



Multitenancy in Cloud Software as a Service Application

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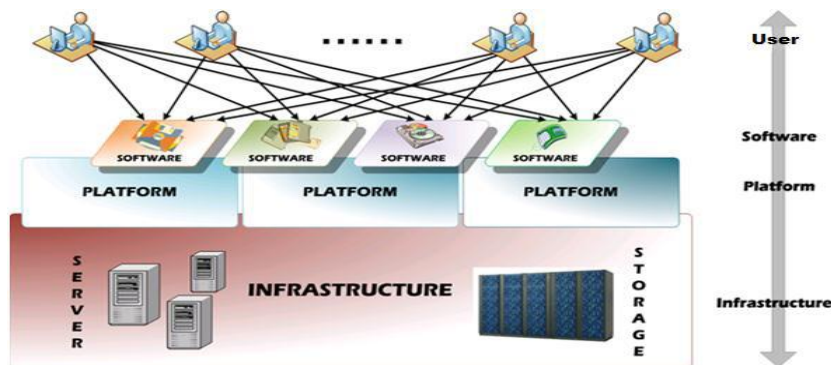
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Abstract - Cloud computing environment provides a great flexibility and availability of computing resources at a lower cost. Multi-tenancy is an important feature of software as a service (SaaS) in cloud computing. Multi-tenant applications provide multiple customers can share a single application instance. By leveraging Multi-tenancy, SaaS providers can significantly ease operations and reduce delivery cost for a huge number of tenants. In this paper, discuss the introduction of cloud computing, saas multitenancy, issues of multitenancy in software as a service model.

Keywords: Software as a service, multi-tenancy.

I. INTRODUCTION TO CLOUD COMPUTING

The word cloud is used as a metaphor for the Internet, based on the standardized use of a cloud-like shape to denote a network. A cloud is a combination of hardware, networks, storage, services, and interfaces that helps in delivering computing as a service. Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction. In addition, the platform provides on demand services that are always on anywhere, anytime and any place. Architecture of cloud computing is shown in the fig 1.



.Fig 1.Architecture of Cloud Computing

The best Example of cloud computing is Google Apps where any application can be accessed using a browser and it can be deployed on thousands of computer through the Internet.

Evolution of Cloud Computing

Cloud computing is seen as a natural evolution of grid and utility computing. It supports both grid and utility Computing with additional features such as accessibility, scalability, flexibility, and reliability Figure 2 shows the evolution of cloud computing

Grid Computing	Utility Computing	Software as a Service	Cloud Computing
- Solve large problems with parallel computing - Made mainstream by Globus Alliance	- Offer computing resources as a metered service - Introduced in the late 1990s	- Network-based subscriptions to applications - Gained momentum in 2001	- Natural evolution of grid and utility computing - Next generation data centers and Internet computing

Figure 2.Evolution of cloud computing

The NIST describes the definition of cloud computing with five essential characteristics of cloud, three service models, and four deployment models. The five essential characteristics consist of broad network access, measured service, on-demand self-service, rapid elasticity, and resource pooling.

In this paper discuss the three cloud service models Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) and its features, the four deployment models with private cloud, community cloud, hybrid cloud, and public cloud according to providers and customers. The contribution of this paper describes multitenancy in software as a service, how to achieve multitenancy at various levels and its methods discussed in section 4.

II. CLOUD SERVICE MODELS

Cloud service models are a Service-Oriented Architecture (SOA) that describes cloud services at different levels of abstraction. Cloud computing services can be broken into three categories are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). Functions of each mode is described in table 1. From this who are all providers for each level of service and example for that services are given.

TABLE 1
CLOUD SERVICE MODELS

Software as a service	Application	Application and Information Centric Allows the consumer to use providers applications running of cloud infrastructure Provides various business models and application processes Ex. Amazon Web Services, Salesforce.Com CRM, Google APP Gmail
	Runtime	
	Hardware	
Platform as a Service	Application	Development Centric Provides a cloud platform to deploy consumer application created using software development kits and tools supported by the provider Provides Web based runtime development and operating environments Ex. Amazon EC2, Google Apps Engine
	Runtime	
	Hardware	
Infrastructure as a service	Application	Infrastructure centric Provides virtual hardware resources such as servers, storage, network, and other fundamental computing resources Ex. Amazon S3, IBM, HP
	Runtime	
	Hardware	

III. CLOUD DEPLOYMENT MODELS/CLOUD TYPES

Cloud service models are imported to any type of cloud. The types of cloud characteristics are measured by who will supply the type of cloud, types of customer for using the cloud, how the communication taken place in the cloud, what is the key factor for success is shown in the fig 3.

