A New Cloud Computing Architecture by Integrating Recent Best Reference Frameworks

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ABSTRACT

Cloud computing concept and technology and its abundant advancement in addition to its inherent advantages has created a new ecosystem in the world of computing and is driving IT industry one step forward. Nowadays, large organizations have transferred part of their data and processes into a cloud. Some well-known IT solution providers such as IBM have introduced a kind of specific architecture to be deployed for cloud environment, which the IBM architecture is now considered the focal reference for implementing cloud in a number of organizations. The purpose of this paper is to provide a novel architecture for cloud environment, based on recent best practices and frameworks and other reference model such as IBM, Oracle, etc. Meanwhile, a new service model has been introduced in this proposed architecture model and the concluded architecture is finally compared with few other architecture to show the benefits exist therein.

KEYWORDS

Cloud, Cloud Computing, Reference Architecture, Frameworks

1 INTRODUCTION

The confluence of technological advances and business development in internet broadband, web services, computer systems and applications has created a complete storm for cloud computing during the past decade. Nowadays, cloud is one of the popular solutions for people who are looking for rapid implementation and/or affordable deployment methods [1-5].

Cloud computing is a type of parallel, virtual, distributed, configurable and flexible systems, which refers to provision of applications such as hardware and software in virtual data centers via internet. Cloud computing services are configurable and customers pay fees based on the use of resources and services [1-5].

The most important element of cloud structure is server which is the brain behind the whole processes in Cloud. Cloud is the major important model for access to distributed computing resources [1-5].

Typically there are three models for delivery of cloud services. *Software as a Service (SaaS)*, such that in this model, users use the launched application on cloud infrastructure. *Platform as a Service (PaaS)*, in which users rent platforms or operating systems and they can expand their required programs on it in an on demand policy [1-5]. *Infrastructure as a Service (IaaS)*, which this model is associated with a virtual engine and users can access to infrastructures with virtual machine [1-5].

Also the decision on implementation of cloud is important. There are four main cloud deployment models. *Public*, the most common model in the cloud deployment model. Large enterprise is owner of a large cloud infrastructure and services to users. *Private*, this model simulates a private network. It is suitable for an organization's infrastructure. *Community*, in this model, enterprises which have common policies, goals and concerns share infrastructure of cloud. *Hybrid*, this model is a combination of two or more cloud deployment models. In this model, resource management may be internal or external [1-5].

There are several reference architectures for cloud computing, such as IBM, Oracle, Cisco, HP, NIST, etc. In following section the IBM architecture will be briefly introduced.

Recently, ICT service management Specially ITIL, IBM, which are two powerful frameworks among others and eTOM which is ITU telecommunication framework, etc. has become more structured [6-13]. Therefore using of these frameworks in cloud environments, which is a service oriented environment, can be quite useful.
The rest of this paper is organized as:
Section 2 introduces related works briefly. Section 3 introduces IBM cloud computing architecture as the focal reference model. Later on in section 4 the main purpose of this paper is provided. In this section and Subsections the new architecture of cloud computing are introduced and a comparison between the new architecture and other architectures are presented. And finally conclusions and future works are listed.

2 RELATED WORKS

Cloud Computing makes the dream of computing real as a tool and in the form of service. This technology has realized service-oriented idea too. Due to needs of organizations to move toward new technologies and reach service orientation and also changes in customer demand, cloud computing has been in the center of attentions and organizations have turned to it. For cloud computing several reference architecture have provided, which few of them are the basis of the proposed architecture in this paper. Some of these reference architectures will be introduced briefly in the following:

