

Effective Cost Reduction Usage of Infrastructure in Small Scale Sectors using Cloud Storage and Internet of Things

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Abstract—Presently many small-scale information technology based private sectors are scare due to spending of high cost for maintaining of infrastructures and resources. In order to avoid to pay more money on maintaining infrastructures, there is a need of an effective price reduction method for the usage of infrastructures in various computer-based private sectors which has been achieved through integration of different online and offline cloud storages along with internet of things sensors. This method delivers huge range of infrastructures, resources and services through online and offline platforms through on-demand basics of user request. This system disables or switch off unnecessary services or resources when it is unused by people in the private sectors which has been controlled through various types of sensors. This integrated cloud storage and IoT method verifies user verification and validation along with storing all information about status of infrastructures in offline and online cloud storage environment. This paper deals dynamic group audit regulation through k-means cluster technique with cryptographic algorithm. The alert messaging and alarm indication system has been enforced in this system. Combining of internet of things and cloud storage techniques which guarantees reduction of cost for usage of infrastructures and also assures privacy, security on quality of service with maintaining of better information transmission. This high skilled method preserves the internet of things with cloud storage environment with better performance evaluation in terms of bandwidth usage and computational and communication cost.

Keywords-internet of things, sensors, cloud storage, authentication, infrastructure, bandwidth, k-means cluster, data leakage.

I. INTRODUCTION

Nowadays, many people in different organizations stored their information in offline as well as online cloud-based storages which has been extremely manageable and secure method. Presently people use remote system to operate various equipment's, hardware, instruments, smart devices with or without assistance of internet which has been increasing rapidly in any type of organizations [1]. Cloud storage platform which is perfectly managed and protected at any time throughout a year by cloud based remote storage datacenter [2]. Internet of Things (IoT) is one of the primarily popular domains in real computational world. IoT related sensors like physical sensor, temperature sensor, micro sensor

and other sensors which played significant role since the usage and characteristics are abundant [3]. IoT based sensors helps to monitor and manage state of various devices, equipment's, instruments, infrastructure security in distinguish small scale organizations by using with or without internet. Feng Xiao et al. [4], investigates two stage bottom-up approaches for infrastructure management to acquire maximum level of maintaining the infrastructure with low cost. According to theme of electricity, internet of things is presently used to alert the management or usage of electricity preservation to consumer [5]. Internet of things and cloud technologies are essentially needed for small scale sectors in order to maintain the infrastructure facilities which able to manage equipment and devices using sensor technology. While raw information is

carried out by cloud technology for analysis and warning messages to organization and user or administrator [5]. Internet of things and cloud technologies are highly associated and maintaining enormous amount of information and operational functionalities of various infrastructural facilities [6]. According to Hanan Elazhary[7], comparing distinguish areas of cloud with smart and information technology based internet of things like IoNT and other related things. Khaled Salah Mohamed [8], investigates the way of coordination of cloud computing and internet of things in terms of hardware, software, sensors, actuators and other related things which leads to high improvements on reliability, sustainability and scalability.

The fundamental pre-eminent facts of internet of things, cloud storage with its types and security is described below:

- Cloud Storage and its types
- Cloud Storage devices
- Cloud storage security
- IoT with cloud system

Cloud storage is most essential requirement in any categories of business in real world which enables storing several confidential data and files on various storage which has been provided by different cloud providers through internet. The cloud client managing the data in cloud servers which has own architecture, highly scalable, elastic, durability and ubiquitous in nature. The cloud storage has the following features:

- High acceleration agility
- More cost effectiveness
- Effective data maintenance
- Better vast expansible storage size
- True assurance of business stability and continuity

There are several categories of cloud storage available in world with respect to usage of storage and its specifications. The major cloud storage are object, file and block storage. Each cloud storage is used for different purposes. Enterprise organizations may use object storage which able to store large amounts of data in terms of videos or images. Moderate organizations can use the file storage which follows hierarchy in manner. The file storage devices like network attached storage which provide storage to users in terms of files. The block storage may use by several cloud clients, they store their details in terms of blocks. Block storage devices which provide raw data to the cloud clients which has divided into different volumes. The cloud storage classes can be divided into two groups as unmanaged and managed cloud storage. The unmanaged cloud storage is pre-setup for the cloud clients. The users never change the format or never install his file system. But Managed cloud storage delivers online cloud storage based on the user-demand in different storage spaces as various partitions. Some of the common cloud storage use cases are email storage, file archives, data backup and so on.

