A Novel Edu-CloudSec Framework for E-Learning System

N. Veeraragavan
Research Scholar in Computer Science,
St. Joseph's College (Autonomous),
Tiruchirappalli, India.

L. Arockiam, Ph.D.
Associate Professor in Computer Science,
St. Joseph's College (Autonomous),
Tiruchirappalli, India.

S. Edel Josephine Rajakumari
Assistant Professor in Computer Science, St. Antony's College of Arts and Sciences for Women, Dindigal, India

ABSTRACT
E-Learning is an enhanced and flexible learning technology used to learn from anywhere at any time through Internet. Web contents are available on the Internet for distance learning students. E-Learning has made a revolution in the domain of education. It provides a virtual classroom environment where teaching and learning take place. Meanwhile, the evolving technology, Cloud Computing offers IT resources as services that makes E-Learning contents available round the clock and facilitates the E-Learners with its optimized services. Though Cloud Computing offers many benefits, it has some limitations in its security mechanisms. In order to meet the existing authentication issues, in this paper a Secure E-Learning architecture for Edu-Cloud is proposed.

Keywords
E-Learning, Cloud Computing, Security, Cloud Service Provider, Authentication and Access Control List.

1. INTRODUCTION
E-Learning is the delivery of education (all activities relevant to instructing, teaching, and learning) through various electronic media. The electronic medium could be the Internet, Intranets, Extranets, Satellite TV, Video/Audio tape, and/or CD ROM [1]. It is a kind of learning through network or internet and is also known as online learning to guide education [2].

E-Learning provides virtual class rooms and E-Contents for E-Learners. E-Forums conduct online quiz tests and provide interactive sessions to students. It demands for more increased hardware and software resources, which in turn require higher cost for installation. Educational organizations are not able to meet these requirements [3].

The architecture of E-Learning System is developed as a distributed application which includes a client application, an application server and a database server [4] as shown in Figure 1.

The E-Learning Clients can have access to the E-Learning Server from wherever they are around the world and can make use of E-Learning Contents. The students who learn through Distance Learning system can make use of these E-Learning facilities to have a better learning experience.
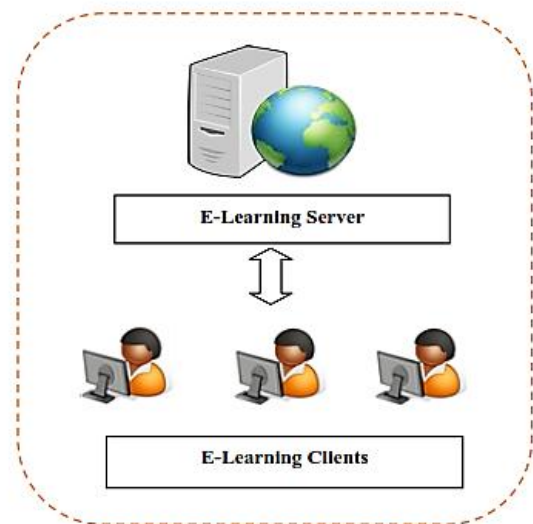

Figure 1. E-Learning System

1.1 Benefits of E-Learning
1.1.1 Lower Cost
E-Learning cuts the costs of travelling, course materials and accommodation.

1.1.2 Instant Learning
E-Learners can be aware of new technologies and tools in the IT field.

1.1.3 Content Delivery
E-Learning doesn't need a physical environment for conducting classes. It provides a virtual environment for teaching the students and there are forums available for discussion on the internet.

1.1.4 Online Classes
The classes are recorded and delivered to the users through internet.

Example: http:// videolectures.net.