- IBM reference architecture, which is the most popular and useful for cloud computing environments [14]. This architecture will be introduced in the next sections.
- HP CloudSystem architecture which is provided by HP Company. This architecture is an integrated system for building and managing services across all cloud environments which combines servers, storage, networking and security together with an integrated approach to automate the application and infrastructure lifecycle. There are three layers of supply, delivery and demand for service delivery therein. The services are provided as three products in those layers, which are called HP CloudSystem Matrix, HP CloudSystem Enterprise and HP CloudSystem Service Provider [15].
- NIST reference architecture for cloud computing is one of the most well-known reference architecture. In the architecture, there are five main roles, which are called cloud consumer, cloud provider, cloud carrier, cloud auditor and cloud broker. In this architecture, there is also an orchestration module which is responsible for the composition of the system components to support their activities and management [16].
- Another important and popular reference architecture is Oracle. In this architecture, cloud management capabilities and policies is developed in five cloud business management, security and policy management, cloud operations, orchestration and design-time categories and also there is cloud computing portfolio to have roadmap for selection is shown in this architecture [17].
- Cisco, Rackspace, Microsoft, etc. are reference architectures for cloud computing environments.

3 IBM CLOUD COMPUTING REFERENCE ARCHITECTURE

The IBM cloud computing reference architecture (CCRA) which is shown in figure 1, introduce the fundamental component of cloud environment. It should be mentioned that, the structure of this architecture is modular [14].
In this architecture there are three main roles, which each of these roles is to present a single person or organizations and sub-roles may be defined based on project scenarios.
A cloud service consumer role consumes cloud service instances. Cloud service provider has responsible to supply and/or provide cloud services. This role and its sub-roles are defined by ownership of a common cloud management platform (CCMP). The third role is cloud service creator which is responsible for creating services in cloud environments [14].

