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Database Security Issues and Challenges in Cloud Computing (Review)
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Abstract:

Today most institutions have adopted cloud computing and moved from traditional database to cloud database as a result of low expenditures for data management and more focus on the product. the cloud has revolutionized the concept of data storage and access in institutions which provided flexible and effective solution .it also solved the problem of the ability to expand, flexibility availability and affordability. However, the challenge of cloud data security, and enhancing public acceptance of cloud computing in general remains a major concern in this paper. the research that took into account security issues and problems associated with adopting cloud database in addition to considering the advantages, disadvantages, challenges and solutions to move to cloud database and suggesting some recommendations.

Keywords: Cloud Computing, Privacy, Security, Cloud Database

INTRODUCTION

Cloud database security is a set of technologies and procedures used to protect data in the cloud and protect it from malicious attacks. Protects data by verifying the identity of users and devices , controlling access to data and resources ,and following regulatory requirements this security method protects against common threats such as DDOS attacks ,viruses hackers unauthorized access and data breaches in cloud environments .the concept of cloud computing is running out as communication and digital data processing progress and storage requirements change .cloud computing is a means of processing storage and managing data on demand using a network of remote servers connected to the internet ,paying only for what you use .they provide access to a range of shared resources rather than local server [Ahmed and Hassan,2018]. Essentially, cloud service providers offer different cloud service to their users when cloud computing is used ,data is distributed across several places as resources that can be accessed remotely by different users throughout the cloud in the cloud architecture ,power and secure computing are paramount .any organization that tries to store data either on host files or on a public cloud loses capacity on physical access to servers that have their own data this makes potentially sensitive data vulnerable to internal hacking . in 2017, Equifax one of the largest credit agencies in the world , was subjected to a security breach that led to the leakage of sensitive data to hundreds of millions of people a loophole in open source software was exploited to leak data the company suffered heavy financial losses due to security negligence hence ,we see the need to pay attention to security updates and institutions must have clear plans to deal with such incidents. [Thomas (2019)]

Cloud Computing Overview

Cloud computing provides an alternative to the local data center. When setting up a local data center the team is responsible for every details. This includes configuring firewalls and network installing the operating system setting up virtual storage acquiring and installing hardware and configuring data storage after all sitting are completed the team is responsible



for maintaining them for the duration of their existence. As everyone knows cloud computing technology allows organization of all size to store data in the cloud and retriever it using an Internet connection from anywhere and anytime [Ahmed and Hassan (2018)].

Cloud computing architecture Cloud computing a shifter considers of combination, event-oriented, and service-oriented, architecture [m.malik.p(2016)].

the cloud computing consists of two distinct parts:

Front end: the front end interacts with the customer integration with cloud computing services can be facilitated through client-side ABIS and applications the front -end includes internet browsers, thin and chubby client mobile devices, tablet and web server

Backend: use it by the services provider the backend monitors all resources associated with the provision of cloud computing services it consists of many things such as large data storage security features, virtual machines deployment models, server and traffic control methods.

The cloud environment provides a user – friendly web interface that allows users to easily manage Their network resource storage commuting and application

Type Of Cloud Computing Model

Cloud refers to cloud resources that are owned and managed by third party many computing resources such as services software and storage can be accessed online

Private cloud : private cloud an individual an individual company or other organization can book a pool of cloud network resources called private cloud the location of the private cloud can be either in the company's data center or with another provider.

hybrid cloud: cloud computing refers to the storage and. processing of data in both the public and private cloud, with the two types of clouds linked together through technological means the hybrid cloud deployment options take advantage of the flexibility offered [m.malik.p(2016)].

software as a service: (saas) the term software as a service describes a model for online application delivery the user does not need to install the software on their computer all they have to do is access it online[patel .r.k(2023)].

platform as a service: (pass): pass allows users to access a development environment so they can install their own apps and write their own code users are allowed to create their own applications that use the service providers infrastructure application management capabilities can be obtained from a preset set of operating system and application server provided by service as examples include [ruby J2EE], andlamp (linux,apache,mysql,and php) [patel.r.k (2023)].

infrastructure as a service Iaas: iaas provides on- demand access to a wide range of computing resources such as data storage networks computers operating systems and storage devices. users can access offers via wan or the internet iaas allows users to build virtual machines [patel .r.k(2023)].

Database as a service (DBAAS): DBAAS is an operational and architectural model that allows service providers to provide DBAAS to larger a number of customers .

