

CS351 - Cloud Computing

Lecture #3



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Service and deployment models

Service models	Deployment models
Software-As-A-Service (SaaS)	Public
Platform-As-A-Service (PaaS)	Private
Infrastructure-As-A-Service (IaaS)	Hybrid

SPI (SaaS, PaaS, IaaS)

Model	Cloud Service Provider (CSP) will provide	E.g.
SaaS	Application hosting, updates, Internet delivery/access to app, data partitioning	Google Docs, Overleaf
PaaS	Browser-based software IDE (development, test, production), integration with external web services and databases, deploys customer apps on provider platform	Google App Engine, Salesforce.com, Microsoft Azure
IaaS	Infrastructure (server/VM, storage, network etc.) that can run arbitrary software	Amazon S3 and EC2, Rackspace

Public, Private, Hybrid

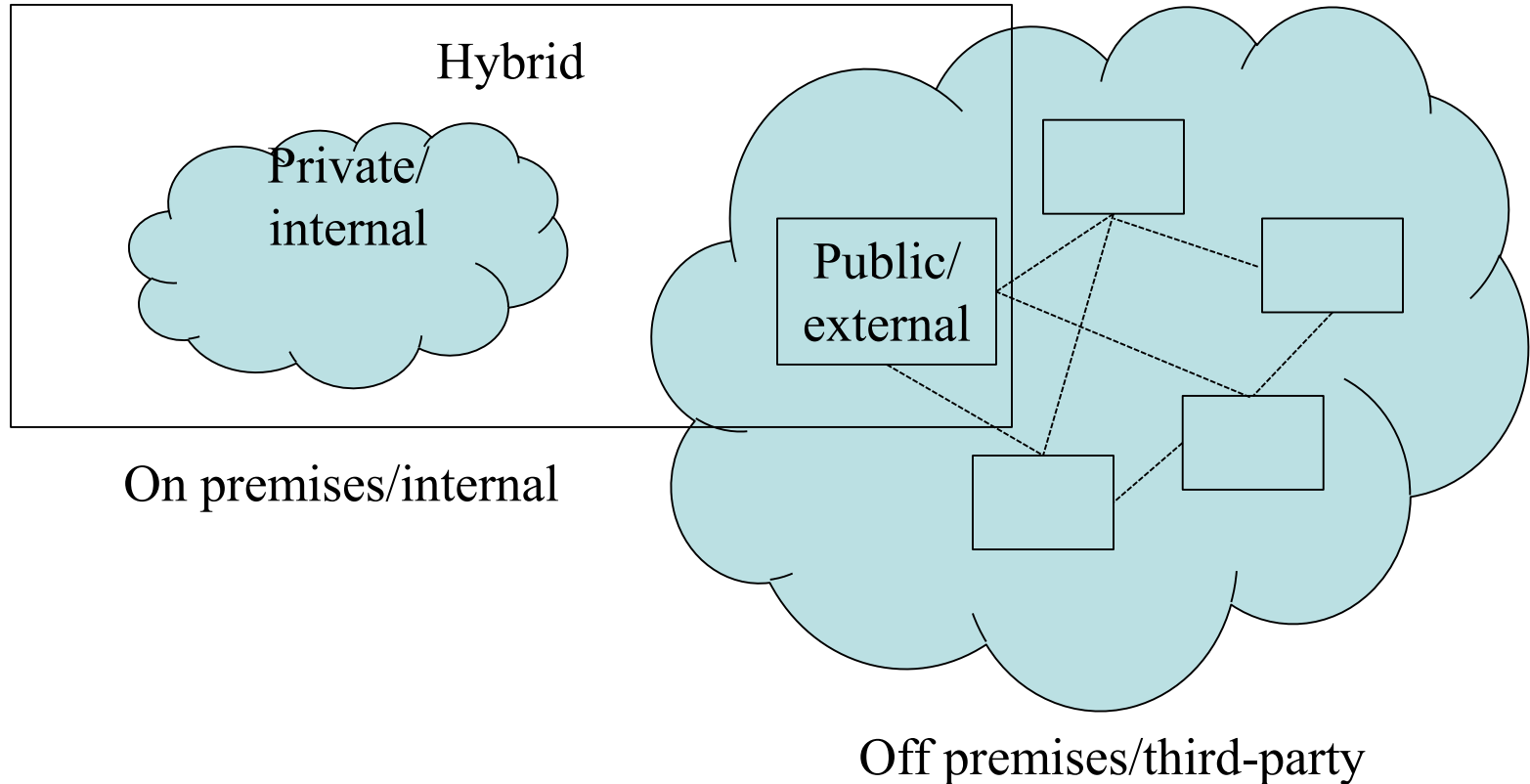


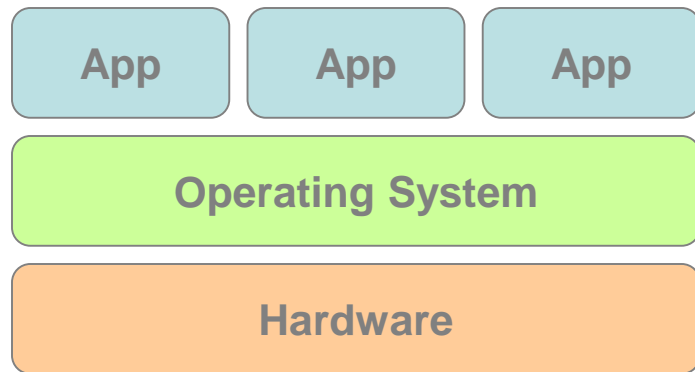
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VIRTUALIZATION

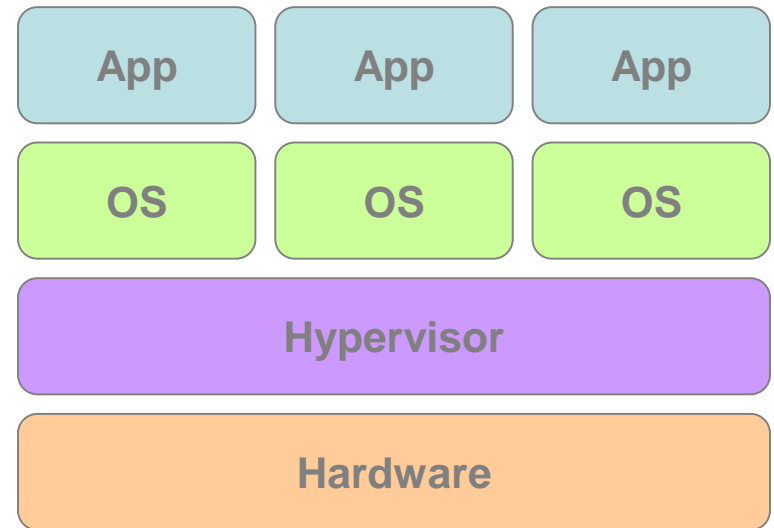
Platform Virtualization

- ◆ Emulation or simulation
- ◆ Native virtualization and full virtualization
- ◆ Hardware enabled virtualization
- ◆ Partial virtualization
- ◆ Paravirtualization
- ◆ Operating system-level virtualization
- ◆ Application Virtualization

