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RESEARCH ARTICLE

A Secure Decentralized Cloud Computing Environment over Peer to Peer

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Abstract— Cloud computing platform is a set of scalable large-scale data server clusters, it provide computing and storage services to customers. A cloud computing provider or cloud computing service provider owns and operates live cloud computing systems to deliver service to third parties. The barrier to entry is also significantly higher with capital expenditure required and billing and management creates some overhead. Nonetheless, significant operational efficiency and agility advantages can be realized, even by small organizations, and server consolidation and virtualization rollouts are already well underway. Cloud computing systems provide large-scale infrastructures for high-performance computing that are "elastic" since they are able to adapt to user and application needs. Cloud computing platform is a set of scalable large-scale data server clusters. The cloud storage is a relatively basic and widely applied service which can provide users with stable, massive data storage space. Research shows that the architecture of current cloud computing system is central structured one; all the data nodes must be indexed by a master server which may become bottle neck of the system. In this project, the proposed new cloud storage decentralized architecture (no centralization is there, that's why it's designed in Peer to peer) and designed a prototype system. The system based on the new architecture has better scalability and fault tolerance and proposed system designed a cloud based environment where request and response is taking place between client and chunk servers through Gateway. Anyone can take multiple chunk servers as well as multiple clients in the proposed system, this environment (client) can make request for deploying a web-service and also in this proposed system, it's implement the cross-technology platform using the cloud based environment and at last proposed an algorithm with the help of "Advance Encryption Standard" which is going to provide security in the form of encryption and decryption in the cloud based environment.

Key Terms: - Cloud computing; fault tolerance; P2P; multi-agent systems; virtualization; encryption; cluster; server storage

I. Introduction

Existing System

A. Google Computing System-GFS

When a client wants to visit some data on a chunk server, it will first send a request to the Master. The master then replies with the corresponding chunk handle and locations of the replicas. The clients then send a request to one of the replicas and fetch the data wanted. The Cloud computing technology has been widely applied in e-business, e-education .Cloud computing platform is a set of Scalable large-scale data server clusters, it provides computing and storage services to customers. The cloud storage is a relatively basic and widely applied service which can provide users with stable, massive data storage space. Research shows that the architecture of current Cloud Computing System is central structured one; all the data nodes must be indexed by a master server which may become bottle neck of the system. In these days a single server handles the multiple requests from the user. Here the server has to process the both the request from the user simultaneously, so the processing time will the high. This may leads to loss of data and packets may be delayed and corrupted. On doing this the server cannot process the query from the user in a proper manner. So the processing time gets increased. It may leads to traffic and congestion. To overcome these problems we are going for the concept called "cloud computing". In this cloud computing we are going to implement the chunk server to avoid these problems.

Limitation

1- The design and maintenance of the system controlled by a central managed architecture.
2- The flaw of central index architecture is that the GFS master may become bottle neck of the system since all the request to the target data chunk must be originated from the index server which burdens the master.
3- Backup recovery very difficult

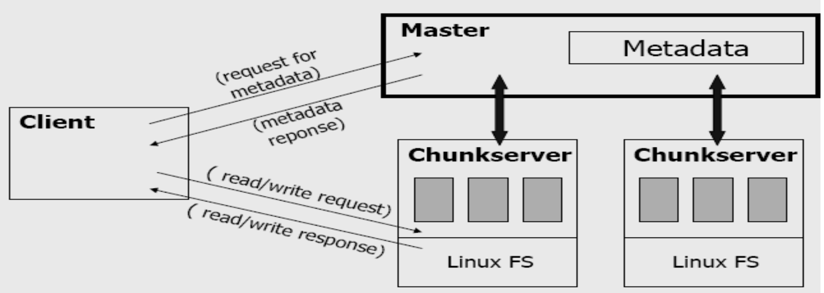


Fig.1 Web service standards and their relations in SOA

Proposed System

B. P2P - Peer to Peer

When a client makes a request the request goes to gateway. The gateway constructs a search request and sends the request to the chunk server P2P network. The P2P search request locates the nearest chunk server based on the memory usage and the request is processed by that chunk server. The client will upload, download and deploy the information from the nearest server (here nearest server means which server is containing the greater value of memory usage, that server will select as nearest server).And also I am going to Secure this cloud architecture using Advance encryption standard. I am going to put this architecture as a service oriented work such as using this we can deploy web services for cross technology(i.e.- Such as I have written a logic in Java, using this cloud service I can deploy the logic in .net platform also and run it there).

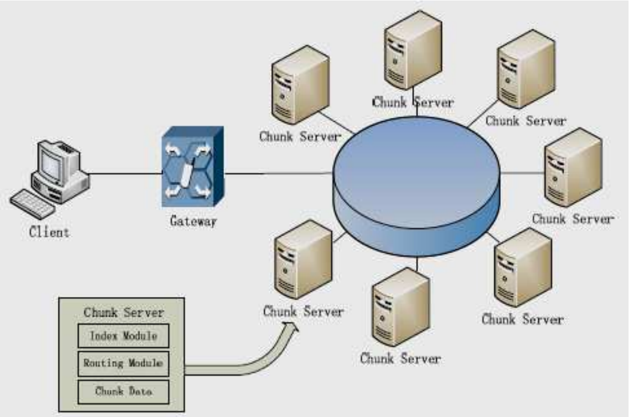


Fig.2 Web service standards and their relations in chunk server

Advantages

1- Improved Reliability than the “client-server” cloud.
2- Much more cost effective because there is no need to build expensive datacenters.
3- Offers much needed Reliability and Security.
4- Provides pure distributed data storage environment without any central entity to offer infrastructure services.
5- Minimize the downtimes using P2P architecture.
6- It is a method of delivering computer network services in which the participants share a portion of their own resources, such as processing power, disk storage, network bandwidth, printing facilities.
7- Such resources are provided directly to other participants without intermediary network hosts or servers.

