Distributed Network and Cloud Computing

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ABSTRACT

Nowadays, cloud computing is becoming more and more powerful and popular, this term is generally used to describe data centers available to many users over the Internet. People prefer store their files and data instead of traditional disk than they done before. Thus, the network in cloud computing is critical to ensure the security and integrity of the uploaded files, besides, the distributed system is also a crucial part of cloud computing, a distributed system is a system whose components are located on different networked computers, which communicate and coordinate their actions by passing messages to one another. The network between systems is aimed to assure that the files can be transferred in high speed without loss. Distributed networking is the network system over which computer programming, software, and its data are spread out across more than one computer, which is used in distributed computing. The modern distributed system is a combination of distributed network. The paper is supposed to investigate the cutting-edged technique of cloud computing and distributed system and try to analyze the mechanism and implementation of them.

Keywords : Cloud Computing, Distributed System, Distributed Network.

I. INTRODUCTION

I.1 Distributed Systems

The distributed system is a system that consists of a collection of autonomous machines connected through a communication network and is equipped with software systems designed to produce an integrated and consistent computing environment. Distributed systems enable people to collaborate and coordinate their activities more effectively. The main purpose of a distributed system can be expressed as: resource sharing, openness, concurrency, scalability, fault tolerance and transparency[1], as the Table 1 shows below:

Table 1 Key Purpose of Distributed System

Key purpose	Function
Resource sharing	In a distributed system, the resources - hardware, software and data can be easily shared among users. For example, a printer can be shared among a group of users.
Openness	The openness of distributed systems is achieved by specifying the key software interface of the system and making it available to software developers so that the system can be extended in many ways.
Concurrency	The processing concurrency can be achieved by sending requests to multiple machines connected by networks at the same time.
Scalability	A distributed system running on a collection of a small number of machines can be easily extended to a large number of machines to increase the processing power.
Fault-tolerance	Machines connected by networks can be seen as redundant resources, a software system can be installed on multiple machines so that in the face of hardware faults or software failures, the faults or failures can be detected and tolerated by other machines.
Transparency	Distributed systems can provide many forms of transparency such as:

I.2 Computer Networks

In the late 1990s, computing has reached the state of Web-based distributed computing. The OSI reference model is a seven-layer model for inter-process communication. Its architecture includes application, presentation, session, transport, network, data link and physical layers and corresponding protocols, as depicted in Table 2.

Table 2 OSI Architecture

Application
Presentation
Session
Transport
Network
Data Link
Physical

I.3 Software for Distributed Computing

I.3.1 Traditional Client-Server Model

Client–server model is a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients.[2] The client and server usually communicate over a computer network on separate hardware, but both the client and server can be on the same system. Fig. 1 shows A computer network diagram of clients communicating with a server via the Internet.

The client-server model describes how the server provides resources and services to one or more clients. Examples of servers include web servers, mail servers, and file servers. Each of these servers provides resources for client devices such as desktops, laptops, tablets, and smartphones. Most servers have a one-to-many relationship with clients, which means that one server can provide resources to multiple clients at once.

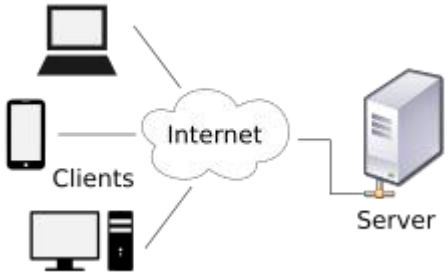

Fig. 1 Client-server model

I.3.2 Web-based Client-Server Computing(WBCS)

WBCS computing uses a typical web browser to access and manipulate dynamic information, stored in a centrally controlled DBMS, over the Internet. This is an alternative to the current client/server model, in which a custom-written graphical user interface (GUI) application accesses and manipulates dynamic information stored in a DBMS using proprietary communication software. WBCS generates HyperText Mark-up Language (HTML) pages on the fly to provide the latest information via the WWW.[7]

Fig. 2 shows the Flow of a simple WBCS scenario.

