

OPEN ACCESS

Manuscript ID:  
ASH-2024-12028216

Volume: 12

Issue: 2

Month: October

Year: 2024

P-ISSN: 2321-788X

E-ISSN: 2582-0397

Received: 10.08.2024

Accepted: 16.09.2024

Published Online: 01.10.2024

Citation:

Venice, AJ, and Albin.

“Overview of Mobile  
Cloud Computing:  
Learning Prospects, an  
Essentiality to Realism  
of the Digital World.”

*Shanlax International*

*Journal of Arts, Science and  
Humanities*, vol. 12, no. 2,  
2024, pp. 119–26.

DOI:

<https://doi.org/10.34293/sijash.v12i2.8216>




This work is licensed  
under a Creative Commons  
Attribution-ShareAlike 4.0  
International License

# Overview of Mobile Cloud Computing: Learning Prospects, an Essentiality to Realism of the Digital World

**J. Arockia Venice**

*Associate Professor, Institute of Virtual and Distance Learning*

*DMI-St. Eugene University, Chibombo, Zambia*

 <https://orcid.org/0009-0005-6115-960X>

**Albin**

*Lecturer, DMI-St. Eugene University, Chibombo, Zambia*

## Abstract

*This paper has been worked on the relational significance of ‘Cloud Computing’ as a newer innovation of the digital world is a supportive system that enhancing the storage capacity of resources and data as needed by individuals who believes in its usage. Most effectively, the new concept ‘Cloud Computing’ has been designed to strengthen the network of communication transfer much faster and safer with more storage possibilities. The framework of this identity enables integrated systems to create a wider scenario of computer’s working space to equip effective processes of mobile cloud computing. The trends of this new technology is most favored among all groups of people and in different organizations as it provides security and privacy for the information stored. The paper explicates on the efficiency and efficacy of cloud computing with its potential usage. The necessity of such a service serves the background of necessity in the globalized digitized scenario. It also will investigate the current state of mobile cloud computing security and privacy, with a focus on the risks and vulnerabilities associated with this technology. It also discusses potential solutions and best practices for protecting mobile cloud users and their data that will give the asset to findings identified. This paper proposes several measures including secure communication protocols, strong authentication mechanisms, data encryption and user awareness with linked deliberation to education. In conclusion, it is clear that Cloud Computing is an innovative and evolving field and it requires a comprehensive approach to protect the users and their data for futurity which is the relevance to contribution from this paper.*

**Keywords:** Innovation, Transmission, Security, Privacy, Vulnerabilities, Authentication

## Introduction

The paper sets to bring into perspective the aspect ‘Mobile Cloud Computing’ and its importance to the world scenario. It is a supportive system to expansive understanding of protected storing of information as like the rain-drops stored in the clouds. In fact, the paper has identified the security associated with mobile cloud computing. The section starts with details on the background to the study of ‘Mobile Cloud Computing’ and relates to the aim and purpose of the research paper as well as the research objectives, scope, limitations and solutions of concern in this research paper.

## Background to the Study

Mobile cloud computing provides services that serves to handle tasks that weren’t possible or just too much to be handled by mobile devices such as smartphones and tablets. These services are usually provided over the internet, and they allow users to access applications and data from anywhere. The deliberation of its application in support to the enhanced information transfer in the modern world has become the main priority in the content analysis of

this paper. When there is information storage and transmission, there is a sure possibility of risks that may arise. The effectiveness of different security measures and the need for more research on user awareness and behavior is also taken to relevance in the content of this paper. More so, security in Computing refers to the measures taken to ensure that the data and systems are protected from unauthorized access, misuse or unauthorized alteration while taken to storage. These measures include encryption, authentication, access control and auditing of the information that are stored through the cloud computing systems.

### **Research Questions**

- What is the specific issue?
- Why is it important to address this problem?
- What are the existing solutions to the problem?
- Who will benefit from this research?

### **Problem Statement**

The paper is in relevance to the general aspects of cloud computing and in specific to Zambian context. Precisely, most corporate organizations, educationist and students everywhere get registered to store information as specific volumes of documents both personal and official and kept in storage possibilities of Mobile Cloud computing. However, many storage platforms like Google, IBM, Microsoft, Oracle, IBM etc provide channels through MCC to receive documents. Proportionately to take to relevance these drives have unlimited storage capacity, providing access to store bulk information for future use. This application is in usage by many Zambians specifically in commercial markets and enterprises. This study will create awareness among people by giving adequate knowledge on varied aspects of CC along with security measures as provided. The problems and challenges faced in relation to such issues will be explained in this research work.

