

National University of Computer & Emerging Sciences

Lecture – 04

Service models, IaaS and
virtualization

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Assignment-01

- Due by the end of this week, that is Friday, 6th September, 2013.
- Summary should be in your own words and should be at-least one page for each paper.

Assignment (Activity)-0.02

A Survey of Virtualization on Mobiles

Suneeta Chawla, Apurv Nigam, Pankaj Doke, Sanjay Kimbahune

Communications in Computer and Information Science Volume 191, 2011, pp 430-441

NoHype: Virtualized Cloud Infrastructure without the Virtualization

Eric Keller Jakub Szefer Jennifer Rexford Ruby B. Lee

Princeton University, Princeton, NJ, USA

Virtualized Networks for Cloud Computing: state-of-the-art and open challenges

<http://www2.icmc.usp.br/~denis/files/T5.pdf>

OR

Survey of Server Virtualization

(IJCSIS) International Journal of Computer Science and Information Security, Vol.11, No. 3, 2013

Service and deployment models

- Three service models
- Four deployment models

Service and deployment models

- Three service models
- Four deployment models



A Simple Analogy

Say, you just moved to a city and you are looking for a place to live.



What is your choice ?

Build a new house ?
Buy an empty house ?
Live in a hotel ?



Let's built a new house !!

You can fully control everything your like your new house to have. But that is a hard work ...



If you buy an empty house ?



You can customize some part of your house. But never change the original architecture.

How about live in a hotel ?

Live in a hotel will be a good idea if the only thing you care is enjoy your life!!
There is nothing you can do with the house except living in it.



**Let's translate to
Cloud Computing !!**

Service Models Overview

- What if you want to have an IT department ?
 - Similar to ***build a new house*** in previous analogy
 - You can rent some virtualized infrastructure and build up your own IT system among those resources, which may be fully controlled.
 - Technical speaking, use the ***Infrastructure as a Service (IaaS)*** solution.
 - Similar to ***buy an empty house*** in previous analogy
 - You can directly develop your IT system through one cloud platform, and do not care about any lower level resource management.
 - Technical speaking, use the ***Platform as a Service (PaaS)*** solution.
 - Similar to ***live in a hotel*** in previous analogy
 - You can directly use some existed IT system solutions, which were provided by some cloud application service provider, without knowing any detail technique about how these service was achieved.
 - Technical speaking, use the ***Software as a Service (SaaS)*** solution.



"IaaS"

Infrastructure-as-a-Service

host



"PaaS"

Platform-as-a-Service

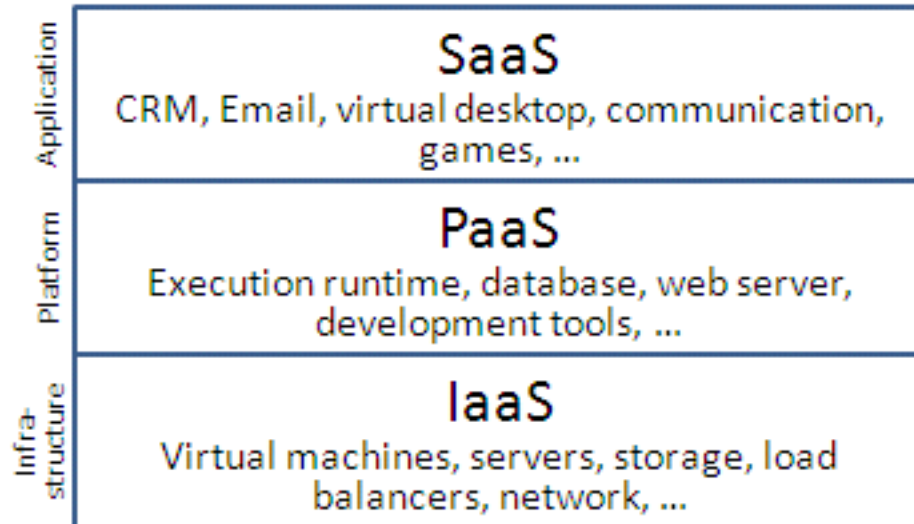
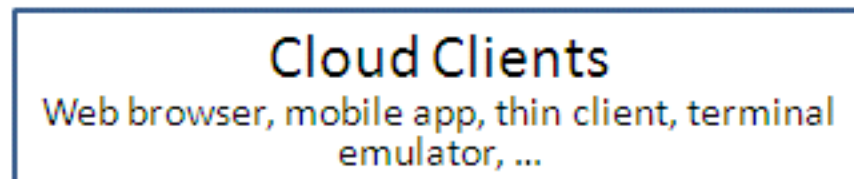
build



"SaaS"

Software-as-a-Service

consume



How to deploy a cloud system ?

DEPLOYMENT MODELS

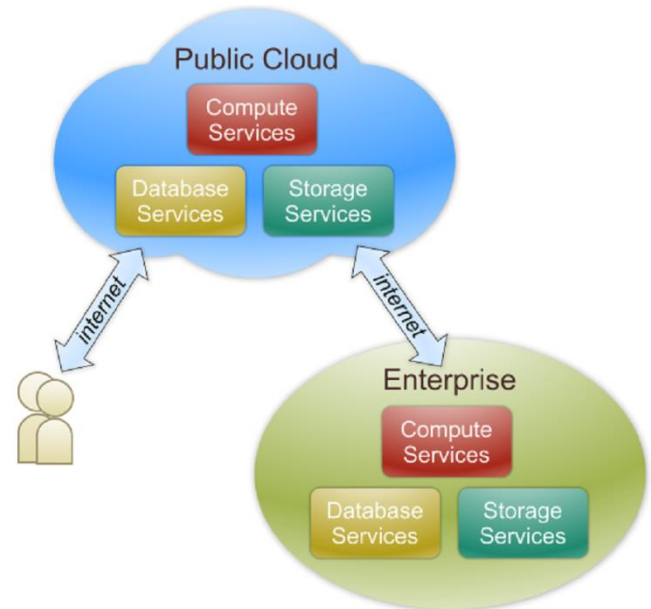


Deployment Model

- There are four primary cloud deployment models :
 - Public Cloud
 - Private Cloud
 - Community Cloud
 - Hybrid Cloud
- Each can exhibit the previously discussed characteristics; their differences lie primarily in the scope and access of published cloud services, as they are made available to service consumers.

