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# Exploring Cloud Computing Paradigms for Ideal Computing Systems

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***Abstract***

An ideal computing system is a computing system with ideal characteristics. The major components and their performance characteristics of such hypothetical system can be studied as a model with predicted input, output, system and environmental characteristics using the identified objectives of computing which can be used in any platform, any type of computing system, and for application automation, without making modifications in the form of structure, hardware, and software coding by an external user. In this paper, we have proposed a cloud computing service model to be used as a part of the computing processor section enabled through information communication technology concept and discussed how it will support the computing processor part of ideal computing processor section by providing virtual system components with both hardware and software from the cloud to realize ideal computing system model. In this model, the infrastructure required for an ideal computing processor section is owned by a third party vendor and the cloud computing services are delivered to the ideal computing system over the Internet on a leased/wireless basis with the capability to extend up or down their service requirements or needs ubiquitously and almost infinite scale-up capability. A well designed flexible cloud computing system can work and fulfill the requirement of the processing section of an ideal computing device. It also offers an innovative business concept for organizations to adopt ideal computing services without advance investment and enables convenient, on-request network accessibility to a shared pool of IT computing resources like networks, servers, storage, applications, and services.

**Indexed keywords:** Ideal Computing, Ideal computing system, Computing models, Cloud computing, Realization of ideal computing system.

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## 1. INTRODUCTION

Automation of business processes improves an organization's overall workflow in terms of simplifying and improving the process, achieving greater efficiency, adapting to changing business needs, reducing human error, speed-up the activities of processes, reducing the cost associated with completing the particular process and clarifying job roles and responsibilities. Automation of business processes needs a computing device along with both hardware and software which are designed for that specific purpose. A designing and developing computer system for various computation processes has a greater challenge and massive work. In this


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paper, we have considered the ideal computer model as a system for ubiquitous computing anytime, anywhere and any amount and discussed how it can be achieved with the help of cloud computing technology. This model supports Universal Automation in industrial and business processes in which computing resources can be accessed over the Internet from the cloud and supports the organizations to enhance their capacity dynamically without investing in new infrastructure, training new IT personnel, or purchasing new licensed software that are required for the automation of various processes. Cloud computing has profited many organizations by decreasing IT expenses and permitting them to focus on their core business competencies and skills rather than IT infrastructure. The objective of a model is to identify significant factors and interrelationships to realize cloud computing models. The reliability of the solution obtained from a model depends on the validity of the model representing the real system. An ideal computing model with the support of cloud technology must have the following characteristics [1-17]:

- An ideal model should be capable of taking new formulations into account without having any changes in its existing framework.
- Assumptions made in the model should be as little as possible.
- Variables used in the model must be less in number ensuring that it is simple and coherent. ☐ It should be open to the parametric type of treatment.
- It should not take much time in its construction for any problem.
- Infrastructures such as software applications, data storage and processing power of the system required to implement the model should be supported by cloud technology.

The significant advantages of using a model for a system are:

- Problems under consideration become controllable through a model.
- It provides a logical and systematic approach to the problem.
- It provides the limitations and scope of an activity of the system.
- It supports scalability, flexibility, elasticity, efficiency, and supports outsourcing non-core activities of an organization.
- It offers an innovative business concept for organizations to adopt IT-enabled services without advance investment.

## 2. Concept of Ideal Computing System:

Ideal computing system, by definition, is a general purpose computing model which can be used for any platform, any type of system, and application automation, without making modifications in the form of structure, coding by an external person/agency and computing resources such as software applications, data storage and processing power of the system. The ideal computing is a hypothetical system/device, supported by optical/quantum computing systems, artificial intelligence, optical neural networks & optical solutions, to provide the algorithms, instructions, and coding based on data processing requirements. An ideal computing system is a predictive model and is a hypothetical computing device having ideal characteristics and is the ultimate goal of computer and computation technology. Identifying ideal computing characteristics gives an idea of how present computers can be improved further by knowing the gap between present computing systems and ideal hypothetical computing systems. The concept of ideal computing motivates computer designers to continuously improve the computing systems towards the ideal machine. The software is a system which consists of a set of instructions used to do certain pre-specified operations on input data and gives output in the form of result/decision. Thus, generally, a computing system is a product with a set of inputs, various software and hardware to process the input, and execution of the processes in a defined format of output which are results of the processed input data. While developing any kind of computing system, the first and foremost objective is that it must meet all the requirements of the customer or end-user. Secondly, the cost of

