Cloud Computing Adoption in Enterprise: Challenges and Benefits

Raja Muhammad Ubaid Ullah[#1], Dr.Kevan A. Buckley[#2],Dr. Mary Garvey[#3], Dr. Jun Li[#4].
School of Mathematics and Computer Science
University of Wolverhampton, Wulfruna Street, Wolverhampton WV1 1LY, UK.

Abstract
Loss of the business and downturn of economics are part of almost all types of business activities. There are also new concepts and technologies evolved and entrepreneurs need to keep update accordingly. Therefore, business people have to concentrate on keep exploring new ways to cut down expenses without compromising on the quality. One of the options is to go for the latest technologies. Taking into consideration these problems, the entrepreneurs always choose the right technology to minimise losses, increase efficiency and maximise their profit.

In order to help out the entrepreneurs, the IT industries have developed platforms for businesses to use shared resources and online applications through cloud computing. The significant role played by cloud computing in providing a solution to the problems faced by business enterprises to increase business growth and help them to stay alive in a competitive environment. Cloud computing also brings efficiency in managing business resources and make improvements in traditional business practices. It also facilitates the enterprises to avoid unnecessary expenses of procedural and administrative nature, hardware and software costs.

Apart from the advantages of cloud computing have certain drawbacks also. The main issue is the security in cloud computing considering the attacks on the cloud too.

The primary objective of this paper is to highlight the benefits, challenges in adopting cloud computing and utilizing services offered by cloud computing. Recommendations have also been made to ease the adoption process and how to address security issues.The method has been used is the secondary research, that is collecting the respective data from published journal papers and conference papers.

Keywords

Benefits, Challenges, Cloud Computing, Cloud, Computing, Internet, IT, Adoption, Technology.

I. INTRODUCTION

Cloud computing becomes the fastest growing technology in today's business market, which result in the easiest availability of computational technology services for business organizations through the internet. It can serve any type of facilities to business organizations, for instance, operating system, network hardware, storage, resources, and software, etc by paying the amount on pay-as-you-go basis over the network with the functionality of increase or reduce requirements. On the other hand, it has the capacity to meet any IT industrial requirements. It offers users to store, manage and create their respective applications on the cloud, also offers virtualized resources in dynamically, bandwidth and other services. The users benefited to overcome economic and technical barriers while starting an organization to benefits with modern IT technology. The major benefit to start organizations in temporarily mode without any huge investment, slowly observing the required performance of organization, provide an opportunity to take a decision to increase or reduce requirements with appropriate use of Information and Communication Technology (ICT) help organisations to become more efficient [1]. Regardless of the size of organization for instance as a small, medium or large, it is suitable for all type of enterprises. Such types of facilities really changed the face of computing.

Irrespective of many services offered by cloud computing than traditional IT models, whereas from the consumer perspective, cloud computing benefits and challenges remain a major issue for its adoption [3]. The important aspect for any business is data or information nowadays, its values are uncountable. The main challenge in cloud computing is information in an open network is automatically creating doubt on the secrecy, availability, misuse of information. According to FORBES [2] reported that Cloud computing is projected to increase from $67B in 2015 to $162B in 2020 attaining a compound annual growth rate (CAGR) of 19%. Whereas, Gartner predicts the worldwide public cloud services market will grow 18% in 2017 to $246.8B up from $209.2B in 2016 and 74% of Tech Chief Financial Officer (CFOs) say cloud computing will have the most measurable impact on their business in 2017. But the primary reason for not using cloud computing

services is that of the data security and privacy concerns.

II. HISTORY OF CLOUD COMPUTING

In 1950 the concept of cloud computing was first introduced. For academia and corporation use large scale mainframes was accessible during that time to perform activities. As the mainframes were too costly and practically it was not possible to have separate mainframes for each user; therefore a new architecture was developed and introduced. The new architecture enables the users to access the mainframe and share the CPU time and power from different terminals. This new architect attracts the users, which result increased the return on investment and decreased the mainframes' idle (inactive) time. This phenomenon got more popular later, in the 1960s after John McCarthy [5] started to claim that someday computation will become a public utility. With the passage of time nowadays this idea gains more popularity than ever. As like other types of utility (water, electricity, gas and telephony), in near future, many believe that the basic level of computing will be provided to people to meet their day to day activities [5].