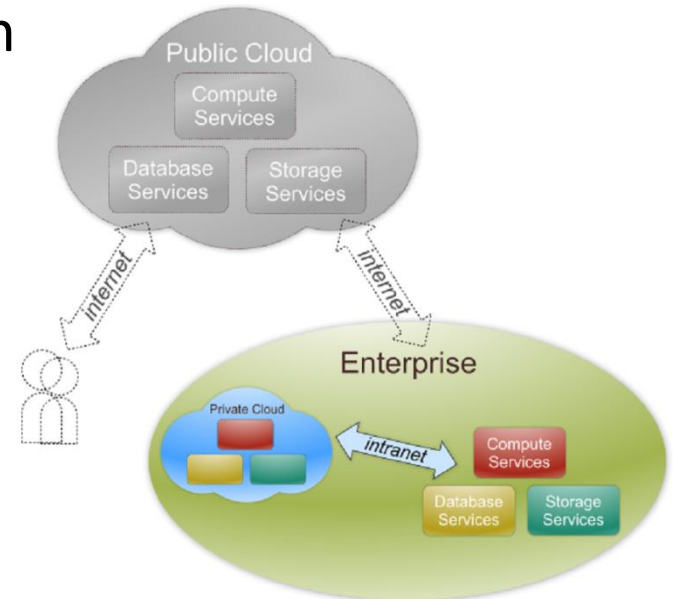
Public Cloud

- Public cloud definition
 - The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.
 - Also known as external cloud or multi-tenant cloud, this model essentially represents a cloud environment that is openly accessible.
 - Basic characteristics :
 - Homogeneous infrastructure
 - Common policies
 - Shared resources and multi-tenant
 - Leased or rented infrastructure
 - Economies of scale



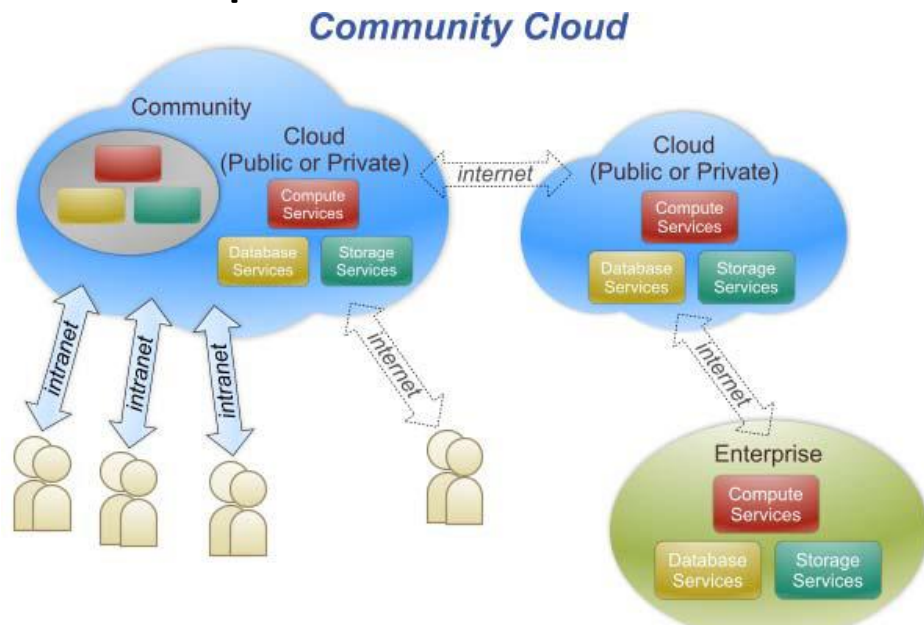
Private Cloud

- Private cloud definition
 - The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.
 - Also referred to as internal cloud or on-premise cloud, a private cloud intentionally limits access to its resources to service consumers that belong to the organization that owns the cloud.
 - Basic characteristics :
 - Heterogeneous infrastructure
 - Customized and tailored policies
 - Dedicated resources
 - In-house infrastructure
 - End-to-end control



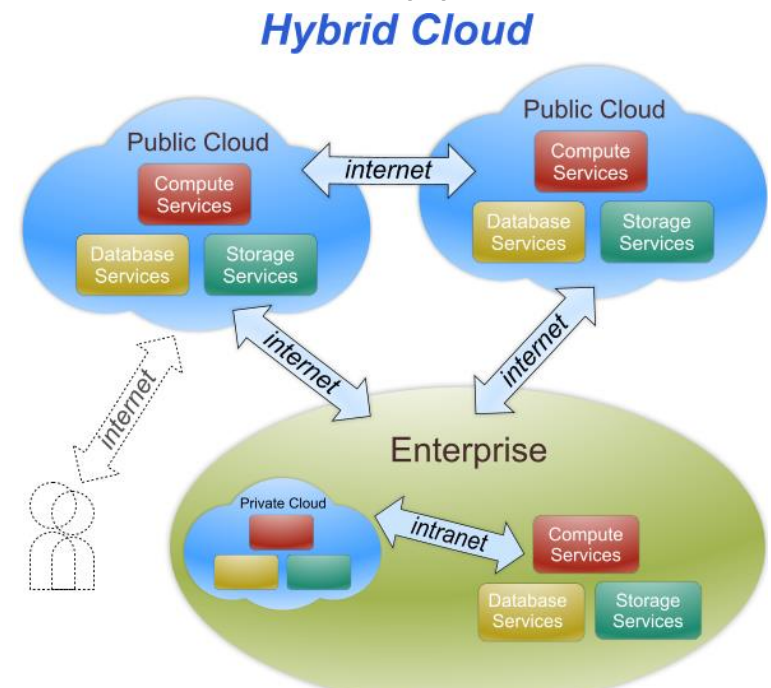
Community Cloud

- Community cloud definition
 - The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations).