1.1.5 Convenience
The users listen to the classes and attend tests regardless of time and distance. There are no time and place constraints for E-Learners.
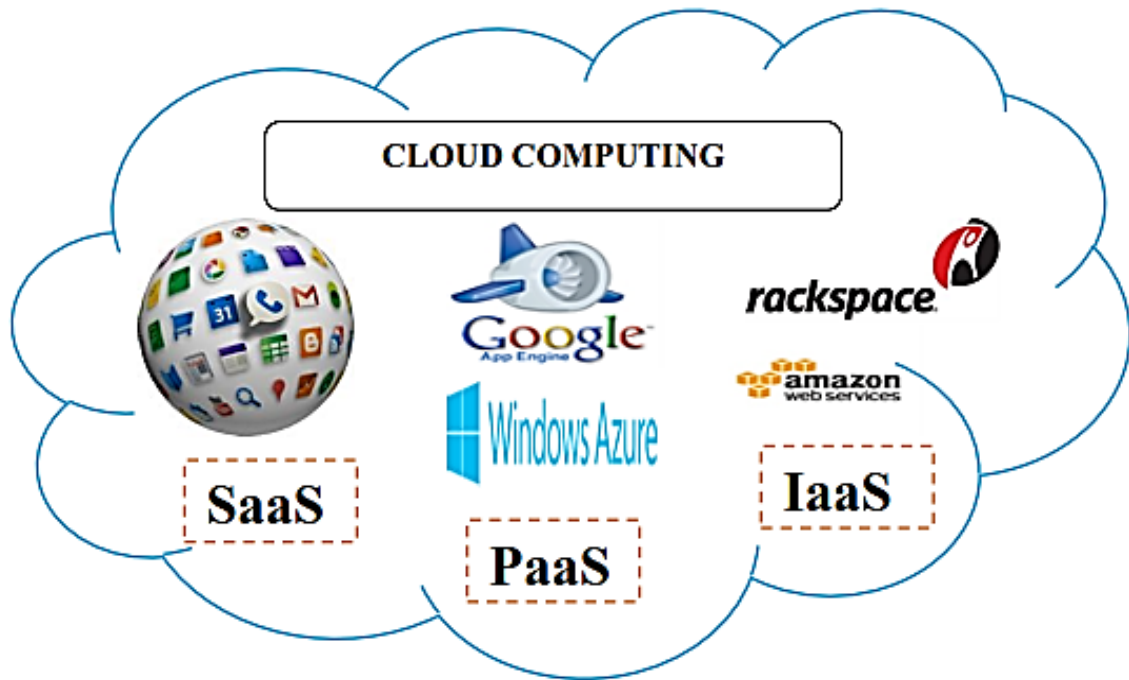
Figure 2. Basic Cloud Services

Cloud Computing can be defined as the utility or subscription based service since it uses "Pay as you go" principle. It delivers IT resources as services on demand. The Cloud user must have an internet connection to access the Cloud services.

National Institute for Standard Technology (NIST) defines Cloud computing as, "A model for enabling convenient, on-demand access to a shared pool of configurable computing resources (Network, Servers, Storage, Application & Service) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [5].

People use Cloud services for computing, storage, and network tasks. Cloud storage allows its users to access their data from anywhere at any time in the world. Cloud users need not spend money in terms of hardware and maintenance. Cloud supports multi-tenancy concept through which the Cloud clients share resources under a Cloud.

Basically Cloud computing provides three types of services viz., Software as a Service (SaaS)-Google Apps, Platform as a Service (PaaS)-Google App Engine, Microsoft Windows Azure, and Infrastructure as a Service (IaaS)-rackspace, amazon web services[6]. The cloud deployment models can be broadly classified as follows: Public Cloud, Private Cloud, Community Cloud and Hybrid Cloud [7] [8].

Since, Cloud computing offers E-Learning services based on "Pay as you go" principle, it reduces the capital, operational, data center and maintenance costs of hardware and software [9].

