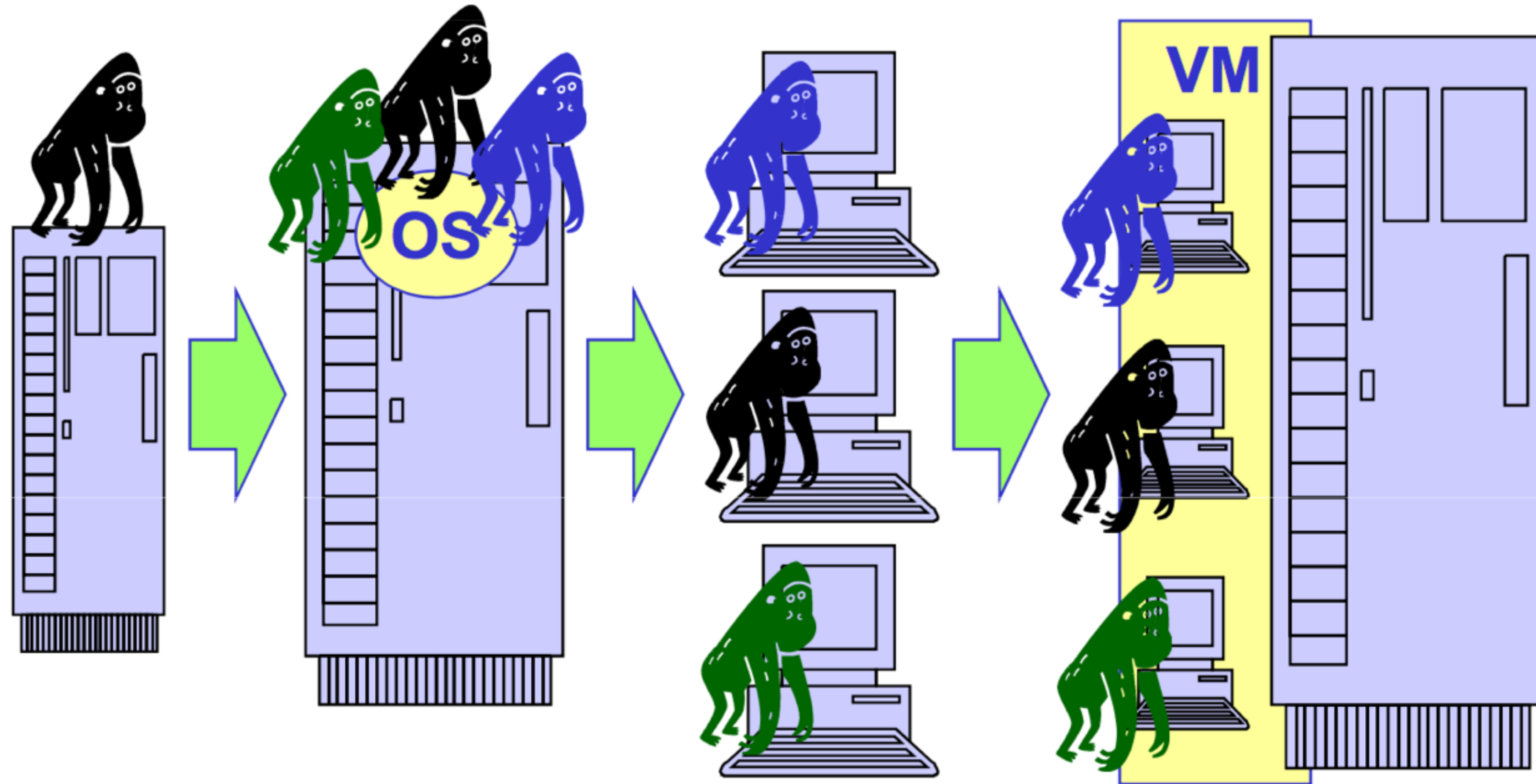
Evolutionary Factors Leading to VMs

- Problems with PC-based computing

  - System management (configuration, security, etc.)

