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Overview on Role Based Access Control Scheme in Cloud Computing

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ABSTRACT

Cloud computing is one of the most popular model based on cloud services and cloud providers.It allows to store their data in cloud services. The security of the data in a cloud is at most important due to the complexity of the system .One of the powerful approach is Role Based Access Control The basic aim of Role Based Access Control(RBAC) is to provide authorization, authentication, assigning permission and session management. In this paper ,basic model of RBAC and different stages for model development are reviewed.

Keywords :-*Cloud computing,Role-based Access control, Role administration, Authorization infrastructure, Outsourced data*

I INTRODUCTION

The one of the most popular and widely used distributed networking model is cloud computing which stores huge data. This model shares pool of various resources such as networks, servers, storage, application and services on-demand basis. The advancement in web technology makes the client much easier for transferring and storing the data in the cloud storage[10]. Normally, service providers take the responsibility for the security and reliability of the data for the storage. The servers are not permitted to see the real data[7]. They are supposed to provide the services to outsourced data. In these cases the servers are considered to be honest. In reality, the servers in many cases are curious to know the data. The security and reliability of the data is in question. To get rid of this problem, before sending a data to a server to the cloud, the owner can encrypt the data and the server can decrypt the data by providing the decrypt key to the authorized user for accessing the data. The system requires separate key for each user which increases the complexity in managing number of keys as many as the number of resources. As the system becomes large, the administration of the security also becomes more complex. Many schemes are available to solve this problem in literature. The one of the important approach is Role based access control(RBAC) which can simplify the security administration of large systems. It is powerful way for safe and secure access[8]. The basic concept of

RBAC is originated with early multicomputer systems. Its basic framework was developed by NIST (National Institute of standards and Technology) [Feinstein H.L.1995]. It describes the ability to articulate and enforce enterprise security policies and also streamline complex process of security management. It also describes a novel framework of reference models to systematically address the diverse components of RBAC and their interactions. In the following sections, the basic concept of RBAC, its various models, different development stages and finally conclusion is drawn.

II BASIC CONCEPT OF RBAC

The basic concept of RBAC (role-based access control)was invented with multi-user and multi-application on-line systems. The author of RBAC are the security experts from National Institute of standards and technologies. The basic RBAC model is shown in Figure1.

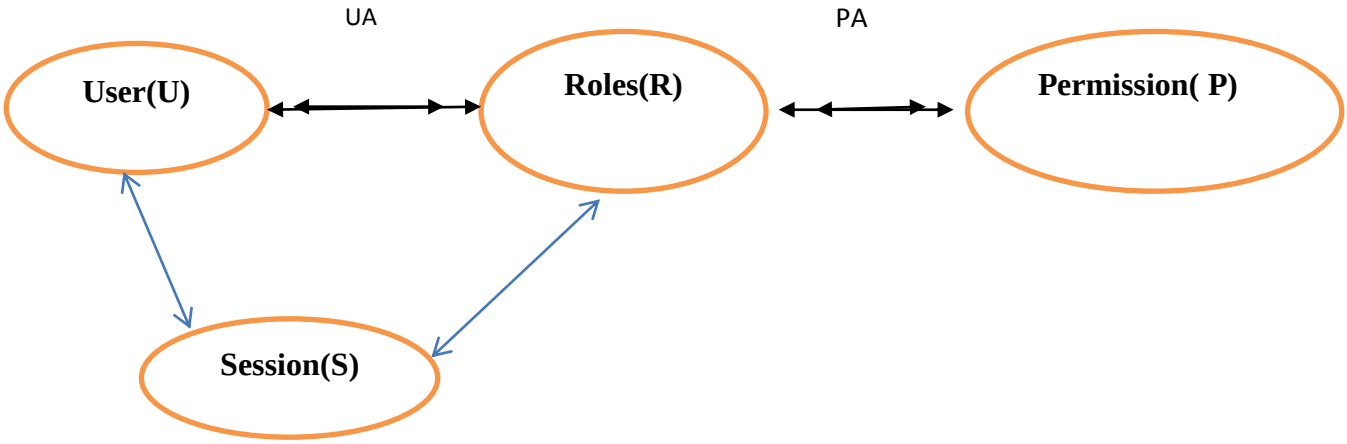

Figure1: Basic Concept of RBAC

It consists of four components: Users, Roles, Session and Permission .