Imagine yourself in the world where the users of the computer of today’s internet world don’t have to run, install or store their application or data on their own computers, imagine the world where every piece of your information or data would reside on the Cloud (Internet).

As a metaphor for the Internet, "the cloud" is a familiar cliché, but when combined with "computing", the meaning gets bigger and fuzzier. Some analysts and vendors define cloud computing narrowly as an updated version of utility computing: basically virtual servers available over the Internet. Others go very broad, arguing anything you consume outside the firewall is "in the cloud", including conventional outsourcing.

Cloud computing comes into focus only when you think about what we always need: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Cloud computing encompasses any subscription-based or pay-per-use service that, in real time over the Internet, extends ICT's existing capabilities.

Cloud computing is at an early stage, with a motley crew of providers large and small delivering a slew of cloud-based services, from full-blown applications to storage services to spam filtering. Yes, utility-style infrastructure providers are part of the mix, but so are SaaS (software as a service) providers such as Salesforce.com. Today, for the most part, IT must plug into cloud-based services individually, but cloud computing aggregators and integrators are already emerging.

II. Cloud Computing – The Concept

Cloud computing is Internet ("cloud") based development and use of computer technology ("computing"). It is a style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet. Users need not have knowledge of, expertise in, or control over the technology infrastructure "in the cloud" that supports them.

The concept incorporates infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) as well as Web 2.0 and other recent technology trends which have the common theme of reliance on the Internet for satisfying the computing needs of the users. Examples of SaaS vendors include Salesforce.com and Google Apps which provide common business applications online that are accessed from a web browser, while the software and data are stored on the servers.

The term cloud is used as a metaphor for the Internet, based on how the Internet is depicted in computer network diagrams, and is an abstraction for the complex infrastructure it conceals.

C. Types

Public cloud

Public cloud or external cloud describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet, via web applications/web services, from an off-site third-party provider who shares resources and bills on a fine-grained utility computing basis.

Private cloud

Private cloud and internal cloud are neologisms that some vendors have recently used to describe offerings that emulate cloud computing on private networks. These products claim to "deliver some benefits of cloud computing without the pitfalls", capitalizing on data security, corporate governance, and reliability concerns.

While an analyst predicted in 2008 that private cloud networks would be the future of corporate IT, there is some uncertainty whether they are a reality even within the same firm. Analysts also claim that within five years a "huge percentage" of small and medium enterprises will get most of their computing resources from external cloud computing providers as they "will not have economies of scale to make it worth staying in the IT business" or be able to afford private clouds.

The term has also been used in the logical rather than physical sense, for example in reference to platform as service offerings, though such offerings including Microsoft's Azure Services Platform are not available for on-premises deployment.

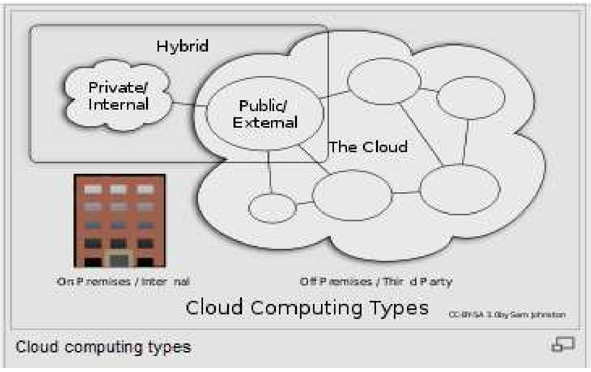


Fig.3 Types of Cloud Computing

Hybrid cloud

A hybrid cloud environment consisting of multiple internal and/or external providers "will be typical for most enterprises".

III. SYSTEM REQUIREMENT

D. .Selection of softwares & languages

Technology	J2EE (Jdk1.5, Servlet, Jsp), HTML
Web Server	Apache Tomcat 6.0
Database	MYSQL
Browser	Internet Explorer 6.0 or above
Platform	Windows 2000, XP

E. Selection of hardware

Processor	Intel Pentium IV processor
Ram	512MB
Hard disk	40GB
Monitor	800 x 600 minimum screen resolutions
Keyboard	Microsoft standard 104 keys
Mouse	Microsoft basic optical mouse

IV. SERVICE ORIENTED ARCHITECTURE (SOA)

The concept of service oriented architecture or SOA deals with reducing the organizational expenses through optimizing resource management from human to other system resources in order to reduce organizational costs and increase the overall throughput and efficiency. The basic tenet of SOA is reusability of the organizational resources. In a service oriented architecture, a resource can be accessed at any time, by each authorized entity, from anywhere at the system. On the other hand, the dispersed independent services can communicate to each other to make new composites for new organizational businesses

One of the important features of service oriented architecture is using a common language among the system nodes which introduces it as an appropriate approach for distributed heterogeneous environments. We implemented a basic version of our proposed algorithm through web services as one of the existing SOA implementation approaches with the following standards:

SOAP

Simple Object Access Protocol is a W3C standard defining protocols for passing objects using XML (Extensible Marked up Language). SOAP Runtime system enables a client to call methods on a SOAO-enabled service, passing objects in XML format.

WSDL

Web Service Description Language is also a W3C standard which is used to describe a web service interface.