The way of creating cloud storage system required multiple servers, storage virtualization which act as storage GRID, file system which may be any type of file system as NFS or CIFS. The cloud storage system which store different multiple copies of cloud clients data on distinguish servers in different locations. If one server fails, the pointer which points to objects residing location. To combine the different storage locations which can be called as storage assets into massive cloud storage systems. The cloud service provider can utilize storage virtualization software as storage GRID. It extracts storage from various storage into one huge storage management system, which also extract data from any type of file system like NFS or CIFS through internet.

Some of the common cloud storage use cases are email storage, file archives, data backup and so on. The major cloud storage service providers provided security like firewall, multi-layer security features to the cloud users data which has been stored in their data centers. The data residing in cloud storages has been measured in terms of security like vertical and horizontal cryptographic mechanism, access control mechanism, IDS and so on.

The Internet-of-Things with Cloud Services combined together which enable higher technological flexibility, minimize the functioning cost on any type of business through reduced usage of infrastructure in any type technology-based industries. For any type of instrument or devices or equipment's can be identified by unique identification number. Whenever any type device or instrument or equipment which may works on/off, this unique identification number is used to authenticate, authorize and audit it through OAuth 2.0 open standard that protect the IoT based sensor system.

IoT application security is ensured by a RESTful API based architecture which enable device security, information security verification and SSL/TLS cryptographic encryption to protect confidential information. PAN communication and WAN communication are involved between IoT based devices.

Nowadays huge number of small-scale private sectors are scared because of maintaining of infrastructures is most expensive. In order to reduce the spending of cost on maintaining of infrastructures in small-scale computer-based organization, which required an efficient cost reduction technique for the maintaining the usage of devices or equipment make it switch off through IoT techniques with combination of offline and cloud storage. This system makes off the unnecessary unused services or resources in the private organization which has been measured and controlled by various IoT based sensors. Storing all details about the current status of infrastructures in offline and online cloud storage environment with alert messaging technique also proposed. This paper also enforces dynamic group auditing method along with encryption and decryption algorithm to achieve privacy and confidentiality in this well-structured authenticated protected environment.

The main objective of this paper is to avoid or reduce spending of money or cost on maintaining of equipment's or devices or reduce the utilization of unused infrastructures in small-scale computer-based organization. In order to achieve the objective, propose a integration of cloud storage method and IoT sensor techniques along with authentication and dynamic k -means audit method. This well-structured authenticated confidential data storage protected method along with internet of things and different storage methods provide high performance evaluation with respect to high bandwidth utilization compared with various methods like HASSM and PPV methods and huge reduction of computational and communication cost

II. LITERATURE SURVEY

Olutosin Taiwo et. al [9] suggested maintaining of smart infrastructure towards protection, ease of use and accessibility. All equipment's, devices, appliances are highly detecting the motion, monitored and its movements are controlled by remote control system through internet. But the logical feature of averting pointless or false reports is still a key challenge in maintaining of infrastructure system.

Ruili Zheng et. al [10] infers to find smart infrastructure location through wireless sensor network and also monitor mostly commonly electronic and electrical appliances, smart operation facilities-based equipment's and provide the alarm functions. Even though missing of indication of alarm is the great issue, which may happen due to improper monitor and maintenance of smart infrastructure system.

Mohammad Motiur Rahman et. al [11] investigates the internet of things base smart infrastructure operated by wireless based smart phone android application by GSM system. It monitors all types electrical devices, where any user can operating television, air conditioner, fan and other devices with the help of IoT based sensors through remote system. Even though all types of appliances and equipment's are operated and monitored by all IoT based remote sensors system but the lack of synchronization of maintaining, operating the equipment's and devices, the way of storing information about equipment's and the status of entire infrastructure equipment's, devices issues are existing and maintain of those equipment's are more difficult.