Cloud components Cloud computing consists of three main components

client hardware: cloud computing allows users to interact with the service through client hardware

distributed servers: servers look like they are collaborating with each other while being distributed to multiple location.

Datacentres: the server cluster is called a datacenter .

Database as a service DBAAS Overview:

cloud computing services typically offer different types of resources leading to a more widespread categorization of cloud types software platforms and infrastructure this study

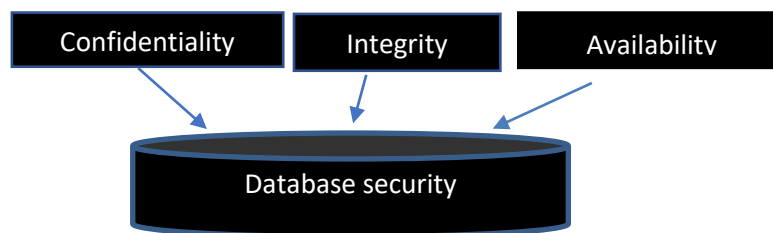


mainly focuses on the type of DBAAS service AAS service baas can be considered an example of a SAaaS service DBAAS is a cloud service that enables applications and is managed by a public or private cloud operator this service relieves the applications team of the burden of handling administrative tasks for standard databases application developers should not pay a database administrator DBA to manage the database or be database experts when using DBaaS,with primary and secondary databases configured in a real application cluster RAC for high availability and load balance this architecture ensures that the application continues to work even if a database case fails ,providing a robust and scalable solution for various enterprise application. [F.H.U. etal 2011].

Database security

the success or failure of any organization depends heavily on its data as most organizations use databases to store vital or important data the data contains all of the organization's credentials and sensitive information not just user details many organization's data spend large sums of money on database security and given the importance of data database security is critical in the public and private sectors so it is necessary to secure the data, availability database security S1 SA confidentiality integrity in today's information focused environment database security is essential to protect sensitive data ensuring the security of databases has become critical as businesses increasingly rely on them to store and process vast amounts of data. [M Malik P(2016)], [Mohammed razid Mohammed novik 2022]

figure 1 shows the three main elements of database security.



Data security requires three key elements availability integrity and confidentiality .

Confidentiality: means that data can only be used by authorized users.

Integrity: indicates that a particular person must manage data using a particular method .

Availability: means that information must be available to authorized users in a timely manner. [M Malik P 2016]

Database attacks

database attacks are mainly divided into two categories:

1. **negative attacks:** negative attacks target surveillance the attacker sees the data in the database although they are less dangerous than active attacks they are less challenging

fixed leakage through this passive offensive method the attacker monitors the database snapshot to extract normal text values at a predetermined time fixed leakage focuses only on the data in the database occurs at predetermined times and does not take into account any changes in that data

linked leakage: these passive attacks work by creating a link between a value in the database and its place in the index then the attacker can get the normal text value to carry out a linked leak attack you must first search the database index for the specific data that will be targeted

dynamic leakage this passive offensive method involves monitoring the database for a certain period of time to create the normal text value

2. **active attacks:** active attacks require variable data which makes them more annoying than passive attacks



delivery attacks: in this active attack there are two possible values for the ciphertext and one is replaced by the other.

counterfeit attacks: in this active attack the a ciphertext is replaced with a new newly created value .

Restart attacks in this ongoing attack the ciphertext value is either destroyed or replaced with an older version that was previously updated

3. **SQL injection attacks:** injecting SQL instructions into SQL statements by entering a web page is a simple way in which malicious people can hack databases there are several subtypes of SQL injection attacks including

matching attacks: databases are a common target for matching attacks because of areas of execution this type of attack an attacker typically passes through authentication pages and obtains access to those that assist in execution by entering SQL codes into one or more fields.

[M Malik P (2016)]

Popular databases in cloud computing [Ahmed and Hassan,2018]

- Strom DB
- PostgreSQL
- Mongo Lab

Google Cloud

GCP uses about 9.5% of the cloud computing market and has expertise in artificial intelligence and data analytics

- Google Cloud SQL
- GC Bigtable
- Google Cloud Datastore
- GC Spanner

Microsoft Azure

Azure offers hybrid cloud computing solutions and advanced AI services catering to multiple enterprise needs and providing a vast global network Microsoft Azure has a 22% market share and is heavily focused on hybrid cloud solutions and dedicated enterprise services

- MA Table Storage
- Microsoft Document DB
- Microsoft SQL Database
- Oracle Database
- IBM