### **Aim/Purpose of the Study**

The paper aims at investigating the challenges faced while using Cloud Computing. The measures taken to resolve the issues related to the application of this type of computing in various dimensions and thereby enhance its reliability and compatibility

to the users. It is done to synchronize the factors and content analysis to replenish the knowledge imparting to the interested people.

### **Significance of the Study**

The study may provide relevant information which can address various challenges that are being faced in accessing Mobile Cloud services, thereby potentially assisting in giving solutions to mobile cloud providers to implement solutions that will protect the data of mobile cloud users. Additionally, the study would also assist mobile cloud users to make informed decisions on which mobile cloud service provider to do business with who has better protection measure in place for their personal data. The study may also contribute to the existing literature on the challenges of using mobile devices to access the cloud, and the study may enhance the levels of knowledge and skills among the mobile cloud users at large in Zambia. Of course, the relational concern is to the globalized system of cloud computing and extending the services to mobile cloud to make the accessibility a wider range of deliverance.

### **Objectives of the Study**

- Delineate the concepts of Mobile Cloud Computing and to establish the privacy and security aspects of cloud computing.
- Analyze implementation of 'Cloud Computing' and to estimate the measures taken to interpret the challenges faced in its application to usage.

### **Salient Aspects of Mobile Cloud Computing (MCC)**

Mobile Cloud Computing (MCC) Cloud computing is the delivery of computing services over the internet, allowing users to access and store data and applications on remote servers rather than on local devices, which has also allowed companies such as website provider companies to allow for transmission of data, voice and video, to their customers very effectively. Quoting the words in relevance on Cloud Computing (CC), 'a kind of internet-based computing that provides shared processing resources and data to computers and other devices on demand'. This thought befits the significance taken to reference here to signify the concept more effectively.

Taking to benefits of Cloud Computing, the major benefits for businesses and end users are categorized into three main identities as taken to reference from the works of system analyst Rayapuri which are (i) Self-service provisioning; (ii) Elasticity; and (iii) Pay per Use (Rayapuri), The mentioned three benefits are key characteristics of cloud computing which become the part of various service models of the cloud computing architecture. The service models can be sectioned as private, public, and hybrid.

Private Cloud is a service that uses a private network and for a systematized operation of this network a specified cloud infrastructure is designed for usage. As the name denotes the private cloud has taken its workability as patterned by the company's information and technology team. It is privatized and the access is restricted to the officials of the corporate circle or any established firm of an area.

Public Cloud is serviced to be in access to the commoners. The system is available to many external users and money is levied on such usage. The security and privacy features are not highly reliable and is less secure. The accessibility is through internet webs which is an open access that may not be highly reliable when stores very important documents.

Hybrid Cloud is a model developed to serve the needs with specified infrastructures developed for usage. It is hybrid because it combines the essentials of both private cloud and public cloud to pattern a specialized infrastructure. In this system, data and applications are made viable through both the channels of private and public cloud infrastructures basing on specific needs and requirements.

These three categories are diagrammatically represented as given below:



**Three Types of Cloud Computing Deployment Models (Cloud-Codes)**

### Service Oriented Cloud Computer Architecture

The service oriented architecture is software developed with special components termed as services. These services support the system in

unifying the diversified applications that are being used in the cloud computing and the processes. Different platforms and languages are put to use whereby transference of information is made possible. It is done most effectively and conducive. The adaptable feature deliberates its intentional identity to establish an approach in this application. The approach is initiated as 'Software Design Approach'. The functional relevance and measurable implications of this service are oriented through this approach enhancing better working possibilities in the use of cloud computing. The functional services provide the effective interaction among users and help to perform varied tasks for which they use the mechanisms of cloud computing.

The major elements of services in software intended architecture is represented as below:



**Service-Oriented Cloud Computing Architecture (Dinh et al.)**

The emulated facts on the above mentioned services as brought to focus for clarity to understanding to a learner is depicted as below:

The foremost reference is taken to Infrastructure as a Service (IaaS) - IaaS allows data storage, network, servers, and networking components to the users. This gives the consumers the ability to deploy and run arbitrary software's (OS, application, etc.) Examples: Amazon Elastic Cloud Computing (EC2) and Simple Storage Services (S3). This gives companies the ability to easily scale without needing to buy more infrastructure equipment at the company but to just request more resources allowing them to even handle even more data.