Saad Najim Alsaad et. al [12] enforces mobile emergency alarm system using GPS and GSM communication. It indicates alarm warning indication in form of audio or visual or light or alarm message sign using internet of things sensors during difficult condition or undesirable state. Even though it having proper alarm indication system but it will not be reachable to many users.

Kumaresan et. al [13] investigates many of private organizations and other small scale sector enterprises are predominantly receive cloud storage services for their activities. He made comparison study of various existing user authentication methods like single sign on, multi-factor user verification, graphical authentication, smart card and various bio-metric based authentication and steganography authentication in cloud environment.

Sonal Gupta et. al [14] solved the challenges of confidential information duplication and data leakage through storage management control and analyzed the cloud data storage technologies like GFS, HDFS. He enforced the different situation of cloud service provider types of storages. The back-up, recover facility, encryption algorithm has been addressed.

Adnan Tahir et. al [15] addressed the various challenges on cloud storages like data availability, information management and also discussed some factors of cloud storage availability like vendor lock-in, cost efficiency and so on. Different operations and outages on cloud storage along with different mechanisms of cloud storage has been enforced. The various models, techniques, schemes of storages like RACS, CDRM, DAC, Syncopy are presently available in real world.

Dr.T.Kamala kannan et. al [16] specified the basic concepts of cloud storages, cloud storage providers like Dropbox, Mega and iCloud and also enforces the way of storing of confidential information on multiple third party storage that lead the issue of data integrity. Several issues are also addressed which is related to cloud storage like improper choosing of cloud storage provider and their service level agreement, internet connectivity issue between client and provider and setting of price on without seeing several aspects.

Durga Venkata Sowmya Kaja et. al [17] mentioned cloud data storage security challenges like information theft, data breach of various cloud providers storage and also enforced comprehensive examination various categories of data integrity cloud-based attacks, threats like data leakage attacks, replay and timeliness attack, rollback attack, SQL injection attack, authentication attacks, byzantine attacks, sniffer attacks and its mitigation methods such as CPDP, NR protocol, Merkle Hash Tree method and so on. Srinivasan S et.al [18] enforces k -means inter-batch cluster mechanism which deals group audit control management which achieves group audit control mechanism.

III. COST REDUCTION USAGE OF INFRASTRUCTURE IN SMALL SCALE SECTORS (CRUIS) USING CLOUD STORAGE AND IOT

In small scale sectors there is need of cost reduction method for the utilization of distinct infrastructures like air-conditioned, well equipped smart devices, electronic and electrical based instruments have been controlled through techniques of internet of things and cloud storage. All the functional activities of this system are recorded and stored in online and offline storage with cryptographic mechanism.

This internet of things with cloud-based system monitoring the equipment's, instruments which has been switched off when unused and also giving alert messages to concern person or department. The separate online log and offline log is maintained to keep track of the status of devices or equipment's. This integrated method of cloud and IoT based cost reduction infrastructures support web-based and mobile based system like android and other operating system.

This CRUIS system authenticates the users' details and segregate the same set of resources or infrastructures by k -means cluster technique which guarantees audit control method.

The synchronization of equipment, resources which highly support integrity in this cloud based IoT environment. The multi-factor authentication of customer is verified successfully through registered email passcode and mobile passcode or graphical based authentication or valid biometric verification with assistance web based and mobile based platform [20]. The client should the mentioned status of resources or services or any type of devices or infrastructures be inactive when it is unused for a long period of time. This system supports multi-layered architecture which safeguard the user verification and validation, security, user privacy and resources or data security while utilizing infrastructure in small scale private sectors.

All registered consumers store their credentials and accessed information about their required utilization of services or resources in different on-line as well as off-line storage like RAID storage, Cloudme and Dropbox also based on valid authentication methods such as multi-factor authentication, one-time password, biometric based verification, mobile or email-based password verification or stenographic authentication method [16,17].

The architecture of cost reduction usage of infrastructure in small scale sectors (CRUIS) using cloud and internet-of-things technologies as shown in Fig. 1.