developing and maintaining such a computer should be low and the development of the internal structure, i.e., the design should be completed within the specified time-frame. At present, the design and development of sophisticated computing systems with high speed, parallel processing capability is a major business worldwide and there are enough opportunities and challenges in running such companies to improve the speed of processing and decrease the manufacturing cost [11-17].

## 3. Ideal Computing System Model:

The block diagram of the ideal computing system is shown in figure 1. It has mainly four sections as input section, processing section, output section and computing environment. An ideal computing system can take infinite input from an infinite number of users and process such input data using an ideal computing processor and present the output information to those infinite number of users instantaneously or periodically as per the computing environment. The computing processor section of the ideal computing system contains internally both hardware and software required to process any amount of data as per user requirement (fig. 2).

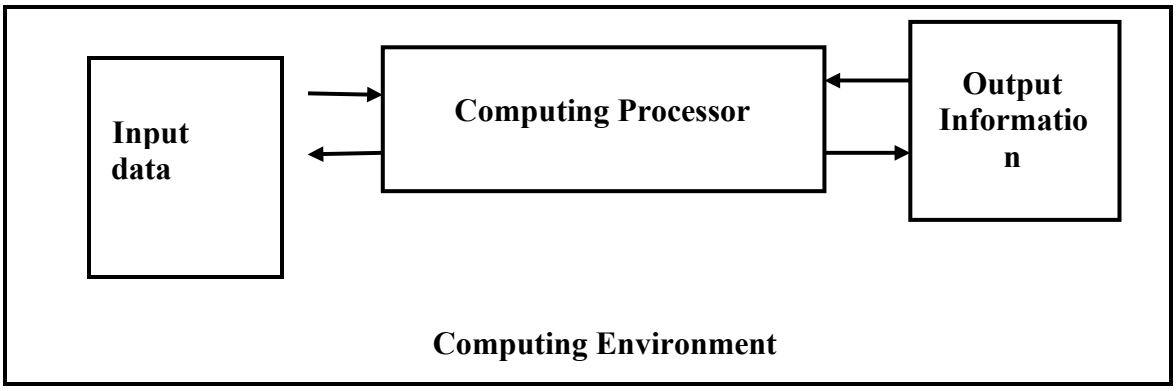


**Fig. 1:** Block diagram of Ideal Computing System


**Fig. 2 :** Subsystems of Computing process

### Characteristics of Ideal Computing Processor:

The processing part of an ideal computing system should provide the function of ideal software executed through ideal hardware. So that it can take any amount of input data and processes almost instantaneously for online processing or stores the input data and processes periodically using the flexible ideal software and presents the information to the user or for any other applications using the output part of the system. The computing processing part combined with both hardware and software must show ideal operational characteristics, ideal transactional characteristics, ideal maintenance characteristics, and other general characteristics of an ideal computing device which are further discussed below :

**(A) Operational Characteristics:** These are functionality based factors and related to 'exterior quality' of the computing system and this tells us how well system works in operations. It can be measured by characteristics such as (1) Zero budgets, (2) Full correctness, (3) Easy usability, (4) Perfect integrity, (5) 100% reliability, (6) 100% efficiency, (7) Infinite tolerance to security threats, (8) 100% safety against hazards, (9) Infinite functionality, and (10) Perfect Robustness.

**(B) Transitional Characteristics:** This aspect is important when the computing system is used to change the working platform from one platform to another and various transition Characteristics of the system includes characteristics like (1) Perfect interoperability of the software, (2) 100% reusability of the system, (3) perfect portability, and (4) 100% performance guarantee.