Secondly, taken to Platform as a Service (PaaS) - This gives a full development environment, it also allows for application hosting that even gives the added ability of the project to scale automatically without the need to manually re-configure. Some examples of PaaS are Heroku, Google App Engine, Microsoft Azure which all provide an environment

to deploy applications on a cloud server making it very easy to scale.

The third identity is Software as a Service (SaaS) - With software as a service the user does not need to install the program directly but they access it over the internet and the managing of the application is done by the cloud provider reducing the work load on the end-user device. This service is usually provided as a pay-per-user service. Examples: Adobe Creative, Sales Force, Google work space, Microsoft Office 365, Microsoft's Live Mesh, etc.

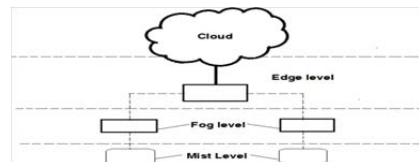
Cloud Computing allows customers to make use of the systems and services available of the cloud computing which will serve the customers as Virtual Machines. Interesting to understand that these Virtual Machines are like a normal computer but it is not a single physical device but one that is created and hosted on another machine which is more powerful allowing for the ability to have more machines without having to buy more hardware and this also allows the main machine resources that would not have been utilized to be taken advantage of.

Furthermore, the Cloud Computing system is a longtime storage package which gives the back-up as needed for the users. It enhances the workability of the CPU time, memory usage, and networking systems. In fact, geographically located Cloud Computing servers help to enrich the networking on an easy access instead of facing latency in its usage factor. However, the data is maintained and made functional using the Virtual Machines.

As a significant relevance to the divisions and types of Cloud Computing, it is identified that there are major two typologies in usage addressed as Fog, Edge and Mist Computing. To take to discussion in referencing to the conceptualized thoughts of Jonathan, from his article, Fog Computing, is the type of computing that is done as close as possible to the device to reduce latency and it also does this by not sending data to one cloud node to process the data but to even send it to multiple nodes for a faster response, this type of computing is usually used in applications that need real-time response such as IoT It refers to extending cloud computing to the edge of an enterprise's network.

Relying on the information assessed from Lopez et al., from his Edge Computing, it is a type of computing that is very closely related to Fog computing but unlike its close relative it mainly focuses on processing the data locally processing directly on the device that produces the data.

Comprehending the relevance of Mist Computing in accordance to Jones, it is identified as a type that comes as an extension of the Fog and Edge Computing it is lightweight and rudimentary form of computing power that takes its residues using microcomputers and microcontrollers to fix the package into Fog Computing nodes as needed for its functioning. Furthermore, the service takes the progression into other platforms as needed to initialize the work as needed in storage



**The Inter-related Network of Cloud Computing Services (Jones)**

Interesting to know, Cloud computing has become a household name in the modern tech generation with the undoubtable benefits that it provides, making tasks that would have been virtually impossible on certain devices such as on Mobile Devices, Microcontrollers. For example a project done by a student, Chikondi Phiri of the computer engineering course of the DMI St. Eugene University had taken advantage of cloud computing for a home automation system that allowed a user to control devices from anywhere in the world and this project was made possible by the use of cloud computing to send data, to and from the microcontroller. This is an impetus to the realism of this paper writing and brought to the general audience as an informative source of knowledge on Cloud Computing.

**Practicality to the Utility of Cloud Computing**

Basing on the referential integral necessity of deployment models that work through the platforms as necessary, herein as an informative analysis the seven cloud computing platforms are brought to reference. The suggestive reliable evidences are taken as references from the writings of Rawat,

which reflects on the descriptive identity of the Cloud Computing Platforms. The seven taken to study are Microsoft Azure, Amazon Web Services, Google Cloud, IBM Cloud, Cloud Linux, Hadoop, Force.com and Salesforce.com.

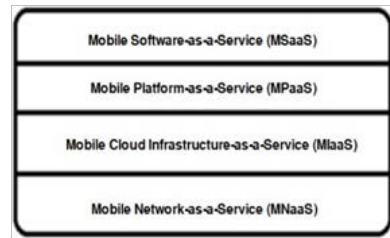
Each of the platforms has specific features that make them unique in the performances and adaptability. The most reliable and efficient working platform is ‘Microsoft Azure’ which has an extensive and a wider range of user friendly services. The services are very appropriately delivered to the varied needs of any sectors of corporate and industrial units. The second major cloud platform is Amazon Online Service which is famous for creating an interactive web applications. In this platform, there are many advanced services to support storage and applications made practical for usage.