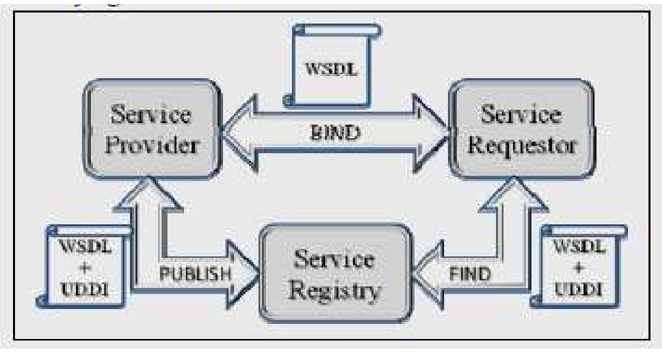


Fig.4 Relation Between WSDL & UDDI

UDDI

Universal Description Discovery and Integration is a protocol for web based registries that contain information about web services such as the Location of its WSDL file.

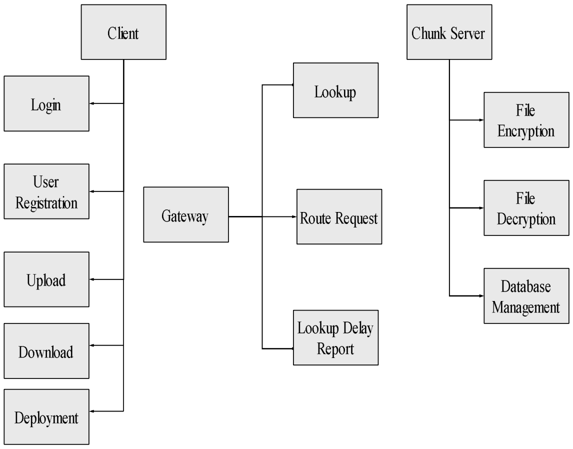
Web services today are frequently just Application Programming Interfaces (API) or web APIs that can be accessed over a network, such as the Internet, and executed on a remote system hosting the requested services. It prepares a distributed strategy for a comprehensive and dynamic stegenography process which improves reusability, facilitates system management, reduces complexity, and improves the overall security.

Advantages

1. Distributed Computing Model.
2. Platform independency: Since services are communicating through common standards and all the request/responses are accomplished through XML, different platforms can collaborate to each other in a totally transparent environment.
3. All web services' public agreements must be described by open and standard protocols such as SOAP (Simple Object Access Protocol) and HTTP. Compared with the general objects, they are more standardized and easier to understand by the machine.
4. Integration capabilities; web service technology adopts simple and easy-to-understand protocols to express its principal which is described by the WSDL (Web Service Description Language).So the technology fully shields the differences between different software platforms.
5. The concept of service oriented architecture or SOA deals with reducing the organizational expenses through optimizing resource management from human to other system resources in order to reduce organizational costs and increase the overall throughput and efficiency.
6. Our system can make use of all the existing possibilities regardless of their different hardware/software platforms, languages and so on.
7. New features can be added to the system as a new service without any other modifications.
8. Advantage of loose coupling; when the web services change, the callers will not feel them. As to the service requesters, as long as the service interfaces do not change, any changes of services will make no influence on the service requesters.
9. Making use of the underlying service oriented architecture, the proposed strategy not only supports the current algorithms, and it also provides an open architecture for the future algorithms.
10. Since the system is based on SOA and the concept is break down as independent (and sometimes general purpose) services, the overall reusability and flexibility would be quite high.