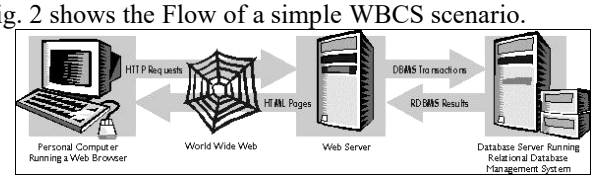

Fig. 2 Flow of a simple WBCS scenario

I.3.3 Agent-based Computing Model

An agent-based model (ABM) is a class of computational models for simulating the actions and interactions of autonomous agents (both individual or collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole.

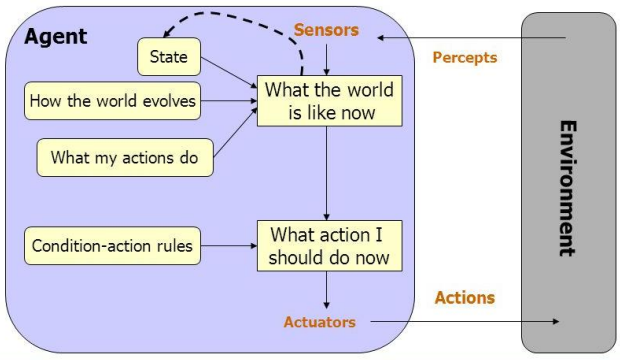

Fig. 3 Agent programs

I.3.4 The Relationship

As the Fig. 4 and Fig.5 shows, then main difference of traditional model and distributed model is distributed computing adds a module to the local centralised operating system of each computer, which allows processes to access remote resources and services; however, in the majority of cases this solution does not fully support transparency, or employs a distributed operating system, which hides distribution of resources and services; this solution, although futuristic from the current practice point of view, provides location transparency.

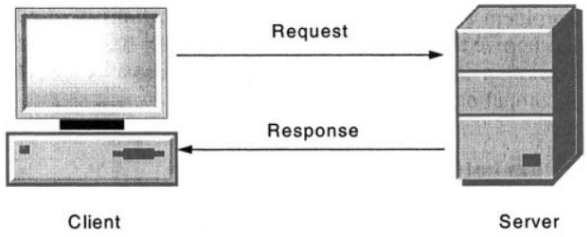

Fig. 4 The basic client-server model

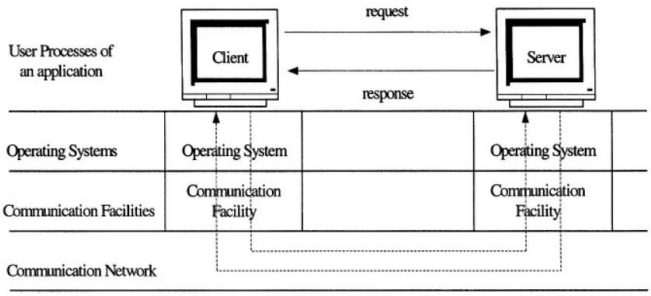

Fig. 5 Distributed computing

II. COMMUNICATION PARADIGM FOR DISTRIBUTED NETWORK

1) Message Passing

Message passing is a type of communication between processes or objects in computer science. In this model, processes or objects can send and receive messages (signals, functions, complex data structures, or data packets) to other processes or objects.[3] As shows in Fig. 6.

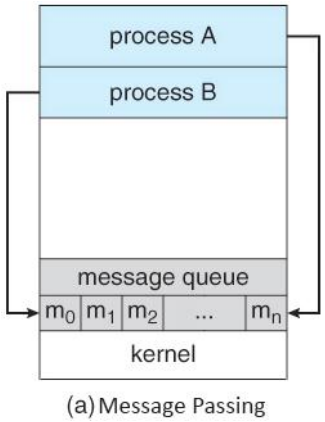

Fig. 6 Message Passing

The biggest advantage of messaging is that it is easier to build massively parallel hardware. The messaging programming model is often more tolerant of higher communication delays.

Shared memory or faster messaging depends on the problem to be solved, the quality of the implementation, and the system running. For example, on a single server, using a shared memory programming environment may be easier and more performant. Throughout a distributed cluster, using a messaging library may be faster.

