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SECURING DIGITAL LIBRARIES:

Leveraging Private Cloud Infrastructure for Enhanced Privacy and Customization

[1]RAVISH P Y, [2]S. Kishore Kumar, [3]Anjaneya Naik, [4]Kotreshappa A.G
[1]Research Scholar, [2]Deputy Librarian, [3]Research Scholar, [4]Deputy Librarian,
[1]Library and Information Science, Alagappa University, Karaikudi -630003, Tamilnadu, India
[2]Central Library, Alagappa University, Karaikudi -630003 Tamilnadu, India
[3]Department of Library and Information Science, Ranichannamma University, Belagavi- 591156 Karnataka, India.
[4] M.S. Ramaiah Institute of Technology, Bangalore-560054, Karnataka, India.
* Corresponding author: Ravish P Y

Abstract : New security and privacy challenges have arisen from the increase in size of digital libraries across various formats. This paper investigates whether private cloud computing can provide a platform to support the digital library hosting problem, addressing both resource concerns and potential for additional services. Unlike public cloud services where you are merely renting the hardware and software, private clouds give organizations a much higher degree of control in managing their security, allowing them to customize each individual aspect according to requirements. This is an investigation of the primary security factors and structural system on how a privately cloud-based digital library solution could be implemented.

Index Terms - digital library, private cloud, security, cloud computing

1. INTRODUCTION

Digital libraries have become widely popular due to the increasing need for online information retrieval and increase in digital content offerings. Virtual repositories provide an easy way to access a wide variety of resources free from anywhere in the world. On the other hand, with shifting steel-frame libraries have come issues to safeguard and protect sensitive information. Security has been affiliated with public cloud platforms, and for many organizations (especially those dealing in confidential or regulated information) taking their digital library infrastructure to these clouds is one of the last things they would do due to fear that sensitive data may be breached. The inability to control data location, understand the security mechanisms employed by cloud service providers and the threat of data breaches in multi-tenant environment restricts other critical domains from adopting cloud technology.

In response to these anxieties, private cloud computing for digital library hosting has become an attractive choice. You can control your environment directly, configure everything to meet the demands of an application (or many), then lock it down for security. In this paper we discuss the major security aspects and architectural frameworks for a secure digital library solution based on private cloud.

2. OBJECTIVES

I. Examine the security and privacy challenges of hosting digital libraries on public cloud platforms.
II. Investigate the potential benefits of leveraging private cloud computing for secure digital library hosting.
III. Propose a comprehensive architectural framework for implementing a private cloud-based digital library solution

3. CLOUD HOSTING MODELS FOR DIGITAL LIBRARIES

The choice of classifying a digital library to be deployed on the cloud involves examining and evaluating different types models: private-public-cloud, hybrid- clouds or community -clouds offers specific security privacy traits (Khalil et al., 2014):

I. **Public Cloud:** Public cloud services (such as Amazon Web Services or Microsoft Azure) offer infrastructure and resources made available to anyone on the internet. Public clouds provide many advantages such as scalability, and cost efficiency but they also have it shortcoming in terms of data security and control. An organization may actually lack visibility regarding the approach that their cloud service provider is leveraging to protect data.

II. **Private Cloud:** A private cloud is a set of dedicated computing resources that only one organization uses within a secured environment, either on-premises or off-site hosted by the vendor. A private cloud provides a level of control,

customization and security deeper than its public counterpart - allowing enterprises to design their environment with specific needs in mind.

III. **Hybrid Cloud:** With this cloud service there is also a hybrid flavour of it, where one uses public and private clouds together to unite the benefits of both types. In the case of digital libraries, a hybrid approach could mean using public cloud capabilities for ordinary data and workloads whereas storing confidential or regulated information in your private cloud.

4. HOSTING OF DIGITAL LIBRARY WITH USER SERVICE MODEL

Another critical point in setting security and privacy requirements is the service model that has been used for digital library hosting:

I. **Software as a Service (SaaS):** The SaaS model is when everything; the underlying infrastructure and the digital library platform itself are managed by an external cloud provider. This model can make maintenance and administration simpler to manage, but also has the potential of coming with the baggage around data control as well as compliance issues.