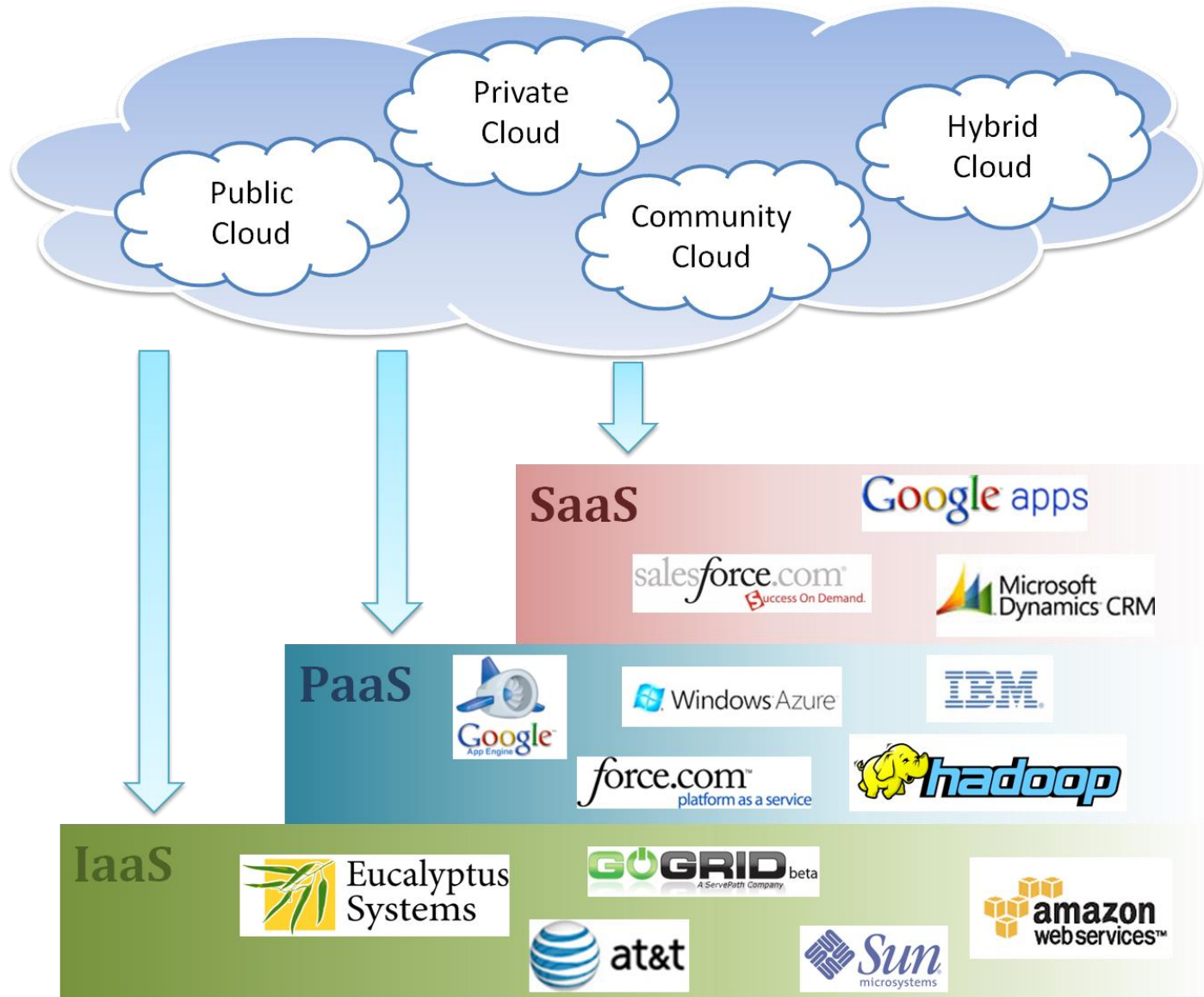


Hybrid Cloud

- Hybrid cloud definition
 - The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).



Cloud Ecosystem



Why do we need IaaS ?

OVERVIEW

Overview

- What is the problems in conventional case ?
 - Companies IT investment for peak capacity
 - Lack of agility for IT infrastructure
 - IT maintain cost for every company
 - Usually suffered from hardware failure risk
 - ...etc
- These IT complexities force company back !!

Overview

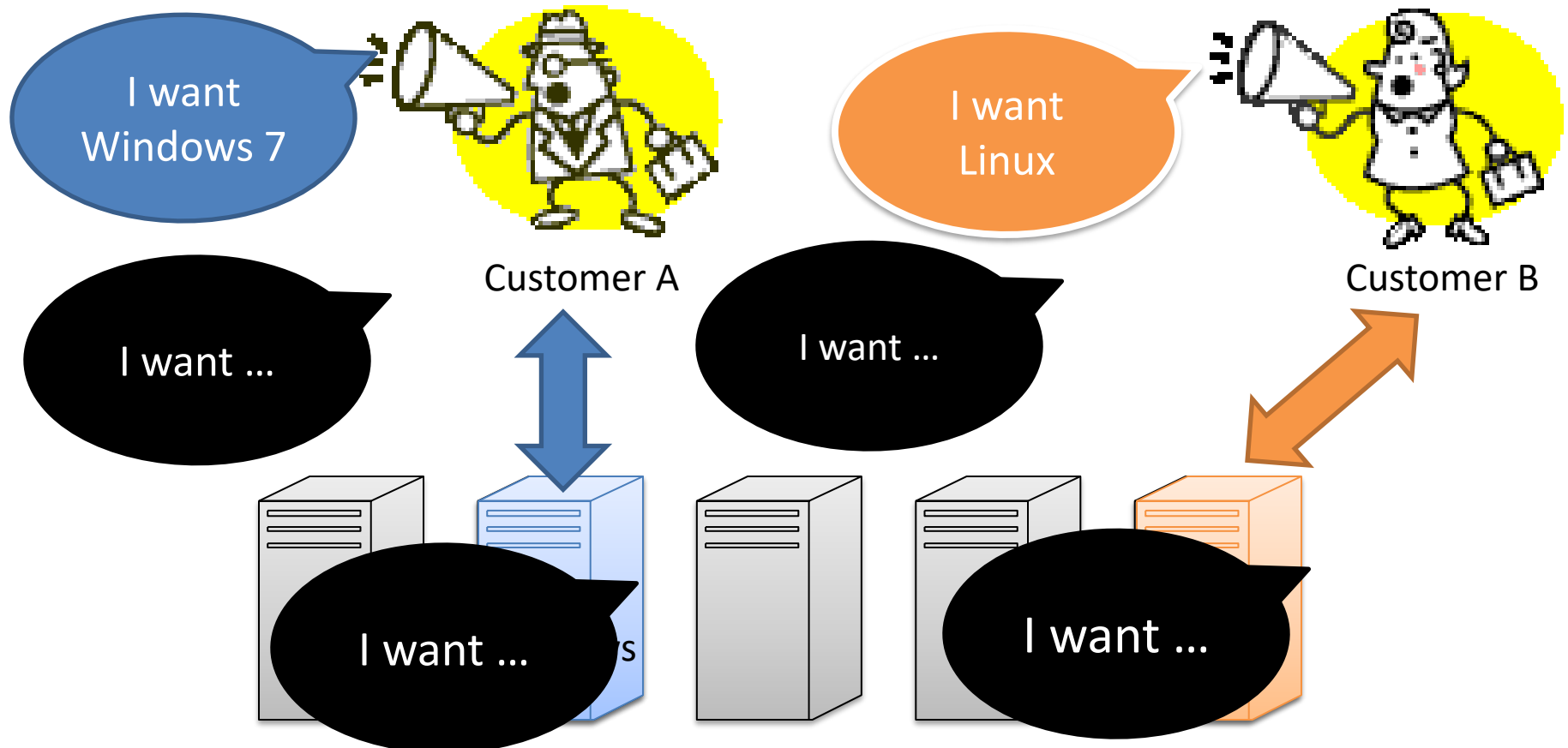
- **Infrastructure as a Service** will be the salvation.
 - IaaS cloud provider takes care of all the IT infrastructure complexities.
 - IaaS cloud provider provides all the infrastructure functionalities.
 - IaaS cloud provider guarantees qualified infrastructure services.
 - IaaS cloud provider charges clients according to their resource usage.
- But, what make all of these happen so magically ?

Reasoning:Virtualization

- Assume that you are going to be an IaaS cloud provider.
 - Then, what are the problems you are facing ?
 - Clients will request different operating systems.
 - Clients will request different storage sizes.
 - Clients will request different network bandwidths.
 - Clients will change their requests anytime.
 - Clients will ...
 - Is there any good strategy ?
 - Allocate a new physical machine for each incomer.
 - Prepare a pool of pre-installed machines for different requests.
 - or ...