2) Remote procedure call

Programmers can see messages passed between remote and local processes. This is a completely typeless technology. Programming messaging-based applications is difficult and error-prone. The answer to these questions is RPC technology, which is based on a basic language concept called procedure call. The very general term "remote procedure call" refers to a type checking mechanism that allows a language-level call on one computer to be automatically converted to a corresponding language-level call on another computer.

In distributed computing, a remote procedure call (RPC) is when a computer program causes a procedure (subroutine) to execute in a different address space (commonly on another computer on a shared network), which is coded as if it were a normal (local) procedure call, without the programmer explicitly coding the details for the remote interaction. That is, the programmer writes essentially the same code whether the subroutine is local to the executing program, or remote.[4]

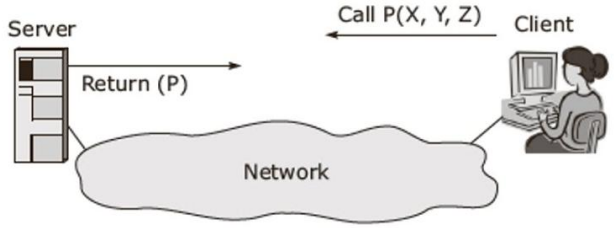

Fig. 7 Remote procedure call

3) Group Communication

A group is an operating system abstraction for a collective of related processes. A set of cooperative processes may, for example, form a group to provide an extendable, efficient, available and reliable service. The group abstraction allows member processes to perform computation on different hosts while providing support for communication and synchronisation between them.[5]

4) Distributed Shared Memory

Distributed shared memory (DSM) is an abstraction used for sharing data between computers that do not share physical memory. Processes access DSM by reads and updates to what appears to be ordinary memory within their address space. As shows in Fig. 8.

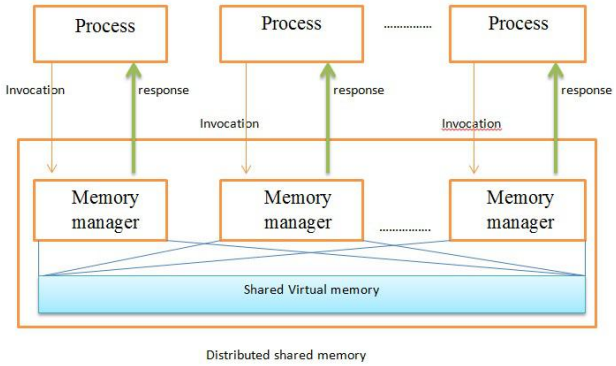

Fig. 8 Distributed shared memory

Distributed shared memory has below advantage:

- Hide data movement and provide simpler abstractions for shared data. Programmers need not worry about memory transfers between machines, such as when using the messaging model.
- Allows complex structures to be passed by reference, simplifying algorithm development for distributed applications.
- Take advantage of "reference locations" by moving entire pages containing reference data instead of just the data.
- Cheaper than multi-processor systems. The idea can be implemented using regular hardware, and no complicated operations are required to connect shared memory to the processor.
- By combining all the physical memory of all nodes, the program can use larger memory. Like traditional distributed systems, this large memory does not cause disk latency due to swapping.
- You can use an unlimited number of nodes. Unlike multiprocessor systems that access main memory through a common bus, the size of a multiprocessor system is limited.
- Programs written for shared memory multiprocessors can run on DSM systems.

III. INTERPROCESS COMMUNICATION MECHANISMS

DCE (Distributed Computing Environment) is an industry-standard software technology for setting up and managing

computing and data exchange in a system of distributed computers.

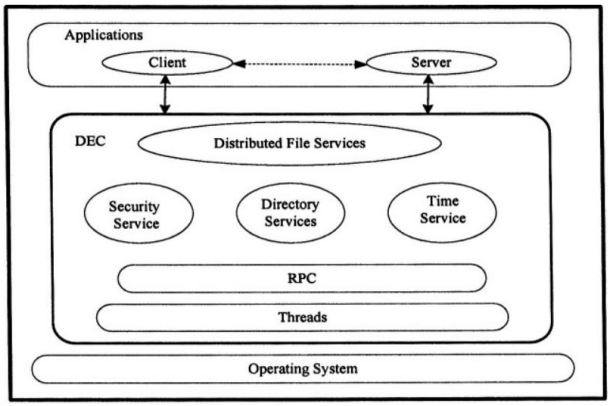

Fig. 9 Distributed Computing Environment

DCE uses threads to improve the efficiency. A thread is a 'lightweight' process that executes a portion of a program, cooperating with other threads concurrently executing in the same address space of a process.