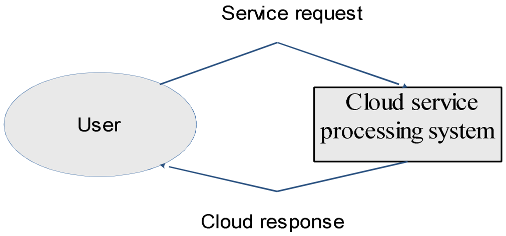
V. SYSTEM PLANNING AND DESIGNING

F. Overall System Design structure

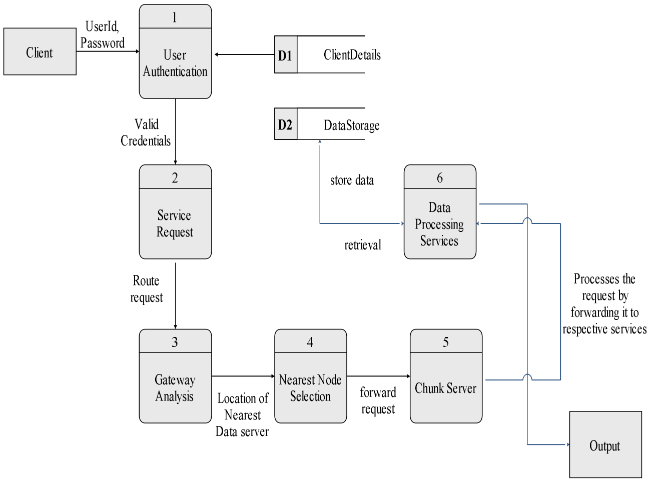


G. Data Flow diagram

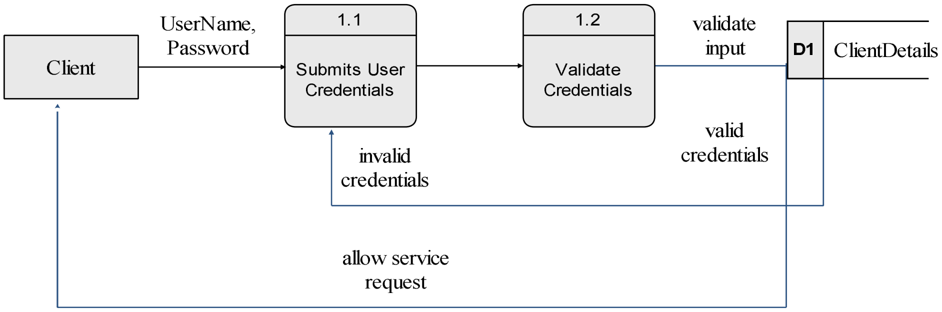
Context Level Diagram – Level 0



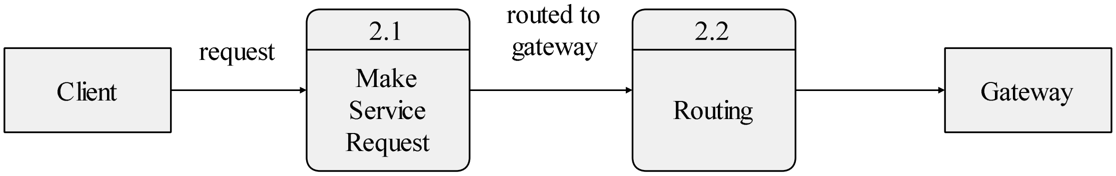
DFD – Level 1



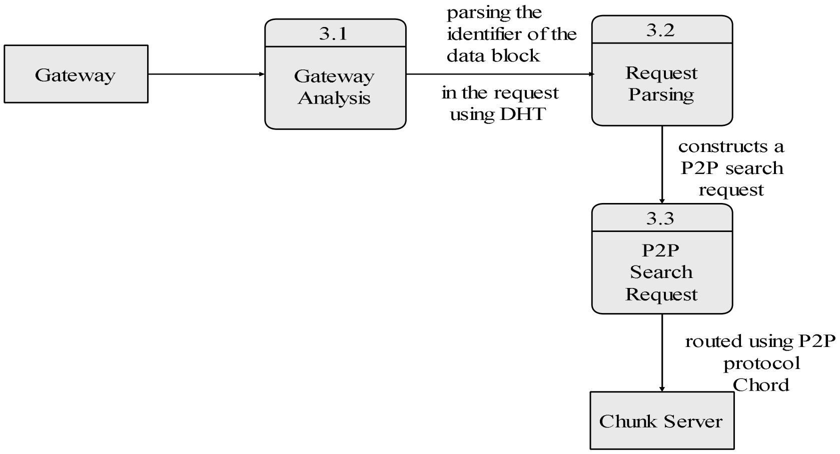
DFD – Level2



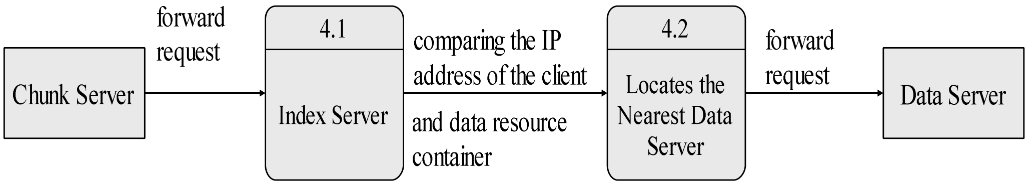
DFD - Level 3



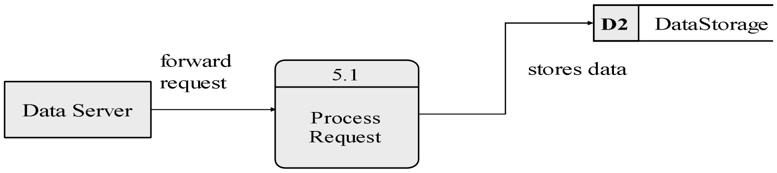
DFD - Level 4


Gateway
3.1
Gateway Analysis
parsing the identifier of the data block
in the request using DHT
3.2
Request Parsing
constructs a P2P search request
3.3
P2P Search Request
routed using P2P protocol Chord
Chunk Server

DFD - Level 5


Chunk Server
forward request
4.1
Index Server
comparing the IP address of the client
and data resource container
4.2
Locates the Nearest Data Server
forward request
Data Server

DFD - Level 6



VI. PSEUDO CODE

```
Cipher(byte[] input, byte[] output)
{
  byte[4,4] State;
  copy input[] into State[]
  AddRoundKey
  for (round = 1; round < Nr-1; ++round)
  {
    SubBytes
    ShiftRows
    MixColumns
    AddRoundKey
  }
  SubBytes
  ShiftRows
  AddRoundKey
  copy State[] to output[]
}
```

Add RoundKey

```
private void AddRoundKey(int round)
{
  for (int r = 0; r < 4; ++r)
  {
    for (int c = 0; c < 4; ++c)
    {
      this.State[r,c] = (byte) ( (int)this.State[r,c] ^
                            (int)w[(round*4)+c,r] );
    }
  }
}  // AddRoundKey()
```

SubBytes

```
private void SubBytes()
{
  for (int r = 0; r < 4; ++r)
  {
    for (int c = 0; c < 4; ++c)
    {
      this.State[r,c] = this.Sbox[ (this.State[r,c] >> 4),
                              (this.State[r,c] & 0x0f) ];
    }
  }
}  // SubBytes
```