According to the study, the first actual cloud computing service operation started in 1999 by Salesforce.com. Delivered an application from its own website, it was the first company. The dot-com bubble was a historic economic bubble and period of excessive speculation that occurred roughly from 1997 to 2001, a period of extreme growth in the usage and adaptation of the Internet by businesses and consumers [4]. During the period of 2000 to 2002, the dot-com bubble collapsed. In this situation some companies, like Pets.com and Webvan, not survived and failed completely, ultimately they shut down. Whereas, other companies, such as Cisco, they faced challenge stock declined by 86%, and on the other hand, Qualcomm after the lost a large portion of their market capitalization but manage to survive. However, companies like eBay and Amazon.com later recovered from this situation and surpassed their stock price peaks during the bubble.

III. WHAT IS CLOUD COMPUTING?

In an October, 2009 presentation titled [7, Chapter 1 - p.2, 90] "Effectively and Securely Using the Cloud Computing Paradigm," by Peter Mell and Tim Grance of the National Institute of Standards and Technology (NIST) Information Technology Laboratory, cloud computing is defined as follows:
Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable and reliable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal consumer management effort or service provider interaction.

Another definition [6, p.3] *by using virtualized computing and storage resources and modern Web technologies, cloud computing provides scalable, network-centric, abstracted IT infrastructures, platforms, and applications as on-demand services. These services are billed on a usage basis.*

IV. CLOUD COMPUTING SERVICE MODELS

Cloud computing services are provided by three different service models: for instance software as a service (SaaS), platform as a service (PaaS) and infrastructure as a service (IaaS). Three service models are explained below.

A. Infrastructure as a Service (IaaS): The IaaS layer is one of the key computing paradigm offered by the cloud service provider over the network. It offers various type of hardware resources in the form of service, for instance, Central Processing Unit (CPU), virtual machine (VM), memory, storage and Network devices, etc [9]. The main advantage of the VM is to play the role of the server, so the VM basically have the same capability of the in-house server. This important layer facilitates instead of keeping the infrastructure, the users can be utilised by lease or rent according to their respective demand. The Virtualization is broadly used in the IaaS cloud with respect to integrating/ decompose physical resources in an ad hoc basis to encounter growing or shrinking resource demand from the respective *cloud consumers [8].

The main advantage for the users to decide CPU usage, size of memory, bandwidth, etc, instead of setting up an expensive server, data centers, etc. The users benefited by service provides relaxation by not worrying about infrastructure, also help by reducing high investment at the beginning of organization. In IaaS the hardware part is fully controlled by the service provider, clients do not have any control over infrastructure but a user can manage and control the software and other applications accordingly. Top IaaS Cloud Computing Companies: Amazon (EC2), Rackspace, GoGrid, Microsoft, Terremark, Elastic Compute Cloud service and Google [10,11].

B. Platform as a Service (PaaS): The PaaS layer in cloud computing provides a combination of both infrastructure and application by a cloud service provider (CSP). PaaS works with the combination of both, infrastructure and application by CSP, to facilitate the user to develop and deploy their respective applications [15]. Which also provide all the services for developing, modifying, testing and running applications in the cloud environment, the platform helps to use (C, C++, .NET, etc) without investing in software's.

PaaS facilitates to use the platform for multiple users to run their same application at a time. Additionally PaaS model allows resources to be easily increased with the demand of end users to share the same cloud. It provides additional tools for development are database, web server, etc. Hence, the infrastructure of PaaS underlying operating system, storage and the network is managed by CSP. In addition, the users have control over their applications and respective data [16, 14]. PaaS facilitates the user to follow the complete software development life cycle, such as planning to deployment of the software.

Therefore, in contrast to SaaS, the solution of PaaS requires staff with IT capabilities to systematically manage their application development and deployment process accordingly. Migrating to PaaS platform, a client needs to investigate the provider's technical capabilities, like the ability to support multitenancy and scalability [13]. The client also requires software management issues like the types of the application lifecycle, applications management and the support of Application Programming Interfaces (API). Focusing on data and application management issues such as programming languages supported and availability of the log data. The other issue regarding the SLA that apply with PaaS solution. Top PaaS Cloud Computing Companies: Salesforce.com, Google, Citrix, Concur Technologies, Ariba, Unisys, LunaCloud, Microsoft Windows Azure, Apps Engine and Cisco [10, 11, 13].

