



# Unit Objectives

- After completing this unit, you should be able to:
- Define virtualization
- Understand the need for virtualization
- Explain the benefits of virtualization
- Identify the different types of virtualization
- Describe the impact of virtualization



**IBM ICE (Innovation Centre for Education)**

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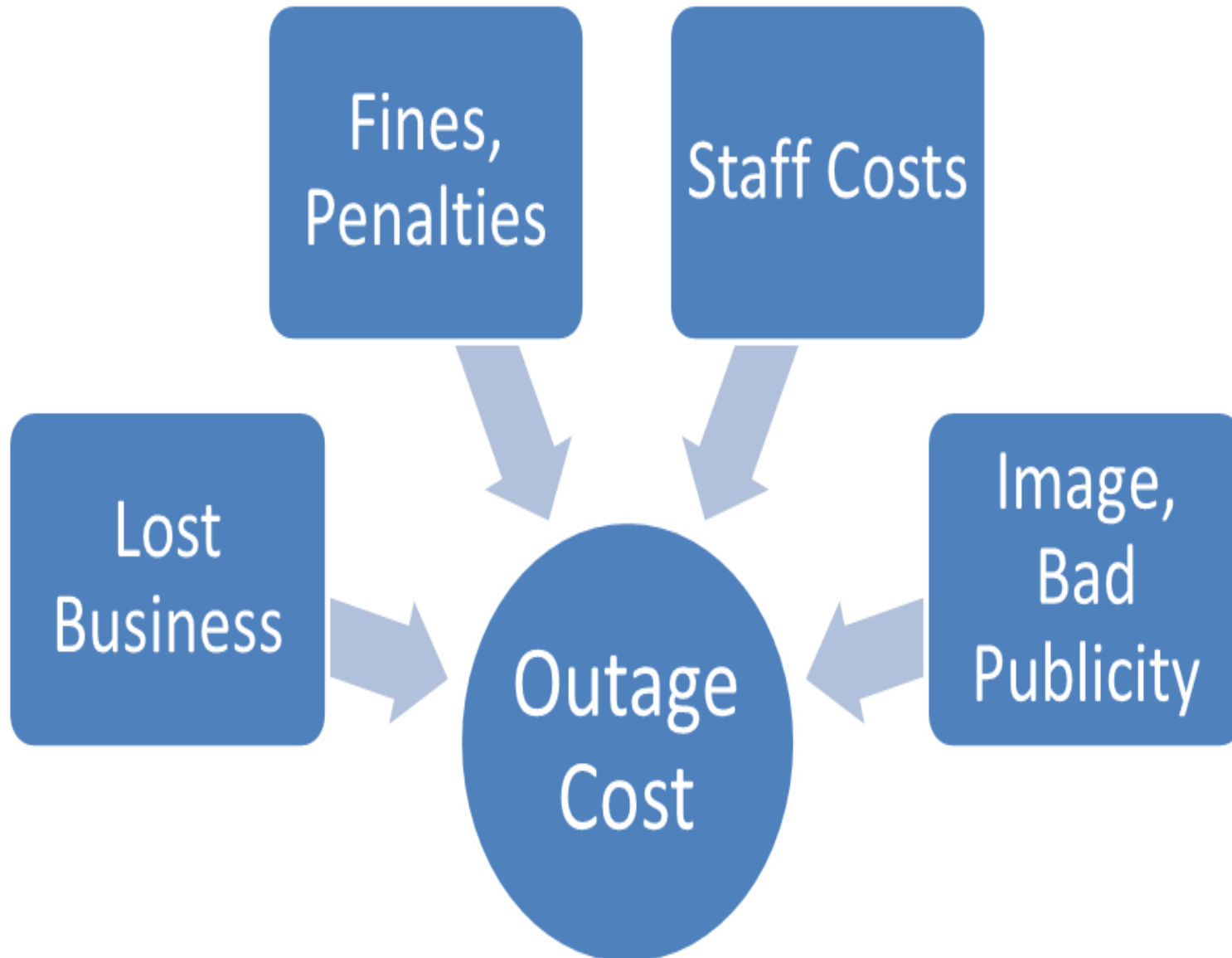
# Overview

- Virtualization: As the term indicates, the technique of building an **abstraction layer** on the hardware that is very similar to the underlying hardware, operating system or other components of the system, therefore cloning the functionality of the original components in the software.
- Need for Virtualization: Virtualization eliminates most of the inherent inflexibility of hardware systems and allows for better manageability, resulting in better system utilization. The basic principle of hardware and software interchangeability helps us to better understand the tradeoffs between performance and flexibility.