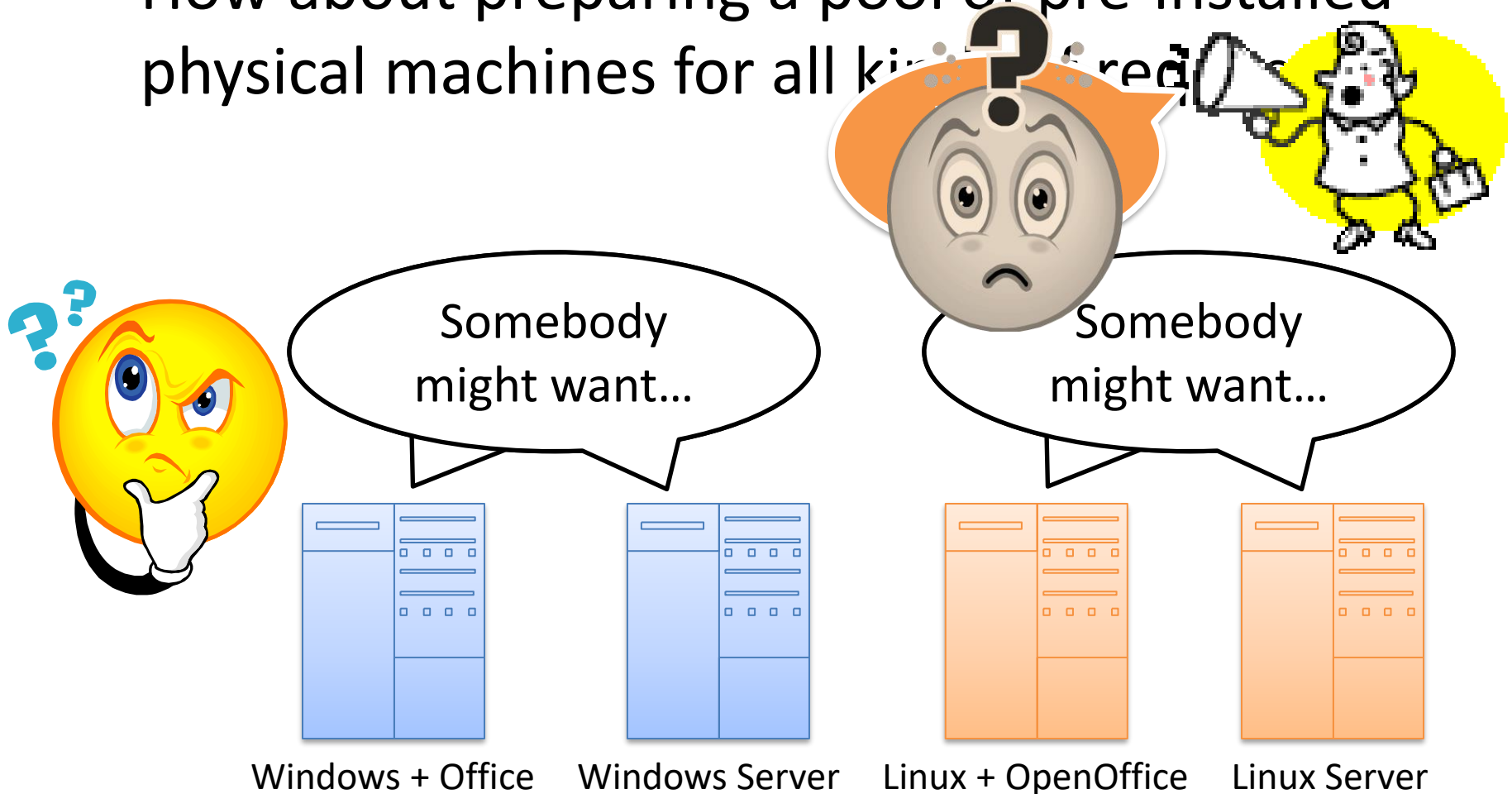
Virtualization

- What if we allocate a new physical machine for each incomer ?



Virtualization

- How about preparing a pool of pre-installed physical machines for all kinds of needs?



Virtualization

- Obviously, neither of previous strategies will work.
- We need more powerful techniques to deal with that.
- Virtualization techniques will help.

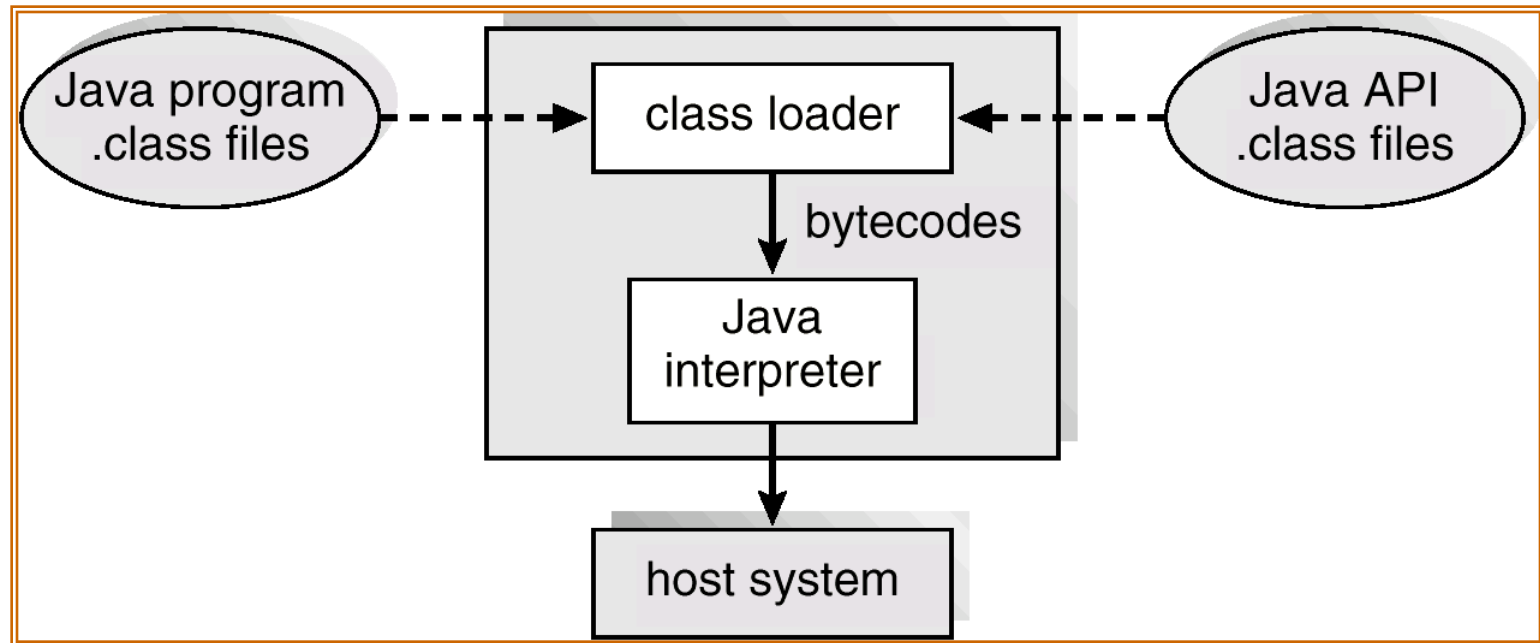
Virtualization Overview

- In a general sense, **virtualization**, is the creation of a virtual, rather than an actual, version of something.
 - For example, you can take a virtual tour of the Masjid Al Haram by going to
 - https://www.360tr.net/saudi-arabia/mecca-kaabe-al-masjid/#google_vignette
 - In other words, you can take a tour of this without actually going to the White House and taking the tour.
- From a computing perspective, you might have already done some virtualization if you've ever partitioned a hard disk drive into more than one “virtual” drive.