Traditional E-Learning requires system construction and maintenance that must be taken care by educational institutions. Also system requires higher investment [18], whereas Cloud based E-Learning provides access to E-Learning services at lower costs by its optimized principle. It allows E-Learners to access e-contents, take tests, and attend classes at anytime from anywhere in the world.
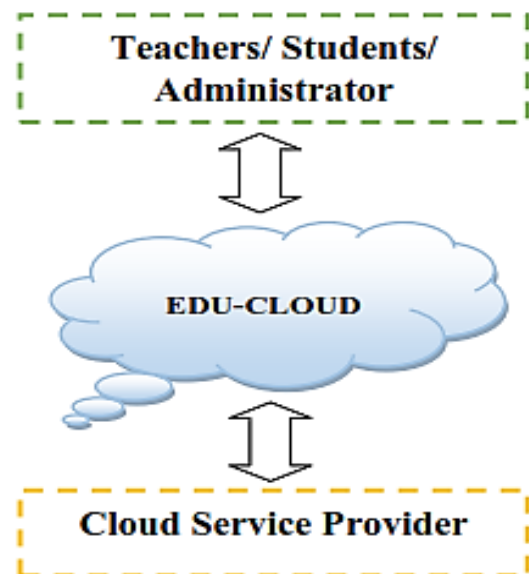

Figure 3. Cloud based E-Learning

1.2 Benefits of Cloud based E-Learning
The benefits of Cloud based E-Learning are as follows:

1.2.1 Availability:
The E-Learners learn from anywhere at any time regardless of their physical location. The only requirement is an internet connection.

1.2.2 Use of third party software:
The Cloud based E-Learning reduces the costs of installation, maintenance, and deployment of software.

1.2.3 Scalability:
Even if the students' count increases, the software performance will not be tainted.

1.2.4 No Backup of data:

No need to back up data. The user can transfer the data to the device and can carry it wherever he goes. The users' data will be there in the Cloud always.

1.2.5 Portability

The E-Learners have permissions to access and edit their content from anywhere namely home, office, library, etc. The applications are available from any device like laptop, mobile, and desktop computers.

2. CHALLENGES FOR CLOUD BASED E-LEARNING SYSTEM

Cloud Computing has its own limitations on delivering its services. It is applicable for Cloud based E-Learning also. The challenges of Cloud based E-Learning are:

2.1 Bandwidth

When the Cloud users are increased, the Service Provider need to afford high bandwidth for providing their services.

2.2 Security

In Cloud based E-Learning, the Cloud Service Providers have the Access Control List (ACL) of E-Learners. It makes secured data prone to risk.

2.3 Authentication

Authentication verifies who is the user accessing the Cloud. There are chances for hacking the Cloud. Adding security to Cloud based E-Learning system reduces performance. This has to be taken care of while implementing security guard that does not affect the system.

2.4 Management

There are some rules established for cloud based E-Learning that include teaching content management, course management, examination management, performance management, student management, teacher workload management, and so on. These ought to be taken care while implementing cloud based E-Learning.

2.5 Resource Development

When it comes to providing high quality education and high grade E-Learning program, E-Learning system requires a group of educational, technical and arts experts to organize and disseminate the contents and materials to E-Learners.

2.6 Role of Teachers

E-Learning is a technology used to provide updated, new contents and concepts to the users. Albeit, it can never replace teachers, teachers have to play leading roles and make use of the E-Learning cloud.

2.7 User data

For SaaS customers, it is not easy entrusting all data and backups to a SaaS provider. The ESaaS (Education Software as a Service), a part of the multi-tenant server framework, makes trust to cloud based E-Learning users.

2.8 Payment

There are different modes of payment in Cloud based E-Learning and combining the categories of Charge where general resources for institution and special resources for personnel are complex.
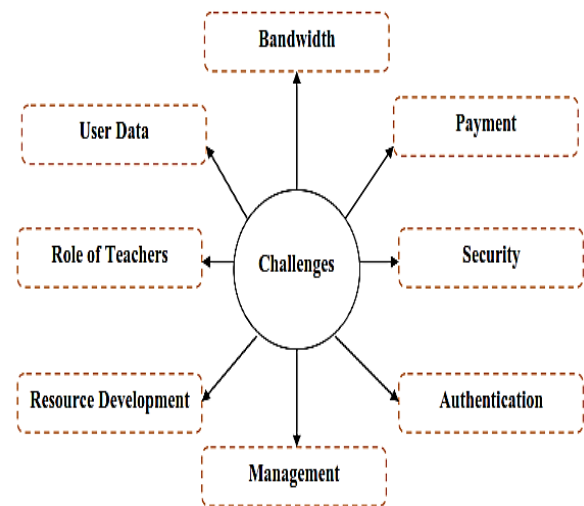

