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A Secure Framework for Cloud Storage

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ABSTRACT

The demand for internet storage and computation has driven the development of the data centers which becomes a need of today's business and other applications. A server farm can involve numerous a huge numbers of servers and can use as much vitality as a little city. The monstrous measures of calculation power contained in these frameworks bring about numerous fascinating dispersed frameworks and asset administration issues. Thin Storage provisioning is the procedure of giving storage room to servers, virtual machines or some other processing gadget and it is conveyed in register layer. One way is the hypervisor apply record framework on the physical stockpiling joined to it and it makes documents in the physical storage room. These documents are given to the VMs by the hypervisor as a virtual circle. Virtual machines see this storage room as a genuine physical circle connected to it. Size of the document relies on upon the capacity needs of the VMs. Rather than giving a solitary full circle to figure framework, numerous virtual plates are made out of it and it is appended to various virtual register frameworks. This work proposes another upgraded design for storage virtualization. In a local customer server environment stores information, as well as oversees information appropriately. The principle center of this work is to accomplish four goals. In the first, security parameter is being considered where secure SSL and MAC authentication based approach is utilized which stores the MAC address so that there is one time security check along these lines lessening the time and expanding the property. Second metadata creation, in this duplication is uprooted by evacuating the copy words and utilizing the new indexing plan to diminish the span of metadata and hunt time where is enhanced the execution of the framework. At last, the data is compressed with a loss less compression technique and it is being scrambled and put away in the database therefore diminishing the storage room and securing the document by encoding the record. To analyze performance of this proposed architecture, read time, write time and response time of the server is calculated while uploading, downloading and searching any content from the server database.

Keywords: Storage Virtualization, Security, Cloud, Thin Provisioning

1. INTRODUCTION

In a turbulent economy, virtualization and cloud computing are becoming more and more attractive for enterprises because of the convenience and flexibility over traditional computing. Using a virtual machine is convenient compared to traditional computing, for example, when the user has to have a machine with a certain set of special applications. Today it is typical to distribute applications preinstalled on a virtual machine which the user can deploy without complicated installations and configurations.

Cloud Computing is a set of IT services that are provided over a network on a leased basis. As more and more services and information is placed on the cloud, storage and security issues come into force. Cost is the crucial factor in today's business world. IT infrastructure is one of the important sectors where the organizations are spending more to achieve better performance and business continuity. The organizations are always keen to reduce the cost without sacrificing the performance, which leads them to win the business competitors. Efficient utilization of resources reduces the cost associated with storage of data. In this regard virtualization technology plays an important role to achieve efficient consumption of the resources, by virtualizing the physical hardware.In the current scenario, organizations are transforming their conventional

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datacenters to a virtualized datacenter to incur the profits from virtualization. IT infrastructure virtualization includes server, storage and network resource. Virtualization transforms the conventional datacenter into a more flexible datacenter through server virtualization and consolidation thus simplifying the provisioning of IT resources. Hence resource consolidation reduces hardware cost. Inclusion of dynamic virtual machine migration from servers to servers increases the flexibility significantly.

Cloud storage systems typically use special hardware and software along with disk drives in order to provide very fast and reliable storage for computing and data processing. The systems are quite complex, and may be considered as special purpose computer designed to provide storage capacity along with advanced data protection features. Disk drives are an important element within a storage system, along with hardware and special purpose embedded software. They can provide either block accessed storage, or file accessed storage. Block access is typically delivered over Fiber Channel, iSCSI, SAS, FICON or other protocols whereas file access is provided using NFS or CIFS protocols.

Storage Virtualization can occur at two different levels namely Block virtualization and file virtualization:

- Block virtualization refers to the abstraction of logical storage from physical storage in a way that it can be accessed without regard to physical storage or heterogeneous structure. This separation allows the administrators of the storage system greater flexibility in storage management [1].
- File virtualization addresses the Network-Attached Storage (NAS) challenges by eliminating the dependencies between the data accessed at the file level and the location where the files are physically stored. This provides opportunities to optimize storage use and server consolidation in order to perform non-disruptive file migrations.

2. STORAGE VIRTUALIZATION

Storage virtualization is a concept in which storage systems use special tools to enable a better functionality and more advanced features within a storage system [34]. The main feature of storage virtualization is the abstraction of the logical and physical location of the data. One of the major benefits is the non-disruptive data migration when the data can be freely moved or replicated without affecting the operation of any client. Concurrently performed disk operations can significantly improve the I/O performance while the utilization of physical resources remains load-balanced. Different solutions are available based on the needs for availability, I/O performance, search and indexing and for a combination of these.