ShiftRows

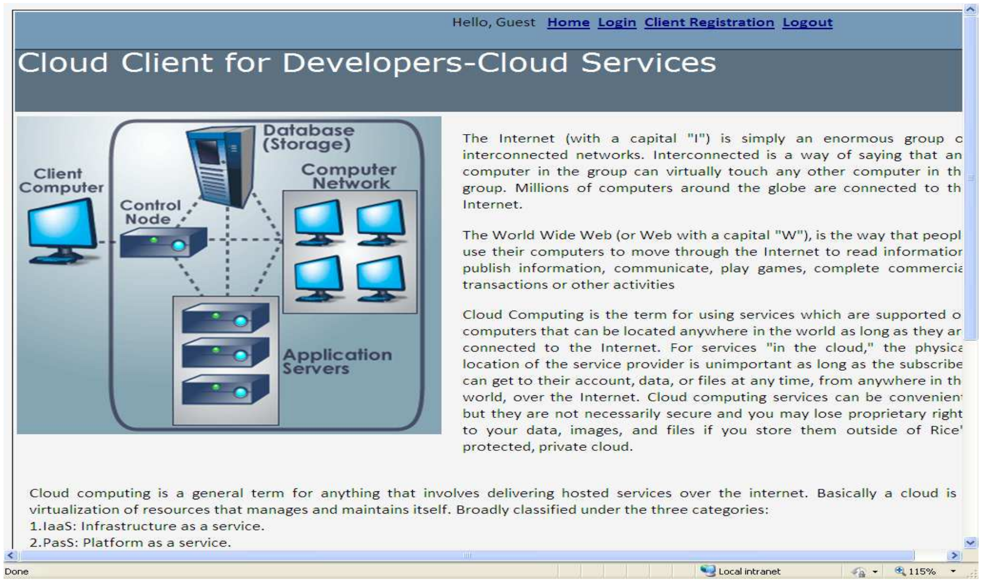
```
private void ShiftRows()
{
  byte[,] temp = new byte[4,4];
  for (int r = 0; r < 4; ++r)
  {
    for (int c = 0; c < 4; ++c)
    {
      temp[r,c] = this.State[r,c];
    }
  }

  for (int r = 1; r < 4; ++r)  //
  {
    for (int c = 0; c < 4; ++c)
    {
      this.State[r,c] = temp[ r, (c + r) % Nb ];
    }
  }
}
```

VII. PROCESS DESIGN

Module Description

H. Client Module

This is a user interface module that allows clients to access the cloud services.



Cloud Client for Developers-Cloud Services

The Internet (with a capital "I") is simply an enormous group c interconnected networks. Interconnected is a way of saying that an computer in the group can virtually touch any other computer in th group. Millions of computers around the globe are connected to th Internet.

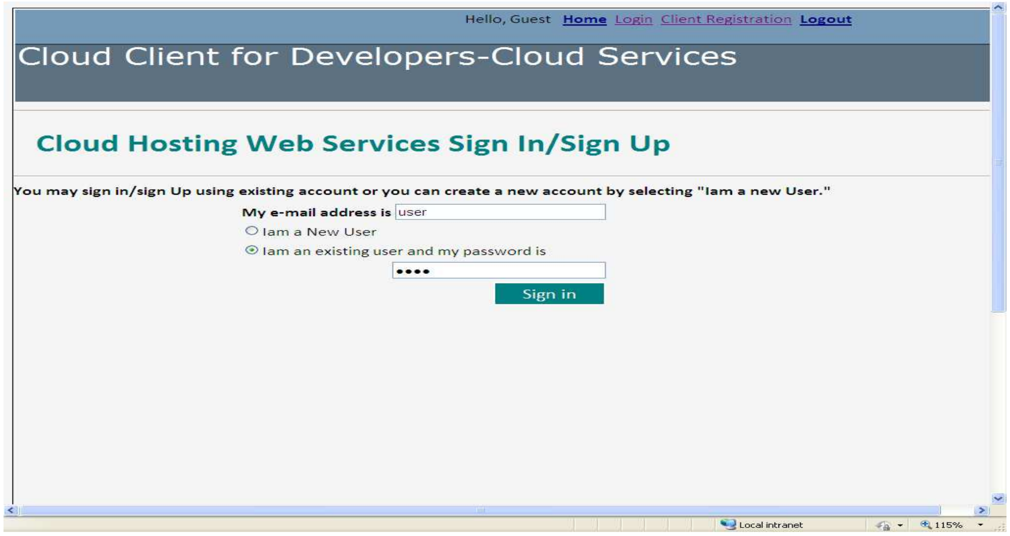
The World Wide Web (or Web with a capital "W"), is the way that peopl use their computers to move through the Internet to read informatior publish information, communicate, play games, complete commercia transactions or other activities

Cloud Computing is the term for using services which are supported o computers that can be located anywhere in the world as long as they ar connected to the Internet. For services "in the cloud," the physica location of the service provider is unimportant as long as the subscribe can get to their account, data, or files at any time, from anywhere in th world, over the Internet. Cloud computing services can be convenien but they are not necessarily secure and you may lose proprietary right to your data, images, and files if you store them outside of Rice' protected, private cloud.

Cloud computing is a general term for anything that involves delivering hosted services over the internet. Basically a cloud is virtualization of resources that manages and maintains itself. Broadly classified under the three categories:
1.IaaS: Infrastructure as a service.
2.PasS: Platform as a service.

Fig.5 Cloud Computing For Developers (Demo)

I. Login Module



Cloud Client for Developers-Cloud Services

Cloud Hosting Web Services Sign In/Sign Up

You may sign in/sign Up using existing account or you can create a new account by selecting "Iam a new User."