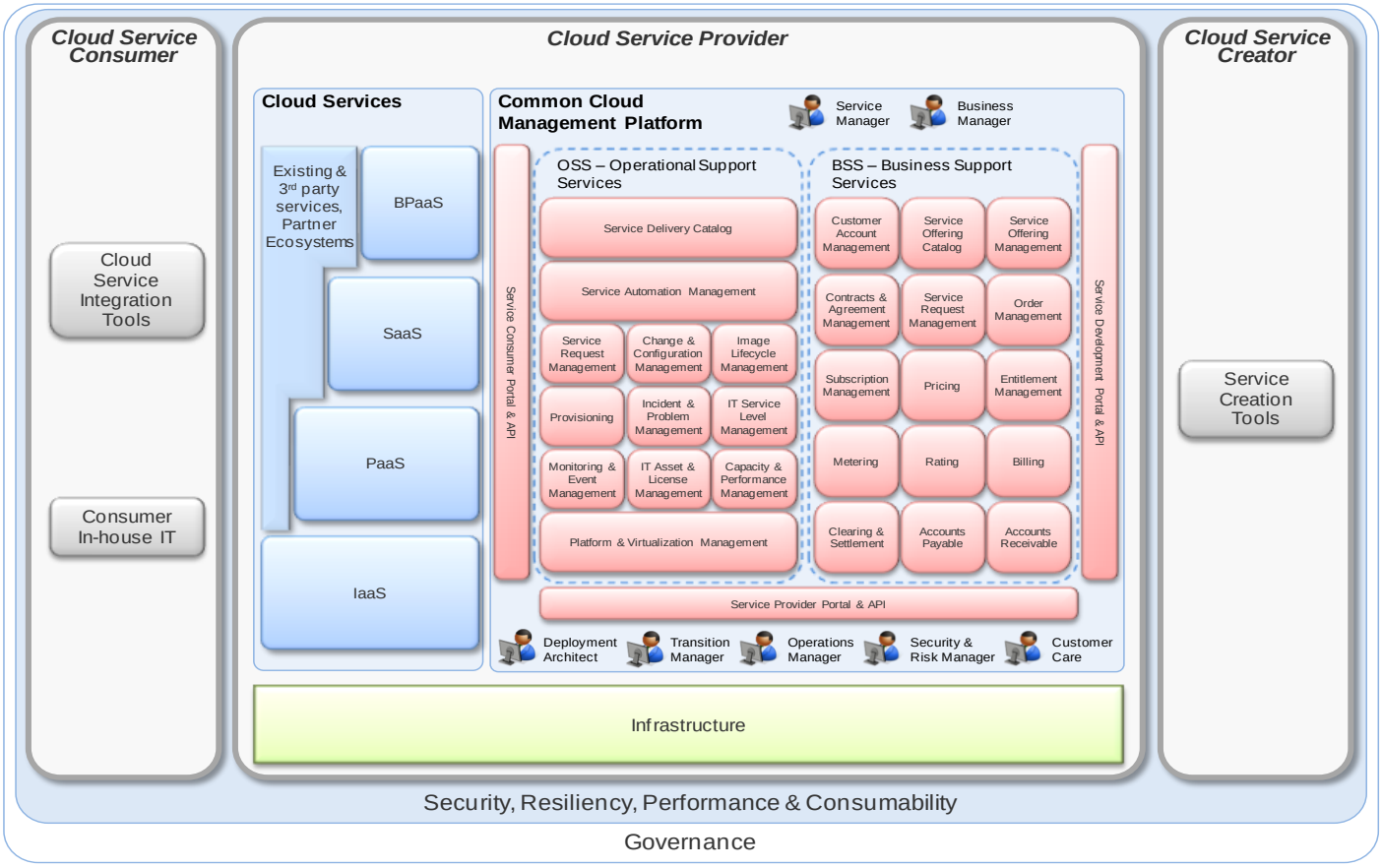

Figure 1. IBM cloud computing reference architecture

The core components of this architecture are mainly cloud services, common cloud management platform and infrastructure [14].
Cloud services may represent any type of IT capability which is provided for cloud consumers. The management functions for cloud services are defined as part of CCMP. As it can be seen in figure 1, the internal components of CCMP are categorized in operational support services (OSS) and business support services (BSS) and this component include processes and services which are required for cloud management [14].

4 PROPOSED ARCHITECTURE

In this section our proposed cloud computing architecture is presented. It should be mentioned that, the foundation of this architecture is based on the existing architectures and use of best practices of ICT frameworks, such as IBM, ITIL, eTOM, etc.

Figure 2 shows the conceptual and high level model of proposed architecture. In the following sub-sections of this paper, components of this architecture will be introduced.

As can be seen in figure 2, the proposed architecture combines the best component of existing architectures and in addition it has the following advantages:

- A new service layer added to this architecture. This layer offers IT and business management services and processes and other related services and processes to business customers.
- With this new service layer, organizations and business clients are separated from normal client and better services is provided to them.
- New service layer is enabling more customization and this customization is better for organizations.
- Cloud management layer of this architecture used ICT frameworks and best practices such as eTOM, ITIL, IBM, etc. to manage

