Unit 16 – Cloud Computing

- Cloud Architecture
- Cloud Components
- Virtualization
- Some Commercial Cloud Offerings

Learning Outcomes

By the end of this unit students will be able to:

LO1. Demonstrate an understanding of the fundamentals of Cloud Computing and its architectures.

Cloud Computing Fundamentals:

Cloud Architecture

Network Connectivity in Cloud Computing

Cloud Architecture

- Cloud computing architecture refers to the components and subcomponents required for cloud computing. These components typically consist of a front end platform (fat client, thin client, mobile device), back end platforms (servers, storage), a cloud based delivery, and a network (Internet, Intranet).

Cloud Architecture
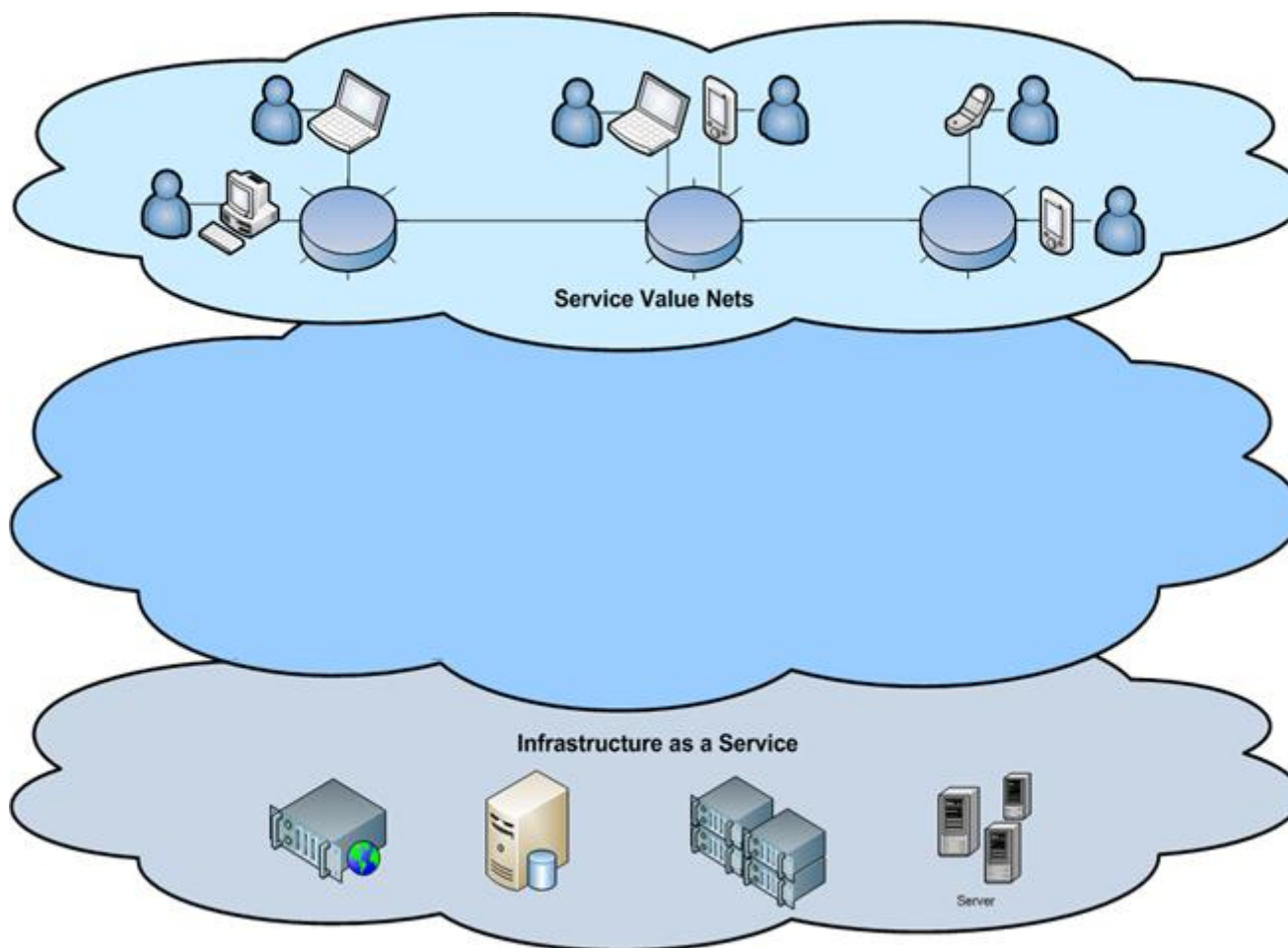
Framework of Cloud Computing
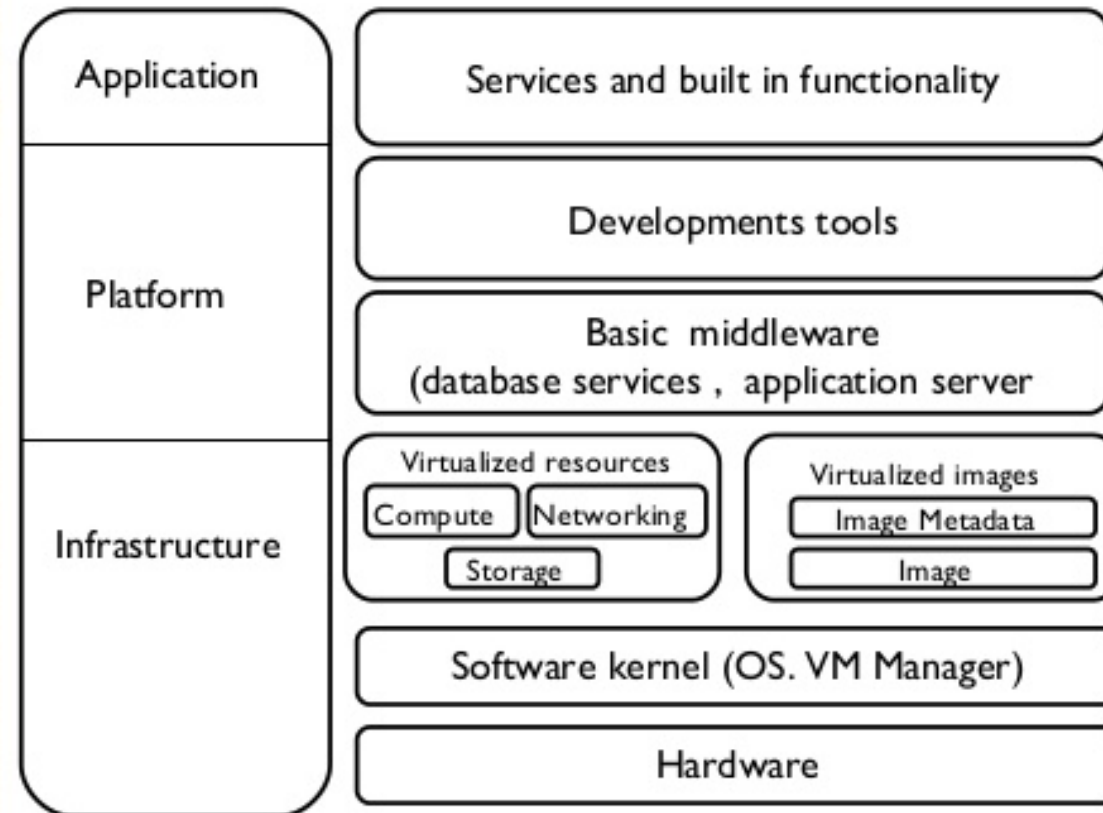
Cloud Components