C. Software as a Service (SaaS): In the SaaS layer, it provides a software delivery model, to run various software applications through the Internet without installing these in the client site [94]. This avoids installing the required software's by the end user [14] and respectively saving the purchasing cost of this software. But end users do not have any sort of control over cloud infrastructure, which is managed by the cloud service provider [18]. In SaaS different cloud consumers applications are organized in a single logical environment in the cloud to achieve the scale of economies and optimization in terms of speed, security, availability, disaster recovery and maintenance [8, 14].

The service provider entirely controls the infrastructure for instance servers, software's etc and enable the end user to use the applications and possibly application configuration settings. Furthermore in SaaS, there is Divided Cloud and the mechanism of Convergence coherence, where every data item has either the "Read / Write Lock" [22]. Enterprises benefits by reducing operation costs by the adoption of SaaS service [58, 59] Furthermore, enterprises are also free from managing IT services and it helps them to focus on their core business activities [19]. Although CSP takes responsibility of maintaining, upgrading, backing up and security, the main concern for many enterprises to adopt SaaS still represents the security, data location, segregation, access and integrity. Some examples of SaaS include - Google Apps, Microsoft office 365, GT Nexus, Marketo and Trade Card.

V. WHAT IS SECURITY FOR CLOUD COMPUTING?

There is no difference in the security controls in cloud computing as compared with any traditional IT environment [27 p. 24]. As concerned the cloud service models employed, the operational models, and the technologies that used to enable cloud services [28], for that cloud computing may present different risks to any organization than any traditional IT solutions.

Cloud computing has the threat of losing control while maintaining accountability and even the operational responsibility falls upon one or more third parties.

There are four aspects to consider for cloud computing data security [26]:-

A. ***Physical Security:***
Physical security basically refers to the protection of personnel, hardware, software, networks and the data from physical actions and the events that could cause the serious loss or damage to an enterprise, agency or institution.

B. ***Infrastructure Security:***
Cloud computing infrastructure is defined as those services that make clouds and the cloud services available to end-user clients and transport mechanisms to the clouds and between the various components within the clouds.

C. ***Application Level Security:***
The application level security involves which users can access the data, how they access it, and the other individual interactions.

D. ***Data and Access Security:***
Data and access security refers such as encrypting data, controlling user privileges, etc.

VI. BENEFITS OF CLOUD COMPUTING

There are different benefits of cloud computing, which are explained below.

A. ***Cost Savings:***Cloud computing facilitates to use different types of services such as infrastructure, platform, etc based upon the user requirements. Which helps to reduce the

initial cost and also to avoid the setting up of high-quality capacity servers [58, 59]. The attractive pay-as-you-go payment model charge depending upon the usage of infrastructure, platform and other required services, this will benefit the end user to reduce the expenses by specifying their exact requirements [25].

B. ***Time Saving:***As the time factor plays an important role, therefore cloud computing reduced the setup time of the organizations by providing all type of facility simultaneously. There is no further need of waiting to set up the infrastructure, platform and other tools. This helps organizations to save time, helps to run a trial basis initially and gradually move to a permanent condition.

C. ***Scalability and Flexibility:***The scalability benefits facilitate the companies to start with a small set up and grow to a large condition fairly rapidly and the same time then scales back if necessary at any time. On the other hand, the flexibility in cloud computing permits companies to use extra resources at peak times and enabling them to satisfy end user demands accordingly. Furthermore, cloud computing enables to meet any peak time requirement of the end user by setting up with high capacity servers, storages, etc.

D. ***Backup and Recovery:***As all the data is stored in the cloud, so backing it up and restoring the same is perhaps relatively much easier than storing the same on a physical device [20]. Also, it has many techniques for recovery from any type of disaster.

E. ***Resource Maximization:*** Cloud computing relatively reduce the load of IT resources from many companies and respective supporting agencies by maximizing the resources from cloud computing pool [22]. Most of the cloud service providers providing different type of facility to meet requirements at any time. Which is one of the exciting feature of cloud computing?

F. ***Mobile Access:***This benefits of cloud computing provide access to high- powered computing and their storage resources to anyone within a network access device [21]. Enables the employees to access and can work on their respective application by sitting home or any part without going to office or organization. Furthermore, nowadays the number of mobile users are going very high as compared to the users of PCs environment and other relative devices. Cloud computing enables the consumers can access their files and other required applications anytime from anywhere by using their mobiles. This benefit has increased the number of adopting cloud computing technology.

