CLOUD COMPUTING APPLICATIONS

VIRTUALIZATION

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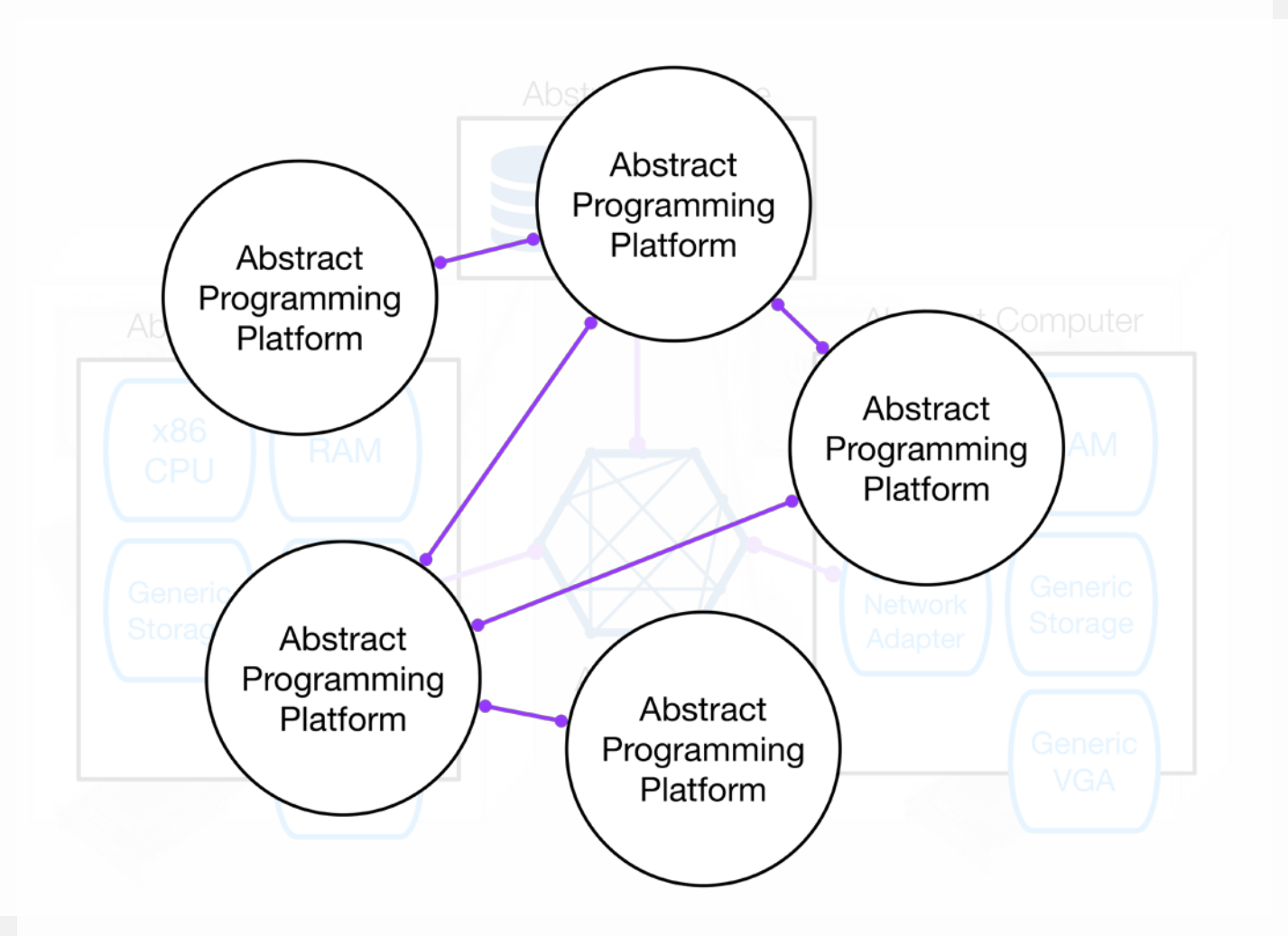
Sharing Resources

- Economics of Clouds requires sharing resources
- How do we share a physical computer among multiple users?
- Answer: Abstraction
  - Introduce an abstract model of what a generic computing resource should look like
  - The physical computer resource then provides this abstract model to many users

Layers of Abstraction



- Introduce an abstract model of what a generic computing resource should look like
- The physical computer resource then provides this abstract model to many users
- Virtualization avoids creating dependencies on physical resources