Key Technology: Virtualization



Traditional Stack



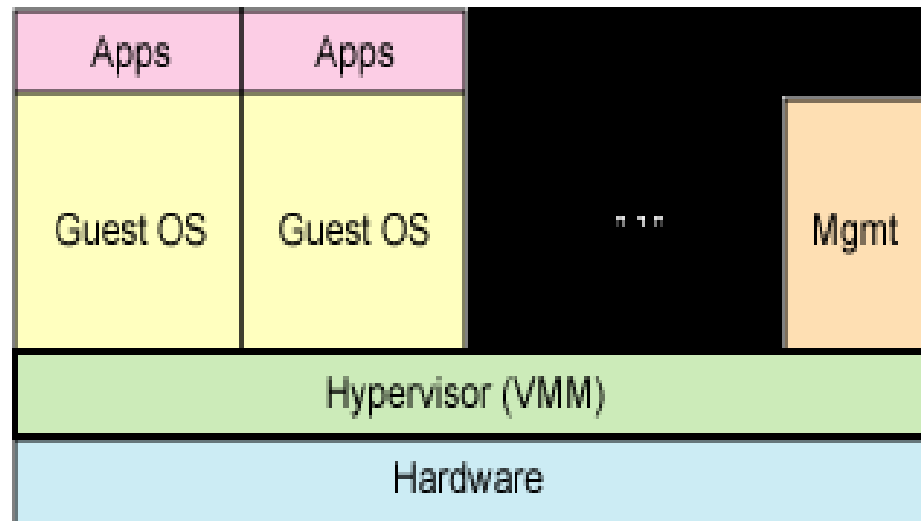
Virtualized Stack

Emulation or simulation

- allowing an unmodified "guest" OS for a completely different CPU to be run.
- Examples:
 - Bochs
 - PearPC
 - VirtualPC
 - QEMU(without acceleration)

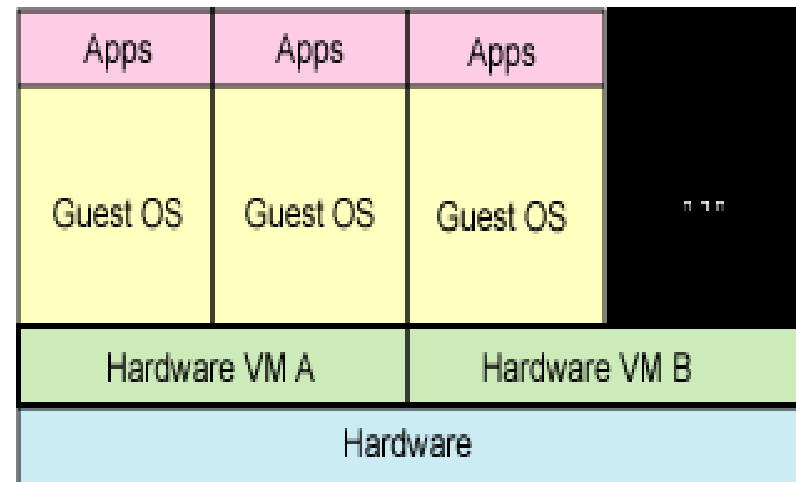
Native and Full Virtualization

- 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
 - Win4Lin
 - XEN/Virtual Iron