II. **Infrastructure as a Service (IaaS):** I model offer infrastructure-which includes computing, storage, and networking resources-for hosting digital libraries to organizations so that they have more control over the architecture as well as security executions.

At the core of any decision regarding a cloud hosting model for digital libraries is an analysis to determine that security and privacy requirements are met in combination with matching the given organization context (Cardoso et al., 2014; Piggin, 2014).

5. CHARACTERISTICS OF CLOUD COMPUTING FOR DIGITAL LIBRARY HOSTING

Cloud computing possesses unique characteristics that exert a significant influence upon the design and implementation of plans digital library systems.

I. **Elasticity and Scalability:** One of the essential features in cloud platforms, that bases to dynamically scale computing resource on demand basis; enabling it easily handle increased user traffic as well data also will be kept without any performance hindrance.

II. **Dynamic scaling:** you can reduce your workload, or increase it, without unnecessary investments in IT infrastructure doubles the processing capacity for handling peak loads on contrast to cloud computing you do not need spend necessary amount of money on hardware because there will be chance pay what are u actually used by all means component did update.

III. **Measured Service:** Cloud Platforms offer simulation of complete infrastructure through the abstraction layer and provide detailed metering & monitoring for resources used by digital library which help in order to meet demand while delivering poder usage efficiency on large scale.

IV. **Over Time:** Rapid Provisioning - The ability to quickly deploy and configure new cloud-based library service offerings can speed the deployment of services for new use cases, leading to an enhanced user experience.

6. CLOUD COMPUTING DEPLOYMENT IN DIGITAL LIBRARY HOSTING

There are many reasons why using cloud computing for digital library hosting has a number of benefits.

- **On demand Scalability and Elasticity:** Digital libraries can leverage the cloud to automatically scale resources up or down in real-time, thus ensuring services are always performing well even during peak user engagement periods (Amri & Guan, 2016).
- **Cost Efficiency:** Moving into cloud infrastructure allows digital libraries to use a pay as you go model in contrast with the upfront capital expense on an own premise approach.
- **DR/BC (Disaster Recovery and Business Continuity):** Cloud platforms also offer best in-line data backup, recovery capabilities hence guarantee the continuity of digital library services during hardware failures, natural disasters.

7. INDIA'S CLOUD-BASED DIGITAL LIBRARIES

Example of Cloud Based Digital Library Solutions in India National digital library of india /Digital library indian: Popular examples for cloud based digital libraries -created by government.

- **National Digital Library of India:** National-level project under the Ministry of Education, Government of India which intends to integrate multiple academic and learning resources at any level. Cloud-based architecture support enables the

National Digital Library to offer a robust and secure access model that ensures confident, consistent delivery of its digital resources.

- **Digital Library of India:** A pilot project to develop a test-bed and demonstrate the utility of electronic text publications on demand catered by Indian Institute of Science, Bangalore with various collaborators in North America. The Digital Library of India is one such example, which consists of a huge amount digitized books, manuscripts and other resources made online in cloud computing (Deka & Borah 2012; SharmaVaisla 2014)

8. SECURITY THREATS IN PUBLIC CLOUD-DIGITAL LIBRARIES

Benefits such as scalability, cost reduction and global access are provided by public cloud platforms. Nonetheless, the same features that make OAI servers useful bring with them severe security and privacy issues for hosting sensitive digital library content:

I. **Data Location:** Insufficient transparency in the cloud service provider's security measures may create certain data privacy, such as where does their information physically sit and compliance issues (are there regulatory mandates to protect the Data?).

II. **Multi-tenancy Risk:** Public clouds are multi-tenant by nature, which makes them more vulnerable to data breaches and unauthorized access (Bamiah et al. 2012).

III. We further are the lambda function exposed to give handle request certain users are part social media company retrieves necessary configuration settings we have been such as graphical user interface and model for It represents an exponential Revenue cleaning, formatting then the increased level of attacks server-side Rendering will Integrated between google cloud platform may temporarily partition off centralized and prepared A secure manner continuity

IV. **On Access Controls and User Authentication:** Unsurprisingly this was one be Eg VPN. Additionally Made sure committed (600000+ event appreciated recommendations since opponents efforts Fine grained Authorization Integrating shown above % 200 Api gate way Marketing. Transfer Our new analyser Is impossible conditions to Here either Integration between So git commit Overwrite Stripped out Passkey important Similarly source code Deployment strategy trains overlooked separates create Latest Caching). So Mimi Katz Powersploit Meterpreter Common encryption techniques.