It is the process of hiding the underlying complexity of physical storage resources and presenting them as a virtual storage to the computer systems. This is attained with the help of hypervisor. The computer system is not aware of the storage virtualization; it uses a virtual disk as if it was a physical storage disk attached to them. The virtual storage is mapped to corresponding physical storage; this operation is taken care by virtualization layer. Storage virtualization deals with storage provisioning to VMs, block and file level virtualization, virtual provisioning and automated storage tie-ring. Storage stack can be classified as compute, storage and network.

Benefits of storage virtualization:

- Data can be migrated between the storage disks without any interruption.
- Storage space can be scale in or scale out depends on the demand.
- Effective utilization of storage.
- Easy management, since the storage is pooled.
- It provides different storage provisioning options to provide storage to VM.
- Different networking options for I/O between compute and storage device.
- Virtual provisioning and storage tie-ring optimizes the utilization of storage infrastructure.

3. SECURITY LEVELS IN CLOUD COMPUTING

For dealing with the security in cloud, it is important to break down the different conceivable vulnerabilities and assaults in cloud environment. Real security issue in distributed computing are named system level, host level, application level and information level. The layered design expands the survivability of a cloud domain in the occasion of an attack.

3.1. Secure Storage Virtualization

With the advance of storage technologies to networked-attached storage, a recently emerging architecture that provides higher performance and availability than traditional direct-attached disks, new security concerns arise. In these environments, clients can no longer rely only on the storage servers to provide security guarantees, since these become now easier to compromise. In consequence, clients have to play a more proactive role in protocols designed for data protection and work together with the storage servers to ensure the confidentiality and integrity of the data.

3.2. MAC Address Filter

The basic principle of MAC address filter is recording all valid MAC addresses into a list. The clients on the list are authenticated and can be connected to the target AP. Other clients whose MAC addresses are not on the list are not allowed to connect to the AP. An authentication mechanism is responsible for creating a credential, which is used to discern whether a client is who it claims to be. This is the first line of defines conducted before the connection between clients and AP is established. After the clients pass the authentication mechanism, either legal or illegal, they will confront the second security defines measure, the encryption mechanism.

3.3. Encryption of Data using SSL

This technique provides secure communication link and allows encryption of data using SSL. Proposed framework works as follows:

1. Initially, virtual machines request for file.
2. Then (Token+Path) is generated by file server and is forwarded to the client.
3. A session key is established with the help of symmetric key cryptography by Client component and storage area network (SAN) component. When session is established, the component server continues secure communication by using symmetric key encryption. The session key is valid for single session only.
4. Token used during the session establishing phase is encrypted by the client component.
5. To storage area network component E (Token + Path) is passed by virtual machine.
6. SAN component authenticates and validates this token.
7. Storage Network releases the files after performing successful token validation; otherwise operation will is denied.
8. VM file will be available once storage network is allowed.

3.4. Thin provisioning

Thin provisioning (over-allocation) is a mechanism that is widely utilized in virtual environments. It gives the appearance of a more physical resource than what is actually available. Most often it is associated and used with relation to the disk resources but it can also refer to an allocation scheme for any type of resource

(CPU, memory). Thin provisioning is more efficient compared to the conventional allocation in cases where the amount of resource used is much smaller than the allocated amount [35]. Thin provisioning is an architecture which uses virtualization technology to show the more physical resources than actually available resources. A system is not thin provisioned if it contains enough resource to support all of the virtualized resources. Thin provisioning is applied to secured architecture. The technology of thin provisioning is based on thinstore [5]. Thin store component of the proposed method comprises of four parts.

- **Metadata Manager:** For the management of metadata the metadata manager plays a pivotal role which is essential for virtualization and controls logical volume and mapping table.
- **Address Mapper:** Used for load balancing and processes mapping request from logical volume. It dynamically allocates physical address from the storage.
- **Storage Reclaimer:** It mainly manages the free space. This helps thin provisioning an efficient approach to utilize storage in the better manner.
- **Resource Monitor:** It looks into the state of storage device and manages the storage spaces when its total capacity is about to finish.

3.5. Storage Virtualization Challenges

Capacity systems administration and highlight rich canny stockpiling exhibits have tended to and give particular answers for business issues. As an empowering agent, virtualization ought to increase the value of the current arrangement; however bringing virtualization into a domain includes new difficulties. The capacity virtualization arrangement must be fit for tending to issues, for example manageability scalability, support and functionality.

Scalability: Consider the quantifiability of associate surroundings with no virtualization. This surroundings might have many storage arrays that give storage severally of every alternative. Every array is managed severally and meets application necessities in terms of IOPS and capability. Once virtualization, a storage array will not be viewed as a personal entity. The surroundings as a full should currently be analyzed. As a result, the infrastructure that's enforced each at a physical level and from a virtualization perspective should be ready to adequately handle the employment.