My e-mail address is user

○ Iam a New User

● Iam an existing user and my password is

••••

Fig.6 Cloud Computing For Developers (Demo Signin)

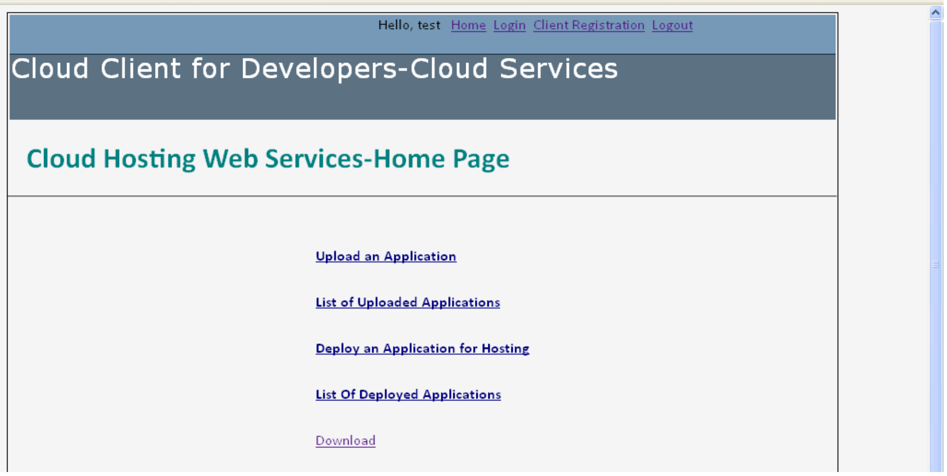
This module ensures security by preventing unauthenticated users from getting access to cloud services. To authenticate user email id and password are collected and the user credentials are validated against the database. If the user is a valid user he is authorized to access cloud services. If the user is found to be an invalid user an error message is reported and prevents the user from accessing the cloud services.

J. New Client Registration

This module helps the users who wished to access cloud services to get registered. User details like name, email id, password, address, city, country, company and other details are collected and validated and details are registered in the database.

K. Cloud Services

This module helps the clients to perform various operations provided by the cloud providers. Clients can perform operations like uploading, downloading and deployment and can see the report of operations that they have performed during various time periods.



Hello, test Home Login Client Registration Logout

Cloud Client for Developers-Cloud Services

Cloud Hosting Web Services-Home Page

Upload an Application

List of Uploaded Applications

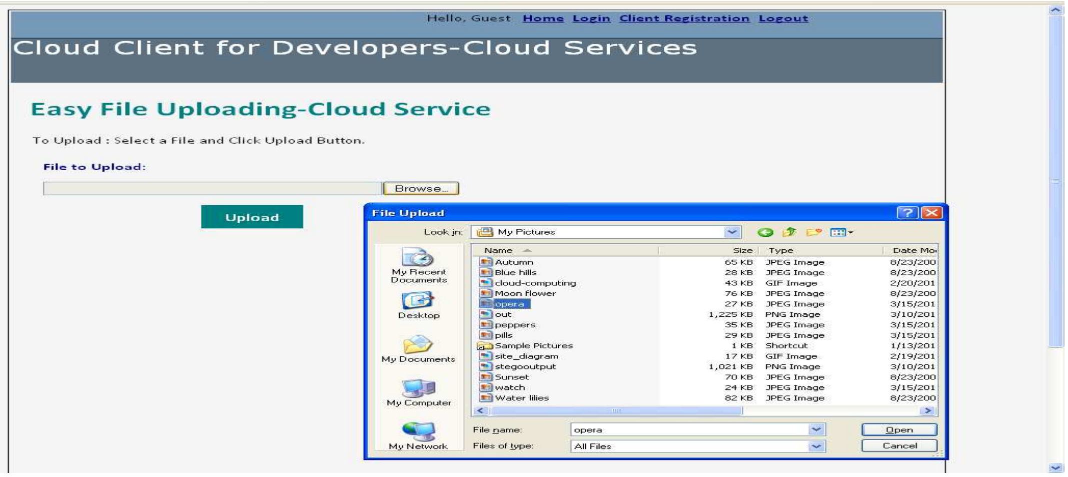
Deploy an Application for Hosting

List Of Deployed Applications

Download

Fig.7 Cloud Computing Web Services (Demo)

L. Upload Service Module



Hello, Guest Home Login Client Registration Logout

Cloud Client for Developers-Cloud Services

Easy File Uploading-Cloud Service

To Upload : Select a File and Click Upload Button.

File to Upload:

File Upload

Look in: My Pictures

Name	Size	Type	Date Mo
Autumn	65 KB	JPEG Image	8/23/200
Blue hills	28 KB	JPEG Image	8/23/200
cloud-computing	43 KB	GIF Image	2/20/201
Moon flower	76 KB	JPEG Image	8/23/200
opera	27 KB	JPEG Image	3/15/201
out	1,225 KB	PNG Image	3/10/201
peppers	35 KB	JPEG Image	3/15/201
pills	29 KB	JPEG Image	3/15/201
Sample Pictures	1 KB	Shortcut	1/13/201
site_diagram	17 KB	GIF Image	2/19/201
stegooutput	1,021 KB	PNG Image	3/10/201
Sunset	70 KB	JPEG Image	8/23/200
watch	24 KB	JPEG Image	3/15/201
Water lilies	82 KB	JPEG Image	8/23/200

File name: opera

Files of type: All Files

Fig.8 Cloud Computing Uploading (Demo)