Figure 4. Challenges for Cloud based E-Learning [12]

3. REVIEW OF LITERATURE

Shahid Al Noor et al. [13] have proposed an architecture called Cloud Central System Internal Architecture which involves providing secured service to educational organizations. The architecture is composed of two sub layers. The upper sub-layer performs several operations such as authentication, credit verification, scheduling, and security prior to offering any service. In addition there is a government central control system associated with the cloud upper sub-layer to monitor the operation of the cloud system. On the other hand the lower sub-layers basically offer four different types of services such as Software as a Service, Platform as a Service, Infrastructure as a Service and E-Learning tools as a service based on the users' demands. The upper sub-layer is meant for security.

The Government central control system has two subsections namely planning and monitoring committee. The planning committee decides how much funding needs to be allocated for individual organization. The corruption monitoring committee monitors the objections coming from the user end. The objections can be categorized as the improper resource distribution, shortage of resources, inappropriate software or unmatched software, etc.

Gunasekar Kumar et al. [14] have suggested some security measures to be taken on cloud based E-Learning: (a) SMS Security mechanism- the users are provided a verification code sent to their mobile phone by SMS. This security code will be changed over sessions so that the passwords cannot be broken up easily. (b) Biometric mechanism-The mechanisms by which the physical presence of the learner will be tested by matching their physical traits such as finger prints, iris recognition, voice recognition, etc. which are already stored in the database. (c) Security Token-the Students of a University will be issued cryptographic tokens so that they can have access into the E-Learning system. (d) ACL mechanism-The Access Control List (ACL) contains the user identity. i.e. the students' identity provided by the university with permissions specified to use the E-Learning content.

AkramAlkouz et al. [15] has proposed a system for user authentication in an E-Learning environment, with two application servers namely SA1 and SA2. If the user wants to access the SA1 and he doesn't have a valid cookie (AuthTicket), he is considered as an unauthenticated user and his request is redirected to the Master Server. Then the Master

Web Service which resides in the Master Web Server is supplied with the user credentials which in turn communicates with the LDAP (Lightweight Directory Access Protocol) and RDBMS (Relational Database Management System) web services to validate user credentials and if it is valid user, Master Server will create Encrypted Master Cookie (EMC) in user's browser. Now, the user will be redirected back to SA1 with Encrypted Authentication Token (EAT) included in the redirected message. SA1 will get the EAT from the query string, and the authenticity of EAT by invoking IsAuthTokenValid() web method in the Master Web Service. If the authenticity check result is OK, SA1 will create encrypted cookie (SAIC) in the user's browser. When the user returns that to SA1, the EAT will return as well, so that SA1 can detect that the user is already authenticated.

Mokuhara et al. [16] have proposed some security architectures based on access control, authentication and identity management, and security visualization. The architectures' results are (i) the logical separation of cloud service layers by virtualization present the same level of security as physical separation of computing environments. (ii) One Time Password provides a powerful authentication mechanism that precludes password leak. Customers are provided with ID management platform based on SAML (Security Assertion Markup Language) and WS (Web Services) Federation frameworks. (iii) Dashboard and information-security services enable the users to visualize the efficiency and cost-effectiveness of information-security measures.

4. EDU-CLOUDSEC FRAMEWORK

Based on the analysis of above discussed models and measures an idea is perceived to implement new security architecture for Edu-CloudSec. The proposed Secure Edu-CloudSec architecture is composed of following components:

(a) E-Learners: E-Learners can be students, teachers and other users.

(b) Authentication: Authentication enables authorized users to have access to certain resources.

(c) Cloud Service Provider: The Companies providing Cloud services.

(d) Access Control List (ACL): The List contains the types of users and their access permissions to the Cloud.

(e) Account Balance: The account details of Cloud subscribers are mentioned here. The Cloud subscribers should have sufficient balance in their account in order to use the Cloud services.