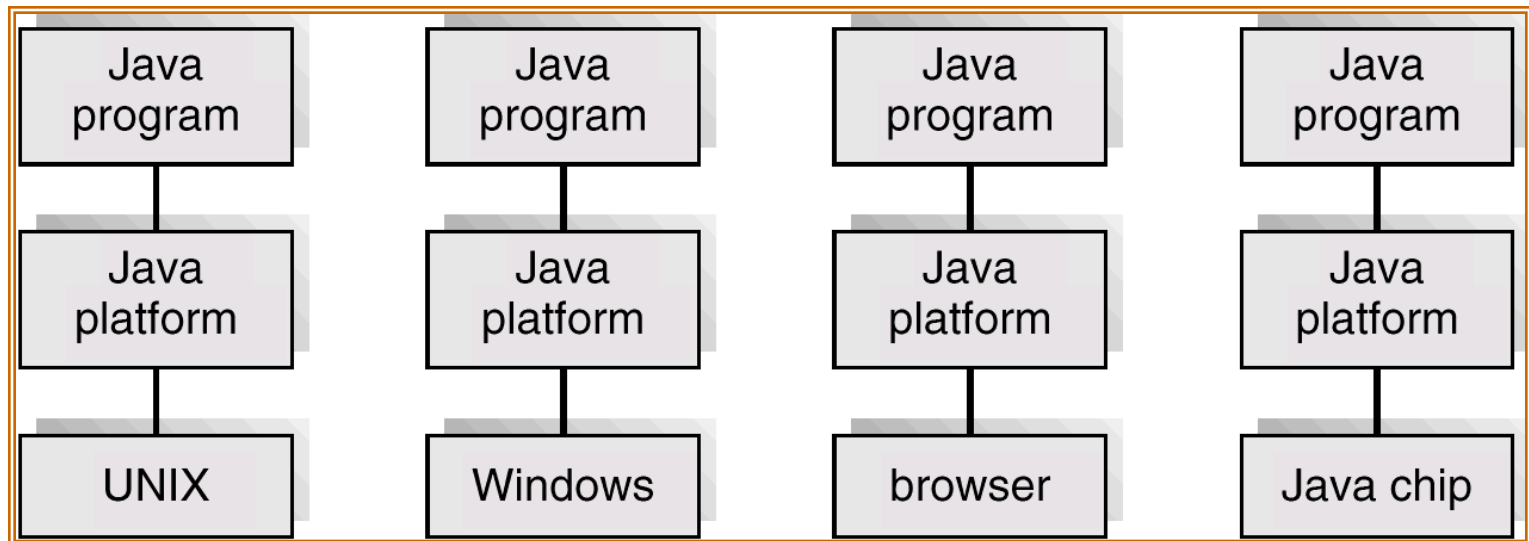
Java Virtual Machine

- Compiled Java programs are platform-neutral byte-codes executed by a Java Virtual Machine (JVM)
- JVM consists of
 - Class loader
 - Class verifier
 - Runtime interpreter
- Just-In-Time (JIT) compilers increase performance

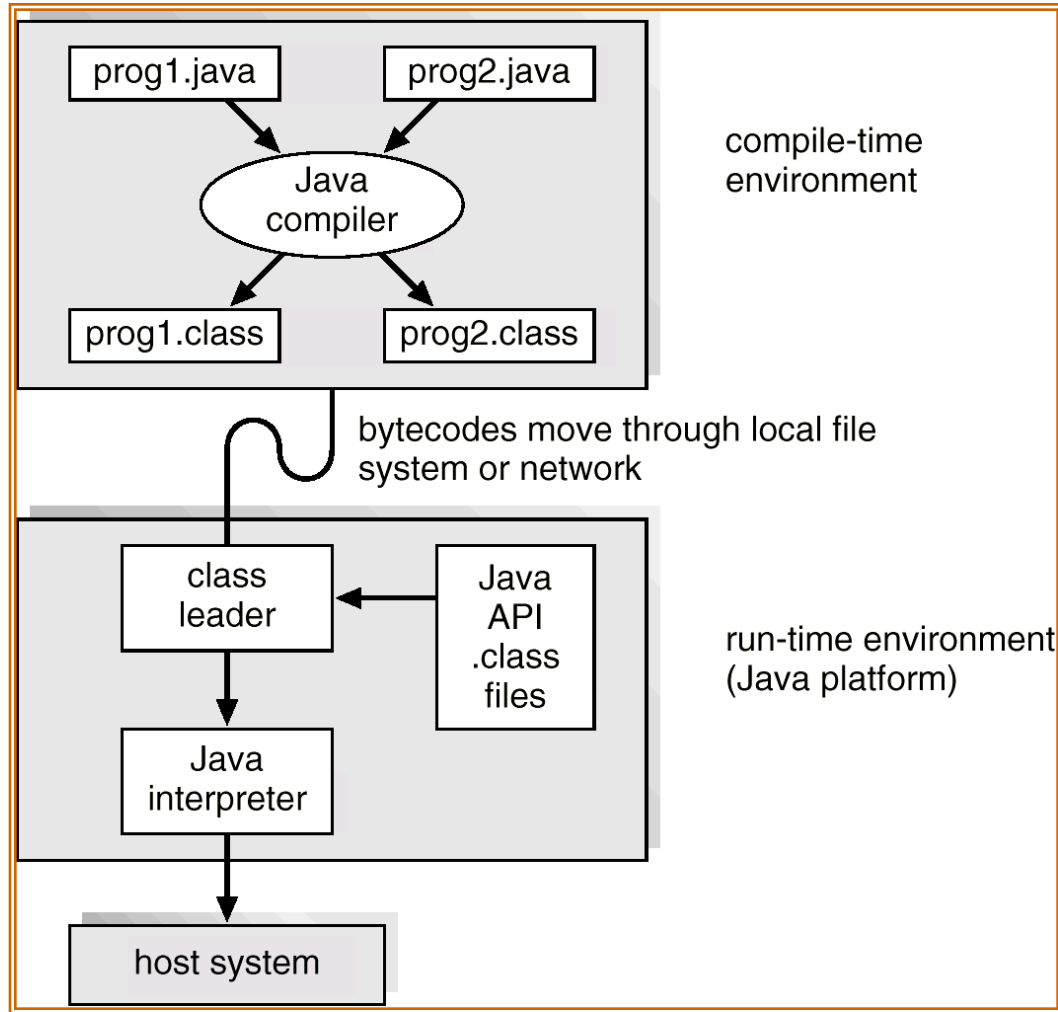
The Java Virtual Machine



The Java Platform



Java Development Environment



Virtualization Overview

- What is virtualization ?
 - Virtualization is the creation of a virtual (rather than physical) version of something, such as an operating system, a server, a storage device or network resources.
 - It hides the physical characteristics of a resource from users, instead showing another abstract resource.