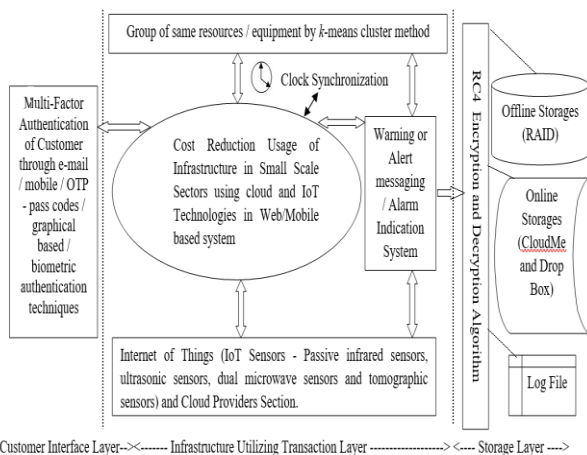


Fig.1 Architecture of Cost Reduction Usage of Infrastructure in Small scale sectors (CRUIS) using Cloud Storage and IoT

The formation of grouping of same services or resources can be attained through k -means cluster method [18]. The group of same services or resources or equipment's may be switched off when it is unused by several users in emergency time if required. To create different group of clusters like G1, G2 and G3 and so on based on seeking of utilization of same category equipment's or resources available in this system.

To ensure the security and privacy and conserving auditing mechanism which handled parallel multiple auditing upon various users' devices equipment's assignment and allocation. Given N auditing distributions on N different equipment's or devices or files from N various clients, it is highly well-organized and more valuable for the reliable

auditing technique to group the same category of multiple devices or equipment's or files together and audited through k -means cluster technique [18] as shown in Fig.2.

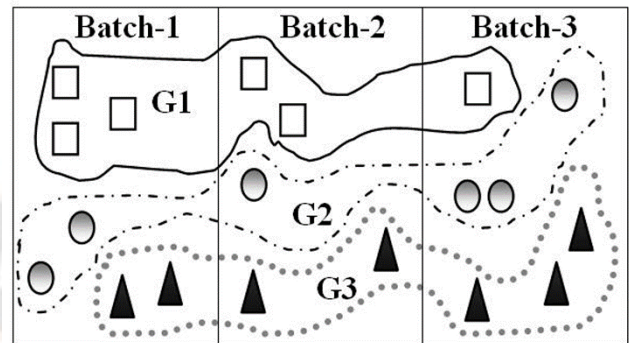


Fig.2 Group Auditing Method through k -means cluster technique in CRUIS method.

Group audit control method has phases like initial-setup, tag-creation and so on. In order to attain the effective cost reduction for this system, motion detecting sensors is necessary for finding operation of equipment's or services or resources those which are unnecessarily used without human participation in this room or system. Seeking of same group of equipment's or resources are also identified through k -means clustering which are used for long period of time without human involvement in this room or small-scale industries, that should be switched off through various IoT sensors [22]. All equipment's or resources are remotely controlled by sensor through IoT based information technology components [23]. Passive infrared sensors, ultrasonic sensors, dual microwave sensors and tomographic sensors are used to detection of motion or to find out status operation equipment or resources in this system. The warning or alert messaging and alarm indication system is also introduced in this system. The alert message or alarm indication is sent to respective concern authorities mobiles or email communication system about the indication unnecessary used equipment's or resources without human participation in this room and also voice warning alarm also produced in recorded based sound system in all places of system. Based on this voice or alert messaging system, the concerned authorities should switch off the equipment's or resources explicitly. The SMS alert messaging system is deployed which able to send txt messages about the status of unnecessary used equipment's or resources without human participation in this room to concern authority's email. The voice notification will reach to concern authorities through their android or iOS devices and separate voice indication system is also implemented in each room of small-scale sectors which make sound in the respective rooms.

The entire information across this an effective cost reduction usage of infrastructure in small scale sectors using cloud storages and internet of things are completely stored in form cryptography RC4 encryption and decryption algorithm [19][25]. All the encrypted details like user authentication information, the used and unused equipment's or resources utilization details are stored in online and offline storages which leads to prevention of data leakage and information security [24]. There are separate log files also maintained in separate

confidential server which is used to keep track of user activities, resources or equipment status in this system that will help to monitor client as well as internal members activities with resources working status in this environment.