(f) Services: The Cloud services such as SaaS, PaaS, IaaS, EaaS, and so on.

There are various steps involved in the EduCloudSec (Education Cloud Security) algorithm as follows:

Step 1: Users (Students, Teachers, and other users) request to access the EduCloud

Step 2: Cloud Service Provider verify the user's identity using One Time Password.

Steps 3: If One Time Password (OTP) is, true the access permission is enabled. Otherwise access is denied.

Step 4: Access permission to various services are defined in the ACL. Based on the permission defined, the users will be permitted to have access to the services.

Step 5: CSP checks the particular user account balance, if sufficient balance is present then their account can access the resources based on their priorities else access is denied.

Steps 6: Account balance is updated with their usage deatils.

If the balance is nil the user request for access the resources is denied.

The E-Learners are students, teachers and other users. They request for Educational resources to Edu-Cloud. There are several authentication methods and techniques available to identify the users [18].When they make a request for a service they will be authenticated by providing One Time Password (OTP) [19] [20]. For every session, new passwords will be generated. The passwords for (RANdom number GENeration) after authentication, the users are authorized and have access to the E-Learning cloud thereby the users' type and their access permissions will be verified with the Access Control List (ACL).

If the user is identified as provisioned, then their account information will be verified for providing the service and if the user has sufficient balance in his/her account the service will be delivered to the user. Otherwise service will be denied.

One Time Password (OTP) is a strong authentication mechanism which provides a password that is valid for only one login session. Since the OTP is generated dynamically for every login session the users need not remember their password. It is unbreakable for malicious users.

The OTP is generated using randomness of symbols. The symbols can be alphanumeric values. There are numerous OTP mechanisms available in the IT market which include Time based OTP, Event based OTP, Challenge Response OTP, HMAC based OTP, SHA-1 and so on. The Cloud Service Provider (CSP) chooses the OTP mechanism based on the Edu-Cloud applications.

In Edu-Cloud, the OTP is used to prevent E-materials theft, Session lock, controlling unauthorized access in Community Edu-Cloud and to keep the users account information protected from intruders.

Thus the proposed model provides secure E-Learning cloud service to its users by overcoming authentication, authorization and accounting issues.
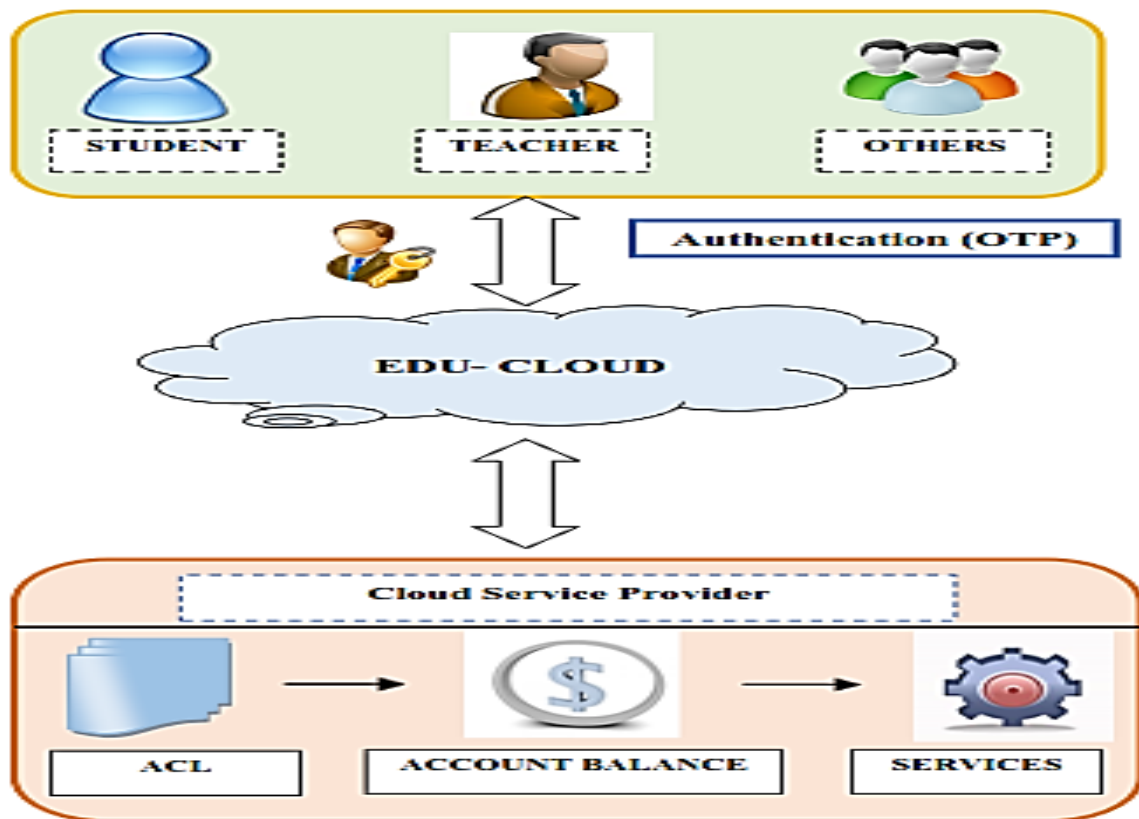
Figure 5. Edu-Cloudsec Framework