  - Software management and cost

  - Relatively slow and small storage systems

- Technological advances enabling

  - High-capacity networks

  - High-capacity storage systems (storage area networks)

  - Fast, capable, and (relatively) low-cost computers

  - Client-server technology (especially the web), leading to "server farms"

  - VM technology itself

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CHECK POINT

As a checkpoint of your understanding, please pause the video and make sure you can do the following:
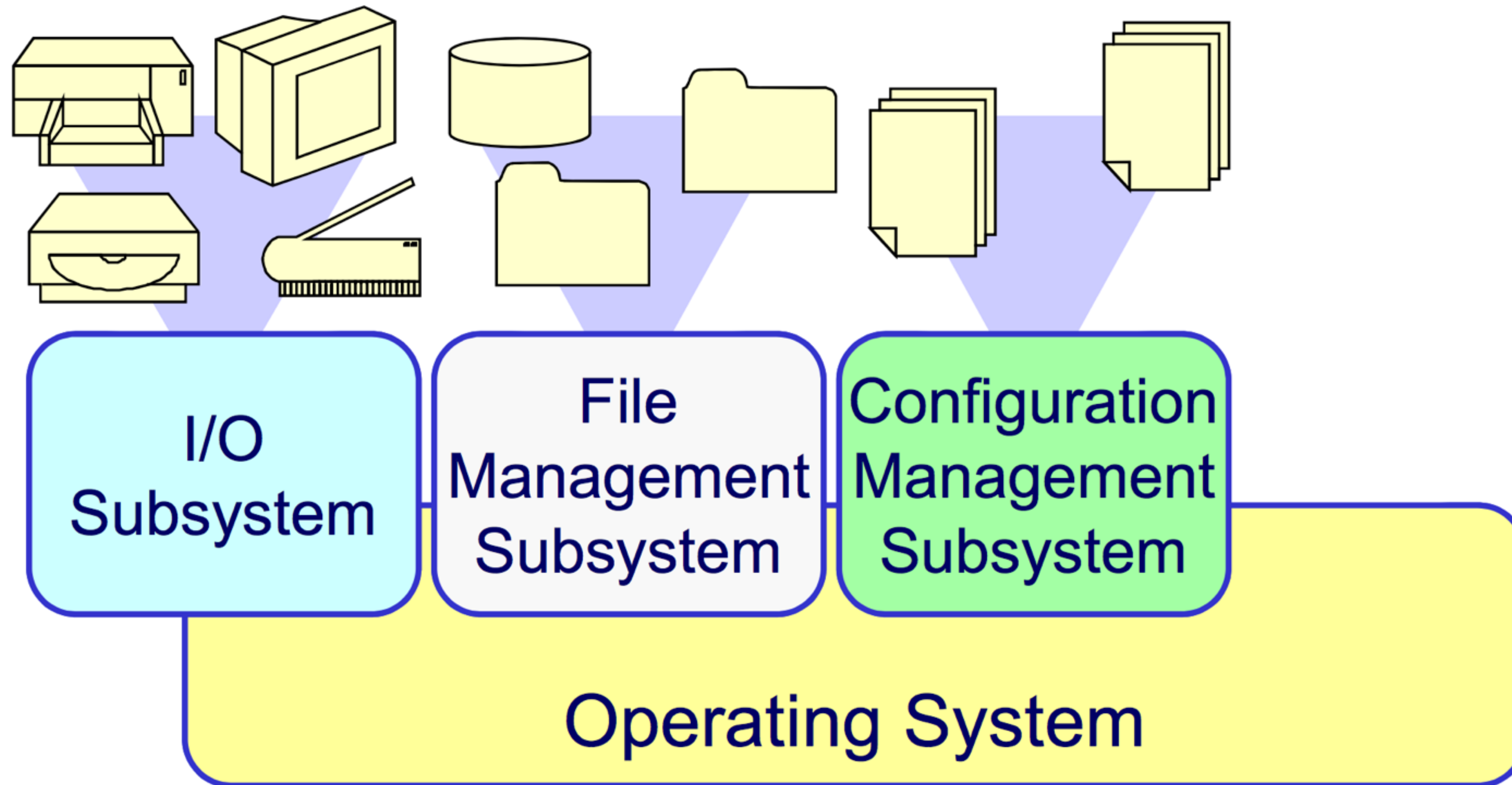
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Subsystems

- A subsystem is an environment, running on top of an operating system, that can be individually configured and managed

- Resources can be assigned to one or more subsystems

- The operating system accesses these assigned resources through the subsystem, not directly

- Subsystem operation – and failures – are isolated from the operating system and other subsystems

- Fundamentally, subsystems partition the larger system into smaller, more manageable components to deal with complexity

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Subsystems (continued)

I/O Subsystem

File Management Subsystem

Configuration Management Subsystem

Operating System

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Partitions

- Partitions further segment a computer system's resources beyond what is provided by subsystems

- Resources are assigned to partitions (perhaps subsystems)