Virtualization Overview

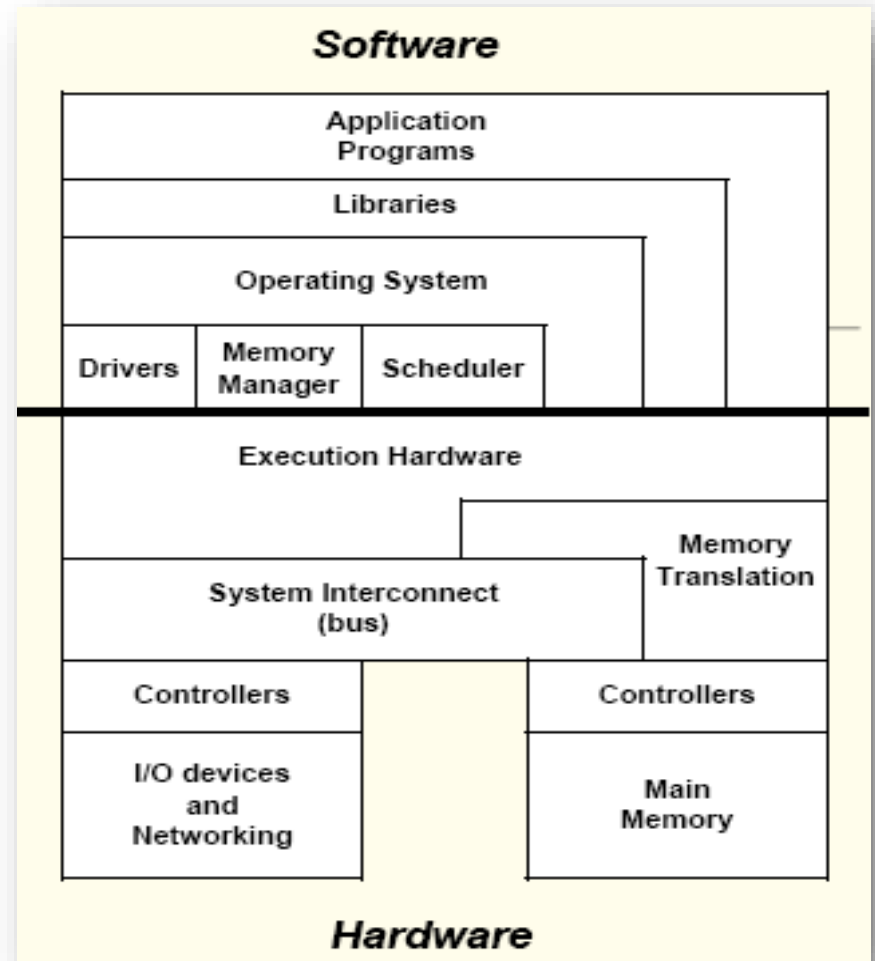
- Despite all the recent buzz about virtualization being a new technology...it isn't. Mainframe computers have offered the ability to host multiple operating systems for more than 40 years.

Virtualization Overview

- But, where does virtualization come from ?
 - Virtualization concept comes from the component abstraction of system design, and it has been adapted in many system level.
 - Now, let's take a look of our original system architecture !!

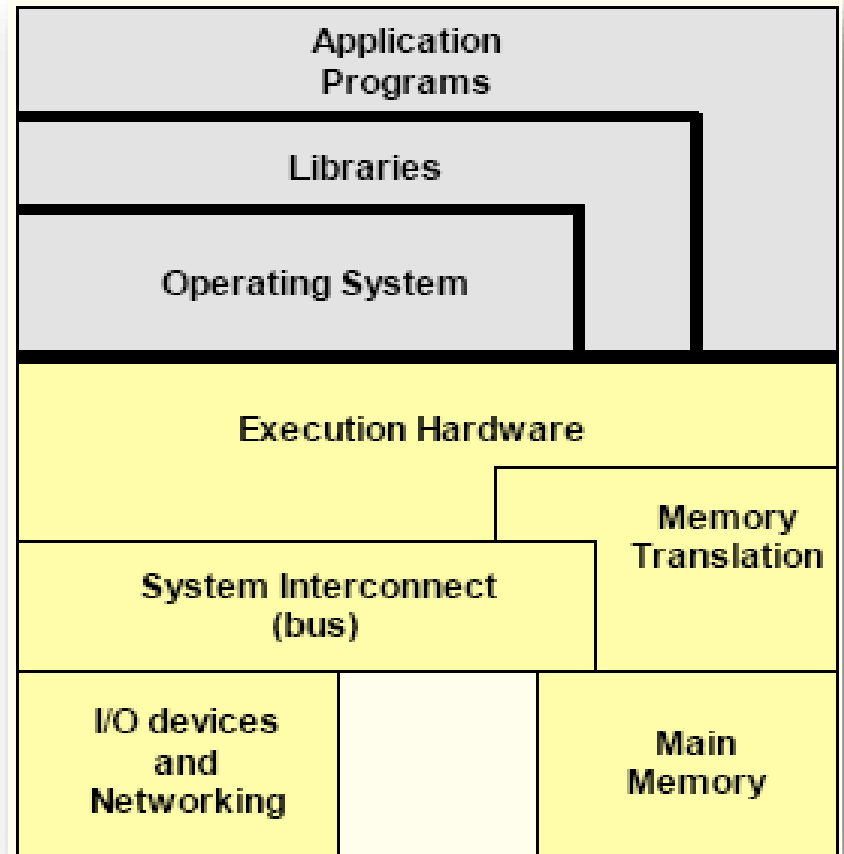
Virtualization Overview

- System abstraction :
 - Computer systems are built on levels of abstraction.
 - Higher level of abstraction hide details at lower levels.
 - Designer of each abstraction level make use of the functions supported from its lower level, and provide another abstraction to its higher one.
 - Example
 - files are an abstraction of a disk



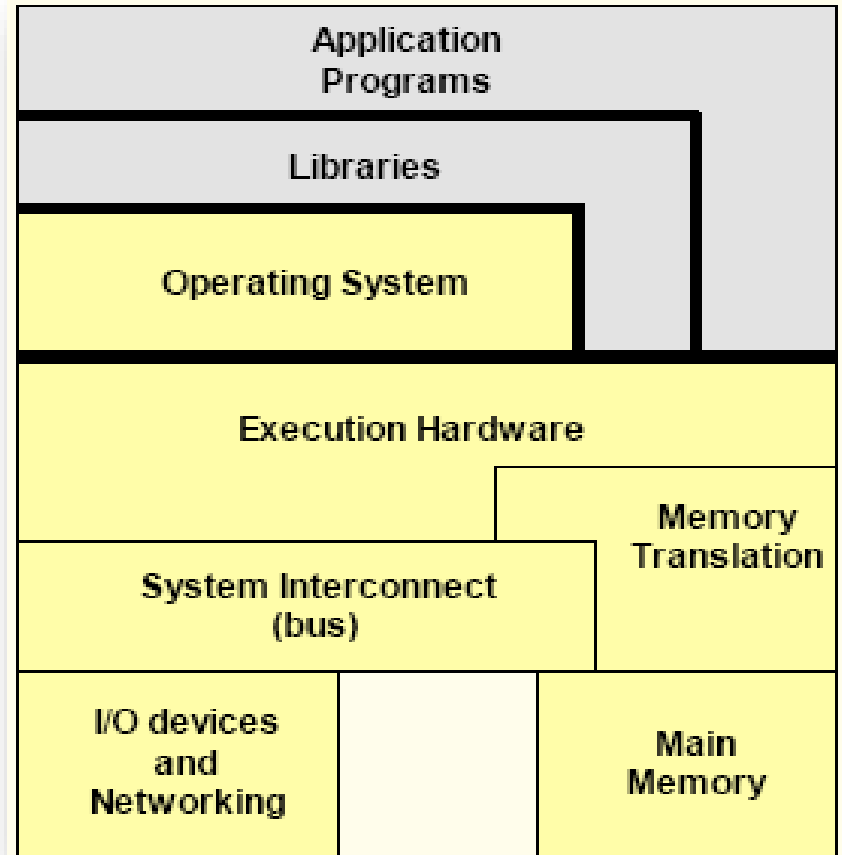
Virtualization Overview

- Machine level abstraction :
 - For OS developers, a machine is defined by ISA (Instruction Set Architecture).
 - This is the major division between hardware and software.
 - Examples :
 - X86
 - ARM
 - MIPS