**(C) Maintenance Characteristics:** This aspect briefs about how well the computing system has the capabilities to maintain its characteristics in the ever-changing environment and various maintenance characteristics of its hardware and software are (1) Zero maintenance cost, (2) Perfect flexibility, (3) Perfect generality, (4) Infinite extensibility, (5) Infinite scalability, (6) Easy testability, (7) Highest modularity, (8) Best readability, (9) Easy documentation for anybody use, (10) Infinite tenant efficiency, (11) Easy configurability, and (12) Free from software based virus attack.

**(D) Environmental Characteristics:** The external environmental and market characteristics of ideal computing system are (1) Capability of managing inelastic demand, (2) Infinite market for ideal computing systems, (3) Infinite ability of computing, (4) Cannot be copied by others/competitors, and (5) High-quality service to every user.

**(E) General Characteristics:**

(a) The ideal computing system is relatively free from all kinds of government regulations or restrictions.

(b) The ideal computing system is portable or easily moveable. This means it can be implemented on any platform.

(c) The ideal computing system satisfies its user's intellectual needs. There are no constraints like minimum and a maximum number of processes can be processed per day.

(d) The ideal computing system is one in which the performance does not limit by a personal output (Leverage) of the user working with it. In the ideal computing system, a computer can provide service to any number of users offline or online as easily as it can have to one.

(e) The ideal computing system, users can process the data at any time, any number of times and results can be presented through the output immediately. There is nothing like wasting time in queue, or waiting time to process the data to get the required information due to fan-in and fan-out problems of practical hardware devices or due to the inadequacy of hardware systems used in the system. (f) The ideal computing system will provide services to its users anywhere, anytime and any amount of time. i.e., it is ubiquitous.

(g) In an ideal computing system, the technology is used in such a way that all processes and services of the system should be delivered effectively.

(h) An ideal computing system provides authenticity and security for all processing and transactions.

## 4. Possibility of realization of Ideal Computing using Cloud Computing:

Cloud computing is one of the advances in computer technology and it uses information communication technology as well. Due to the ubiquity of cloud computing facilities with flexibility in scaling it has become an important topic of research and provides the value for computing processes in the business. The cloud computing model offers so-called Business Intelligence (BI) for any kind of business decisions via the Internet. However, in practice, to create BI environments to improve business decisions, a large capital layout is required to handle large volumes of data. Providing BI individually to business decisions of an organization by establishing such a facility in the neighbourhood of such business also requires enormous processing power which places pressure on the business resources. Therefore, through the cloud computing model, one can offer a rented hardware as well as software to process the data online. Thus the cloud computing model has three variations as Software as a Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service

(PaaS) to provide ubiquitous computing service solutions to the business. The cloud computing solution to any business will allow companies to reduce their investment cost and maintenance cost without compromising to have access to BI solutions which will give the business an edge on their competition. It removes the need for organizations to install and run applications on their own computers or in their own data centers and eliminates the expense of hardware acquisition, installation, provisioning, and maintenance, as well as software licensing, and support. SaaS is most often implemented to provide business software functionality to enterprise customers at any required time and at low cost while allowing those customers to obtain the same benefits of commercially licensed, internally operated software without the associated complexity of installation, management, licensing, support, and high initial cost. The cloud computing solution provides virtualized computing resources over the Internet and it is a single tenant cloud layer service where the Cloud computing vendor's dedicated resources are only shared and benefited contracted clients at a pay-per-peruse fee basis. It reduces the need for huge initial investment on computing hardware such as data servers, networking devices, and processing power. The cloud computing solution provides hardware resources and software tools needed for application development to its users as a service. Here, software and development tools are hosted on the provider's servers and they deliver consumers with a platform including all the systems and technical environments comprising the software development life-cycle components such as developing, testing, deploying, required tools and software applications for software development. Cloud computing service provider hosts the hardware and software requirements on its own infrastructure that are required by the automation of business processes. So it relieves users from installing hardware and software requirements to develop or run a new application on site [18-43].