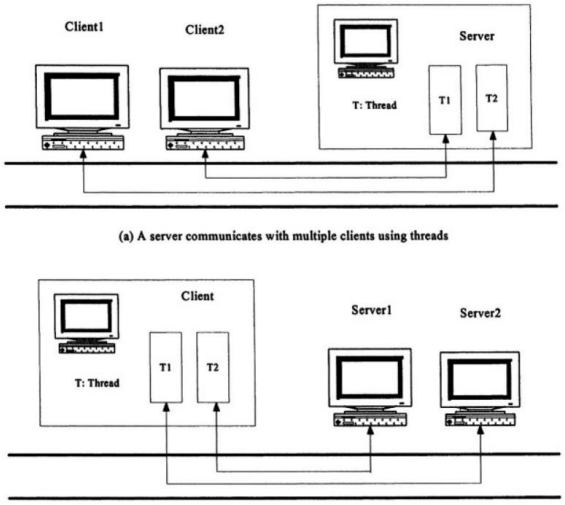

Fig. 10 DCE threads

All the high-level DCE services, such as directory services, security services, time services, and distributed file services, are provided by relevant servers:

1) Directory Services

The main job of the directory services is to help clients find the locations of appropriate servers.

2) Security Services

DCE provides the following four security services, as shown in Table 3.

Table 3 Four security services

security services	Meaning
Authentication	When a client requests some service from a server, it must identify itself and must provide some information to prove its true identity
Authorisation	Once a client's identity has been authenticated, the next question is whether the client has the right to perform the service it is requesting
Data integrity	This service guards against the alteration of data during the transmission of the data. It allows a recipient of a message to determine whether the data has been tampered with
Data privacy	It ensures that data sent between clients and servers cannot be read by anyone but the parties involved in the communication

3) Time Services

Distributed time service (DTS) of DCE is designed to keep a set of clocks on different computers synchronised.

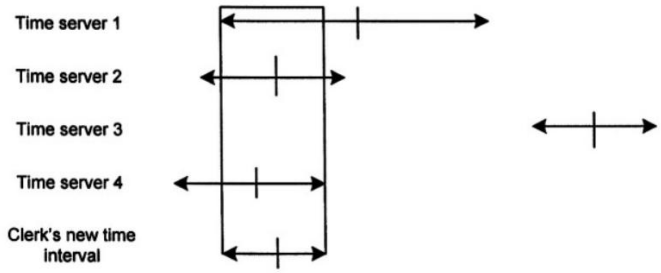

Fig. 11 Time synchronisation using intervals

4) Distributed File Services

DCE uses its distributed file services (DFSs) to join the file systems of individual computers within a cell into a single file space. A uniform and transparent interface is provided for applications to accessing files located in the network.

IV. APPLICATIONS OF DISTRIBUTED NETWORK

1) Mobile Computing

Mobile computing is a general term that refers to various devices that allow people to access data and information from anywhere. Mobile computing is sometimes referred to as "human-computer interaction," which transfers data, voice, and video over a network through a mobile device.
Mobile devices can be connected to a local area network (LAN), or they can take advantage of Wi-Fi or wireless technology through a wireless local area network (WLAN) connection.[6]

The Benefits of Mobile Computing are:

Connectivity: You can stay connected to all sources at all times.

Social Engagement: You can interact with a variety of users via the Internet.

Personalization: You can tailor your mobile computing to your individual needs.

Fig. 12 shows the main part of mobile computing.

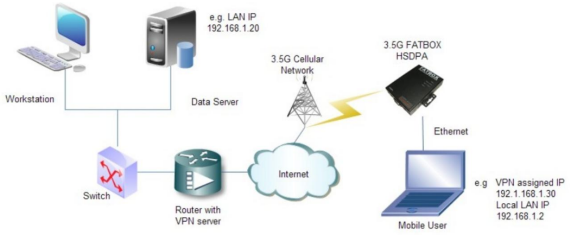

Fig. 12 Mobile computing

2) Cloud Computing

Cloud computing is a term that applies to applications and data storage delivered over the Internet or via wireless technology. An individual user's device, such as a computer or mobile phone, only provides an interface to interact with computer programs and data. The program runs on the service provider's computer, and the data is stored where it is deemed necessary by the provider. As long as you are connected to the Internet or a wireless network, you can use these applications and related data.