A user is normally considered as a human being. The conception of a user can be observed to include intelligent agents such as robots and networks of computers [2]. A role is an approval to perform an operation on an object i.e. an action, function or task that user can bring. It is properly viewed as a semantic construct around which access control policy is formulated. It is a job/function within the organization that represents the authority and responsibility granted on a user assigned to the roles. It is a set of transaction that a user or a set of users can execute in an organization. The system administrator allocates transactions to the roles. The transition is referred to a binding a transformation procedures and data storage access. For example “read saving a file”. Session is the mapping of one user to possibly many roles. Each session is a linking of one user to interaction with many roles, a user start the session during which user runs some subset of roles that he or she is a member of the double-headed arrow from the session. A permission is to manage the particular mode of access to one or more objects

in the system. Each system protects objects of the abstractionit implements. Hence, an operating system protects such things as files, directories, devices and ports with operations such as read, write and execute. The relational database management system protects relations, tuples, attributes and varies with operations such as SELECT, UPDATE, DELETE and INSERT.

User assignment (UA) and permission assignment (PA) both are many to many relations. A user can be a member of many roles and roles can have many users. Hence, many permissions can assigned to a role and a permission can applied to many roles.

Access control policy is embedded in various parts of RBAC, i.e. RBAC model is capable to establish relation between roles, between permissions and roles, and between users and roles[3]. These relationships collectively decide to grant the access to particular set of data in the system to authorized user. The different components of RBAC may be formatted as per the policy imposed in a particular system. The capability to change the imposed policy in a system for accessing a data is the requirement of the organization which is an important advantage of RBAC.

A relationship between users, roles, transformation procedures and system objects is given in figure1. The following are the basic rules for role assignment and authorization[1].

- Role assignment: The identification and authorization are not considered as transactions. A transaction can only be executed by a subject if the role has been assigned i.e.

$$\forall s: subject, trans, (exec(s,t) \Rightarrow AR(s) \neq \emptyset$$

- Role authorization: This ensures user can perform the roles for which they are authorized i.e.

$$\forall s: subject, (AR(s) cRA(s))$$

- Transaction authorization: A subject can execute a transaction only if the transaction is authorized for the subject's active role i.e.

$$\forall s: subject, t: tran, (exec^{(s,t)} \Rightarrow t \in TA(AR(s))).$$

- Transformation procedures: This approach is helpful in enforcing confidentiality requirements. This would need to enforce control over the modes in which users can access objects through transaction programs i.e.

$$\forall s: subject, trans, o: object, (exec(s,t)$$

$$\Rightarrow access(AR(s), t, o, x))$$

III DIFFERENT MODELS OF RBAC

RBAC has been proposed as an supplement to traditional Mandatory access control and Discretionary Access Control[12]. The two basic type of access control mechanisms which are used to protect the information from unauthorized users DAC(Discretionary Access Control). It allows the only authorized users to change the access controls of objects [5]. It is based on the matrix based model. DAC is controlled by the user and root/administration of the operating system. MAC(Mandatory access control) is also called as a Latices –Based Access Control which is used to secure access control model than DAC[5,6]. In MAC model the system controls a special security to subject and object. RBAC is MAC to fulfill the requirement of the commercial systems.

The family of RBAC has four conceptual models represented as RBAC0, RBAC1,RBAC2 and RBAC3 as shown in Figure2.

RBAC0, the base model, has minimum requirement for any system that technically support the RBAC.

RBAC0 is the independent features to it. RBAC1 adds the RH (Role hierarchy) whereas RBAC2 adds the constraints[8]. RBAC1and RBAC2 both include RBAC0. They are also called as advanced models. RBAC1 is based on the role hierarchy(i.e. situations where roles can inherit permissions from the another roles). RBAC2 adds additional features which depends upon the different components of RBAC. RBAC1 and RBAC2 are included in the RBAC3.