G. ***Customization:*** Cloud computing platform enables the user where we can modify to our needs with being redevelopment. It also offers a platform for creating and amending respective applications accordingly to address a diversity of tasks and challenges [22].

H. ***Deliver new services:*** Cloud computing services are provided by multi-national companies like Amazon, Google, IBM, Microsoft, Salesforce.com, etc. These companies can capability to easily deliver any new application/product at the release time itself.

VII. CHALLENGES OF CLOUD COMPUTING

There are many challenges of cloud computing, despite having many benefits discussed above. While moving from in house to cloud space environment, the companies must aware about the benefits and challenges of cloud computing. Some of the challenges are discussed below.

A. ***Privacy of data:***The privacy of data is a primary concern for cloud computing. Most of the organizations feeling more comfortable while storing valuable data in their site than cloud [29]. As in the cloud end, the user has no idea regarding the location of data and operations on the cloud, etc.
There are many questions concerned by consumers such as

- Which are the other organizations sharing services.
- How creation and deletion of files taking place.
- What about the back-up of data.
- Which type of consumers can access data?
- Location of data.
- Etc.

B. ***Confidentiality of data:***Confidentiality is an important factor of data privacy, which ensures that the visibility of data is only to authorised users [34, 35]. Which is very difficult in a cloud environment due to the virtualization and multi-tenancy characteristics that multiple users sharing the hardware, software simultaneously in a distributed network. Ensuring confidentiality is the core responsibility of the cloud service provider [23]. The common solution to confidentiality

is encryption. There are many symmetric and asymmetric algorithms are available in the market for data confidentiality, even though encryption and decryption is also the solution to confidentiality, but there is much concern related to this.

- Where is encryption and decryption taking place (client side or cloud side).
- How can search data in an encrypted form.
- What are threats while transferring data from client to cloud?
- Any miss use of data by service provider.
- Any miss use of keys by service provider.
- Etc.

C. ***Data Remanence:*** Data stored in the cloud must be deleted after its life-cycle, or the memory should be reformatted or recycled. The reformatting of storage media does not remove the previously written data from the media, but it can be accessed or recovered from the media later. No clear standard is available to recycle the storage media. This data remanence makes difficult the vacation of hardware resources from the cloud. Most consumers are unknown to allotted resources and storage space, due to this issue consumers are locked in one service provider. Various techniques have been developed to counter data remanence. These techniques are classified as cleaning, purging/sanitizing, or destruction. Specific methods include overwriting, degaussing, encryption, and media destruction [31].

D. ***Data integrity:***The preservation of information from loss or any modification by unauthorized users is referred to as data integrity. Integrity makes sure that data held in a system is a proper representation of the data intended and that it has not been modified by an unauthorized person. When an application is running on a server, the backup routine is configured so that it is safe in the event of a data-loss incident. Normally, the data will back up to any portable media on a regular basis which will then be stored in an off-site location [30].

E. ***Transmission of data:***Most of the time transmission of data between end user and cloud. Originally data is sent from an end user to cloud and respectively data is returned in forms of queries from cloud to end user. For the protection point of view, encryption is used while the transmission of data. If the data is transferred without encryption as the encryption and decryption for each operation upon data required a lot of time. During this type of transfer, an attacker can easily trace the communication, interrupt the data transmission and misuses the data. There is a different algorithm which allows processing of the data in an encrypted form, but there is a chance of data transfer interruption as well.

F. ***Data Breaches:***As in cloud environment resources are shared by multiple users and organizations of the different part of the world, their valuable data is stored in one place. Sometimes any break or sort of problem on the cloud may expose the sensitive data to the users of other organizations which share the same storage and resources. Because of multi-tenancy, the end users using different types of applications on virtual machines could chance to share the same database and any corruption event occur to affect others sharing the same database [32]. In [33], it was reported: ”2011 Data Breach Investigations Report” that hacking and malware are the common causes of data breaches, with 50% hacking and 49% malware.

G. ***Availability:***All time availability of cloud computing system from anywhere is very important for the success cloud computing environment. Availability ensures that data processing resources are not made unavailable by malicious action. It is a simple idea that when a user tries to access something, it is available to be accessed. This is vital for mission-critical systems. Availability for these systems is critical that companies have business continuity plans (BCP‟s) in order for their systems to have redundancy [34].