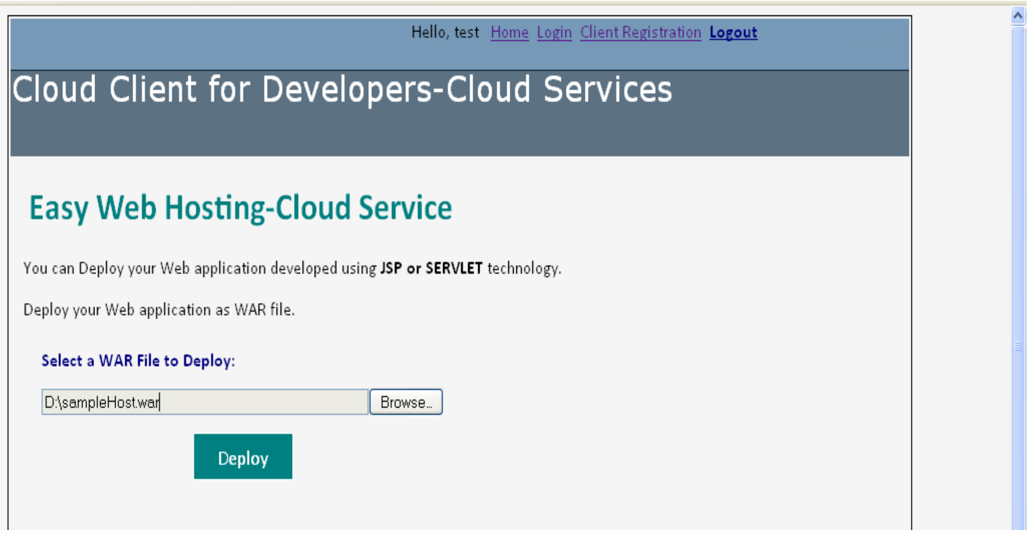
This module provides room for the clients to upload their file. To upload a file a web page is designed which prompts the user to select a file using open dialog box. Once a file is chosen the file securely gets uploaded on a chunk server for later retrieval and log details like file uploaded, user id of the user and timestamp are recorded in database for user to track their uploads any time.

M. Download Service Module

This module helps the users to download their uploaded files. To download a file, a web page is designed which displays the user list of files so far he/she has uploaded and a download button to download. User can click on the download button of the file he/she is interested. On clicking the download button a save dialog box is shown which prompts the user to specify the location to save the file and file gets downloaded automatically at the user specified location.

N. Deployment Service Module

This module is used to deploy a WAR (Web Archive) file meant for web hosting. The deployment service module web page prompts the user to select a war file to deploy. The selected war file securely gets deployed in a chunk server and IP address of the chunk server at which deployment has taken place is displayed on screen to access the web site. The date and time at which deployment has taken place, user id and deployed war file details are registered in the database for tracking.



Cloud Client for Developers-Cloud Services

Easy Web Hosting-Cloud Service

You can Deploy your Web application developed using **JSP or SERVLET** technology.

Deploy your Web application as WAR file.

Select a WAR File to Deploy:

D:\sampleHost.war

Fig.9 Cloud Computing Web Hosting (Demo)

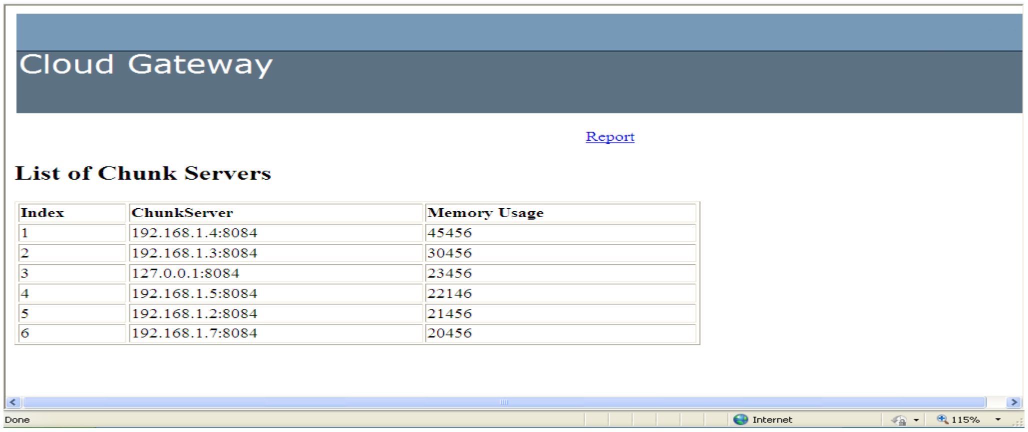
O. Upload and Deployment List

This module helps the users to track their file uploads and war file deployments. Name of the uploaded/deployed file, date and time of the operations are displayed on the screen in a tabular format for easy tracking.

P. Gateway Module

This module forwards the client request to the nearest chunk server based on the memory usage.

When a client makes a request the request is intercepted by the gateway. A gateway acts intermediates between requested client and chunk servers in P2P network. The gateway is periodically updated with list of chunk servers currently available in a network and also the amount of free memory currently available in each chunk server.


Cloud Gateway

List of Chunk Servers

Index	ChunkServer	Memory Usage
1	192.168.1.4:8084	45456
2	192.168.1.3:8084	30456
3	127.0.0.1:8084	23456
4	192.168.1.5:8084	22146
5	192.168.1.2:8084	21456
6	192.168.1.7:8084	20456

Fig.10 Cloud Computing (Demo Gateway)

So when a request comes gateway determines where to forward the client request (to which chunk server) based on the memory availability of chunk servers. So gateway forwards the request to chunk server that has maximum free memory. Information regarding lookup operation such as time taken by the gateway to do lookup operation is recorded in the database for analysis

Q. Chunk Server module

This module is used to implements data security for user uploads.

R. Data Security - Encryption/Decryption module

When a client upload his/her file the contents in the file are encrypted and then stored in chunk server thereby preventing anyone to see the actual content.

When a user makes a request for download then the encrypted file contents are decrypted and original data is constructed and then gets downloaded.

Database Design

S. Data Dictionary

Database users and application developers can benefit from an authoritative data dictionary document that catalogs the organization, contents, and conventions of one or more databases. This typically includes the names and descriptions of various tables and fields in each database, plus additional details, like the type and length of each data element. There is no universal standard as to the level of detail in such a document, but it is primarily a distillation of metadata about database structure, not the data itself. A data dictionary document also may include further information describing how data elements are encoded. One of the advantages of well-designed data dictionary documentation is that it helps to establish consistency throughout a complex database, or across a large collection of federated databases.