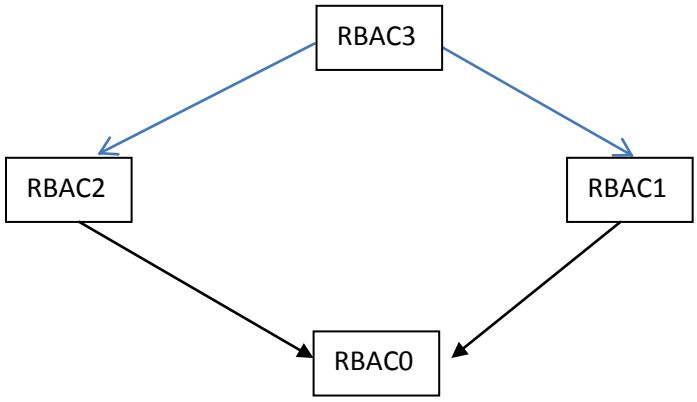

Figure2: Family of Role Based Access Control Models

The consolidated model RBAC3, which includes RBAC1 and RBAC2 and by transitivity RBAC0, is shown in Figure3.

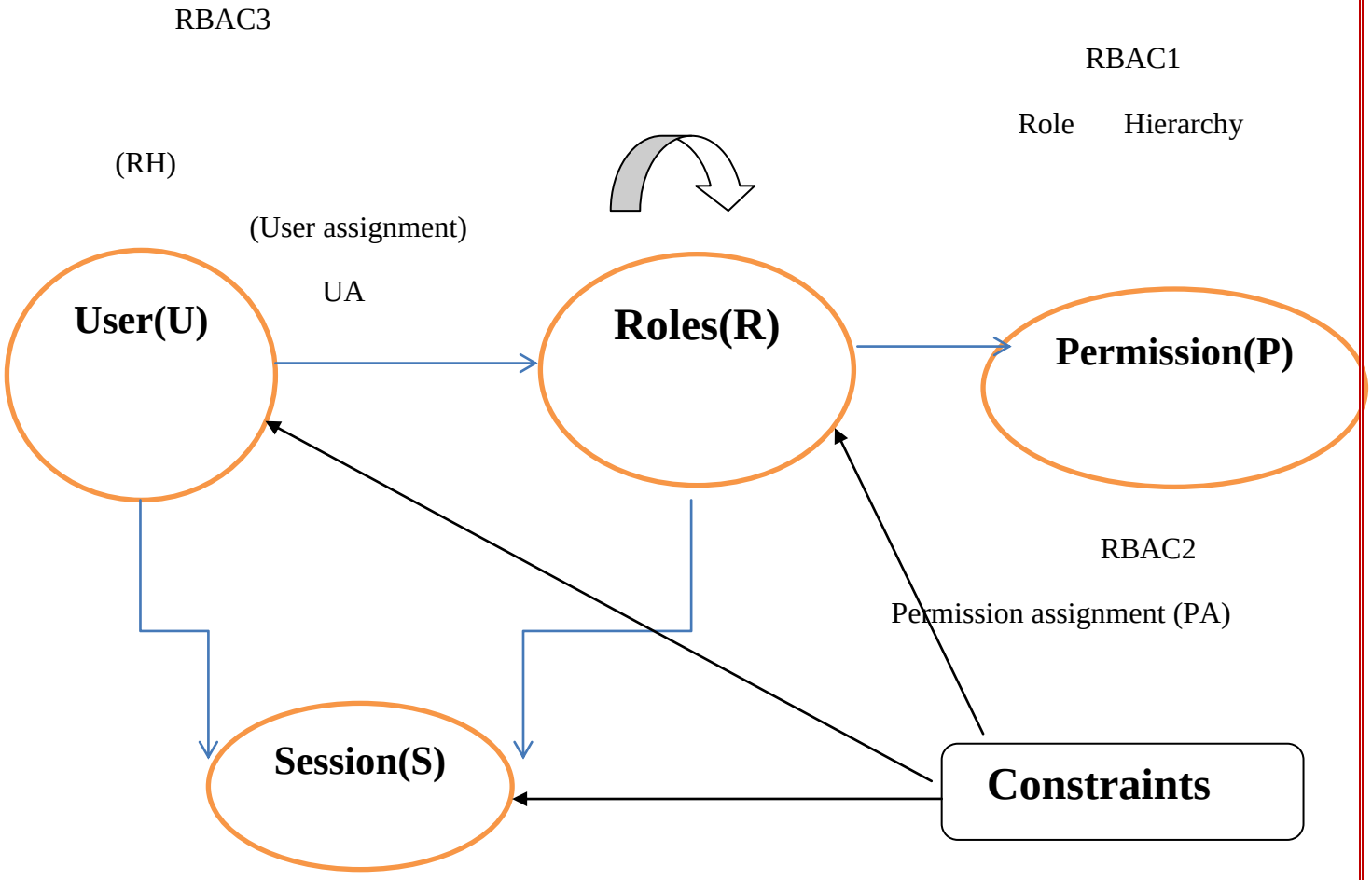

Fig: 3 Consolidated model with various reference models.