H. ***Malicious Insiders:*** Malicious basically are insiders and authorised employees, these users are appointed for managing and maintaining the cloud by the cloud service provider. These users sometimes steal or corrupt the sensitive data of different organizations in the cloud and pass this sensitive information to other organizations which share the same cloud [35, 36]. The action of these malicious insiders may get payment for this malicious work. Sometimes the service provider may not be able to take any action against these employees.

I. ***API issues:*** Application Program Interface (API) is used for the communication between the cloud service provider and end user site. API basically is used to manage and control the data in the cloud. If there is any sort of failure on this API, which may lead to different security issues. If they are weak and the capability of security mechanism cannot protect them, this could resultin accessing the

resources even as privileged user [36]. The issues of failure around API calls are a large source of faults that could resultin application failures, especially during irregular activities. The infrastructure outages can also be sometimes exacerbated by APIrelated issues. There are different solutions proposed [37] to avoid insecure interfaces and APIs:

- Analysing the security model for interfaces of the cloud provider
- Making a strong access control and authentication when data is transmitted
- Understanding dependencies in API

J. ***Data location:***Cloud computing offers a high grade of data mobility. Mostly end users do not know the location of their data. For instance, the emails and photographs uploaded to Facebook can reside anywhere in the world, whereas Facebook users are generally not concerned but on the other hand, while storing sensitive data, organization concerned about the storage location [38]. Whereas, some organizations may prefer that their valuable data store in their country or jurisdiction. For this purpose, there are certain regulations in some countries, where the company is authorised to store their data. In certain cases, the location of data really matters when the user data is stored in a location that is prone to wars and disasters [36]. For example, Indian organizations don't want to store data in China jurisdiction similarly Chinese organizations don't want to store data in India jurisdiction.

K. ***Data Relocation:*** Movement of the data from one location to another is a primary issue. Originally data is stored in a particular location with the consent of organization, but in some situation,a provider may change the location of data from one place to another due to unavoidable situations. But data location may be specified in the contract itself; it makes trouble to the movement of data.

L. ***Account or Service Hijacking:***The users are using passwords to grant access to the cloud service resources, but when their accounts are hijacked and stolen, the passwords are misused and altered unsurprisingly [32]. By this, the unauthorized user who got the password can access the clients' data by stealing it, altering it, or deleting it, or selling it to others for their benefit.

There are many solutions proposed [37] to avoid account or service hijacking:

- Preventing users from sharing their credentials
- Using a two-factor authentication system
- Monitoring all activities to detect unauthorized access.

VIII. SECURITY SOLUTIONS OF CLOUD COMPUTING

This section reviews the research on the security solution of cloud computing. So the end user performs activities in the best possible manners.

A. Authentication and Authorization

The important factors that need to be taken into the consideration when adopting or developing a solution for the authentication and authorization for instance, to identifying the appropriate requirements, categories, services, deployment models, lifecycle, and entities. The authentication solution with MiLAMob [39], which offers a SaaS authentication middleware for the consumers of mobile IaaS cloud applications. MiLAMob is a middleware-layer which handles the real-time authentication actions on behalf of user devices with minimal HTTP traffic. The middleware currently supports mobile the consumption of data on IaaS clouds such as Amazon's S3.

The different approach for authentication and authorization - isbased on public key infrastructure (PKI) X.509 certificates for user identification and authentication [41]. FermiCloud 140 Computer Science & Information Technology (CS & IT) is built in OpenNebula117 and it develops both X.509 authentication in Sunstone OpenNebula- a Web interface intended for user management – and X.509 authentication via command-line interfaces. To avoid the limitations of OpenNebula access control lists that are used for authorization after successful authentication of users, authors integrated an existing local credential mapping service. This solution has also been extended in cloud federations to authorize users across different cloud providers that have established trust relationships through trusted certification authorities.

The collaborative access control properties,for instance, centralized facilities, agility, homogeneity, and outsourcing trust [42]. They have introduced an authorization-as-a-service (AaaS) approach using a formalized multi-tenancy authorization system and enabling administrative control over improved fine-grained trust models. Integrating trust with cryptographic role-based access control

(RBAC) [40] is another solution that ensures trust for secure sharing of data in the cloud. The authors propose using cryptographic RBAC to enforce authorization policies regarding the trustworthiness of roles that are evaluated by the data owner.