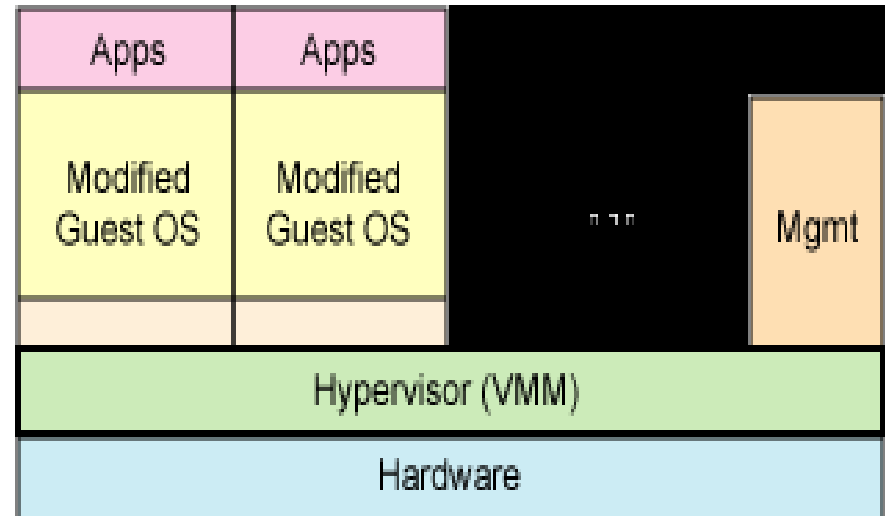
Hardware enabled virtualization

- 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



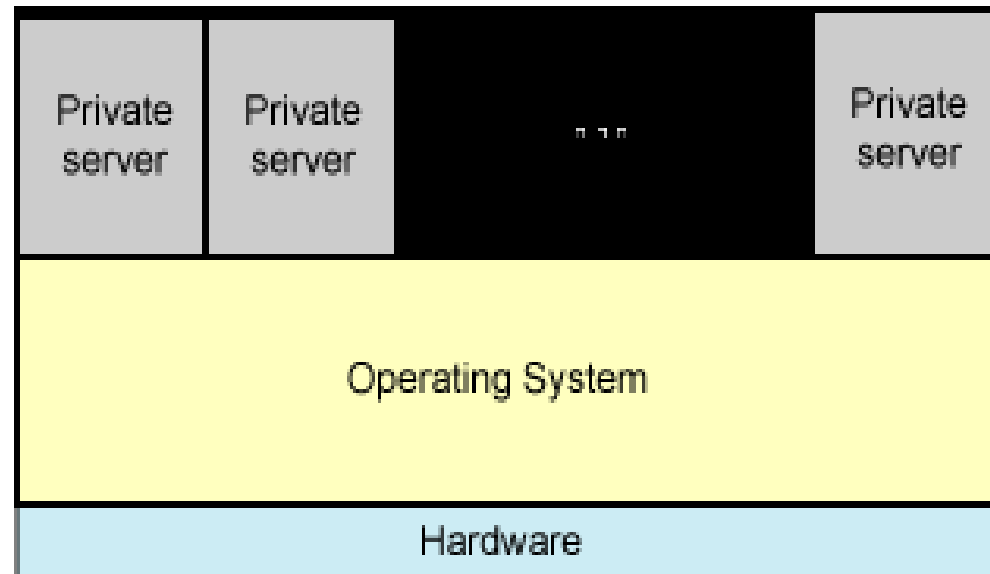
Paravirtualization

- 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.
- Terminologies
 - Hypervisor, hypercall
 - Enomalism
- Examples:
 - XEN, KVM, Win4Lin 9x



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:
 - Parallels Workstation
 - Linux-VServer
 - OpenVZ, Virtuozzo
 - Solaris Containers
 - FreeBSD Jails
 - Chroot ?