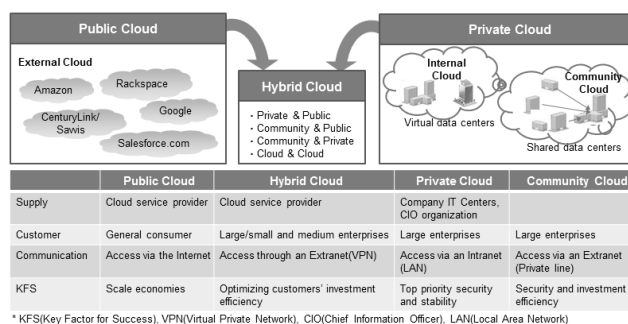


Fig 3. Characteristics of cloud deployment models

IV. SAAS MULTITENANCY

Software as a Service (SaaS) is a software delivery model in which users access software resources remotely. Multi-tenancy is an important feature of software as a service (Saas) in cloud computing[5]. Multi-tenancy is an architectural style that enables SaaS providers to serve end users from different tenants simultaneously by a single application instance on top of shared hardware and software infrastructure. Today, SaaS applications are expected to take advantage of centralization through a single-instance, multi-tenant architecture, and to provide a feature-rich experience competitive with comparable on-premise applications. Advantage of multitenancy are operational costs are reduced by dividing hardware, software resources among the different tenants are shared, simplifying the maintenance and management effort. All these benefits of multitenancy give result in lower application costs and give the major benefit to small and medium enterprises (SME).

Multitenancy Service Requirements for Cloud Services Providers are Isolation of tenant data, Isolation of the tenant workspace (memory), Isolation of tenant execution, Tenant-aware security, monitoring, management, reporting and self-service administration, Isolation of tenant customizations and extensions to business logic, tenant-aware version control, Tenant-aware error tracking and recovery.

Reference Architecture for Multitenancy [8], which is shown below in fig 4. One of the key assumptions of this model is that multitenancy is a mode of operation where multiple, independent and secured instances of applications run in a shared environment. Multitenancy architecture gives the various models as shared nothing, shared hardware, shared OS, shared database, shared everything and custom multitenancy. In Shared Hardware approach in an attempt to create backward compatibility to their legacy applications via Virtual Machines. Shared Everything Multitenancy is ideal for quickly on-ramping and off-ramping applications, tenants and individual system users and is what nearly all enterprise vendors claim to do. Salesforce.com's platform, VMWare, Wave Maker and Zoho Creator are all examples of companies who have successfully delivered Shared Everything multitenancy.