There are another network application in cloud computing, called cloud networking. Cloud networking refers to hosting or using some or all network resources and services (virtual routers, bandwidth, virtual firewalls, or network management software) from the cloud, whether public, private, or hybrid. The network can be cloud-enabled or fully cloud-based.

In a cloud-enabled network, the network is on-premises, but some or all of the resources used to manage the network are in the cloud. The core network infrastructure (packet forwarding, routing, and data) remains internal, but operations such as network management, monitoring, maintenance, and security services are all done through the cloud. One example is the use of SaaS-based firewalls to protect the local network.

In a cloud-based network, the entire network is in the cloud. This includes network management resources and physical hardware. Cloud-based networks are used to provide connectivity between applications and resources deployed in the cloud.

Fig. 13 shows the main features of cloud computing.

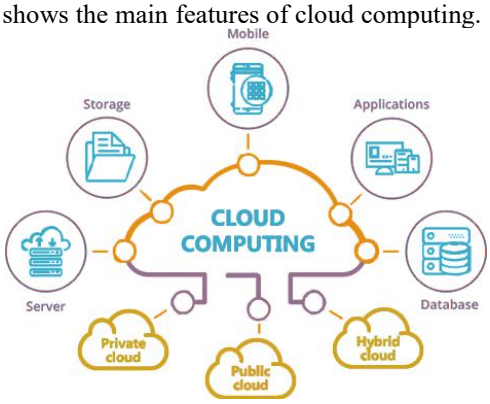

Fig. 13 Cloud computing

3) Blockchain

A blockchain is a growing list of records, called blocks, that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data.

Fig. 14 shows the process of how the blockchain works.

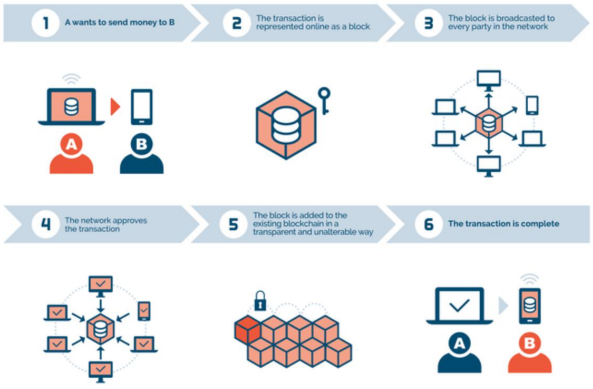

Fig. 14 How Blockchain works

4) Peer-to-Peer(P2P) network

In a P2P network, the "peers" are computer systems which are connected to each other via the Internet. Files can be shared directly between systems on the network without the need of a central server. In other words, each computer on a P2P network becomes a file server as well as a client.[7]

Fig. 15 shows the comparison of traditional client-server network and P2P network.

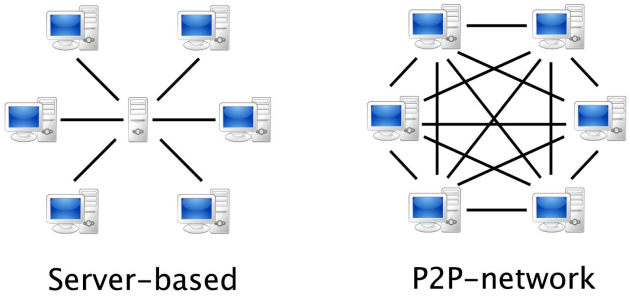

Fig. 15 Comparison of traditional client-server network and P2P network

V. CONCLUSION

This paper elaborate the distributed networking, introduces its principles, attributes, advantages and the applications and implementations of distributed network. We can conclude that with the rapid development of various emerging distributed computing technologies, the future distributed network will be more and more “lightweight” and self-managed.

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