Survey of Computing Technologies: Distributed, Utility, Cluster, Grid and Cloud Computing

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Abstract –In the last few years there has been a rapid exponential increase in computer processing power, communication and data storage. But still there are many complex and computation intensive problems, which cannot be solved by supercomputers. These problems can only be met with a vast variety of heterogeneous resources. In the field of computing, a lot of changes have been observed due to the increased use and popularity of the Internet and the availability of high-speed networks. This paper describes various types of computing technologies like distributed computing, cluster computing, utility computing, grid computing and cloud computing. All these technologies have actually contributed in the development of computing.

Index Terms –Cluster, Grid, Cloud.

1. INTRODUCTION

Computing describes the way how computers and computer systems work and how they are constructed and programmed. Its major aspects of theory, systems and applications are drawn from the disciplines of Technology, Engineering, Design, Mathematics, Social Sciences and Physical Sciences. The rising popularity of the Internet and the availability of powerful computers and high-speed networks as low-cost commodity components are changing the way we do computing. Through the 1990s to 2012 the internet changed the world of computing drastically. It started with parallel computing after it advanced to distributed computing and further to grid computing. And now it creates a new world which is pronounced as a Cloud Computing. [1] .Cloud computing is the most recent announced technology that has been launched on the network world.

There are various types of computing technologies:

1) Distributed computing

2) Utility computing

3) Cluster computing

4) Grid computing

5) Cloud computing

2. DISTRIBUTED COMPUTING

It is a type of computing in which different parts of a program run simultaneously on two or more computers that are communicating with each other over a network. It also refers to the processing in which different parts of a program run concurrently on two or more processors that are part of the same computer. Both types of processing require that a program be segmented—divided into segments that can run concurrently. Over the decades, distributed computing has been an essential component of scientific computing. It comprises of a set of processes that cooperate to achieve a common specific goal. Mostly social network sites are implemented by using the concept of distributed computing systems. These are running in centrally controlled data centers. [2]. One of the major requirements of distributed computing is a set of standards that specify how objects communicate with each other. There are two chief distributed computing standards: CORBA and DCOM.

3. UTILITY COMPUTING

Due to its flexibility and economy, utility computing is one of the most popular IT service models. Grid computing, cloud computing and managed IT services are based on the concept of utility computing. Utility computing is the process of providing computing service through an on-demand, pay-per-use billing method. Utility computing is a computing business model in which the provider owns, operates and manages the computing resources, infrastructure and the subscribers accesses it as and when required on a rental or metered basis [1]. Utility computing usually envisions some form of virtualization so that the amount of storage or computing power available is considerably larger than that of a single time-sharing computer. For this purpose, multiple servers are used on the back end. These might be a dedicated computer cluster specifically built for the purpose of being rented out.

This model is based on that used by conventional utilities such as telephone services, electricity and gas. The backend infrastructure and computing resources management and delivery is governed by the provider. Utility computing solutions consists of virtual servers, virtual storage, virtual software, backup and most IT solutions.

4. CLUSTER COMPUTING

A cluster computing is a type of parallel or distributed processing system, which consists of a collection of interconnected stand-alone computers working together as a single integrated computing resource. The components of a cluster are commonly, but not always, linked to each other through fast local area networks [2].

A computer node will be one or multiprocessor system (PCs, workstations, or SMPs) with memory, I/O facilities, and an operating system. A cluster generally refers to two or additional computers (nodes) connected along. The nodes can exist in a single cabinet or be physically separated and connected via a LAN. An inter-connected (LAN-based) cluster of computers will seem as a single system to users and applications. Such a system can provide a cost effective way to gain features and benefits (fast and reliable services) that have traditionally been found solely on more expensive proprietary shared memory systems.

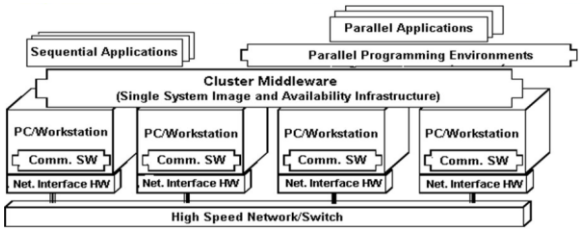

Fig 1: Cluster Computing

Clusters are commonly deployed to improve performance and accessibility over that provided by a single computer, while usually being much more cost-effective than single computers of comparable speed or availability [3]. The architecture of the cluster computing environment is shown in the Fig. 1

The following are some prominent components of cluster computers:

Multiple High Performance Computers (PCs, Workstations, or SMPs)

State-of-the-art Operating Systems (Layered or Micro-kernel based)

High Performance Networks/Switches (such as Gigabit Ethernet and Myrinet)

Network Interface Cards (NICs)

Fast Communication Protocols and Services (such as Active and Fast Messages)

Cluster Middleware (Single System Image (SSI) and System Availability Infrastructure)