5. CONCLUSION

E-learning technology provides users comfort learning experience to the users and access to the E-materials regardless of distance and cost. Though E-Learners can be anywhere in the world and learn through Internet, it affords higher cost for setting up E-learning environment. Cloud eliminates this issue by providing E-learning resources as services on demand basis. E-learning and Cloud computing are combined together to make a revolution in the field of Education. Though there exists some security issues in Cloud based E-learning that are to be resolved. The proposed model offers an abstract idea for eliminating the existing authentication security issues in cloud based E-learning. Also, this paper suggests that by providing One Time Password during user authentication secures the Edu-Cloud from security attacks. The One Time Password is the best authentication technique, cost effective and it is widely accepted by most of the companies nowadays.

6. REFERENCES

[1] Alex Koohang and Keith Harman, "Open Source: A Metaphor for E-Learning", Informing Science Journal, Vol.8, 2005.

[2] D.KasiViswanath, S.Kusuma, and Saroj Kumar Gupta, "Cloud Computing Issues and Benefits Modern Education", Global Journal of Computer Science and Technology, Cloud & Distributed, Vol.12, Issue 10, Version 1.0, Double Blind Peer Reviewed International Research Journal, Global Journals Inc. (USA), July 2012.

[3] S.Hameetha Begum, T.Sheeba, and S.N.Nisha Rani, "Security in Cloud based E-Learning", International Journal of Advanced Research in Computer Science and Software Engineering, Vol.3, Issue 1, ISSN:2277 128X, January 2013.

[4] Paul Pocatilu, "Cloud Computing Benefits for E-Learning Solutions", Oeconomics of Knowledge, Vol.2, Issue 1, 1Q 2010.

[5] A.P.Nirmala and Dr. R.Sridaran, "Cloud Computing Issues at Design and Implementation Levels – A Survey",Vol.03, Issue 06, Pages: 1444-1449,Int. J. Advanced Networking and Applications, 2012.

[6] RohitBhadauria, RituparnaChaki, NabenduChaki, and SugantaSanyal, "A Survey on Security Issues in Cloud Computing", 2011.

[7] K.S.Suresh, and Prof.K.V.Prasad, "Security Issues and Security Algorithms in Cloud Computing", IJARCSSE, Vol.2, Issue 10, October 2012.

[8] DanimirMandic, Vladimir Urosevic, MihajloTijanic, "E-Learning and Security Problems in Cloud Computing Environment", Selected Topics in Education and Educational Technology, ISBN: 978-960-474-232-5, ISSN: 1792-5061.

[9] Pankaj Arora, "Cloud Computing Security Issues in Infrastructure as a Service", IJARCSSE, ISSN 2277128X, Vol.2, Issue 1, January 2012.