The next significant platform of the ‘Google Cloud’ is widely been used and is highly user friendly. It’s operational system is widely been monitored and regulated by an established platform that supports many IT companies of the macrocosm. The ‘IBM’ cloud platform is also an effective and a renowned service of the digital world. It encompasses SaaS, PaaS and IaaS services to hold the storage identities of different users. Significant platform is ‘Cloud Linux’ which supports any user who intends to create a new service with their own IT infrastructure. It provides hand-on-information using Linux-based operating systems. The free and open source service that is used to process a massive amount of data is ‘Apache Hadoop’. This feature was an extended version of Google which had an application programming model to help in processing operations as needed for the effective working of a cloud computing platform. Evidentially analyzed a fact is that most social enterprises use Force.com and Salesforce.com as a service solution. It works through apps and with a software generated to serve the system of cloud computing and establish a platform for its workability.

**Mobile Cloud Computing Service Models**

In reflecting the words of Change et al., taken to relevance to the interwoven linkage of cloud computing to mobile Cloud Computing we are able to combine the power of a mobile device with Cloud

Computing which greatly enhances the applications and services running on the device by offloading heavy tasks to the cloud for computing can be categorized as in the table below:



**Mobile Cloud Infrastructure-as-a-Service (MIaaS)** is a pay-as-you-use model where the clients receive mobile cloud infrastructure and resources based on their payment. It is a renting site that supports computing, storage providing network components, and devices. These devices are designed in accordance to the needs of the customers to work in terms to their capacity requirement.

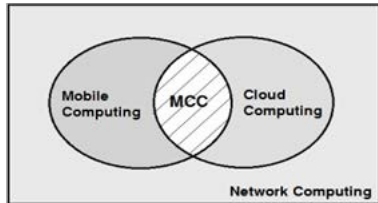
**Mobile Network-as-a-Service (MNaas)** offers clients a flexible network infrastructure to meet on-demand requests. Vendors dynamically configure, deploy, and design wireless networks for mobile connectivity to existing cloud infrastructure. The main advantage is the low start-up cost due to high scalability and elasticity. Examples include OpenStack, Google App Engine, and MS Azure.

**Mobile Platform-as-a-Service (MPaaS)** supports mobile application development, deployment, hosting, and validation tools. For example, App Mobi helps users develop, deploy, and validate mobile applications easily.

**Mobile Software-as-a-Service (MSaaS)** is a system that initiates mobility and location-aware software that provides access to cloud-deployed application services via thin mobile client-based Internet communication.

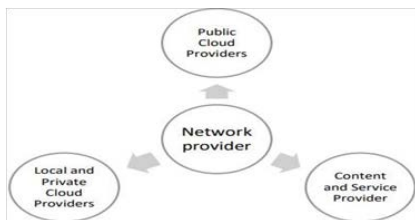
The relational stances of cloud computing taken to implication through Mobile Cloud Computing which is a derivative of Cloud Computing has brought a greater significance to the users. This condition creates an impetus in the usage of mobile cloud computing. Cloud computing has generated a newer possibility in its application with the extended opening of its mechanism into mobile systems. This aspect has opened a wider version of usage by cumulative assortment of computational resources,

storage possibilities and providing work related services to the user on an easy access. Hence to be precise mobile networking is interlinking with the cloud computing to provide a rich resource implementation to the users. The ‘Venn Diagram’ represents the overlapping of the network computing on different perspectives. It is taken to reference at this juncture from the research writings of Chang et. al., to support the identity of the discussion in this paper.



Mobile Cloud Computing (MCC) is an advanced mobile computing technology that uses unified elastic resources from diversified cloud platforms and network technologies. It provides limitless functionality with enhanced storage, and mobility to numerous mobile devices that is made accessible anytime and anywhere via Ethernet or Internet. Accordance to the writings of Sanaei et al., it is adjudged that this service is also made available on payment to make the platform specific for the user. A mobile ecosystem is made expansive that it can be of service to defined mobile cloud computing.