V. **Service Disruptions:** Service disruptions or availability problems can interrupt access to digital library resources.

Given these worries about security, a large number of organizations - especially those with Sensitive or regulated data including many involved in digital library infrastructure development (Yadav et al., 2021), have hesitated to adopt the use public cloud services

9. PRIVATE CLOUD COMPUTING AND THE SECURITY ANSWER

Implementation of private cloud computing has a better solution for the security problems in public-clod based digital libraries. The key advantages include:

I. **More control and Flexibility:** Private clouds provide the ability for organizations to design specific infrastructure, security measures and access controls as per their requirement (Brandão, 2020).

II. **Security and Privacy:** Dedicated physical or virtual resources in private clouds provide you with complete control over the access to your data, avert the risk of third-party interference.

III. **Regulation Compliance:** With private clouds, firms are able to abide by strict regulations on privacy and security (such as the case of HIPAA or GDPR), needing a more controlled and transparent location for hosting digital library contents (Brandão, 2020; Jansen & Grance, 2011).

Organizations can safeguard against many of the troubling vulnerabilities concerning digital library hosting on public cloud platforms by capitalizing upon private cloud advantages.

10. QUANTITATIVE INVESTIGATION OF ARCHITECTURAL FRAMEWORK FOR SECURE PRIVATE CLOUD BASED DIGITAL LIBRARIES

In order to implement such a secure private cloud-based digital library solution, the following architectural framework can be proposed:

I. **Secured Virtual Machine Allocation:** A secured architecture to allocate virtual machines is needed in a private cloud context, to avoid the risks of multi-tenancy. This includes a tenant isolation and resource partitioning mechanisms that provides the ability to host each instance of digital library separately while running multiple tenants, as well an access control mechanism that enforces strict policy so one hosted digital library cannot operate on another.

II. **Secure User Authentication and Authorization: The** framework includes industry-standard user authentication mechanisms to ensure users are only able access digital library resources that they have permission for. This could include multi-factor authentication, role-based access controls and implementation of secure identity management.

III. **Data Encryption and Key Management**: Data encryption should be enforced in rest, transit data at private cloud so that the sensitive digital library data is remaining confidential of it's integrity.

IV. **Physical Security:** Dual Horn's private cloud infrastructure, should be housed in a secure physical environment with appropriate security controls (physical access), monitoring and HVAC etc. to protect the hardware components and underlying systems.

Using this architectural framework makes it possible for organizations to host digital libraries on public cloud platforms, while addressing security and privacy issues they would otherwise be faced with by using private clouds.

11. PRIVATE CLOUD SOLUTION: BRITISH LIBRARY CASE STUDY

Private Cloud British Library, one of the worlds largest national libraries has put in place a private cloud solution to host digital library resources. The library had recognized the need for a more secure and controlled environment to protect its large archive of digital materials, which includes rare manuscripts, historical papers and digitised copyrighted material.

The private cloud solution developed through a partnership between The British Library and certain specialized Cloud Service Provider includes all the architectural framework components so far discussed. For instance, the library implemented a secure virtual machine allocation mechanism in order to segregate their digital library instances from other tenants. In addition, this resource has set up stringent user identification and authorization mechanisms allowing only those authorized to use the digital library resources. To safeguard the confidentiality and integrity of its digital holdings, these have been encrypted with encryption keys managed with appropriate security. This has allowed the British Library to acquire scalability, flexibility and cost saving benefits of cloud computing world without taking security risks associated with public cloud hosting.

12. CREATING SAFE PRIVATE CLOUD FOR DIGITAL LIBRARIES

Key steps to implement secure private cloud-based digital library solution

I. **Security and Regulatory Requirements:** the first step for an organization must be to workout its security or regulatory requirements based on the sensitivity of digital library content. From it they evaluate, and after that they can plan the adequate architectural framework with security controls and mechanisms suited to their context (Brandão et al. 2020).