- Resources in one partition are not accessible from another partition

    - Full separation of resources

    - Virtually as though the resources are attached to different physical computers

    - There are sharing mechanisms, such as pipes, much as there are ways to share resources between different computers
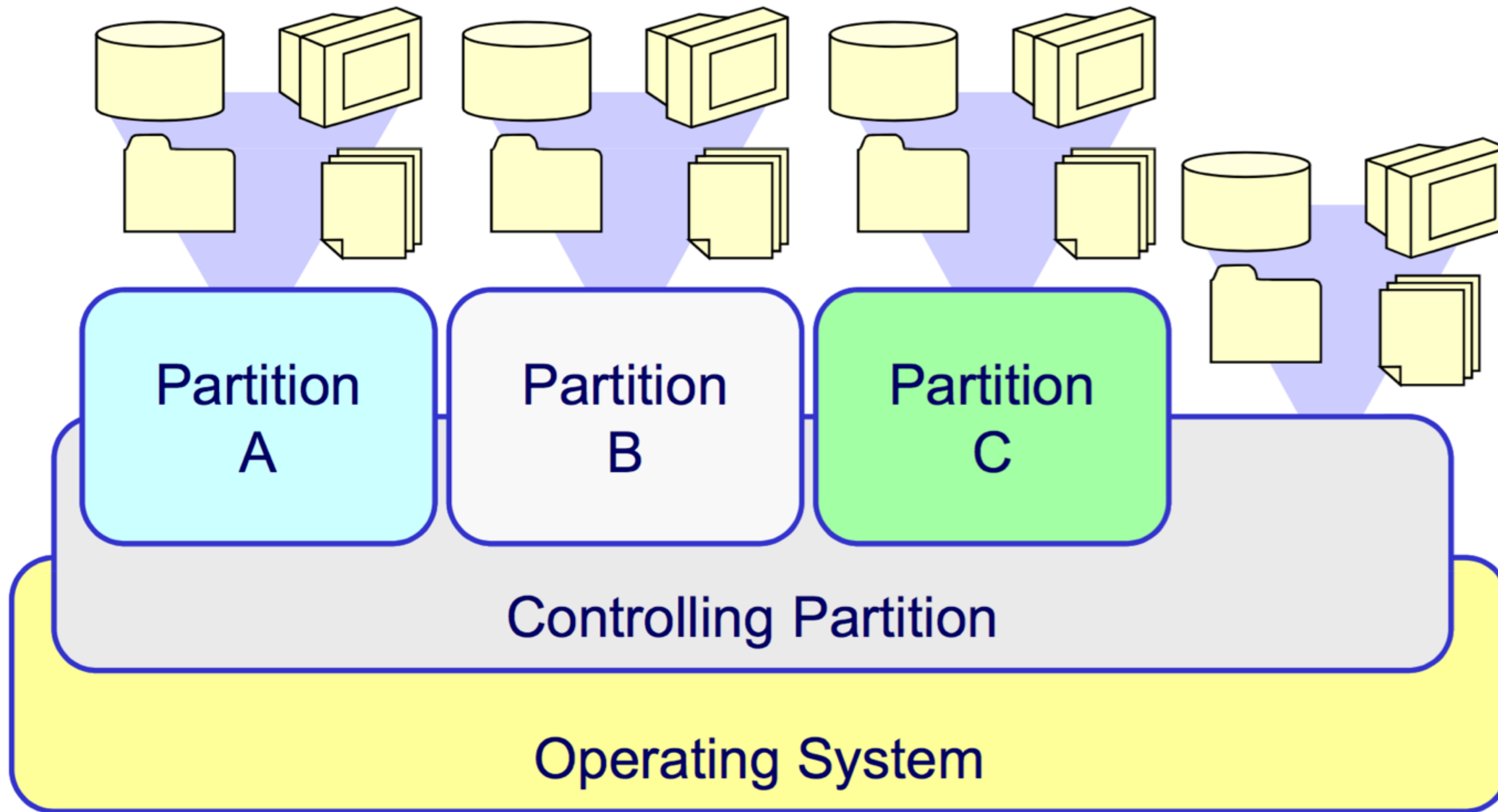
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Partitions (continued)

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Summary

- Virtual machines allow a processor and operating system environment to be created in software on top of another system

  - Allows multiple environments to run on a single PC

  - Allows multiple virtual PCs to be supported by a single larger computer system

- Subsystems partition a system functionally by imposing a hierarchy to reduce system complexity

- Partitions segment sets of resources, with limited access to resources across partitions

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