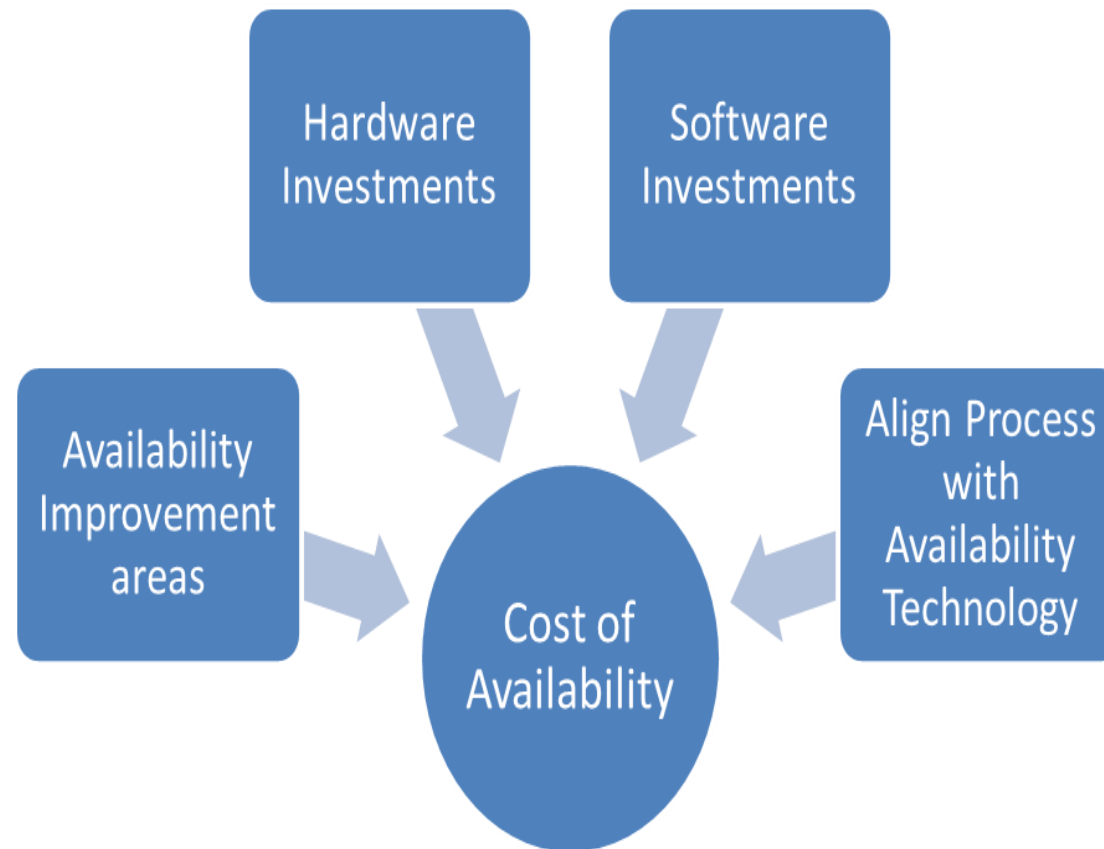
# Cost of an outage

- Identifying the value of availability, or the **cost of unavailability** is a difficult task.