IV VARIOUS DEVELOPMENTS IN RBAC MODEL

The basic model of the RBAC and RBAC's various dimensions i.e. a family of four conceptual models has been given in the above sections [4] from time to time. There has been various modifications in the basic model .

For multilevel secure applications (like military), Mandatory Access controls (MAC) are appropriate whereas Discretionary Access controls(DAC) are sufficient to meet the security processing needs of and civil and government [9]. But it was founded later on that DAC is not appropriate for many commercial and civil organizations. RBAC was developed by NIST scientists in 1992 which could be utilizes as the basic criteria for access controls based on user roles. For next two years there was insignificant development. In 1995 Ferraiolo [FERR95] suggested two main motivations behind RBAC. Firstly , the ability to articulate and enforce enterprise-specific security policies and secondly, to streamline the typically burdensome process of security

management. Hence users do not have discretionary access to enterprise objects in RBAC. This simplifies the management of authorization. In1996, Sandu et.al assigned rights and permissions to roles rather than two individual users. This simple idea greatly simplifies the administration of authorization, so RBAC is a MAC, which has perceived to meet the requirements of commercial informationfor greater productivity on the part of the security administrators, resulting in fewer errors and a great degree of operational security.The basic model as discussed in Figure1 was given along with family and reference model.

In 1998, Sandu recapitulated amongst others, amongst the RBAC 96 models and the ARBAC 97 administration models.

In the year 2000 and 2001 the characteristics and policy of RBAC were reviewed by Rhodes and Caelli(2000), Ferraiolo and Sandu(2001). A consensus standard model of RBAC was developed for authorization of administration of RBAC and related paradigms.

In 2002 the economic impacts of RBAC have been developed by Gallaher et.al. In 2003 Dongwan shin and Gail et.al proposed a role based administration (RA) system in various implementation of RBAC services. The main purpose of RA system is to help the role administrator for establishing a valid set of roles and role hierarchies with assigned users and associated permissions.

In 2004 Essmayr et.al. discussed and overviewed the security models. In 2008 Zhu and Zhou partially focused on roles in information security.

To resolve the problem of the authorization management in dynamic and ad-hoc collaborations between different groups or domains, in 2009 Qi Li et.al proposed a decentralized security administrative modelfor GB- RBAC to address the management issues of RBAC in collaborations. GB-RBAC model is based on the RBAC 96 model and extended with a group concept. It is a two-level administrative model with a features of decentralized management, tunable group based tunable group-level administrative permissions, and the principle of administration of Separation of Duty(SoD).

To verify the validity of model and algorithm and feasibility of mechanism and security, lot of work reported 2010, 2011 and 2012.

In 2013 Lilli Sun et.al proposed a model RBAC to outsourced data in cloud computing and investigated the effect of role hierarchy structure in the authorization process [11].

In 2014 An Binh Nguyen et.al proposed a model of role –based templates for large scale cloud monitoring scenarios[13].

In 2015 Hsing-Chungchen describes the hierarchal virtual role assignment for negotiation based RBAC.

Willaim C, Adam et. al[2016] showed that the cryptographic enforcement of dynamic access controls on untrusted platforms incurs computational costs that are likely prohibitive in practice[14].

Carlos Eduardo da silva et.al[2017] developed a self- adaptive role-based access control for business process to protect against insider threats[15].

The total research publications in role based access control are summarized year wise in figure4. The vertical axis represents total number of publications and horizontal axis represents the year in which the scientific work

related to RBAC. In the beginning most of the work is theoretical but later on, lot of practical applications of RBAC has been reported.