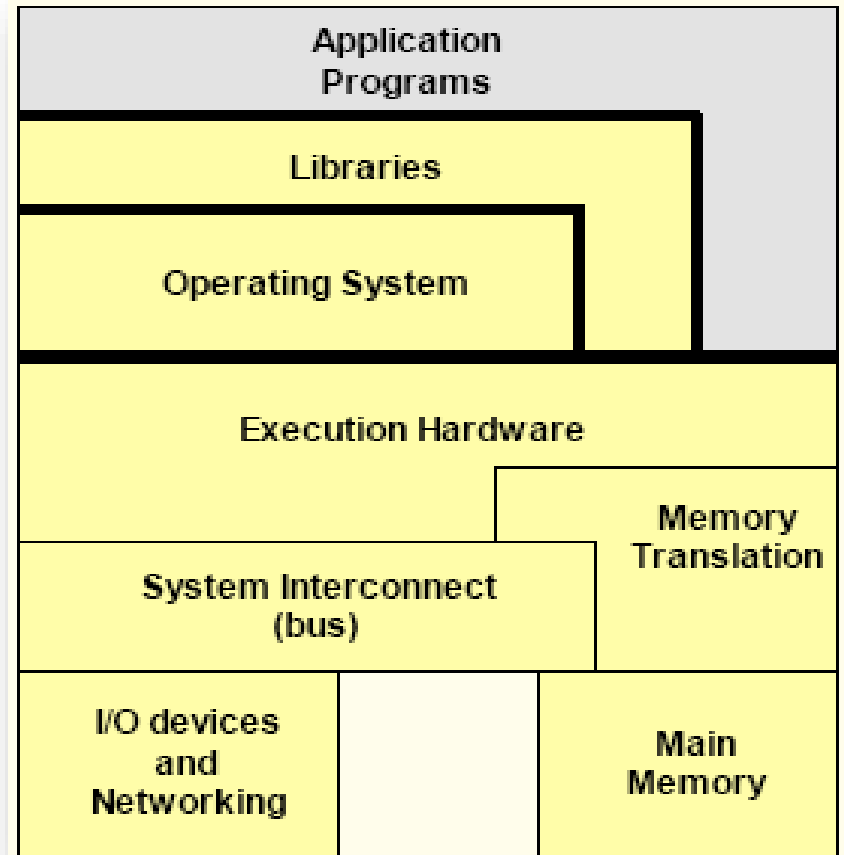
Virtualization Overview

- OS level abstraction :
 - For compiler or library developers, a machine is defined by ABI (Application Binary Interface).
 - This define the basic OS interface which may be used by libraries or user.
 - Examples :
 - User ISA
 - OS system call



Virtualization Overview

- Library level abstraction :
 - For application developers, a machine is defined by API (Application Programming Interface).
 - This abstraction provides the well-rounded functionalities.
 - Examples :
 - User ISA
 - Standard C library
 - Graphical library



Abstraction levels

- What are different kinds of programming Languages?
 - Low-level/Assembly/High-level languages
- Programming in a certain type of language involves abstraction
 - In order to simplify the representation
 - In order to make it easier to program

Abstraction levels

- While programming in a high-level language we are not *that* bothered about low level representation

Virtualization Overview

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Why Virtualization Is Hot, Hot, Hot

- Four major reasons to virtualize
 - Underutilized hardware
 - Out of space
 - Energy costs
 - IT operations costs

Underutilized hardware

- Without virtualization, many data centers had servers and storage running at 10 percent or less of total capacity. In other words, 90 percent of a device's potential was unused.
- By applying virtualization, organizations can raise their hardware utilization rates from 10 or 15 percent to 70 or 80 percent.
- It breaks the one-to-one relationship of the physical assets or devices and the system view

Question

How much digital information was created worldwide in 2009?

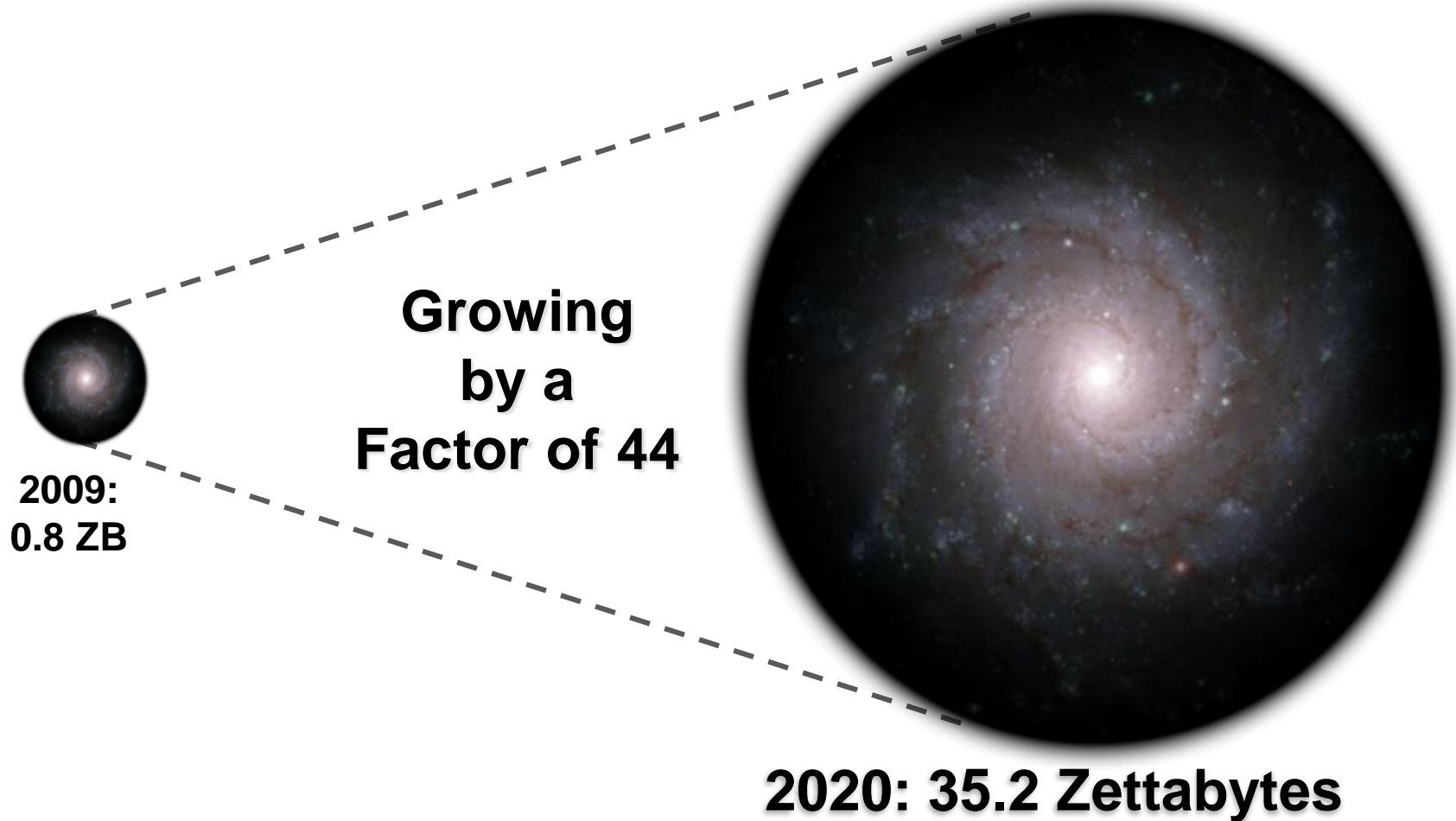
A. 846 Terabytes

B. 686 Petabytes

C. .8 Zettabytes

D. 2502 Exabytes

The Digital Universe 2009-2020



One Zettabyte (ZB) = 1 trillion gigabytes

1.2 ZB in 2010 is Equal to . .

•

75 Billion Fully Loaded 16GB iPads



What is Driving the Digital Explosion?