Amazon

DynamoDB

- Amazon Aurora
- Simple DB

Literature Review

we discussed the most important security problems related to cloud databases and some possible solutions to fix them firstly the researchers investigated security concerns related to cloud databases it provided the means to address the problems to some extent by taking advantage of these facts

cloud database security issues

- **R.Patel(2023)** the importance of encryption in protecting data stored in cloud databases where it contributes significantly to enhancing data security the researchers also stress that in order to activate strategies to protect privacy it is necessary to go to ways to solve problems they discuss data protection needs and a look at the basic principles of



security measures in cloud computing privacy strategies in cloud environments were compared

- **Mohammed raziq Mohammed novik 2022** the researcher in this paper described how to overcome many security issues in cloud databases and discussed major security issues such as authentication confidentiality encryption key management multiple tenants and data partitioning it will conclude that it is necessary to reduce these issues and improve encryption the researcher also recommended the need to use appropriate key management techniques to distribute keys to authorized cloud users and to take into account the system security requirements while maintaining the speed of the system

- **Sharma and Sharma(2015)** in this paper some of the barriers and threats to the cloud database have been clearly analyzed and this paper addresses the privacy and security of cloud databases potential attacks and approaches to securing data on cloud databases the most likely attacks on the cloud database have also been described (SQL) injection cross site scripting (XSS) man in the middle attacks denial of service attacks and cookie poisoning are examples of such attacks the adversary can completely take over the database for your web application by entering a random SQL code into the database query the unauthorized person becomes able to gain unauthorized access to the database stored in the cloud

Cross site scripting is another malicious script inserted into the actual web context that help the enemy obtain the victim's confidential information the man in the middle the middle tries to Snoop between the client and the server to access the data

- **Aurora and Gupta (2012)** in this paper potential issues related to cloud database development are highlighted by highlighting database security and privacy the risks of storing data on untrusted hosting systems have been widely identified and sensitive data must be encrypted before being transferred to the cloud to avoid unwanted access

In reviewing research on cloud database security issues few research has been found related to cloud databases most of which face the problem of unauthorized access and modification of customer data solution technologies have also been found in their research many security issues have been identified in the cloud computing environment some important issues are listed below

- ❖ Data storage integrity
- ❖ theft of data by authorized users
- ❖ production data and backup data are stored at the same physical location
- ❖ DBAAS provider can access your data
- ❖ DDoS attacks and database performance
- ❖ non company users can access the database
- ❖ hidden sensitive data
- ❖ SQL injection attacks
- ❖ neighbouring tenants have access to data
- ❖ DBAAS regulatory compliance.

.**ShCHERBININA et al, (2020)** reported some other potential attacks against cloud databases including SQL injection weak authentication data breaches account takeovers cross site scripting (XSS) intermediary attacks denial of service attacks and cookie poisoning the term weak authentication refers to a very weak authentication method.

When there are data breaches hackers have easier access to private information such as credit card numbers and personal data that is held in cloud databases .

attackers can obtain data from the cloud database in an unauthorized manner through SQL injection in most cases therefore dangerous SQL code helps attackers bypass cloud protection



when cookies are poisoned it shows that hackers have changed them
attackers typically conduct denial of service(dos) attacks when they send wrong requests
from outside the server to a noisy database server database failures occur as a result of the
servers inability to meet actual needs

- Attacks that place an attacker in the middle of a client server connection in an attempt to steal data are known as "man in the middle" attacks

- **Table 1: Literature review summary for database security in cloud**

refrences	Challenge	Methodology	Key Findings	Limitations	Future Work
[4]	Storing data on unreliable system	Literature review and case studies	Unauthorized access leads to significant data theft or loss; various strategies exist to mitigate these risks.	Focus on preventative measures may overlook detection and response strategies.	Develop more robust real-time monitoring systems.
[6]	Privacy and data security	Comprehensive review of the literature on database security	SQL injection via XSS sites can lead to unauthorized access to confidential data	User awareness is often insufficient to mitigate risks.	Develop user education programs alongside stronger security measures.
[10]	Encryption	A comprehensive review of the literature in cloud database security	Analyse and evaluate privacy strategies used in encryption	effective encryption provide significant data privacy protection	more about cloud data security more about managing encryption
[2]	Key management and distribution	Analyze key security challenge	The need for a careful balance between system security requirement and system speed	The study is mainly limited to key management and distribution	More investigation on how to integrate advanced encryption technologies.
[5]	Sql injection weak authentication	review of the literature on database security	Adversary can take over database and out malicious attacks	Not all proposed measures may be appropriate in all situations	More investigation into the impact of the attacks on end-users