Ever since advancements in the information technology world started taking place, cloud computing was the demanding technology that emerged as a boon for businesses of all sizes. However, cloud model offers certain characteristics for the users so that they can avail maximum benefits in terms of monetarily as well as establishing a strong customer base. In this research, it is proposed and argued that the cloud computing model can be used in any practical computer system to realize ideal computing system characteristics (figure 3). Some of the **characteristic** features of cloud computing model which can make it as ideal processing partner for an ideal computing processor section are listed below:

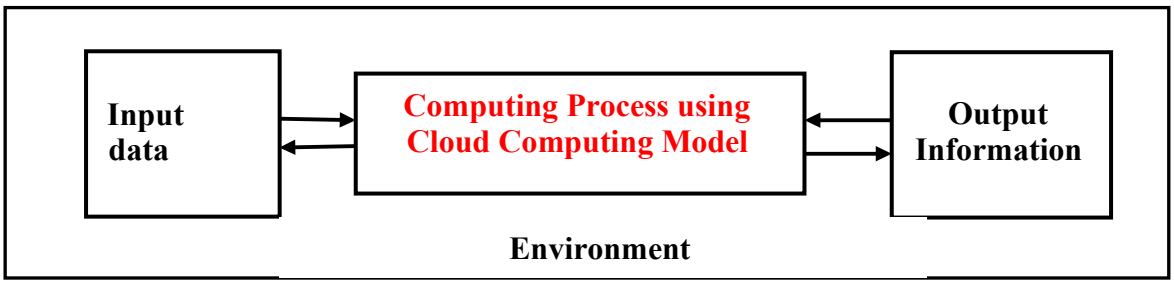


**Fig. 3:** Ideal Computing System using Cloud Computing

## Characteristics of Cloud Computing Model:

### (1) Cloud Model is Highly Scalable

Organizations can begin with a small deployment of cloud and can develop quickly, then scale it back if required. Additionally, the adaptability of cloud computing permits consumer organizations to utilize additional resources as required, empowering them to fulfill their necessities. It also improves employee coordination due to the fact that the cloud computing

model supports device independence to decrease the burdens of software and hardware applications, further supporting the scalability levels of a system.

**(2) Cloud Model is Flexible**

Cloud computing is one among very few technologies which provide a flexible work environment by expanding and growing the computation application facility for the entire globe. The emergence of cloud computing models provides a flexible platform for automating BI. The cloud model is divided into three platforms consisting of IaaS, PaaS, and SaaS, which further include three optional models like public cloud, private cloud, and hybrid cloud. The flexibility option of cloud computing technology has a major advantage to the business of all sizes and operates their daily tasks and work activities smoothly and efficiently. **(3) Cloud Model is Cost-Effective**

Cloud computing technology offers the feature of device independence to its users so that the cost of infrastructure and IT communication are likely to go down. The existing businesses and the emerging businesses, by using cloud computing models can avoid purchasing and deploying software and hardware applications in their in-house IT infrastructures. This will end up with optimum spending and huge cost savings.

**(4) Cloud Model is Pay as per Use**

There are many one-time-payment or pay-as-you-use options available, which make it very reasonable for the consumer company. The consumer company can demand more cloud resources when required and can release them when they are not in use. **(5) Cloud Model Unlimited Storage space**

Storing information on the cloud gives consumers almost unlimited storage space. Hence, no more need to worry about running out of storage space.

**(6) Cloud Model Supports green computing**

The more efficient use of computer resources to help the environment and promote energy saving. Usage of ready-made computing resources tailored to an organization's needs certainly helps it to reduce electricity expenses. While it saves on electricity, it also saves on resources required to cool off computers and other components. This reduces the emission of dangerous materials into the environment.