This integrated CRUIS method strengthens the monitoring information and also provides access-controlled list privileges to user to access certain special tasks. In order to provide this access control list, the hackers or malicious user activities should be reduced. This cost reduction usage of infrastructure in small scale sectors using cloud storage and internet of things method operated in both web-based application and various mobile based operating systems like android and IoS users. In order to achieve integrity, all resources or services or equipment's are operated through clock-based synchronization system that leads to identify keep track of status of each equipment clearly in terms of usage and non-usage of equipment in this system.

Bandwidth utilization or consumption and computational with communication data transfer cost are crucial parameters, which has been measured for this CRUIS method. Bandwidth utilization is foremost parameter which has measured and compared with other methods like HASSM and PPV methods in this cost reduction usage of infrastructure in small scale sectors (CRUIS) using Cloud Storage and IoT techniques.

The calculation of Bandwidth by file size in term of gigabytes and multiply with number of files per second as show in equation 1.

$$BW = F_{GB} * N_s \quad \dots (1)$$

Where BW is Bandwidth, F_{GB} is the size of the file and N_s is number of file transfer per second.

The reduction of computational and communication cost also other parameter which also measured through respect file size or devices or equipment's with various measurement ratio and samples in this CRUIS method.

IV. RESULTS AND DISCUSSION

This Cost Reduction Usage of Infrastructure in Small scale sectors (CRUIS) using cloud storage and IoT techniques evaluates and achieved efficient bandwidth consumption compared with HASSM (Homomorphism Authenticators using Sphere Shaped Marker) method and PPV (Probabilistic query and Periodic Verification) method. The performance analysis for Cost Reduction Usage of Infrastructure in Small scale sectors (CRUIS) using Cloud Storage and IoT in terms of comparison of bandwidth utilization with file size among HASSM and PPV methods as represented in Table 1.

25	8739	8363	6832
45	15437	14772	12392
80	27621	26432	23432
105	36012	34461	32742
118	40517	38772	36562
168	57853	55362	51433
199	68408	65462	63433
230	78858	75462	71433
264	90676	86771	82392
287	98713	94462	89553

Table 1: Comparison of Bandwidth Utilization among CRUIS, HASSM and PPV methods

Fig. 3 shows that the CRUIS method has effective bandwidth usage compared to HASSM and PPV [21]. To utilization of bandwidth is determined by the user's information or confidential data audit rate. It represents the values from the Table 1 which shows bandwidth usage (M bits/sec) for the corresponding device or equipment request size or file size (Gb) . To determine the utilization deployment of bandwidth usage by the client's information based on the infrastructure or equipment's or devices. The bandwidth consumption of this cost reduction usage of infrastructure in small scale sectors (CRUIS) is increased by 4.0% to 4.5 % with Homomorphism Authenticators using Sphere Shaped Marker Method (HASSM). Similarly, the efficient bandwidth consumption of this CRUIS method is rapidly rise from 9 % to 34 % with Probabilistic query and Periodic Verification (PPV) method for various infrastructure or equipment's or devices. This massive amount of bandwidth is consumed through integration of infrastructure utilization, resources and devices with assistance of various types of IoT sensors and cloud storage techniques.

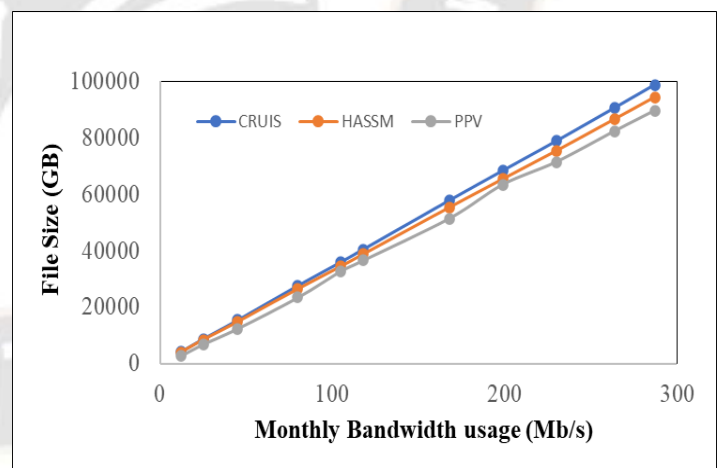


Fig. 3 Comparison of Bandwidth Utilization among CRUIS, HASSM and PPV methods

The performance analysis for CRUIS using Cloud Storage and IoT in terms of reduction of computational and communication costs metrics ratio on various size of equipment's or device or infrastructure or files as represented in Table 2.