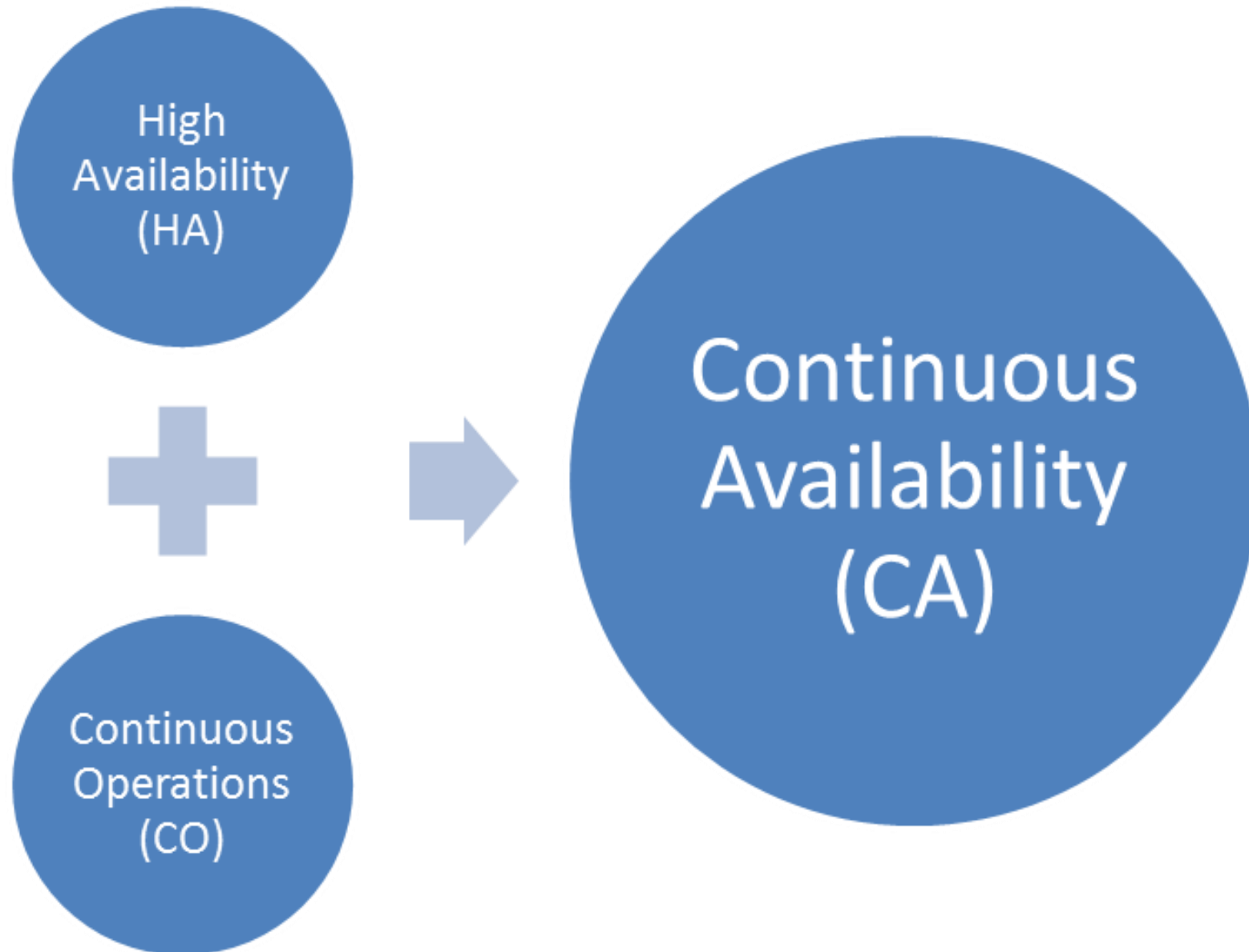


# Cost of availability

- The amount of availability one requires is difficult to determine. For this, we need to understand the below costs.



# Availability definitions



# Types of virtualization

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Virtualization is classified based on the extent of hardware emulation.

- Full emulation
- Full/native virtualization
- Para-virtualization
- Os virtualization
- Application virtualization