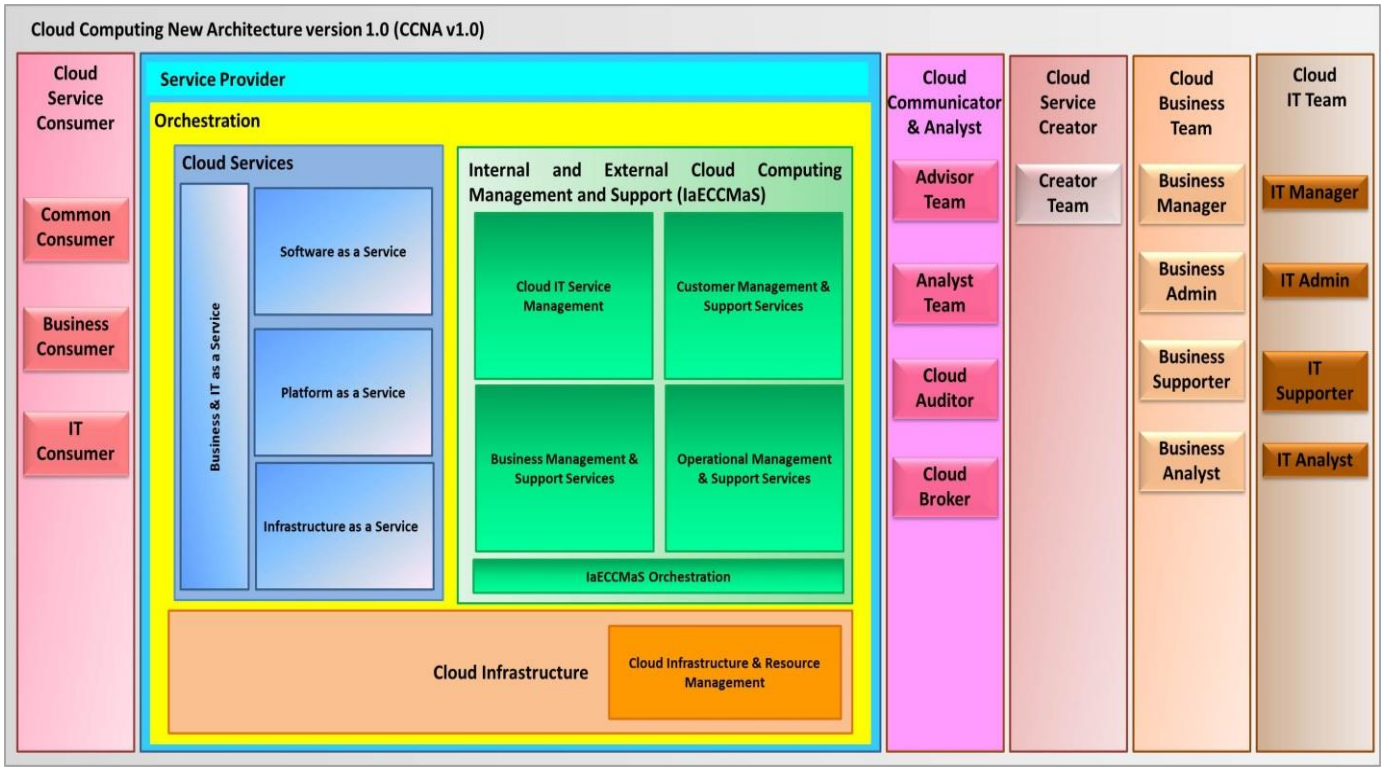

Figure 2. The conceptual and high level model of proposed architecture

service layers, infrastructure, customer and everything related to cloud.

4.1 Components of Architecture

As depicted above, the proposed architecture has six major roles and also has four major components. These components are called as orchestration, cloud services, cloud infrastructure and internal and external cloud computing management and support (IaECCMaS), which would be discussed in each of the following sub-sections.

4.1.1. Cloud Services Component

This component provides services to client in four types. In SaaS, like all common architectures, software are provided for clients. These kinds of services have limited customizable and this feature is not being sufficient for organizations and business customers. In PaaS, a platform is provided to clients and clients deploy their own services or software on top of the platform. In this model, clients will install their favorite software or services and service provider does not involve in it. Service variation in this model is low so this feature is not being favorable for organizations and business customers too. In IaaS, the infrastructure and hardware provided to clients. So due to provide hardware only, it is not being optimal for organizations and business customers.

The new service layer in this architecture is business and IT as a service. In this layer, services, processes, packages and systems that contribute to business and IT management and also other related services provided to clients are shaped in type of packages or services.

This layer is a hybrid and this is the advantage of it. This means that cloud services and also organization's specific services can be deployed in this layer. The layer can also design specific services for organizations.

Another benefit of this layer is that organizations can have hybrid package services, which is the combination of Iaas, SaaS and PaaS. B2B services and ERP systems can be considered as examples of services and the package of cloud services, organization specific services and storage media for them may be considered as example of hybrid package in this layer.

It should be mentioned that, clients have only a single interface in order to notify and negotiate with service provider. This interface called service provider help desk. The role of service provider is to support these services and interacts with other roles in order to track and manage anything related to the service and cloud service consumer directly consume the services of this component.