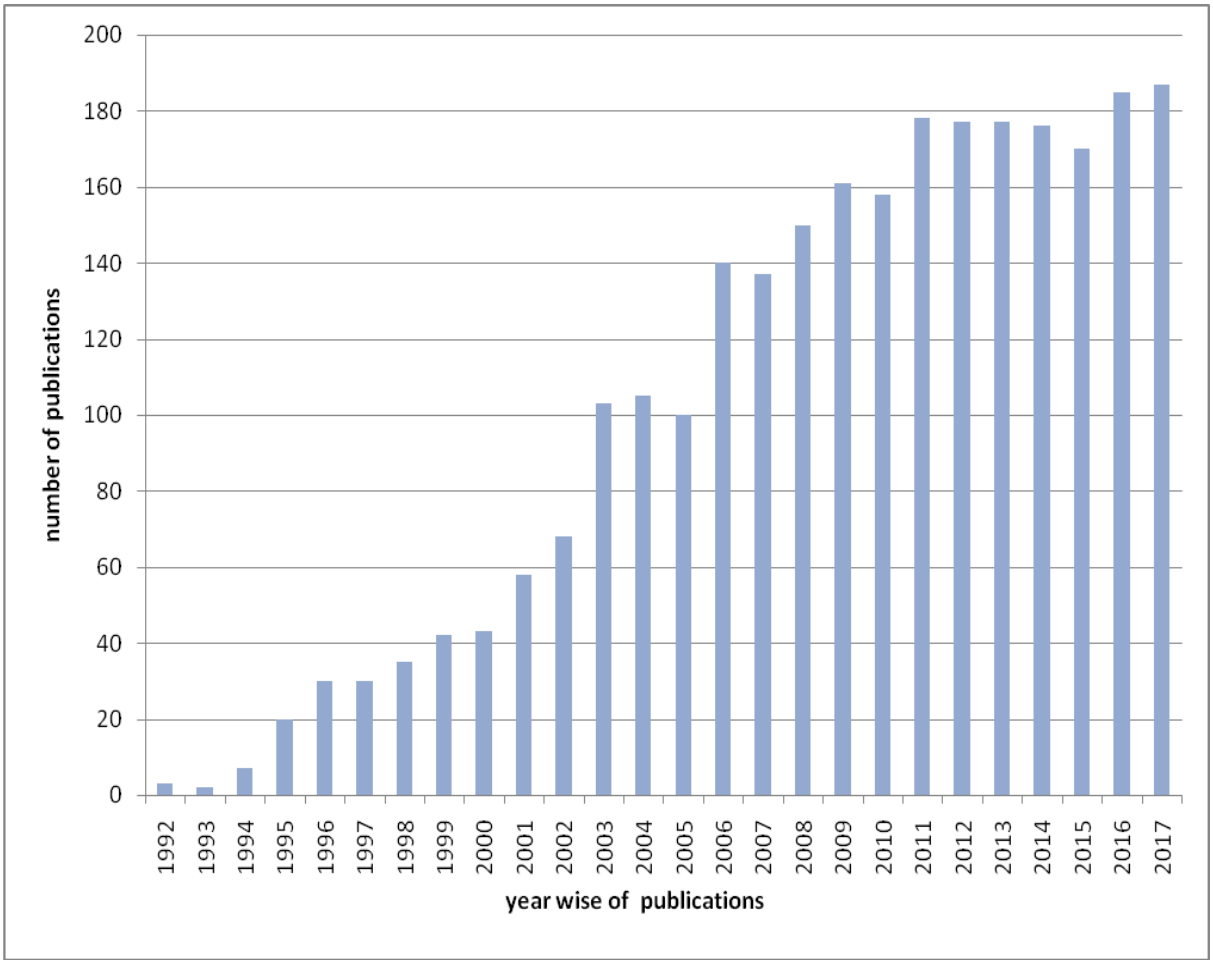

Figure4: Number of publications in RBAC

V CONCLUSIONS

This paper gives the basic requirement of security in cloud computing .Role based Access Control is very important technique for providing a security. The basic structure of RBAC and its different models are given. A review of the development of various frameworks of basic RBAC model (RBAC96) has been given. The basic model has been upgraded for risk awareness ,outsourced data ,group based users and self adaptive RBAC models. Finally, the total number of research publications related to RBAC has been summarized year wised.

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