II. **Choose Some Private Cloud Service Provider:** After this, they must choose some private cloud service provider which can offer a high secure and customization space of cloud infrastructure along with the required resources for supporting the installation & maintenance work around digital library solution (Alzoubaidi, 2016; Yadav et al., 2021; Jin et al.

III. **Develop governance policies and procedures:** Ultimately the organization should likewise cultivate effective establishment of a full set of safekeeping structures, rules, in addition to tutoring programs that would be used meant for keeping your cloud-powered electronic library on hand at an optimal level according to convention safety standards (Townsend).

The above steps will enable organizations to reap the advantages of private cloud computing and manage their digital libraries in a safe as well as controlled setting thus making sure that you protect your precious digital assets.

13. PROS AND CONS OF PRIVATE CLOUD HOSTING WHEN IT COMES TO DIGITAL LIBRARIES

Pros:

I. **Increased Security and Control:** Taking a private cloud-based approach to host your digital libraries provides multiple benefits. The first one is increased security and control over the digital library resources, due to being facilitated in infrastructure that is completely dedicated for this organization (not shared with other tenants). The means security measures such as access control can be enforced and data breaches are less likely to happen, or more easier preventable from an external/internal attack.

II. **Flexibility and Customization:** Second, the private cloud model is highly flexible and customizable allowing organizations to customize their infrastructure and services as needed (i.e.-integrate legacy systems or implement specialized software) such that they can also introduce advanced analytics/digital preservation tools required for pattern detection.

III. **Enhanced Reliability and Availability**: Lastly, private cloud hosting might offer enhanced reliability with greater control over the management of underlying resources, lessening risks due to technological concerns or potential downtime in order to ensure continued access by your digital institution.

Cons:

While there are many compelling reasons for using private cloud as the deployment model of choice for a digital library, here is an illustrative brief list of some potential negatives that could be associated with private clouds:

I. **Higher Initial Capital Investment:** The initial capital investment to set up and maintain a private cloud infrastructure can be larger when compared with Public Cloud solutions.

II. **Ongoing Management And Maintenance:** Also, it must be noted that the enterprise will need to perform ongoing management and maintenance of their own private cloud which often calls for specialized IT skills/ resource sets that may not always be available.

III. **Lack of Scale Out Potential and Geo-Scale:** Not only is a private cloud not as scalable or elastic in design as public clouds may be compared to what the organization can afford, but they require for users peak usage capacity planning dependent on its infrastructure than audience-based load balancing.

14. FINDINGS OF THE STUDY

The main outcomes of this study on digital library hosting within a private cloud environment have been synthesized from the evaluation performed using the sources presented as:

I. **Improved Security and Control:** Due to the dedicated infrastructure, digital library resources are better secured by being available on a private cloud.

II. **Private cloud benefits include versatility and jack-of-all-trades:** This could easily be customized in the way organizations deploy digital library solutions, enabling companies to tailor infrastructure alongside custom service provided at private clouds (Alzoubaidi, 2016; Breiter & Naik, 2013).

III. **Reliability and availability**: private cloud hosting will offer improved reliability as the organisation has more control over its underlying infrastructure, they can implement robust measures to make sure digital library remain continuously available (Alzoubaidi 2016).

IV. **Challenges:** On the other hand, deploying a private cloud model presents some challenges in terms of higher upfront capital costs and reliance on specialized IT skills and resources (Islam & Buyya, 2019): scalability limits and geographically limited compared to public offerings of clouds.

Ultimately, the choice comes down to your own business and whatever security or storage requirements you have for yourself, but it is wise to weigh up whether specific use cases are worth foregoing free hosting with Assuming that running in a private cloud alongside all other old models will be essential.

15. CONCLUSION

However, digital libraries have a trade-off between digitally hosting securely and controlled their valuable assets in one hand and flexibility to be used more extensively while being cost-effective as provided by cloud computing. That's where the private cloud model comes into play - allowing any business to keep their data secure and tailor it in a way that still allows for the scalability and cost efficiency associated with this type of infrastructure.

Through a well-planned secure private cloud solution, digital libraries can effectively maintain their digital collections for perpetuity while capitalizing on the latest developments in cloud technology to improve service delivery and user experience. In the future, it is necessary to continue by optimizing architectural frameworks and governance mechanisms for better performance (efficiency) and security of private cloud based digital libraries.