- A front-end platform that can include fat clients, thin clients, and mobile devices

- Back-end platforms, such as servers and storage

- Cloud-based delivery

- A network (internet, intranet)

Cloud Components

Front End

- This is the visible interface that computer users or clients encounter through their web-enabled client devices. But it should be clear here that not all cloud computing systems will use the same user interface.

Back End

- On the other hand, back end is the "cloud" part of a cloud computing architecture, comprising all the resources required to deliver cloud-computing services. A system's back end can be made up of a number of bare metal servers, data storage facilities, virtual machines, a security mechanism, and services, all built in conformance with a deployment model, and all together responsible for providing a service.

Fat client/ Thick Client

- A fat client (also called heavy, rich or thick client) is a computer (client), in client–server architecture or networks, that typically provides rich functionality independent of the central server.

- Ability to perform many functions without connecting to the Server. In contrast, a thick client generally does as more processing as possible.

Thin client

- A thin client is a lightweight computer that has been optimized for remoting into a server-based computing environment. The server does most of the work, which can include launching software programs, crunching numbers, and storing data.

- A thin client generally does as little processing as possible, relying on access to the server each time input data needs to be processed or validated.

Mobile Device

- A mobile device (or handheld computer) is a computing device small enough to hold and operate in the hand. Typically, any handheld computer device will have an LCD flat screen interface, providing a touchscreen interface with digital buttons and keyboard or physical buttons along with a physical keyboard.

Zero Client

- Zero client, also known as ultrathin client, is a server-based computing model in which the end user's computing device has no local storage. A zero client can be contrasted with a thin client, which retains the operating system and each device's specific configuration settings in flash memory.
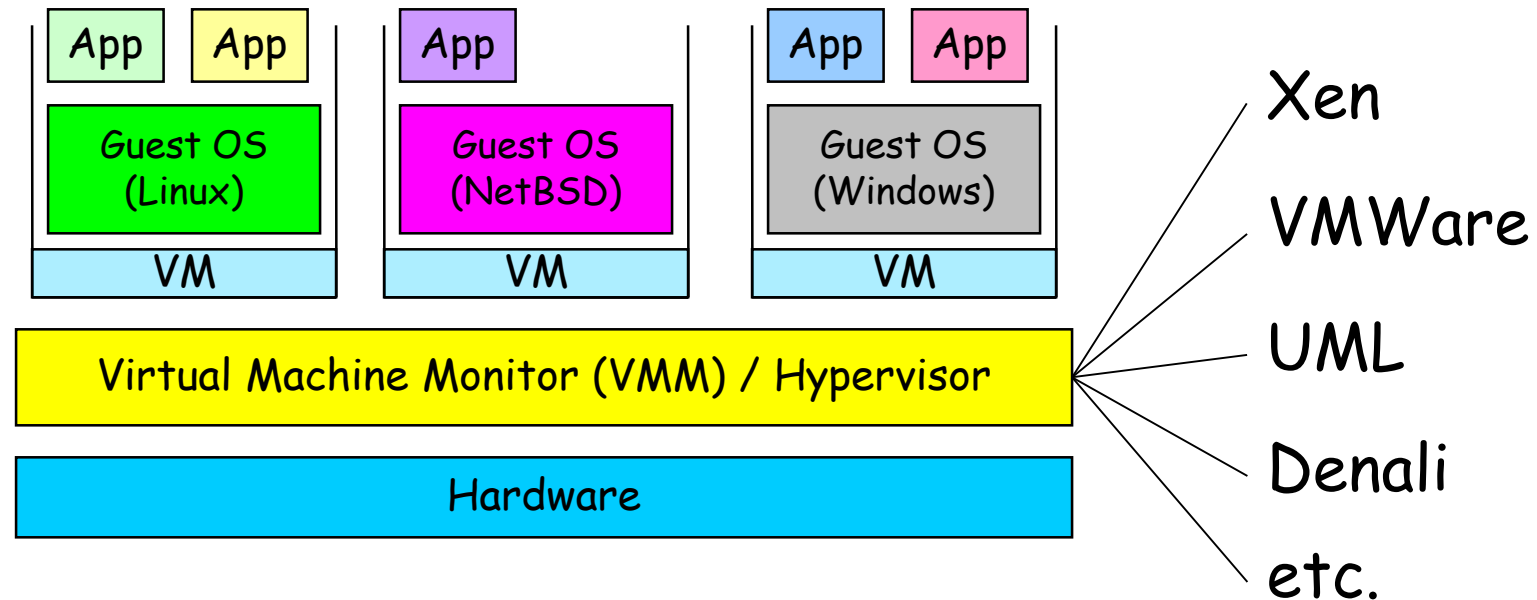
Virtualization

- Virtualization allows multiple, independent operating systems to run concurrently on the same physical hardware. Administrators can treat each virtual machine as a unique server, satisfying most vendors while simultaneously reducing data center costs.

- Resource quota (e.g. CPU, memory share), Software configuration.