B. Identity and Access Management

The major functionalities of identity management systems in relation to the success of clouds with respect to consumer satisfaction is discussed in [46]. The authorization system for cloud federation using Shibboleth is presented by authors - open source implementation of the security assertion mark-up language (SAML) for the sake of single sign-on with different cloud service providers. This solution establishes how organizations in a cloud environment can outsource authentication and authorization from third party clouds by using an identity management system. The proposal by Stihler et al. [44] that integral federated identity management for cloud computing. The SaaS users can access the application and required resources that are provided is based on the trust relationship between the user and the SaaS domain. On the other hand in a PaaS domain, there is an interceptor which acts as a proxy to accept the request of the user's and execute them. The action of interceptor based on the secure token service (STS), and finally requests the security token using the WS-Trust specification.

IBHMCC [43] is introduced another solution which is based on the identity-based encryption (IBE) and identity-based signature (IBS) schemes. By using IBE and IBS schemes, another identity-based authentication has been proposed for cloud computing. The main theme based on the identity-based hierarchical model for cloud computing without using certificates for simplified key management with the corresponding encryption and signature schemes.

The approach by Contrail [45] which aims to enhance integration among heterogeneous clouds both vertically and horizontally. Vertical integration offers a unified platform for various types of resources, whereas horizontal integration abstracts the interaction models of different cloud service providers. Therefore, the authors [45] develop a horizontal federation scheme as a requirement for vertical integration. The suggested federation architecture comprises several layers, such as user's identities, the logic of business and manager of the federation to support APIs for resources, storage, and networking across different providers.

C. Confidentiality, Integrity, and Availability.

The designed approach enables the users to verify the integrity of VMs in the cloud [47, 48]. The proposed solution is called the trusted cloud computing platform (TCCP), and the entire IaaS is considered to be a single system instead of granular hosts in Terra. This approach enables all nodes to run a trusted virtual machine monitor to isolate and protect the virtual machines. Access to cloud services is given through the cloud manager component. The trust coordinator service is provided by an external trusted entity (ETE) in order to keep the track of the trusted VMs in a cluster. The ETE component is used to attest the security of the VMs. The confidentiality, integrity of data and computation is guaranteed by TCCP and it also facilitates the users to attest by the cloud service provider, to make sure the security of services prior to setting up their VMs. These features are based on the trusted platform module (TPM) chip. The function of TPM is based on private endorsement key that uniquely identifies the TPM and some cryptographic functions, which cannot be altered.

The proposed CloudProof [50] for a secure storage system to guarantee confidentiality, integrity and write-serializability by using certifiable pieces of evidence of a violation by external third parties. The confidentiality is ensured by private keys that data is encrypted for the data owner satisfaction. The use of attestation mechanism is the main idea behind CloudProof. Stability of users is ensured with the proof of attestations, where data owners use a block identifier to obtain the content of a block. This particular mechanism allows users to store data by putting a block identifier and the subjects of the block in the cloud. The process of attestation structure implements a solution is called "block hash" for performing the integrity checks through signature verification. The block hash offers proof for write-serializabilty by using a forked sequence of the attestations, whereas a chain hash method is used for a broken chain of attestations which is not sequenced correctly.

Fuzzy authorization (FA) the flexible and scalable approach for cloud storage [49] to enable data to be shared securely among cloud users. FA ensures confidentiality, integrity and also secure access control by utilizing secret

sharing schemes for those users usingcloud services with smartphones.

D. Security Monitoring and Incident Response

The solution of centralised monitoring for cloud applications comprising of monitoring the server, monitors, agents, files configuration and components notification [52, 60]. Redundancy, automatic healing, and multi-level notifications are additional benefits of the solution proposed, which are designed to particularly avoid the usual drawbacks of a centralized monitoring system, for instance, limited scalability, low performance and single point of failure.

The scalable distributed monitoring system for clouds using a distributed management tree, which covers all the specific protocol parameters for the data collection [53]. The acquisition of data is done through the specific handler implementations for each infrastructure-level of the data supplier. Interoperability with cloud software provided by data suppliers, virtualization libraries and OS-level monitoring tools. The limitations of existing intrusion detection systems review and discuss VM-level intrusion detection as an emerging area for securing VMs in the cloud environments by the authors. The specific requirements for an efficient intrusion detection system for particular cloud infrastructures, including multi-tenancy, scalability and availability, are identified and a VM introspection detection mechanism via a hypervisor is proposed.