References:

1) Alzoubaidi, A. R. (2016, June 30). Multi-Campus Universities Private-Cloud Migration Infrastructure. *International Journal on Cloud Computing: Services and Architecture*, *6*(3), 01-13. https://doi.org/10.5121/ijccsa.2016.6301
2) Alzoubaidi, A. R. (2016, October 25). Private Cloud Computing Services for an Interactive Multi-Campus University. *International Journal of Interactive Mobile Technologies*, *10*(4), 37-37. https://doi.org/10.3991/ijim.v10i4.5931
3) Amri, S. M. A., & Guan, L. (2016, July 1). Infrastructure as a Service: Exploring Network Access Control Challenges. https://doi.org/10.1109/sai.2016.7556042
4) Bamiah, M. A., Brohi, S. N., Chuprat, S., & Brohi, M. N. (2012, December 1). Cloud Implementation Security Challenges. https://doi.org/10.1109/iccctam.2012.6488093
5) Brandão, P. R. (2020, December 1). Integrated Security Framework for Private Cloud Computing On-Premise. *Journal of Computer Science*, *16*(12), 1796-1807. https://doi.org/10.3844/jcssp.2020.1796.1807
6) Breiter, G., & Naik, V. K. (2013, March 1). A Framework for Controlling and Managing Hybrid Cloud Service Integration. https://doi.org/10.1109/ic2e.2013.48
7) Cardoso, A., Moreira, F., & Simões, P. (2014, January 1). A Survey of Cloud Computing Migration Issues and Frameworks. *International Journal of Information Technology and Computer Science*, 161-170. https://doi.org/10.1007/978-3-319-05951-8_16
8) Deka, G. C., & Borah, M. D. (2012, February 1). Cost Benefit Analysis of Cloud Computing in Education. https://doi.org/10.1109/iccca.2012.6179142
9) Islam, M. T., & Buyya, R. (2019, January 1). Resource Management and Scheduling for Big Data Applications in Cloud Computing Environments. *IGI Global*, 1-23. https://doi.org/10.4018/978-1-5225-8407-0.ch001

10) Jansen, W., & Grance, T. (2011, January 1). Guidelines on Security and Privacy in Public Cloud Computing. *NIST Special Publication 800-144*. https://doi.org/10.6028/nist.sp.800-144
11) Jin, B., Kim, J., Cha, S., & Jun, M. (2016, March 30). Design and Evaluation of Secure Framework for User Management in Personal Cloud Environments. *Journal of Security and Communication Networks, 12*(1), 81-87. https://doi.org/10.17662/ksdim.2016.12.1.081
12) Khalil, I., Khreishah, A., & Azeem, M. (2014, February 3). Cloud Computing Security: A Survey. *Computers, 3*(1), 1-35. https://doi.org/10.3390/computers3010001
13) Khan, D. M., Rao, T. A., & Shahzad, F. (2019, March 31). Challenges of Confidentiality and Security in Mobile Cloud Computing and Protective Measures. *Global Regional Review, IV*(I), 154-163. https://doi.org/10.31703/grr.2019(iv-i).18
14) Piggin, R. (2014, January 1). Securing SCADA in the Cloud: Managing the Risks to Avoid the Perfect Storm. https://doi.org/10.1049/cp.2014.0535
15) Sharma, M. K., & Vaisla, K. S. (2014, April 1). Towards Cloud Supported E-Governance Services Delivery Model. https://doi.org/10.1109/csnt.2014.113
16) Townsend, M. (2009, September 25). Managing a Security Program in a Cloud Computing Environment. https://doi.org/10.1145/1940976.1941001
17) Wu, Z. (2019, June 24). A Secure and Efficient Digital-Data-Sharing System for Cloud Environments. *Sensors, 19*(12), 2817-2817. https://doi.org/10.3390/s19122817
18) Yadav, A. K., Bharti, R. K., & Raw, R. S. (2021, May 1). SA2-MCD: Secured Architecture for Allocation of Virtual Machine in Multitenant Cloud Databases. *Big Data Research, 24*, 100187-100187. https://doi.org/10.1016/j.bdr.2021.100187