- Hypervisor intercepts and emulates instructions from VMs, and allows management of VMs,

- VMWare, Xen, etc.
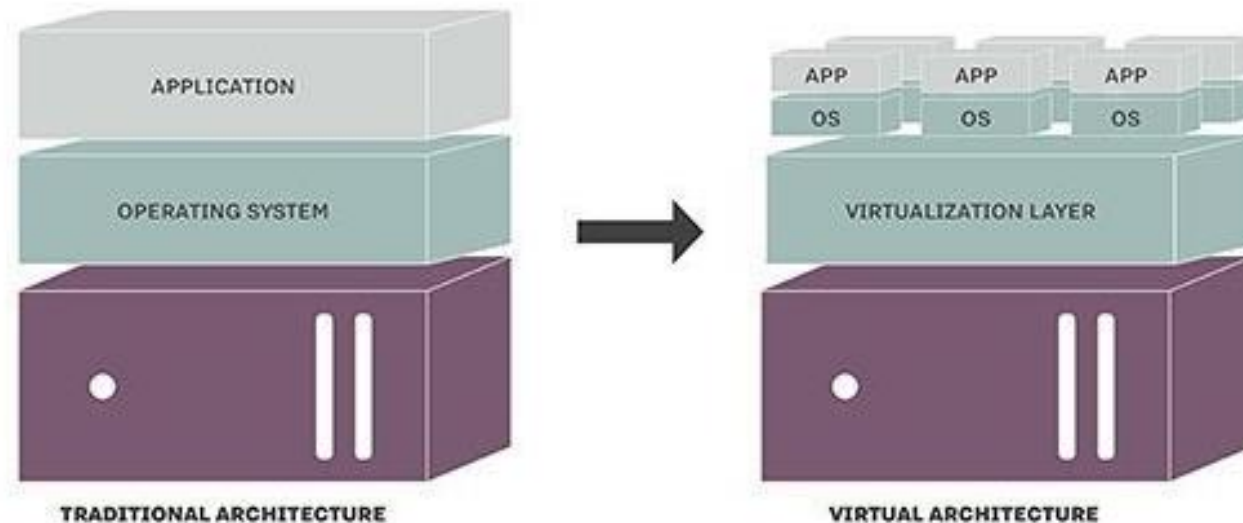
Virtual Machines

- VM technology allows multiple virtual machines to run on a single physical machine.

App	App		App		App	App

Guest OS (Linux)	Guest OS (NetBSD)	Guest OS (Windows)
VM	VM	VM

Virtual Machine Monitor (VMM) / Hypervisor

Hardware

Xen

VMWare

UML

Denali

etc.

Virtualization in General

Advantages of virtual machines:

- Run operating systems where the physical hardware is unavailable,
- Easier to create new machines, backup machines, etc.,
- Software testing using "clean" installs of operating systems and software,
- Emulate more machines than are physically available,
- Timeshare lightly loaded systems on one host,
- Debug problems (suspend and resume the problem machine),
- Easy migration of virtual machines (shutdown needed or not).
- Run legacy systems!

Some Commercial Cloud Offerings

Cloud Taxonomy

Cloud Storage

Several large Web companies are now exploiting the fact that they have data storage capacity that can be hired out to others.

- Allows data stored remotely to be temporarily cached on desktop computers, mobile phones or other Internet-linked devices.

- Amazon's Elastic Compute Cloud (EC2) and Simple Storage Solution (S3) are well known examples

Amazon Simple Storage Service (S3)

- Unlimited Storage.
- Pay for what you use:
  - $0.20 per GByte of data transferred,
  - $0.15 per GByte-Month for storage used,

Utility Computing – EC2

Amazon Elastic Compute Cloud (EC2):
- Elastic, marshal 1 to 100+ PCs via WS,
- Machine Specs…,
- Fairly cheap!

Powered by Xen – a Virtual Machine:
- Different from Vmware and VPC as uses "para-virtualization" where the guest OS is modified to use special hyper-calls:
- Hardware contributions by Intel (VT-x/Vanderpool) and AMD (AMD-V).
- Supports "Live Migration" of a virtual machine between hosts.

Linux, Windows, OpenSolaris

Management Console/AP

EC2 – The Basics

- Load your image onto S3 and register it.

- Boot your image from the Web Service.

- Open up required ports for your image.

- Connect to your image through SSH.

- Execute you application…

The Future

- Job opportunities ?

- Companies can focus on their core business

- Grid Computing was the last research-led centralised approach

- Many new open source systems appearing that you can install and run on your local cluster

- However there are concerns that the mainstream adoption of cloud computing could cause challenges for users

Thank You