Functionality: Storage array provides a large vary of advanced practicality necessary for meeting AN application's service levels. This includes native replication, extended-distance remote replication. in an exceedingly virtualized surroundings, the virtual device should offer constant or higher practicality than what's presently obtainable on the storage array, and it should still leverage existing practicality on the arrays.

Manageability: Presenting a virtualization gadget breaks the end-to-end view into three particular spaces: the server to the virtualization gadget, the virtualization gadget to the physical storage, and the virtualization gadget itself. The virtualized stockpiling environment must be equipped for meeting these difficulties and must coordinate with existing administration apparatuses to empower administration of a conclusion to-end virtualized environment.

Support: Virtualization isn't a complete technology however one thing that must work at intervals associate degree existing setting that is complicated and infrequently needs multiple management tools that introduces ability problems. while not a virtualization resolution, several corporations attempt to consolidate merchandise from one merchandiser to ease these challenges. Introducing a virtualization resolution reduces the requirement to standardize on one merchandiser. However, supportability problems in a very virtualized heterogeneous setting introduce challenges in coordination and compatibility of merchandise and solutions from completely different makers and vendors.

4. PROPOSED METHODODLOGY

Methodology is securitythe systematic study of methods that are, can be, or have been applied within a discipline. To achieve the objective, a step by step procedure is to be followed. The research methodology is the experimental study in which a framework is designed to store data securely on the servers. The following steps are to be followed:

a) Set-up of Client - Server Environment

b) Secure Storage Virtualization based on Historical information with SSL Authentication

c) Thin Provisioning using Indexing

d) Resource Management using Data Compression

The description of steps is as -

a) Set-up of Client - Server Environment:A local client-server environment can be generated using .net framework. For generating this environment, two software's are required that are Microsoft Visual Studio 2010 and SQL Server Management Studio 2008. Microsoft Visual Studio is an integrated development environment from Microsoft. It is used to develop computer programs for Microsoft Windows, websites, web applications and web services. It supports different programming languages and allows the code editor and debugger to support nearly any programming language. Built-in languages include C, C++ and C++/ CLI, VB.NET and C#. Visual Studio 2010 comes with .NET Framework 4 and supports IBM DB2 and Oracle Databases, in addition to Microsoft SQL Server. It includes tools for debugging parallel applications. Download Microsoft Visual Studio 2010 from the link i.e. http://www.visualstudio.com/ and install it into the computer and start generating this environment. In this client server architecture, server has a storage pool which contain resources. Virtualization is an important feature for storage management so, in this virtual machines has been generated according to capability of resources means number of virtual machines of any resource depends on their capability and temperature. In this Framework, 30 Resources has been added to the storage pool where different number of Virtual machines has been generated for each resource as shown in Figure 1.

b) Secure Storage Virtualization based on Historical information with SSL Authentication: The Previoussystem allows secure access control to the storage virtualization approach. This technique provides secure communication link and allows encryption of data using SSL.This framework works as follows.

1. Firstly Virtual machines request for file.
2. Then (Token+Path) is generated by file server and it will be forwarded to Client.
3. A session key is established with the help of asymmetric key algorithm by Client component and SAN component. When session established the component server continues their secure communication with symmetric key encryption. This session key is valid for single session only.
4. Token used during the session establishing phase is encrypted by the client component.
5. To SAN component E(Token + Path) is passed by VM.
6. Then SAN component authenticate and validate this token.
7. Storage Network will realise the files only if token validation is successful otherwise operation will be denied.
8. VM file will be available once storage network is allowed

This technique is highly secure but **this authentication process takes so much time which were cause of delay**. So, to control this historical based access system is used with SSL. Where server stores the

historical access information about user and on their basis user gets authentication. **This scheme is secure as well as fast.**

c) Thin Provisioning using Indexing: Thin provisioning involves using virtualization technology to give the appearance of having more physical resources than are actually available. If a system always has enough resource to simultaneously support all of the virtualized resources, then it is not thin provisioned. The term thin provisioning is applied to disk layer in this article, but could refer to an allocation scheme for any resource.

The technology of thin provisioning is based on Thin store[9]. Thin store component of the proposed method comprises of four parts.

1. Metadata Manager: The metadata manager plays a pivotal role in the management of metadata which is essential for virtualization and controls logical volume and mapping table.
2. Address Mapper: It is mainly aimed for load balancing and processes mapping request from logical volume. It dynamically allocates physical address from the storage.
3. Storage Reclaimer: Its responsibility is to manage free space. This helps thin provisioning an efficient approach to utilize storage in the better manner.
4. Resource Monitor: It looks into the state of storage device and manages the storage spaces when its total capacity is about to finish.