**(7) Cloud Model Supports Backup and Recovery**

Services using multiple redundant backup sites, which can support business continuity and disaster recovery. Since all data is stored in the cloud, backing it up and restoring the same is relatively much easier than storing the same on a physical device. Hence, this makes the entire process of backup and recovery much simpler than other traditional methods of data storage.

**(8) Cloud Model Supports Work from anywhere and Mobile Accessible**

The access to the information is from anywhere using Internet connection with proper credentials and access rights. This convenient feature lets the user move beyond time zones and geographic location issues and increased productivity due to systems accessible in an infrastructure available from anywhere.

**(9) Cloud Model Supports Quick Deployment**

Cloud computing gives the benefit of quick deployment of sought or required setup. The whole framework setup can be completely functional within a couple of minutes, conditioning the correct sort of innovation that client needs are accessible. Programmed Software Integration is simple as the user/decision maker needs to handpick those services and programming applications that are the best suit for that organization. Access to data is through APIs that do not require application installations on PCs.

**Table 1:** Similarities between Ideal Computing Processor Model & Cloud Computing Model [18-43]

| S. No. | Ideal Computing Processor Characteristics | Cloud Computing Model Characteristics |
|---|---|---|
| 1 | An ideal computing processor is a flexible elastic system in terms of its capability to support any amount of processing data between zero to infinity at any given time. | Cloud computing systems have internal provision to vary the computing facilities depending on client requirement so that it can support any amount of processing data between zero to infinity at any given time. |
| 2 | Maintainability - Maintenance of both the software and hardware part of an ideal computing system should be easy and trouble free operation should be possible for any kind of users. | Maintenance of cloud computing systems is given priority from the vendor side and enough backup systems along with required software are always available for ubiquitous online service to any computing system so that trouble-free operation is possible. |
| 3 | Flexibility – Both hardware and Software parts of a cloud computing system should be flexible enough to handle most of the changes in input and processing without having to modify any of the hardware and without rewriting the entire program. | Every business enterprise aims for a flexible work environment for being clear throughout their way in expanding and growing business branches across the globe through using a flexible cloud computing system. |
| 4 | Scalability - It should be very easy to upgrade the system to more work depending on requirement instantaneously. | One of the advantages of cloud computing is organizations can begin with a small deployment of cloud and can develop quickly, then scale it back instantaneously if required. |
| 5 | Multi-Tenant Efficiency – In an ideal computing system, all the users share the same instance of the software, providing significant saving in server resource use, maintenance, and costs. Updates are rolled out instantly to users, all at once. | In cloud computing systems, many registered customers can share computing resources in a public or private cloud simultaneously. Each tenant's data is isolated and remains invisible to other tenants. |
| 6 | Atomicity – Failures in the system should have provision to recover and restore the data. | Services using multiple redundant backup sites, which can support continuity of business and recovery of any disaster by instantaneous recovery of the data. |
| 7 | Ubiquitous – The ideal computing system provides ubiquitous services to process the huge amount of data at any time, anywhere, any amount of time. | In a cloud computing system, the access to the information is from anywhere, anytime and any amount using Internet connection with proper credentials and access rights. |

While realizing the ideal computing system, the input data from any number of sources should be processed by the ideal computing processor and which can be achieved by connecting the local computing processor to the cloud computing system so that all ideal characteristics if cloud computing model can be utilized in the local computing processor to make it an ideal computing processor. Figure 4 shows the concept and idea on how the local processors of low capabilities to cloud computing systems based on need and hence how to modify the capability and scalability along with other features of local processor towards an ideal computing system.