User details table

Field Name	**Field Type**	**Size**	**Key**	**Description**
Firstname	Varchar	25		Firstname of the user
Lastname	varchar	25		Lastname of the user
Email address	Varchar	25	Primary Key	Email Id of the user for login.
Password	varchar	25		Password to login
Address1	varchar	75		User Address Line1
Address2	Varchar	77		User Address Line2
City	Varchar	25		User Address – City
State	Varchar	25		User Address – Postalcode
Country	Varchar	25		User Address-Country
Phoneno	Varchar	11		User contact number
Company name	Varchar	100		Company in which user is working.
Company url	Varchar	100		URL of the company website.

User Uploads table

Field Name	**Field Type**	**Size**	**Key**	**Description**
Upload Id	Int		Primary key	Unique Id to track each uploads.
User Id	varchar	25	Foreign Key references User details table.	Login Id of the user
Uploaded Date	Datetime			Date and time at which upload operation taken place.
Uploaded File	varchar	100		File the user has uploaded
Chunk server	varchar	75		IP Address of the chunk server.

User deployments table

Field Name	**Field Type**	**Size**	**Key**	**Description**
DeployId	Int		Primary key	Unique Id to track each deployment.
UserId	varchar	25	Foreign Key references Userdetails table.	LoginId of the user
DeployedDate	Datetime			Date and time at which web application deployment has taken place.
DeployedFile	varchar	100		File the user has deployed.
Chunkserver	Varchar	75		IP address of the chunk server where web application has been deployed.

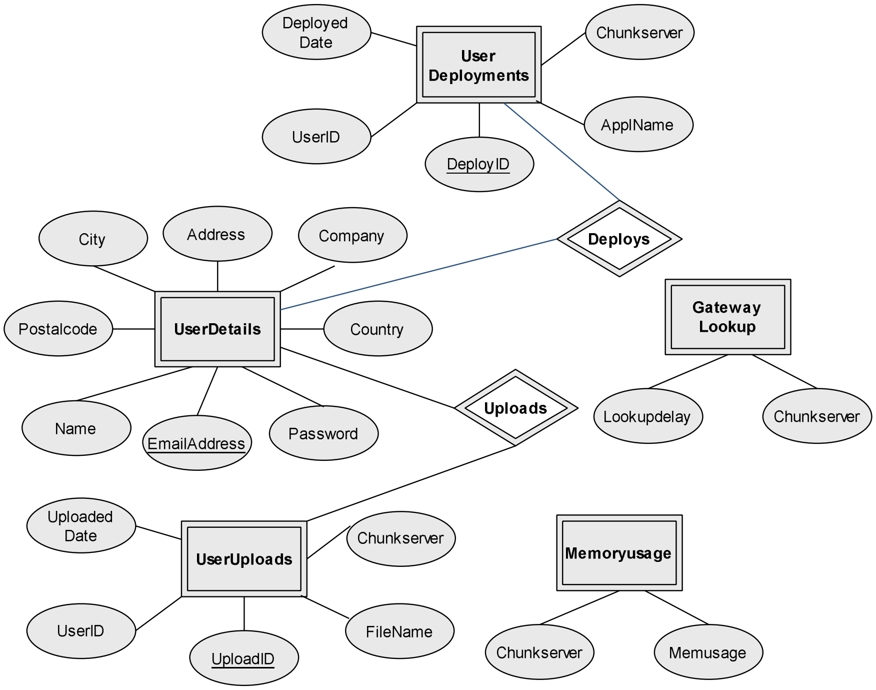
Memory Usage table

Field Name	**Field Type**	**Size**	**Key**	**Description**
Memusage	Int			Amount of free memory currently available in a chunk server.
Chunkserver	varchar	75		IP Address of the chunkserver.

Lookup delay table

Field Name	Field Type	Size	Key	Description
LookupTimestamp	Datetime			Date at which gateway has performed lookup operation.
Delaytime	Int			Time taken by the gateway to complete the lookup operation.
Chunkserver	varchar	75		IP Address of the chunkserver .

VIII. TABLE RELATIONSHIPS



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Database normalization is the cornerstone of database theory. Once a database is normalized, relationships between the data in multiple tables must be established. Database relationships are associations between tables. There are three types of relationships:

1) One-to-one: Both tables can have only one record on either side of the relationship. Each primary key value relates to only one (or no) record in the related table.

2) One-to-many: The primary key table contains only one record that relates to none, one, or many records in the related table.

Many-to-many: Each record in both tables can relate to any number of records (or no records) in the other table. Many-to-many relationships require a third table, known as an associate or linking table, because relational systems can't directly accommodate the relationship.

IX. CONCLUSION

Cloud computing is a recent trending in IT that moves computing and data away from desktop and portable PCs into large data centers. It refers to applications delivered as services over the Internet as well as to the actual cloud infrastructure — namely, the hardware and systems software in data centers that provide these services.

We propose a new architecture of cloud computing system based on P2P protocol, which resolve the problems of bottle neck come from central structure. A cloud computing platform dynamically provisions, configures, reconfigures, and provisions servers as needed. Our new architecture provides a different mean to manage the chunks without any central master, the cost is more delay when lookup a node. The cloud based on the proposed architecture is self-organized and self-managed and has better scalability and fault tolerance.

To ensure data security Advanced Encryption technique has used which makes it extremely difficult to descramble the contents. Thus the delivery of many diverse computing services over the Internet using cloud offers much greater efficiency, substantial cost savings, and many ways to enable and empower end users.

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