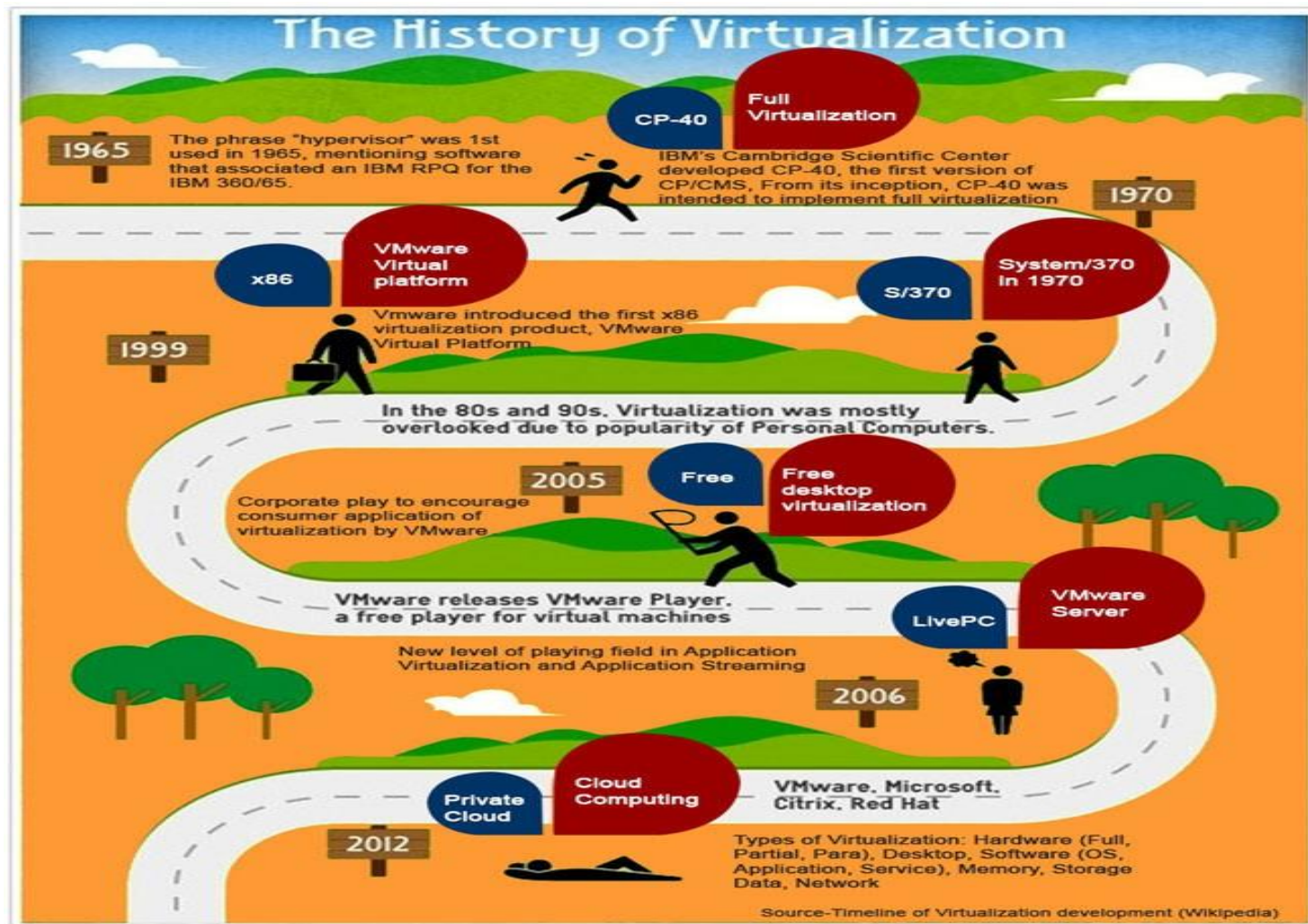
# Area & technology-based classification