5. GRID COMPUTING

Grid computing is a distributed architecture that combines computer resources from various domains to reach a main objective. In grid computing, the computers run independent tasks and are loosely linked by the Internet can work on a task together, thus functioning as a supercomputer. Typically, a grid works on various tasks among a network, but it is additionally capable of performing on specialized applications. It is designed to resolve issues that are too big for a supercomputer while maintaining the flexibility to process various smaller problems. Computing grids deliver a multiuser infrastructure that accommodates the discontinuous demands of large information processing. A grid is connected by parallel nodes that form a computer cluster, which runs on an operating system like Linux or free software. The cluster can differ in size from a small work station to numerous networks. The grid technology is applied to a wide range of applications, such as mathematical, scientific or educational tasks through several computing resources. It is often used in structural analysis, Web services such as ATM banking, back-office infrastructures, and scientific or marketing research. Grid computing is made up of applications used for computational computer problems that are linked in a parallel networking environment. It connects each PC and computation intensive.

Grids have a variety of resources based on diverse software and hardware structures, computer languages, and frameworks, either in a network or by using open standards with specific guidelines to achieve a common goal. Grid operations are generally classified into two categories:

A. Data Grid

A system that handles large distributed data sets used for data management and controlled user sharing. It creates virtual environments that support dispersed and organized research. The Southern California Earthquake Center is an example of a data grid; it uses a middle software system that creates a digital library, a dispersed file system and continuing archive.

B. CPU Scavenging Grids

A cycle-scavenging system that moves projects from one PC to another as needed. A familiar CPU scavenging grid is the search for extraterrestrial intelligence computation, which includes more than three million computers.[3]

6. CLOUD COMPUTING

Cloud computing is a form of computing that relies on sharing computing resources instead of having local servers or

personal devices to handle applications. Cloud computing means storing and accessing information and programs over the Internet rather than your computer's disk drive. The cloud is just an image for the internet, so the phrase cloud computing means that "a sort of Internet-based computing," where totally different services — such as servers, storage associated applications — are delivered to an organization's computers and devices through the web. Cloud computing is analogous to grid computing, a type of computing where unused processing cycles of all computers during network are harnesses to resolve issues too intensive for any stand-alone machine.

A. Types of cloud computing

Cloud computing is categorized in two ways [3]:

1) Location of the cloud computing

2) Type of services offered

B. Classification based on the location of the cloud

Cloud computing is typically classified in the following ways:

1) Public cloud: In Public cloud the computing infrastructure is hosted by the cloud vendor. The customer has no visibility and control over where the computing infrastructure is hosted. The computing infrastructure is shared between any organizations.

2) Private cloud: The computing infrastructure is dedicated to a specific organization and not shared with other organizations. Some experts take into account that personal clouds don't seem to be real examples of cloud computing. Private clouds are more expensive and more secure than public clouds. Private clouds are of two types: On-premise private clouds and externally hosted private clouds. Externally hosted private clouds are also exclusively used by one organization, but are hosted by a third party specializing in cloud infrastructure. Externally hosted private clouds are cheaper as compared to On-premise private clouds.

3) Hybrid cloud Organizations may host vital applications on private clouds and applications with comparatively less security issues on the public cloud. The usage of both private and public clouds together is called hybrid cloud. A related term is Cloud Bursting. In Cloud bursting organization use their own computing infrastructure for traditional usage, but access the cloud using services like Sales force cloud computing for high load requirements. This ensures that a sudden increase in computing demand is handled graciously.

4) Community cloud involves sharing of computing infrastructure in between organizations of the same community. For example, all Government organizations within the state of California may share computing infrastructure on the cloud to manage data related to citizens residing in California.

C. Classification based upon service provided

Based upon the services offered, clouds are classified in the following ways:

1) Infrastructure as a service (IaaS): It involves offering hardware related services using the principles of cloud computing. These could include some kind of storage services (database or disk storage) or virtual servers. Leading vendors that provide Infrastructure as a service are Amazon EC2, Amazon S3, Rackspace Cloud Servers and Flexiscale.

2) Platform as a Service (PaaS): It involves offering a development platform on the cloud. Platforms provided by different vendors are typically not compatible. Typical players in PaaS are Google Application Engine, Microsoft's Azure.

3) Software as a service (SaaS): It includes complete software providing on the cloud. Users can access a software application hosted by the cloud vendor on pay-per-use basis. This is a well-established sector. The pioneer in this field has been offering in the online Customer Relationship Management (CRM) space. Other examples are online email providers like Google's gmail and Microsoft's hotmail, Google docs and Microsoft's online version of office called BPOS (Business Productivity Online Standard Suite)[3].

7. CONCLUSION

In this paper, various computing technologies like distributed computing, utility computing, cluster computing, grid computing and cloud computing has been discussed. Distributed computing is a type of parallel computing in which different parts of a program run simultaneously. Social networking sites are based on distributed computing. Utility computing forms the basis of grid and cloud computing by using the concept of virtualization. Cluster computing on the other hand are deployed to handle heavy workload by connecting a group of computers to make a single computer. Cloud computing is a new technology of computer network, providing the web services in high quality and lower cost comparing to other computing state-of-the-art techniques.

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