Table 1: Literature review summary for database security in cloud



Solutions for security issues related to cloud databases [Huang,k,Tso,T (2012)], [Shetan and singh(2016)] .

access to resources should be restricted by allowing only the lowest level of access while allowing the application to function normally in order to develop separate special privileges management must first examine this requirement grant each user application and process with access To the database absolute minimum privilege is no unintended changes in data or data leaks will occur as a result

- privilege segregation separates critical functions that can affect database security into parts that are implemented by different people or systems
- delegation and authentication the delegation process determines who has access to resources the identity of the entity requesting access to a resource is verified through authentication
- another critical security element is authorization as only authorized users will have access to protected information preventing data leakage
- defense in depth ensures that security controls are in place throughout the information architecture including the database network server and operating system cloud kits can be used to accomplish this policy the common pool of resources that many tenants can use is called a cloud pool
- recording and auditing tracks all activities by keeping a record of any work that may be related to security
- the most important element of security is data logging we can track issues and sometimes recover lost data these records can be used to implement special compliance certificates that require proof of actions that can be tracked and audited and that have been taken
- **data encryption to ensure privacy** encryption allows to protect data from unauthorized access and helps to stop data flows and breaches
- iteration reproducing important components in this system for the entire system with the aim of improving the reliability of the system in addition periodic DMBS backups are required in order to restore damaged or lost data if necessary
- continuous monitoring of the system status to ensure that the specifications are met this is a critical step because if a security breach is not observed it cannot be remedied most databases do not follow all of the above rules because it is impractical to do so as increased security may result in reduced productivity and durability cloud databases in particular need to respond to queries quickly in order to be effective to help developers implement security in cloud databases and settings more effectively many of these rules are presented in a style format
- various security methods and techniques have been proposed to secure databases located online or in the cloud however despite progress hackers continue to discover new ways to exploit vulnerabilities that go unnoticed during development testing and deployment for online databases access management is a fundamental and critical security challenge

METHODOLOGY

in this work we will use the inductive approach by relying on secondary sources which specialize in the current research topic database security issues and challenges in cloud computing review from an article available on the Internet and previous studies and works

. DISCUSSION

Migrating database to cloud should be an individual decision each time that depends on type of the data and the purpose of the solution. Decision makers should be aware of cloud



limitations and challenges; however, they should not forget about benefits that cloud database is bringing. This paper has 3 objectives.

CONCLUSION

this paper addressed security issues related to cloud databases it also discussed possible solutions I can conclude that in order to improve the service provided by cloud databases

- 1) security issues should be reduced and the encryption process improved
- 2) remote data storage and database management on 3rd party infrastructure is one of the areas where cloud computing is an advanced and cutting edge technology
- 3) most organisations apply a cloud database to store their big data although cloud computing is a new emerging technology that offers a good number of benefits to users it faces a lot of security challenges there are ethical security and privacy issues that affect the use of cloud services but to overcome these issues data can be stored and retrieved from the cloud using new and advanced encryption technologies appropriate key management techniques can also be used to distribute the key to cloud users so that only authorized have access to the data
- 4) databases need effective access control security mechanisms to protect stored data in particular cloud databases or a difficult problem because they can be accessed from anywhere over the Internet and therefore effective security mechanisms are necessary to protect them without affecting normal business operations not only is it important that the database service security controls but in addition a wide range of security policies at different levels of the system architecture are needed to adequately protect it a new idea that provides users with a plethora of benefits is the cloud database cloud users may also be affected by some of the security issues you face and this article describes the issues related to databases and their solutions maintain system speed cloud database systems are not safe 100% however we can guarantee that they offer far more features than traditional databases.

Recommendations

- the need to implement strict access management and control policies for cloud data and resources
- the need to implement monitoring and analysis mechanisms to detect illegal or unusual activities techniques such as event logs analysis intrusion detection systems (S5S) and computer edge detection abuse can be used
- the need for security challenges related to cloud computing monitoring new security and technological developments and raising awareness of new threats and existing typical security practices to deal with them such as cyber threats unauthorized access and data loss
- databases need effective security mechanisms to control access and protect stored data cloud databases pose a challenge because they can be accessed from anywhere over the Internet
- The need for a wide range of security policies at different levels of the system architecture to adequately protect databases
- system designers must account security requirements while maintaining system speed cloud data Bay systems cannot be guaranteed to be 100% secure but they offer more features than traditional databases



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