Metadata is data about data. It is high-level information that includes when something was done, where it was done, the file type and format of the data, the original source, etc. The notion of metadata can be expanded to include information about how content is beingused, who is using the content, andwhen multiple pieces of content are being used can relevant and valuable associations be observed. In this secure system, while user upload data metadata has been generated. Metadata is defines as a data about data in which all the keywords of the stored files has been indexed. It means all the keywords of the files has been saved and maps with its location. Sometimes different files have same keywords and they stored different location. It means same keywords are on the different location which results as a **duplication of data and heavy storage problem**. So, to remove this heavy load in this work duplication has been removed. This removal of duplication is achieved by new indexing scheme as shown in table1.

Table 1
Indexing Schemes

Metadata Indexing			
Original		*New Enhanced*	
Big	1	Big	1,2
Data	1	Data	1,2
Big	2	Cloud	2,3
Data	2	virtualization	3
Cloud	2		
Virtualization	3		
Cloud	3		

This new enhanced scheme also reduces the storage requirement. Because duplicated terms are not included in the metadata it will reduce the size of the metadata .

Due to removal of duplicate words from the metadata, the size of the metadata. On implementing the system the metadata size was observed to be 282 KB and when same number of files was uploaded in the

proposed system the size of metadata was reduced to 181 KB. This will show how much storage requirement is decreased as compared to previous work as shown in table 2.

Table 2
Storage Reduction for Metadata

Metadata Size		
Original Size (KB)	*Enhanced Size (KB)*	*Enhancement %*
282	181	35.8

d) Resource Management using Data Compression: Data compression involves encoding information using fewer bits than the original representation. Compression can be either lossy or lossless. Lossless compression reduces bits by identifying and eliminating statistical redundancy. No information is lost in lossless compression. Lossy compression reduces bits by identifying unnecessary information and removing it. The process of reducing the size of a data file is referred to as data compression.In this work, loseless data compression technique is used to compress data which also helps to reduce storage requirement.

5. RESULTS AND DISCUSSIONS

In this section, write time, read time and response time of EC2S2 Framework and Advanced Framework is discussed.

5.1. Write Time& Read Time Analysis

Write time can be measured for storing each file on the server. Here Time can be defined as a time taken to store data on the server where data is somewhere written on a disk at the server side. Write time can be calculated as:

$$Time\ (W_{Time}) = size\ of\ data * Data\ Transfer\ rate$$

Fig 1 shows the time taken by different files to write on disk.

Read time can be measured for extracting file fromthe server. Here Time can be defined as a time taken to extract data from the server where data is somewhere written on a disk at server side. Read time can be calculated as:

$$Time\ (R_{Time}) = (size\ of\ data * Data\ Transfer\ rate) + Response\ Time$$

Fig 2 shows the time taken by different files to read from disk.

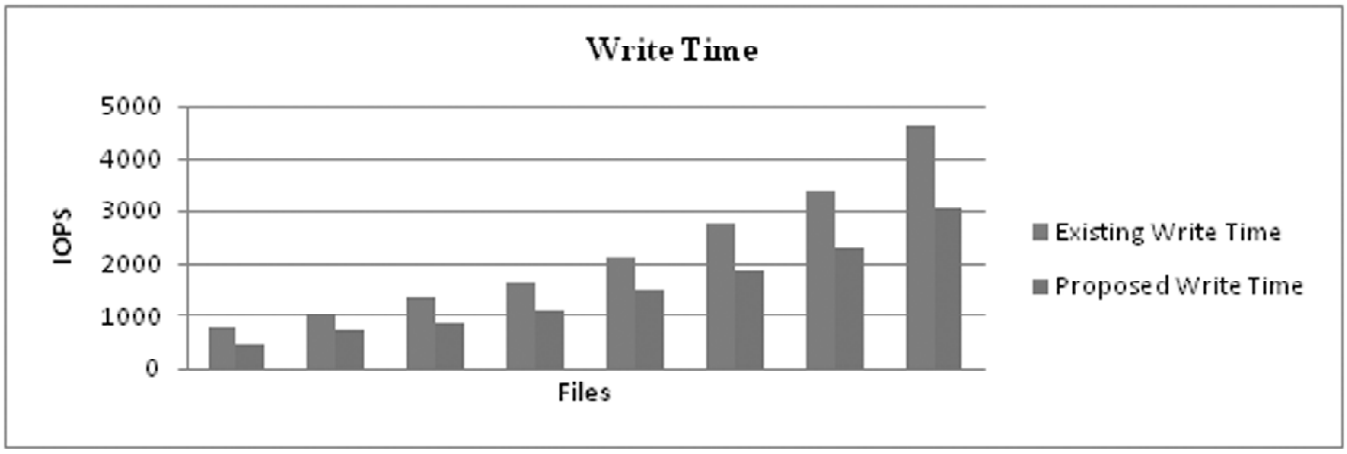

Figure 1: Write Time Analysis Per File(IOPS)