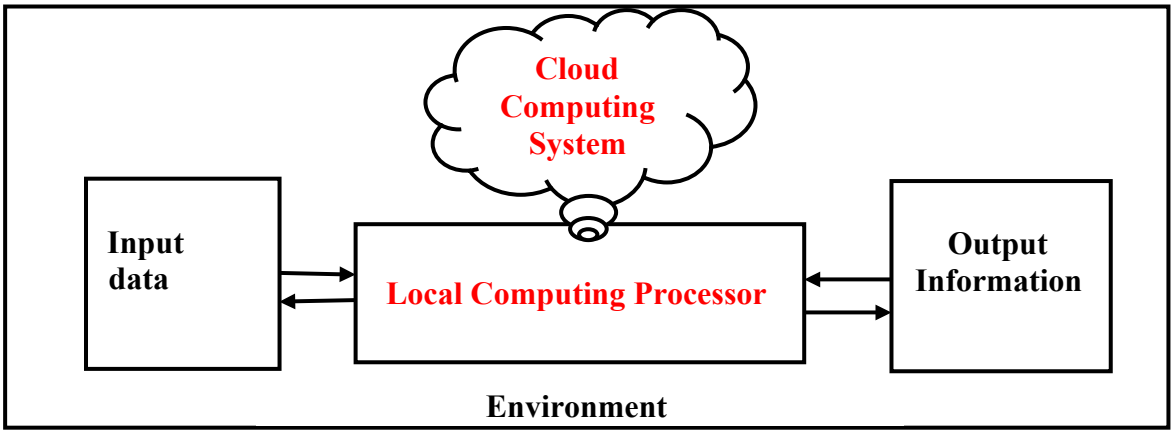


**Fig. 4:** Ideal Computing System consisting of Local computing processor combined with Cloud Computing system

## 5. Challenges to Achieve Ideal Computing using Cloud Computing:

The adoption and usage of cloud computing model by organizations for the optimum management of their computing resources as ideal computing are associated with numerous challenges because organizational users are still skeptical about its authenticity. The major challenges that the business will face when automating computing solution using Cloud Computing model are as follows:

(1) **Security Challenges:** The security aspects have played an important role in hindering the acceptance of Cloud computing. Storing organizational crucial data, executing them using software on someone else's hard disk, and using someone else's processor appears daunting to many. Well-known security issues such as data loss, phishing, running remotely on a collection of machines will cause serious threats to organization's data and software. Moreover, the multi-tenancy model and the collective computing resources in cloud computing has introduced new security challenges that require advanced security techniques to tackle. For example, hackers can set up a Cloud service and provide it to client organizations with more reliable infrastructure services at a relatively cheaper price for them to start an attack.

(2) **Costing Model Challenges:** Migration to the Cloud model can significantly reduce the infrastructure cost, but it does raise the cost of data communication, i.e. the cost of shipping an organization's data to and from the public and community Cloud and the cost per unit of computing resource used is likely to be higher in many cases. This cost is particularly prominent if the consumer organization uses the hybrid cloud deployment model where the organization's data is distributed amongst a number of public/private/community clouds.

(3) **Pricing Model Challenges:** The flexible computing resource pool has made the cost investigation significantly more convoluted than standard data centers, which often calculates their cost based on utilization of static computing. Moreover, creating virtual servers has become the unit of cost analysis for the client organizations rather than the underlying physical server. For cloud computing facility providers, the cost of developing architecture in which a single instance of a software application serves multiple customers within their offering can be very substantial. Which include: reconstruction of the software that was originally used for single-customer, the cost of providing new features that allow for intensive customization of software, performance and security enhancement for concurrent multi-user access, and dealing with complexities induced by the above changes using required software. Consequently, cloud computer facility providers need to consider the exchange between the provision of multi-occupancy and the cost reduction yielded by

multi-occupancy such as reduced overhead through paying off, reduced number of on-site software licenses, etc. Therefore, a strategic and feasible charging model for cloud computing facility providers is critical for the gainfulness and supportability of SaaS cloud providers in a cloud environment.