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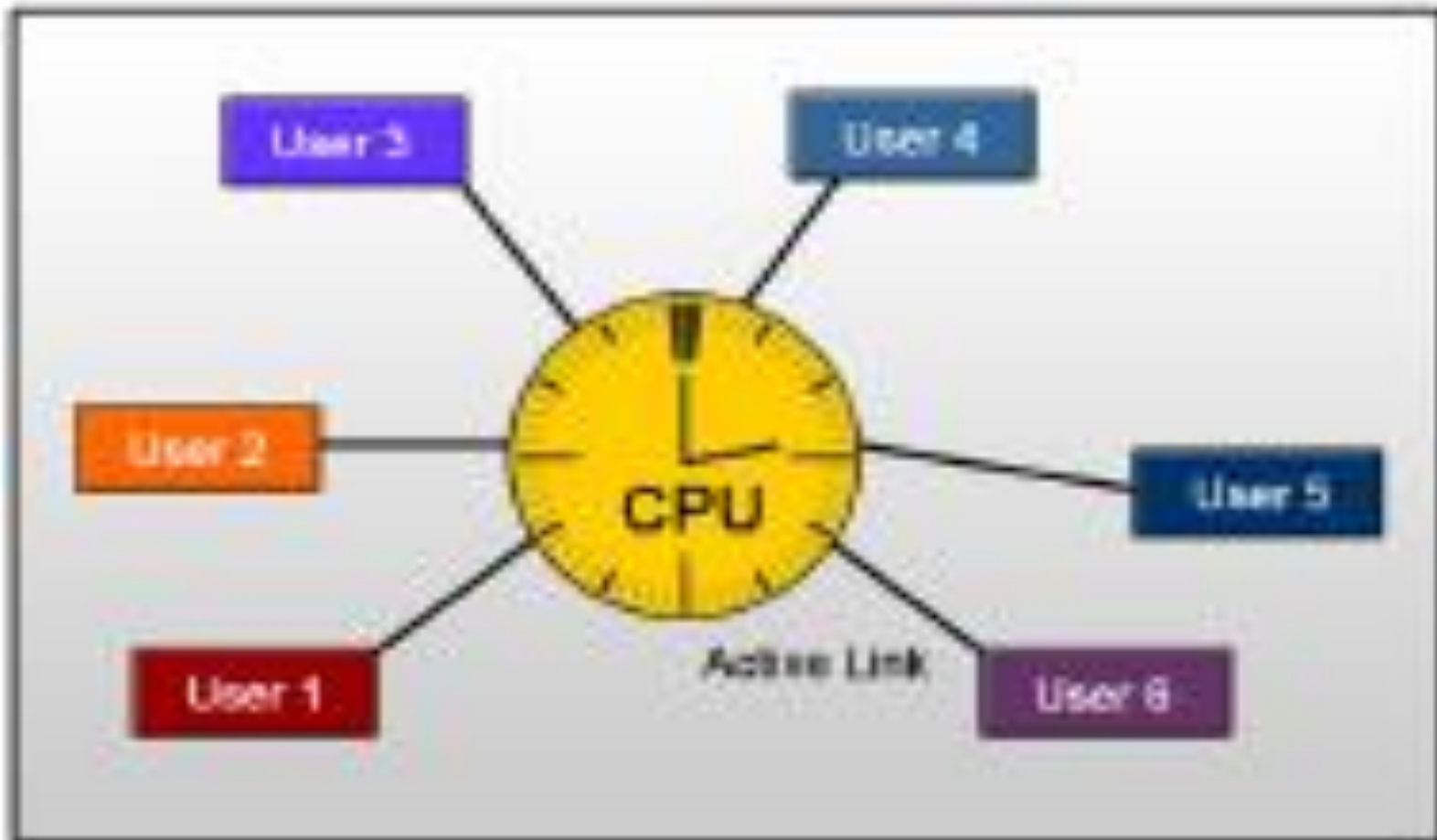
- Virtualization can be also be classified based on the technology or the area that is being virtualized
  - Server virtualization
  - Storage virtualization
  - Network virtualization

# History of virtualization

- Virtualization started out as a concept of time-sharing in the 1960s.
  - The machines were large and there was a need to split up the machines into multiple portions that can be used for different purposes simultaneously.
  - This resulted in the evolution of newer innovations related to hardware sharing, paging techniques and multiprogramming.



# Time-sharing systems



# IBM mainframe virtualization

- The earliest pioneer of modern virtualization technology was IBM. IBM invented virtualization nearly 50 years ago.



- In the late 1960s, IBM introduced the first successful virtual machine operating system, the CP-40 which was geared for the System/360 Mainframe. A revision of CP-40 was introduced by the name of CP-67 and was later implemented as S/360- 67 and finally as S/370.

# Extending virtualization to X86

- The virtualization on x86 Architecture was introduced in the year 1985.
- In 1997, Connectix released the first version of “Virtual PC” for MAC platforms.
- In 1998, VMware filed a US Patent 6,397,242 for virtualization techniques for x86 architecture and subsequently, a VMware Virtual Platform was introduced for IA32 architecture.
- In 2000, [FreeBSD](#) introduced [FreeBSD](#) Jails for [OS Virtualization](#).
- In 2001, Connectix building on its initial success on Virtual PC launches the first version for Microsoft Windows.
  - The year 2003, marked the release of the first open source hypervisor for x86 machines called Xen Hypervisor. The company XenSource that developed the hypervisor was later acquired by Citrix. Citrix is currently one of the major virtualization solution provider in the x86 market.
  - In 2006/2007, Virtual Iron released Virtual- Iron, an x86 bare-metal hypervisor for enterprise customers. Virtual Box was also introduced as an open source alternative under the GPL license.