Hypervisor-based cloud intrusion detection systems are a new approach (compared to existing host-based and network-based intrusion detection systems) is discussed [51]. The main idea is based on the hypervisor capabilities to improve performance over residing of data in a VM. The performance metrics are defined as networking transmitted and received data, read/write over data blocks, and CPU utilization. Furthermore, these metrics are retrieved in real-time intervals by endpoint agents,which are connected directly to a controller that analyses the collected data by particularly using signatures to find any sort of malicious activity. Then the controller component sends an alert to notification service in case there is any risk of a potential attack.

E. Security Policy Management

The generic security management framework allowing providers of cloud data management systems to define and enforce complex security policies through a policy management module [55, 60]. The user activities are stored and monitored for each storage system and are made available to the policy management module. Users' actions are evaluated by a trust management module based on their past activities and are grouped as "fair" or "malicious". An appropriate architecture for security management which satisfies the requirements of policy definitions (such as flexibility, expressiveness, extendibility and correctness) has been implemented. The authors evaluated the proposed system on a data management system that is built on data storage.

The policy management as a service (PMaaS) to provide users with a unified control point for managing access policies in order to control access to cloud resources independently of the physical location of cloud providers [57]. PMaaS is designed specifically to solve the issue of having multiple access control authorization mechanisms employed by cloud service providers that restrict the flexibility of applying custom access control to a particular service. For this purpose, the PMaaS architecture includes a policy management service provider that is the entry point for cloud users to define and manage the policies. The cloud service provider imports the user-defined policies and acts as a policy decision point to enforce user policies.

The challenges associated with policy enforcement in heterogeneous distributed environments are discussed in [56]. The authors propose a framework to support flexible policy enforcement and a feedback system using rule- and context-based access control to inform cloud users about the effect of defined policies. There are three main requirements for building a general policy enforcement framework. First, it must support various data types such as image, structured and textual data. Secondly, in a distributed environment there need to be several compute engines such as Map/Reduce, relational database management systems or clusters. Finally, access policy requirements in terms of access control policies, data sharing policies, and privacy policies need to be integrated with the general policy management framework. Several policy enforcement mechanisms (such as extensible access control mark-up language

or inline-reference monitors to enforce user-centric policies in accord with cloud provider approval) were also discussed.

The Cloud with the aim of developing solutions to ensure accountability and transparency in cloud environments [54]. Users need to be able to track their data usage to know how the cloud provider satisfies their expectations for data protection. For this purpose, cloud providers must employ solutions that provide users with appropriate control and transparency over their data, e.g. tools to define policies for compliance with regulatory frameworks. In another effort [48, 60] the authors discuss the issue of usable transparent data processing in cloud computing and also consider how to enable users to define transparency policies over their data. They identify the requirements for transparent policy management in the cloud based on two aspects: user demands and legal aspects of transparent data processing.

IX. CONCLUSION

Cloud computing is world emerging, next-generation technology that is tremendously important to improve ways of doing business. Variety of benefits offered by this technology proved to be a valuable asset for organizations to stay competitive in the market and enable the business to accomplish their tasks accordingly. Cloud computing has been defined by different experts from different perspectives. In this paper cloud computing discussed with a concern related to benefits and challenges for adoption perspective. Cloud computing provides a number of benefits, for instance, cost-saving, time-saving, scalability and flexibility, backup and recovery, reliability, resource maximization, mobile access, customisation and delivery new service. Whereas, the main benefits is to reduce the cost for instance purchasing of hardware and software.

On the other hand, there are also some issues also related to cloud computing. Some of the issues are the privacy of data, the confidentiality of data, data remanence, data integrity, the transmission of data, data breaches, availability, malicious insider, API issues, data location, data relocation and account or service hijacking. There are more organisations are willing to adopt cloud computing technology only if issues are solved. In this paper, some solutions have been suggested to overcome these issues related to cloud computing. In this regards the safety of the cloud computing service should be placed at the front. The cloud service providers should ensure the authentication and authorization to help the user. The identity and access management, confidentiality, integrity, and availability, security monitoring and incident response and must place the security policy management for the satisfaction of the user. Due to the limitations few case studies will be chosen and discussed on how business and organisations gained the benefits of cloud computing and improve their secure working. Here I conclude that, even though it has a lot of benefits, it is suggesting you adopt cloud computing services only after analysing all the major security issues in cloud computing.

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