Virtualization: Foundation of Cloud Computing

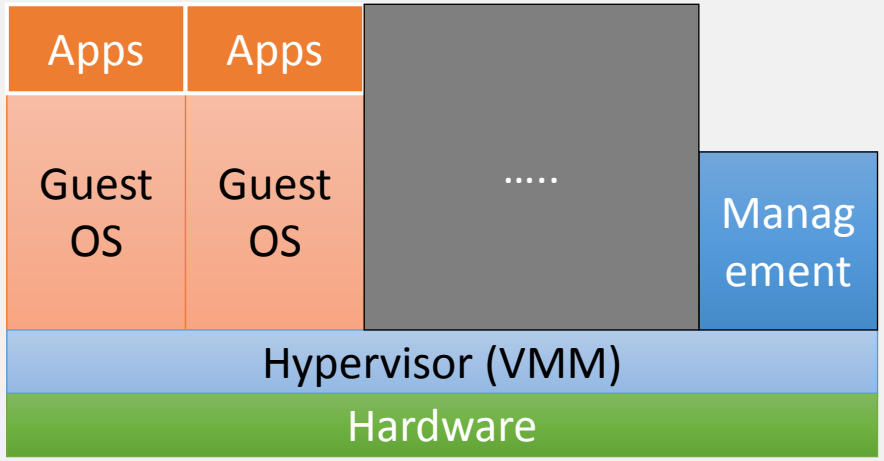
- Virtualization allows distributed computing models without creating dependencies on physical resources
- Clouds are based on Virtualization
  - offer services based mainly on virtual machines, remote procedure calls, and client/servers
  - provide lots of servers to lots of clients (e.g. phones)
- Simplicity of use and ease of programming requires allowing client server paradigms to be used to construct services from lots of resources

Types of virtualization

- Native, full
- Hardware assisted
- Para-virtualization
- OS level
  - Containers
  - Jails
  - Chroot
  - Zones
  - Open-VZ → Virtuozzo

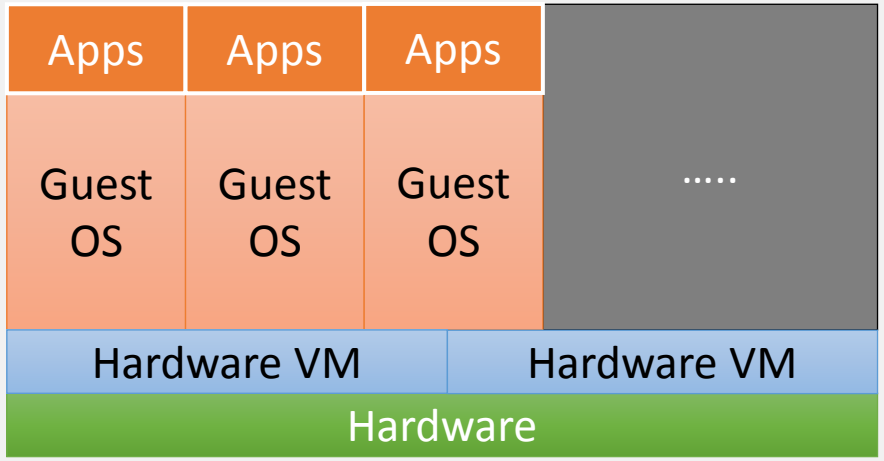
Native and Full Virtualization

- the virtual machine simulates enough hardware to allow an unmodified "guest" OS (one designed for the same CPU) to be run in isolation.
- Examples:
  - VirtualBox
  - Virtual PC
  - Vmware
  - QEMU



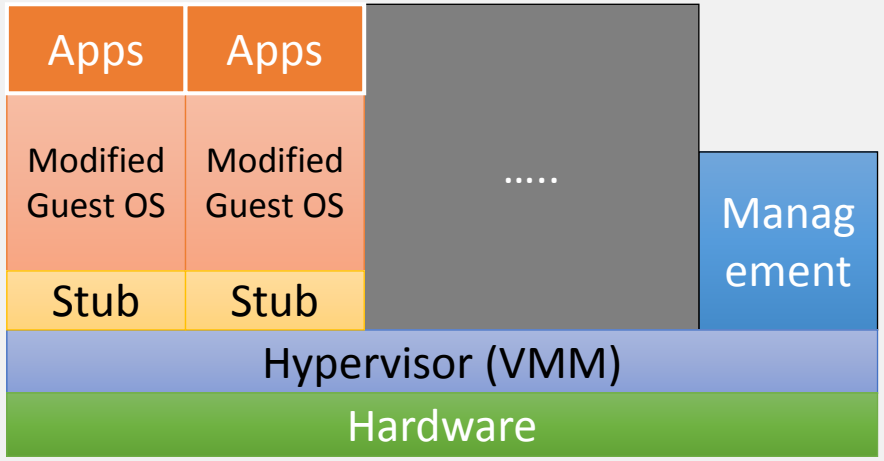
Hardware enabled virtualization

- the virtual machine has its own hardware and allows a guest OS to be run in isolation.
- Intel VT (IVT)
- AMD virtualization (AMD-V)
- Examples:
  - VMware Fusion
  - Parallels Desktop for Mac
  - Parallels Workstation



Paravirtualization

- the virtual machine does not necessarily simulate hardware, but instead (or in addition) offers a special API that can only be used by **modifying** the "guest" OS.
- Examples:
  - XEN



Operating system-level virtualization

- virtualizing a physical server at the operating system level, enabling multiple isolated and secure virtualized servers to run on a single physical server.
- Examples:
  - Linux-Vserver
  - Solaris Containers
  - FreeBSD Jails
  - Chroot
  - CGroups