CHALLENGES

Control, liability and accountability

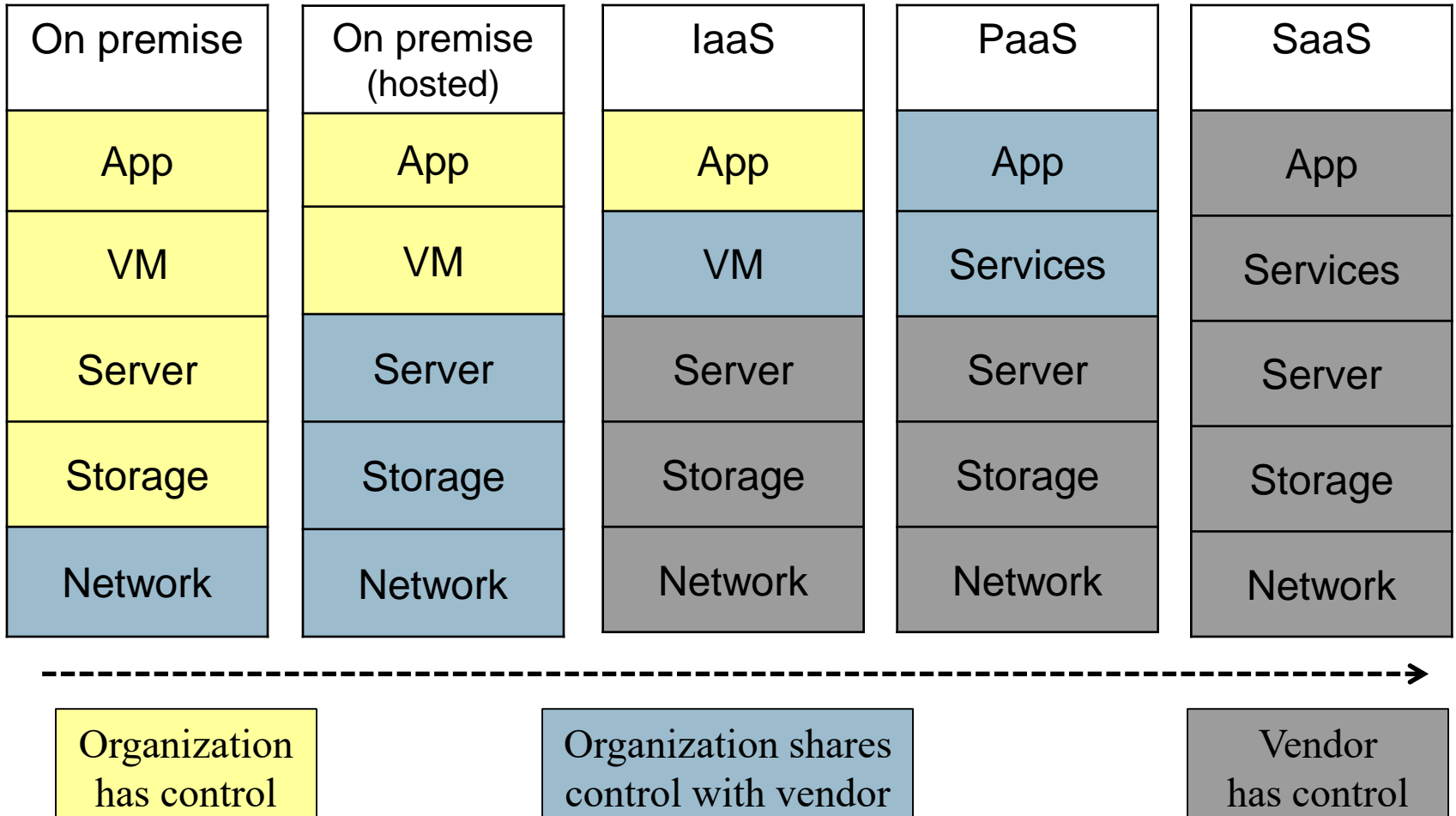
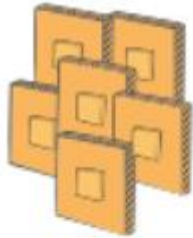


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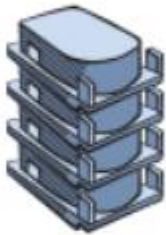
Challenges in using the cloud

- Security
- Privacy
- Compliance

Amazon Web Services (AWS)



Compute
Amazon EC2



Storage
Amazon S3



Database
DynamoDB

- Elastic Cloud Compute (EC2)
“Virtual Servers in the Cloud”
- Simple Storage Service (S3)
“Scalable Storage in the Cloud”
- DynamoDB
“Fast, Predictable, Highly-scalable
NoSQL data store”
- Other services ...



Availability

- Why is this important?
 - “Amazon Web Services suffers outage, takes down Vine, Instagram, others,” Aug 26, 2013*
- E.g. AWS features
 - Distributed denial of service (DDoS) protection
 - Fault-tolerant, independent failure zones

Access control

- Who should have access?
 - To VM, app, services etc.
 - Users, admin, business admin, others?
- E.g. AWS features
 - Built-in firewalls control access to instances
 - Multi-factor authentication: password + authentication code from MFA device
 - Monitor AWS employee accesses

Monitoring

- Monitor
 - Availability, unauthorized activities etc.
- E.g. AWS features
 - DoS, MITM, port scan, packet sniffing
 - Password brute-force detection
 - Access logs (request type, resource, IP, time etc.)