The established mobile ecosystem can be diagrammatically represented as shown below which is a referential identity from Rahimi et al., wherein, the component analysis is made for convenience of comprehending the organizational structure of mobile cloud computing.



**The Components are Elucidated as below in brief**

**Network Providers:** Supply network infrastructure for MCC components to communicate.

**Public Cloud Providers:** Offer scalable and elastic storage and computational resources to the public via the Internet.

**Content and Service Providers:** Provide services like gaming and videos, using storage and servers from public and local cloud providers, though they are not scalable or elastic.

**Local and Private Cloud Providers:** Despite limited scalability and elasticity, they deliver high-performance services to portable devices, ensuring efficiency in terms of delay, security, and privacy.

It can be estimated that Mobile Cloud Computing (MCC) aims to enhance the user experience on mobile devices with limited resources like computation, storage, and battery life (Rahimi et al.). Dinh et al., explain that mobile devices do not require powerful configurations since complex computing tasks are handled in the cloud. This positions MCC as a new avenue and a change shift for mobile applications. Recently, MCC research has focused on boosting mobile device usage and ensuring data security and privacy for users.

**Current Security and Data Privacy Challenges in MCC**

The study has taken details and relevance on the topic of concern from the works of author Sen. In concurrent to Sen, the identified threats and risks are exemplified for effective security and privacy standards to be taken to practice. Threats are in general, assessed as below:

**Confidentiality Threats**

Insider user threats involve malicious users from the cloud provider, customer, or third-party organizations accessing customer data. Each cloud delivery model (SaaS, PaaS, IaaS) introduces multiple internal users, increasing this risk.

External attacker threats include remote software and hardware attacks on cloud infrastructure, applications, and user endpoints. Social engineering attacks also target cloud provider and customer users. Public Internet-facing clouds are particularly vulnerable, but private clouds are not immune.

Data leakage can occur due to failures in security access rights or transport systems for cloud data and backups. This can lead to widespread information compromise across multiple organizations using the same cloud provider.

## Integrity Threats

Data segregation issues arise from incorrectly defined security perimeters and misconfigured virtual machines or hypervisors. In SaaS environments, improper data segregation can threaten data integrity.

Poor user access management can lead to threats, such as disgruntled ex-employees causing intentional damage to data sources. Effective identity and access management procedures are crucial.

Poor data quality results from introducing faulty application or infrastructure components. This can impact the integrity of data for multiple cloud users sharing the same infrastructure.

## Availability Threats

Poor change management can negatively affect cloud services. Changes in software or hardware by the cloud provider, customer, or third-party systems can introduce disruptions.

Denial of service threats includes network bandwidth, DNS, and application/data denial of service attacks. These threats can impact all cloud service models, caused by both external and internal threat agents.

## Risks in MCC

**Privileged User Access:** Cloud providers often have extensive access to user data, necessitating controls to mitigate the risk of compromised customer data due to privileged user access.

**Data Location and Segregation:** Customers may be unaware of where their data is stored, posing a risk of it being stored alongside other customers' information.

**Data Disposal:** The dynamic allocation of hardware to customers increases the risk of data not being properly deleted from data stores, backups, and physical media during decommissioning.

**E-Investigations and Protective Monitoring:** Cloud customers may face limitations in conducting their own electronic investigations due to the delivery model and cloud architecture complexity. They must rely on the cloud service provider's systems for monitoring and investigations.

**Assuring Cloud Security:** Customers cannot easily adapt the security systems that are controlled directly. Service Level Agreements (SLAs) and

the right to audit security controls are essential for assurance.

In conclusion, this paper explored the security and privacy risks associated with mobile cloud computing and discussed measures to mitigate these risks. The study is structured as follows: the introduction covers the background, problem statement, study aim/purpose, significance, specific research objectives, and research questions. It then provides significant information on Mobile Cloud Computing (MCC). The literature review is based on six scholarly writings, consistently referenced throughout the paper. The qualitative content analysis addresses current security and data privacy challenges in MCC. Additionally, the paper discusses the target population, inclusion criteria, and article identification. The overall significance of this paper is to raise awareness among the general public about specific features of MCC.

## Future Research

This paper identifies several areas for future research, including the effectiveness of frameworks, user awareness and behavior, education on risks, best practices for mobile cloud computing, and the legal and regulatory implications to ensure compliance.