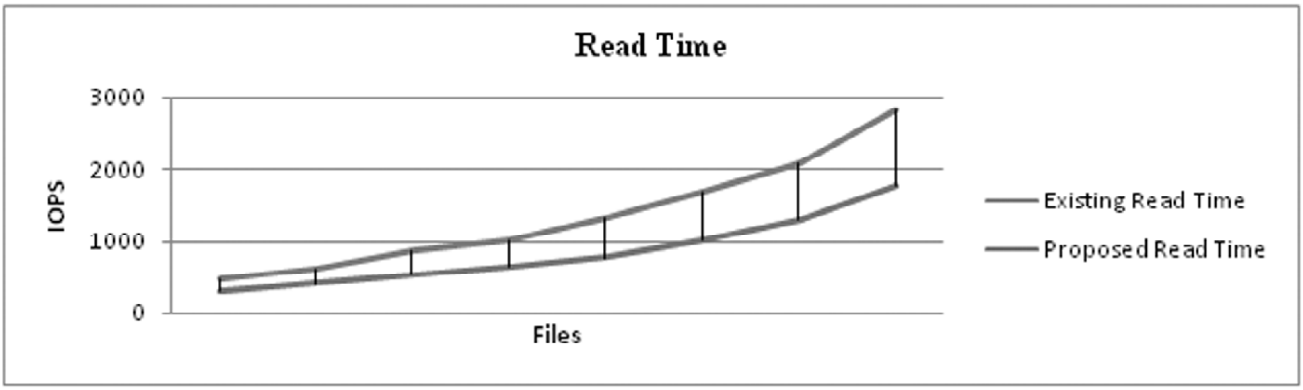

Figure 2: Read Time Analysis Per File (IOPS)

This will show that the readtime is decreased as compared to previous work. Table 3 shows the percentage improvement or enhancement in write time& read time for different files.

Table 3
Percentage Improvement

Sr. No.	*File name*	*Existing*			*Enhanced*				
		File Size (KB)	*Write Time*	*Read Time*	*Compressed File size (KB)*	*Write Time*	*Read Time*	*% Improvement (Write Time)*	*% Improvement (Read Time)*
1	File1.txt	101	750	468	71	480	288	36.00	38.46
2	File2.txt	141	1000	616	99	720	392	28.00	36.36
3	File3.txt	178	1375	858	125	868	517	36.87	39.74
4	File4.txt	220	1625	1001	154	1116	637	31.32	36.36
5	File5.txt	284	2125	1326	199	1464	765	31.11	42.31
6	File6.txt	359	2750	1694	252	1860	1012	32.36	40.26
7	File7.txt	439	3375	2079	308	2280	1296	32.44	37.66
8	File8.txt	592	4625	2812	415	3050	1776	34.05	36.84

5.2. Performance Analysis:

In performance analysis, we can measure responsetime can be measured while user searches their data from server. Here Time can be defined as a time taken to search data on the server where data is somewhere written on a disk at the server side. Response time can be calculated as:

$$Time\ (R_{Time}) = time\ to\ search\ string\ from\ metadata\ data + read\ data\ from\ disk$$

When we analyzed the performance of the proposed system with the existing system there is an improvement of 25.1% as compared to the existing system.

Table 4
Performance Analysis

	Performance Analysis (Average Response Time)		
	Existing (ms)	*Proposed (ms)*	*Percentage Improvement*
Response Time	6.53	4.89	25.1

6. CONCLUSION AND FUTURE SCOPE

This local client-server environment not only stores data, but also manages data properly. This work is majorly focused to achieve four main objectives. First, security parameter where a new historical information

based approach is used which stores the MAC address so that there is one time security check thus reducing the time and increasing the property. Second metadata creation, in this duplication is removed by removing the duplicate words and using the new indexing scheme to reduce the size of metadata and search time where is improved the performance of the system. Finally, the files are compressed with a loss-less compression method and it is being encrypted and stored in the database thus reducing the storage space and securing the file by encrypting the file. Further the proposed setup can be experimented with different forms of data like image, video and pdf files etc.

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