[10] A.Fernandez, D.Peralta, F.Herrera, and J.M.Benitez, "An Overview of E-Learning in Cloud Computing", Springer-Verlag Berlin Heidelberg 2012.

[11] Anjali Jindia, Sonal Chawla, "E-Learning and Cloud Computing", IJAIR, Department of Computer Science and Applications, Punjab University, India, 2012.

[12] MD. Anwar Hossain Masud, Xiaodi Huang, "A Novel Approach for Adopting Cloud-based E-Learning System", IEEE/ACIS 11th International Conference on Computer and Information Science, 2012.

[13] Shahid Al Noor, Golam Mustafa, ShaifulAlamChowdry, Md. Zakir Hossain, FarihaTasminJaigirdar, "A Proposed Architecture of Cloud Computing for Education System in Bangladesh and the Impact on Current Education System", International Journal of Computer Science and Network Security, Vol.10, No.10, October 2010.

[14] Gunasekar Kumar, AnirudhChelikani, "Analysis of security issues in cloud based E-Learning", 2011.

[15] AkramAlkouz and Samir A. EI-Seoud, "Web Services Based Authentication System for E-Learning", International Journal of Computing & Information Sciences, Vol.5, No.2, August 2007.

[16] Maninder Singh and Sarbjeet Singh, "Design and Implementation of Multi-tier Authentication Scheme in Cloud", IJCSI International Journal of Computer Science Issues, Vol.9, Issue 5, No.2, September 2012.

[17] Masayuki Okuhara, Tetsuo Shiozaki, Takuya Suzuki, "Security Architectures for Cloud Computing", FUJITSU Sci. Tech. J., Vol.46, No.4, October 2010.

[18] Christopher Mallow, "Authentication Methods and Techniques".

[19] "An Overview of Different Authentication Methods and Protocols", SANS Institute InfoSec Reading Room, 2002.

[20] Hafiz ZahidUllah Khan, "Comparative Study of Authentication Techniques", International Journal of Video & Image Processing and Network Security, Vol.10, No.04.

7. AUTHOR'S PROFILES

N. Veeraragavan has completed his graduation, B.Sc., B.Ed., (Computer Science) in Pope John Paul II College of Education, Pondicherry and his Master in Computer Science at St. Joseph's College (Autonomous) at Tiruchirappalli. He has earned M.Phil in Computer Science in Bharathidasan University at Tiruchirappalli. Currently he has been working as an Assistant Professor in the Department of Computer Science, St.Joseph's College (Autonomous), Tiruchirappalli, Tamil Nadu, India. He has skilled himself with 6 years of experience in teaching and 3 years of experience in research. He has published 6 research articles in the International / National Conferences and Journals. He has attended many International and National Conferences, Seminar and Workshops. His area of research is Cloud Computing.

Dr. Arockiam. L is working as Associate Professor in the Department of Computer Science, St. Joseph's College (Autonomous), Tiruchirappalli, Tamil Nadu, India. He has 25 years of experience in teaching and 17 years of experience in research. He has published more than 187 research articles in the International / National Conferences and Journals. He has also presented 2 research articles in the Software Measurement European Forum in Rome. He has chaired many technical sessions and delivered invited talks in National and International Conferences. He has authored a book on "Success through Soft Skills". His research interests are: Big Data, Cloud Computing, Software Measurement, and Cognitive Aspects in Programming, Data Mining and Mobile Networks. He has been awarded "Best Research Publications in Science" for 2010, 2011, & 2012, "Best Teacher Award" for 2012-13, 2013 -14 and ASDF Global Awards for "Best Academic Researcher" from ASDF, Pondicherry for the academic year 2012-13.

S. Edel Josephine Rajakumari had completed her Master of Computer Application in Holy Cross College, Tiruchirappalli. She had completed her M.Phil (CS) in St. Joseph's College (Autonomous), Trichy. Currently, she is working as an Assistant Professor in the Department of Computer Science, St. Antony's College of Arts and Sciences for Women, Dindigul, Tamil Nadu, India. Her area of research is Cloud Computing.