Monthly Bandwidth	Bandwidth	CRUIS	HASSM	PPV
12		4151	3972	2742

File Size (GB)	Computational and Communication Cost		
	Measurement ratio 20%	Measurement ratio 40%	Measurement ratio 50%
100	10	23	33
1000	38	58	73
10000	75	89	102
100000	127	157	189

Table 2: Computational and Communication Cost vs File Size (GB)

Fig. 4 the values from Table 2 indicates that computational and communication costs increase gradually with development of request infrastructure or equipment or device or file size and sample metrics ratio. The main objective is to reduce computational and communication data transfer cost and maintain a balance between functional expenditure with standard consistent precision, which helps us to enhance the better efficiency of cloud based IoT systems.

Compute the efficiency or performance of effective cost reduction usage of infrastructure in small scale IT based sectors under various dimensions such as infrastructure or device or equipment request size or size of file sz, sample metrics ratio w, and infrastructure or device or equipment request number or part or sector number per equipment's or device or infrastructure pooling or blocks. Our examination shows that the value of s should lift up with the increase of sz to decline computational and communication costs.

For example, the requested infrastructure or device or equipment or files were chosen from 100 GB to 1000 GB, the part or sector number or device or equipment request number were changed from 80 to 1400 in terms of device or equipment request size or file size, and the sample metrics ratios were changed from 40 to 80 percent.

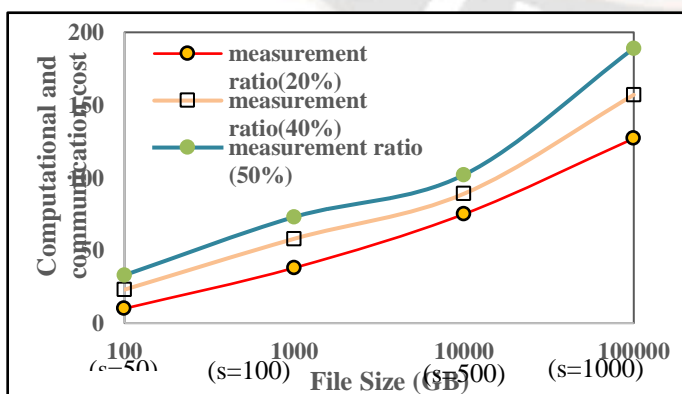


Fig. 4 Computational and Communication Cost vs File Size (GB)

V. CONCLUSION AND FUTURE IMPROVEMENT

Nowadays small-scale private sectors used many equipment's, devices and infrastructures which has been working all days while consumers were not available in the room, this leads to spending of more money for maintaining infrastructures and make heavy loss for small scale IT based private sectors with respect to cost. To avoid spending more cost on maintaining equipment's, devices and infrastructures, proposed a method as operative huge price reduction technique for the utilization of devices and infrastructures in small scale private sectors using online and offline cloud storage and IoT techniques. The proposed method automatically switched off all unnecessary equipment's and devices while it is unused by consumers in room which has controlled by various internet of things-based sensors. It can pass to consumers through cautioning or alert messaging and alarm indication system. This method authenticated users' details through various ways and store all information about the users and their accessible equipment's or infrastructures in online and offline cloud storage along with log file in cryptographic form through RC4 encryption and decryption algorithm. The way of identifying the same group of equipment's or devices through k-means cluster technique has been enforced which able to assure group audit control and also organization of devices through clock-based synchronization in this cloud based IoT environment. This efficient emerging method of IoT and cloud-based storage imposes cost reduction for utilization of resources implemented in internet-based web development environment and also supports android and other operating system under mobile operating system. This paper assured reduction of price, security, privacy for usage of devices with preserving improved data communication with better performance assessment with respect to bandwidth consumption and reduced the computational and communication data transfer cost in this Cost Reduction Usage of Infrastructure in Small scale sectors (CRUIS) using cloud storage and IoT.

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