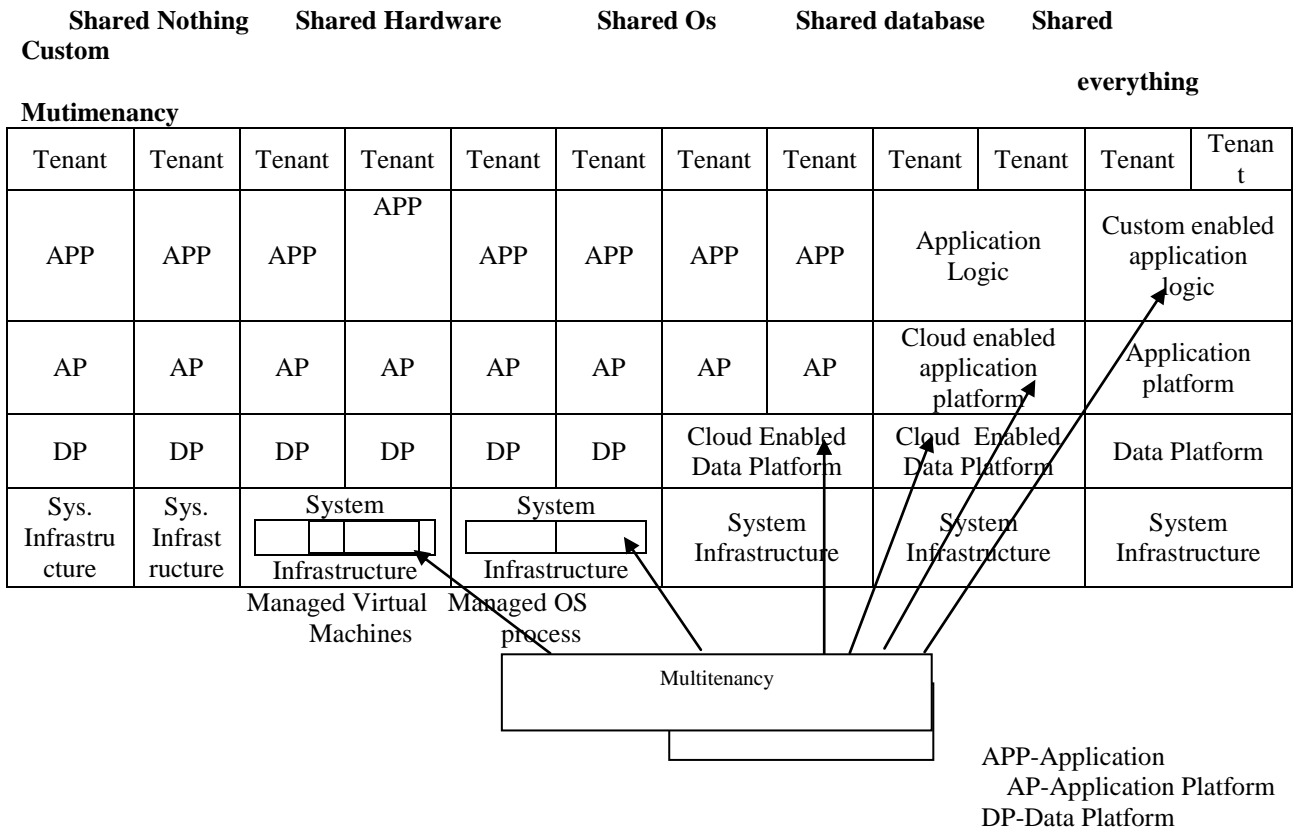


Fig 4. Reference Architecture for Multitenancy

4.1 Related work

Whenever handling multitenancy in cloud saas application many problems are arises for the users of the application, solution developer and service providers or owners [1][2]. Related to the end users are Performance isolation and variability for all resources, Scalability with the number of tenants, Support for value-added ops for each application type and Security for data. Solution developers facing the main problems are access control, customizability. Customizability involves in the database, Business logic, user interface, workflows, tenant provisioning, and usage based metering. Related to the service providers concentrate on data sharing, backup, restore of tenant specific data, enablement of multitenancy without any code changes, scalability, improved hardware usage, operational costs, Human management of multi-tenancy, development effort and required skills, Time-to-market and tenant specific quality of services Multi-tenancy support, tenants to customize their own service in runtime without impacting others. As all the tenants share the same application instance, once the customization is done for a particular tenant, the services for all tenants will be affected, and possibly interrupted during the update. As the number of tenants increases, the interruptions become more frequent and lead to very serious service availability issues.

Multitenancy Issues for different types of users can be solved at three different levels in cloud computing. The levels are Infrastructure Level by Virtualization, Middleware Level by sharing operating system and Application Level. Using these levels we can develop a model and verify the functional and non-functional behavior of the system. In this work how to prevent one tenant from adversely affect the performance of other tenants. Under the different levels there are many methods can be used for achieving multitenancy such as database, virtualization and separate isolation.

Virtualization is a concept where we run multiple operating systems on a single hardware by sharing all available resources. In Virtualization method assign the separate virtual machine for each tenant. For virtualization install the virtual box on local machine either VMware and XEN hypervisor. We can implement the virtualization concept by

having VMM virtual machine monitor. Virtualization provides the core attributes like scalability and flexibility. Whenever handling databases in the multitenant application, separation of services provided to each tenant, scaling conveniently with the number and size of tenants, meet SLAs for each tenant, support for per-tenant service customization, Support for value-adding ops, e.g., backup, upgrade, Secure data processing and storage and Support for regulatory law .The database uses the three approaches are separate database, shared database Separate schema and shared database-shared schema. Separate isolation will be done for each tenant.

V. CONCLUSION

In recent days Multi-tenant applications are used in every business applications. In this paper we have analyzed the deficiencies of multi tenancy of different users in saas application. It can be solved at various levels; using these levels validates the functional and non-functional behavior of the system. In our proposed work, we can develop a model to achieve customize and secure the multi tenancy of the application.

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