To investigate security and privacy measures in mobile cloud computing, a few strategies can be concurrently done to establish effective performances with user friendly assets

- Risk assessments to identify potential threats.
- Privacy impact assessments to evaluate privacy implications.
- Security audits to assess the effectiveness of current security measures.
- The privacy policies and terms of service of mobile cloud providers.

The influx in writing this paper is to create a general awareness to the modern trends of cloud computing technology with its applicability to the general public. It is an authentic source of established innovation that supports efficient storage of information, resources and documents to make this macrocosm a safe and a secure place. Nevertheless, the efficacy of work ethics and related documentation unique of each organization is protected for the futurity of the global realism on Cloud computing.

The conclusion is the cumulative expression of a more forward-looking pretext wherein the future prospects is a move forward to the progressive alignment to the development of newer innovative ideas of cloud computing extended into mobile computing as a reflection towards, automation, artificial intelligence warehousing, data mining and enhanced security measures for effective protection and privacy in storage. The milestone achievement of cloud computing is also applied in the workability aspects of cryptography and complex data analysis which is in usage every day in the digital world. This paper has brought in the findings as theoretical implications to enhanced data security management, facilitating access to any part of the world, with growth prospects of an individual's career development in leveraging reliability and sustenance.

## References

- Al-Gburi, Ahmed, et al. "Differentiating Security from Privacy in Internet of Things: A Survey of Selected Threats and Controls." *Computer and Network Security Essentials*, 2018.
- Bouzefrane, Samia, et al. "Evaluation of Java Card Performance." *Smart Card Research and Advanced Applications*, 2008, pp. 228-40.
- Dinh, Hoang T., et al. "A Survey of Mobile Cloud Computing: Architecture, Applications, and Approaches." *Wireless Communications and Mobile Computing*, vol. 13, 2011.
- Fanchi, Christopher. "Mobile Cloud Computing: Is it right for your App?." *Backendless*, 2022.
- Gu, Qijun, and Mina Guirguis. "Secure Mobile Cloud Computing and Security Issues." *High Performance Cloud Auditing and Applications*, Springer, 2014, pp. 65-90.
- Jones, Jake. "Edge Computing: The Cloud, the Fog and the Edge." *SolidRun*, 2017.
- Lilien, Leszek, et al. "The Pervasive Trust Foundation for Security in Next Generation Networks." *Proceedings of the New Security Paradigms Workshop*, 2010, pp. 120-42.
- Lopez, Pedro Garcia, et al. "Edge-centric Computing: Vision and Challenges." *ACM SIGCOMM Computer Communication Review*, vol. 45, no. 5, 2015, pp. 37-42.
- Maheswari, J. Uma, et al. "Data Privacy and Security in Cloud Computing Environments." *E3S Web of Conferences*, 2023.
- Manigandaa, C. S., et al. "Navigating Mobile Cloud Computing: Challenges and Protective Strategies." *International Journal of Research Publication and Reviews*, vol. 4, no. 8, 2023.
- Nagarajan, Aarthi, et al. "Property based Attestation and Trusted Computing: Analysis and Challenges." *Third International Conference on Network and System Security*, 2009.
- Rahimi, M. Reza, et al. "Mobile Cloud Computing: A Survey, State of Art and Future Directions." *Mobile Networks and Applications*, vol. 19, 2013, pp. 133-43.
- Rawat, Ayush Singh. "Top 7 Cloud Computing Platform." *Analytic Steps*, 2021.
- Rayapuri, Bhuvanewari. *A Survey and Security and Privacy in Mobile Cloud Computing*. Western Michigan University, 2018.
- Song, Zhexuan, et al. "Trustcube: An Infrastructure that Builds Trust in Client." *Future of Trust in Computing*, Springer, 2009, pp. 68-79.
- Yin, Robert K. *Case Study Research: Design and Methods*. Sage Publications, 2009.
- Zelkowitz, M. V., and D. Wallace. "Experimental Models for Validating Technology." *Computer*, vol. 31, no. 5, 1998, pp. 23-31.
- Zhang, Xinwen, et al. "Securing Elastic Applications on Mobile Devices for Cloud Computing." *Proceedings of the 2009 ACM Workshop on Cloud Computing Security*, 2009.

## Author Details

**J. Arockia Venice**, Associate Professor, DMI, St.Eugene University, Institute of Virtual and Distance Learning, Chibombo, Zambia

**Albin**, Lecturer, DMI-St. Eugene University, Chibombo, Zambia