**(4) Service Level Agreement (SLA) Challenges:**

In spite of the fact that cloud consumer organizations do not have control over the fundamental computing resources, they do need to guarantee the quality, accessibility, dependability, and performance of provided resources when consumer organizations have relocated their core business activities onto their entrusted cloud. In other words, it is essential for consumer organizations to obtain a guarantee from service providers on service delivery. Usually, these are given through Service Level Agreements (SLAs) negotiated between the providers and users of cloud. The issue in this is the definition of SLA details in such a way that has suitable level of granularity, specifically the tradeoffs amongst articulacy and multifaceted nature, so they can cover a large portion of the client's desires and is generally easy to be weighted, confirmed, assessed, and implemented by the resource allocation and management mechanism on the cloud. In addition, different types of cloud offerings (IaaS, PaaS, and SaaS should characterize distinctive SLA meta specifications. This also causes a number of implementation issues for the cloud providers. Furthermore, advanced SLA mechanisms need to always consider and incorporate user feedback and customization highlights into the SLA assessment framework.

**(5) Cloud Interoperability Issue Challenges:**

At present, each cloud offering has its own way on how cloud clients, applications, and users collaborate with the cloud, leading to the "Foggy Cloud" phenomenon. This extremely prevents the advancement of cloud ecosystems by constraining vendor locking, which restricts the ability of users to choose from alternative vendors/offering simultaneously in order to improve resources at different levels within an organization. More importantly, proprietary cloud application programming interface makes it extremely hard to coordinate cloud services with an organization's own existing legacy frameworks. The primary aim of interoperability is to understand the flawless transfer of data across clouds and between cloud and local applications of an organization which works as a client. There are a number of levels where interoperability is essential for cloud computing for smooth functioning. First, the need to optimize the IT asset and computing resources of the organization often need to keep in-house IT assets and capabilities associated with their core competencies while outsourcing marginal functions and activities on the cloud. Second, more important for the purpose of optimization is an organization may need to outsource a number of marginal functions to cloud services offered by different service providers. Standardization emerges to be a good solution for interoperability problems. However, as cloud computing just begins to take off, the interoperability issue has not shown up on the pressing agenda of major industry cloud vendors [18-43].

## 6. Suggestions

✓ To safeguard server failure, Public Cloud service providers should implement strong data replication mechanisms to distribute customer's data across the globe in various geographies so that cloud based ideal server concept for ideal computing can be achieved.

✓ All communications with cloud computing processors which act as processor parts of an ideal computing system should be protected using encryption and key management because Services can be accessed through a thin client, laptop or mobile phone and data is easily accessible through these channels and transferred across multiple networks when your cloud service provider is extremely far away from your location.

✓ In cloud computing, part of an ideal computing system, to prevent offline attacks disk encryption can be used to encrypt all the data including user files on the disk which helps to keep data secured.

✓ Data stored in IaaS infrastructure in public cloud systems should be monitored using robust logging and reporting systems to keep track of the location of information, who has accessed it, in which machines are handling it and which storage arrays are responsible for it.

✓ The use of virtual processing systems act as a mechanism in the PaaS layer in Cloud computing. Virtual machines must be safeguarded against different harmful security attacks such as cloud malware. So during the data transfer over network channels, it is necessary to maintain the integrity of applications and enforce accurate authentication checks for the secured data transfer.

✓ In Software as a service model of cloud computing systems, the applications are accessed using web browsers over the Internet, therefore, web browser security is crucially important. A security architect needs to consider various methods of securing SaaS applications such as Web Services (WS) security, Extendable Markup Language (XML) encryption, Secure Socket Layer (SSL) and the available methods and facilities used in enforcing protection to data transmitted over the Internet.

## 7. Conclusion:

The objective of every computing system is to improve efficiency, scalability, multitasking, and generality of functioning so that it can be operated satisfactorily for any variation in input and operating environment. Improving efficiency of performance of any device from present level to ideal level is the challenge for the researchers and continuous improvement is required in the performance of such devices/systems until their characteristics are elevated towards ideal characteristics. In this paper, we have proposed, designed and discussed the characteristics of an ideal computing system which can be realized in practice using a new emerging computing model to be used as the ideal computing processor section. This idea allows the designer to realize the most of the expected ideal computing system characteristics in practice. The paper also contains an elaborated discussion on challenges and suggestions while achieving an ideal computing system using a cloud computing model.

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