# Hardware support for X86 virtualization

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- Early x86 processors had no built-in support for Virtualization. The virtualization was achieved using a software-only hypervisor using complex techniques to multiplex resources among virtual machines.
- Hardware assisted virtualization began to take shape in 2005, which implemented some of the commonly used functions into x86 hardware.
- As time progressed, in addition to hardware-assist for CPU virtualization, advanced hardware techniques to virtualize memory and I were introduced through different chipsets. A basic principle behind these techniques was to provide a shadow copy of the hardware to each virtual machine and to have a bypass implemented in the hypervisor to access these copies directly.

# Impact of virtualization

The impact of virtualization can be classified under two major headings:

- Cost.
- Manageability.

# Cost impact

- Security/segregation of critical applications.
- Limited or no monitoring.
- Ineffective asset management.
- Provisioning turnaround.



# Management impact

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- An important aspect of virtualization is the visibility it brings to the IT infrastructure by enabling better manageability in the system.
- Improved visibility helps to plan the infrastructure better, avert any disasters, optimize and fine-tune backups, better accounting to plan for new hardware requirements and overall growth.
- Virtualization is a vast field. It is now possible to virtualize all aspects of an IT infrastructure ranging from Desktops to Enterprise servers. The decision to virtualize is solely based on the customer requirements.

# Checkpoint (1 of 2)

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## Multiple choice questions:

1. Which supercomputer take advantage of the concepts of shared physical hardware?
  - a) The Summit
  - b) The Atlas Computer.
  - c) The Sunway TaihuLight
  - d) The Frontier
2. A technique that creates a logical abstraction of the underlying storage hardware/firmware components is called as:
  - a) Server Virtualization
  - b) Storage Virtualization
  - c) Network Virtualization
  - d) All the above
3. The technique of building an abstraction layer on the hardware that is very similar to the underlying hardware, operating system or other components of the system is called as:
  - a) Virtualization
  - b) Normalization
  - c) Organization
  - d) Randomization

# Checkpoint (2 of 2)

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## Fill in the blanks:

1. The earliest pioneer company of modern virtualization technology was \_\_\_\_\_ and it invented virtualization more than 40 years ago.
2. Intel introduced Intel VT-x and AMD introduced AMD-V to support \_\_\_\_\_ in hardware.
3. \_\_\_\_\_ eliminates most of the inflexibilities inherent in the hardware systems and allows for better manageability leading to a better utilization of the system.
4. The \_\_\_\_\_ is responsible for allocating memory, CPU resources, network and storage to each virtual machine.

## True or False:

1. The computer allowed for the separation of the supervisory (OS) components from the user components. True/False
2. The virtual machine does not emulate a complete set of peripheral hardware and components. True/False.
3. Early x86 processors had no built-in support for Virtualization. True/False.

# Checkpoint Solution (1 of 2)

Multiple choice questions:

1. Which supercomputer take advantage of the concepts of shared physical hardware?
  - a) The Summit
  - b) The Atlas Computer.**
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  - a) Virtualization**
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  - c) Organization
  - d) Randomization

# Checkpoint Solution (2 of 2)

Fill in the blanks:

1. The earliest pioneer company of modern virtualization technology was **IBM** and its invented virtualization more than 40 years ago.
2. Intel introduced Intel VT-x and AMD introduced AMD-V to support **Virtualization** in hardware.
3. **Virtualization** eliminates most of the inflexibilities inherent in the hardware systems and allows for better manageability leading to a better utilization of the system.
4. The **Hypervisor** is responsible for allocating memory, CPU resources, network and storage to each virtual machine.

True or False:

1. The computer allowed for the separation of the supervisory (OS) components from the user components. **True**
2. The virtual machine does not emulate a complete set of peripheral hardware and components. **False.**
3. Early x86 processors had no built-in support for Virtualization. **True.**

# Question bank

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Two-mark questions:

1. Define virtualization.
2. Define High Availability (HA).
3. Define Full emulation.
4. Define Server virtualization.

Four-mark questions:

1. Explain in brief Cost of an Outage.
2. Explain in brief the different types of Availability definitions.
3. Explain in brief Area & technology-based classification.
4. Explain in brief IBM Mainframe Virtualization.

Eight-mark questions:

1. Explain in detail Time-sharing systems.
2. Explain in detail all types of virtualization.

# Unit summary

- After completing this unit, you should be able to:
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- Describe the impact of virtualization