Web 2.0 Applications



Ubiquitous Content-Generating Devices



3G/4G



Longer Data Retention Periods

Freedom of
Information Act

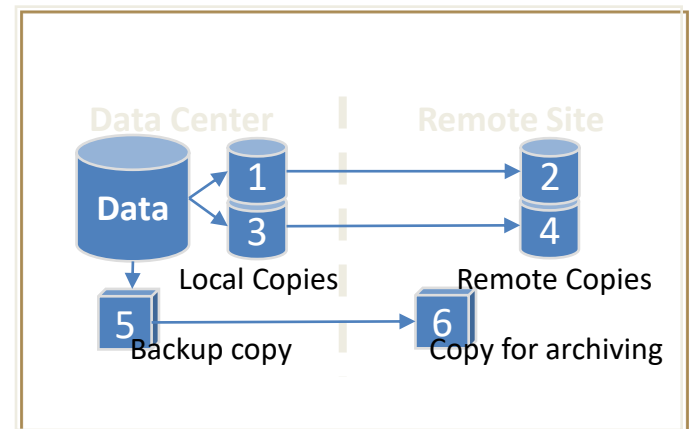
SEC 17a-4

HIPAA

Sarbanes-Oxley

Regulation Landscape

Secure Collaboration



Question

What percentage of the .8 zettabytes of digital information is created by individuals?

A. 30%

B. 50%

C. 70%

D. 90%

The Digital Information World

Individuals create data ...companies manage it!

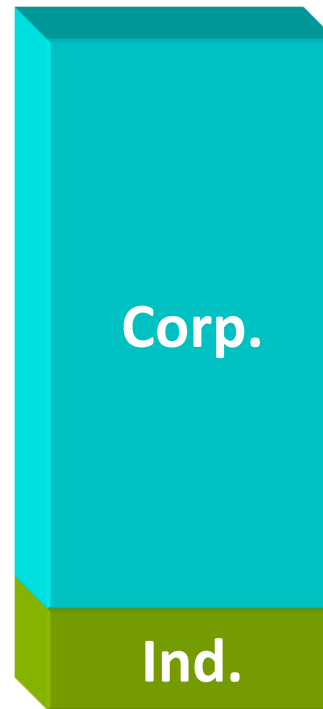


70%

Of the digital universe
will be created by individuals



Create



Manage

85%

Of the digital universe will
be the responsibility of
companies to manage
and secure



Data centers run out of space

- The rise of the Internet has meant massive increases in e-mail, websites, video, and mobile applications.
- The net effect of all this is a real estate problem for companies: They're running out of space in their data centers.
- Data centers cost in the tens of millions of U.S. dollars to construct

Energy costs go through the roof

- Power costs used to rank somewhere below what brand of soda to keep in the vending machines in most companies' strategic thinking.
- No now !!!

IT operations costs mount

- Computers don't operate all on their own. They require care and feeding by system administrators
- Consequently, IT operations costs have risen in lockstep with the growth of overall computing resources.
- Companies are challenged to find ways to operate their IT infrastructures with less labor and lower costs.

The Benefits Of Virtualization

- Server consolidation:
 - One of the primary benefits of virtualization software is that it allows you to increase the scale of your server infrastructure without purchasing additional pieces of hardware.
- Energy conservation:
 - In addition to savings in hardware costs, virtualization software may also save you money on your energy bill. According to [Energy Star](#), the energy costs for running a server for a year will soon exceed the price of acquiring it.

The Benefits Of Virtualization

- Improving ease of management:
 - Managing virtual machines is a lot easier than managing “real” machines, since hardware upgrades, for example, can be done with the click of several buttons, rather than having to power down the machine, install the hardware, verify the change, then power up again. Moreover, managing virtual machines can often be done via a console server, thereby reducing the time needed to deploy them.

The Benefits Of Virtualization

- Reducing backup and recovery time:
 - Since virtual machines are essentially files, backing up and restoring them is a lot less time-consuming. And while the files can be huge, a directory of many 2-GB files is still easier to restore than a real machine of the same specifications. Moreover, hardware failures — such as a failed hard drive — will not affect virtual machines in the same way they would a physical machine. (Of course, the real hard drive on which the virtual machine reside needs to be backed up as usual.)

The Benefits Of Virtualization

- Testing software configurations:
 - Another way you can use virtualization software is for testing software configurations before deploying them on a live system. If you needed to verify whether a program is incompatible with your existing setup, for example, you may try testing in on a virtual machine first. This can be immensely useful for organizations that have legacy systems or applications and must test out systems before deploying them. Virtual machines can also interact with one another in virtual networks, allowing you to test server-client applications virtually.

The Benefits Of Virtualization

- Maintaining legacy applications:
 - If you do have old applications that have compatibility issues with newer software or that must run on a certain version of an operating system, you can dedicate a virtual machine just for those tasks. That way, your IT architecture and planning won't be constrained because of a few applications.
- Maintaining a cross-platform office:
 - It is not uncommon for offices that run mostly Macs to need to run one or two Windows-only programs; in this case, virtual software can be an affordable, easy way to do this. Note, however, that the reverse is not applicable; many virtualization applications for PCs allow you to run Linux, but not Mac operating systems.
- Virtualization Is Green

- Despite its many benefits, keep in mind that virtualization software is not for everyone. There is a learning curve in both conceptualizing how virtual machines will function in your network and organization, as well as managing them reliably and cost-effectively.
- If the employees of your organization have trouble with “real” computers, you may need to consider making which machine is the guest and which is the host extremely transparent to your users, or explaining to them in simple terms how this will affect their day-to-day work, if at all.

Drawbacks Of Virtualization

- Unfortunately, there are also some disadvantages to virtualization. These include a drain on performance, limited scalability, and common hardware.
- In most cases the benefits of virtualization outweigh the drawbacks, however, you need to be aware of the disadvantages when considering virtualization so that you can make an informed decision as to the use of virtualization.

Drawbacks Of Virtualization

Performance Issues:

- Virtualization software adds a certain amount of overhead to the computer system on which it is running.
- Determining the overall impact that virtualization software imposes is a difficult task, but generally speaking, virtualization software has a minimal impact on processor and memory performance. A more significant impact is imposed on the disk and networking performance of the system.

Scalability:

- Most virtualization software is scalable to multiple VMs in the same physical system, however, almost all are uni-processor systems and limited to the amount of physical memory of the host system and can only run 32-bit OS??

Drawbacks Of Virtualization

Common Hardware:

- Since the only physical hardware on which the VMs run is the same for all VMs, this represents both benefits and drawbacks when it comes to virtualization. Rapid provisioning and system flexibility are benefits of a common hardware arrangement. However, if the OS and application that you want to virtualize are not capable of running on the system hardware or require other hardware, you're out of luck with virtualization.