4.1.2. Cloud Infrastructure Component

It should be mentioned that, infrastructure may be servers, memory, storage, network facilities, etc. Another component in this part is cloud infrastructure and resource management. This component and their processes are responsible to manage infrastructure and resource and also to orchestrate when providing infrastructure and resource. Figure 3 shows the component, this component involves processes. Most of processes in this component are taken from eTOM framework.

These processes are generally in charge of capability definition or requirements to deploy resources or infrastructures, development and retirement of resources or infrastructure, provisioning, etc.

Resource Orchestration is responsible to undertakes any type of orchestration and any necessary interactions and communications of resources with cloud infrastructure and resource management and other components in order to resource provisioning.

All roles exception cloud service consumer interact with this component directly or indirectly.

4.1.3. Internal and External Cloud Computing Management and Support Components

This component is responsible to support and manage all kind of processes and activities which manage and support cloud service layers and each component related to cloud environments. These processes are classified in Cloud IT Service Management, Customer Management & Support Services, Business Management & Support Services, Operational Management & Support Services and IaECCMaS Orchestration. It should be granted that, OSS and BSS components of IBM architecture are completely supported in these components in addition to more processes. Figure 4 shows this component and its sub-processes and these processes are introduced in sections below. All roles exception cloud service consumer interact with this component directly or indirectly.

4.1.3.1. Cloud IT Service Management Component

All type of processes and services which are related to manage IT services in cloud service layer and internal IT processes in cloud environment should be located in this component. Figure 4 shows processes and services of this component.

Most of processes in this component are taken from ITIL and IBM frameworks.

These processes and services are generally responsible to support cloud IT services, establish IT policies, manage security of IT information in

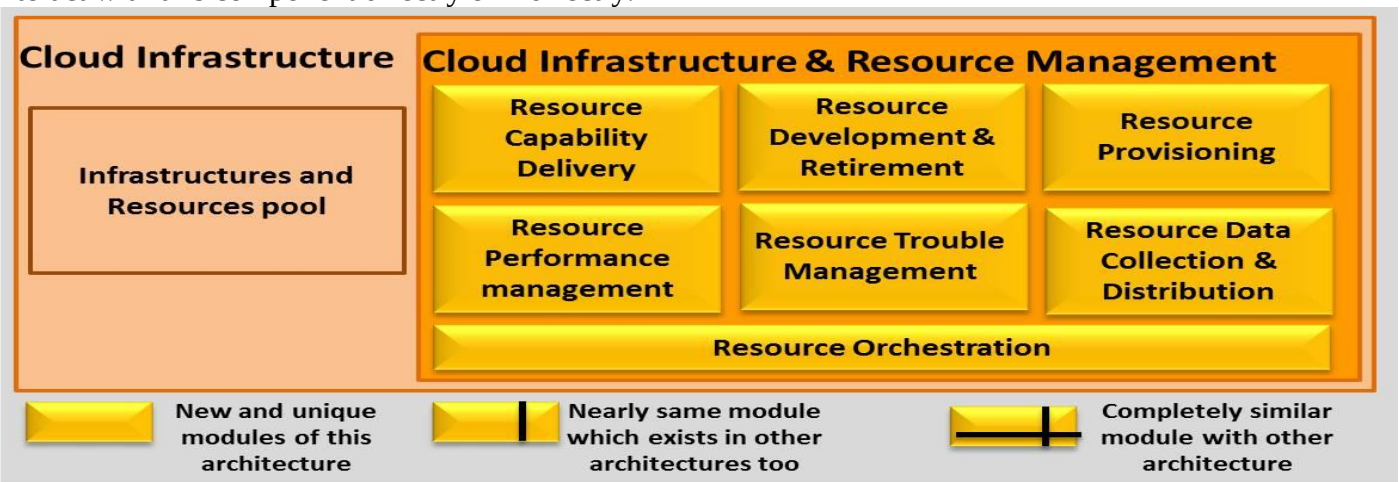

Figure 3: Components of Cloud Infrastructure and Resource Management

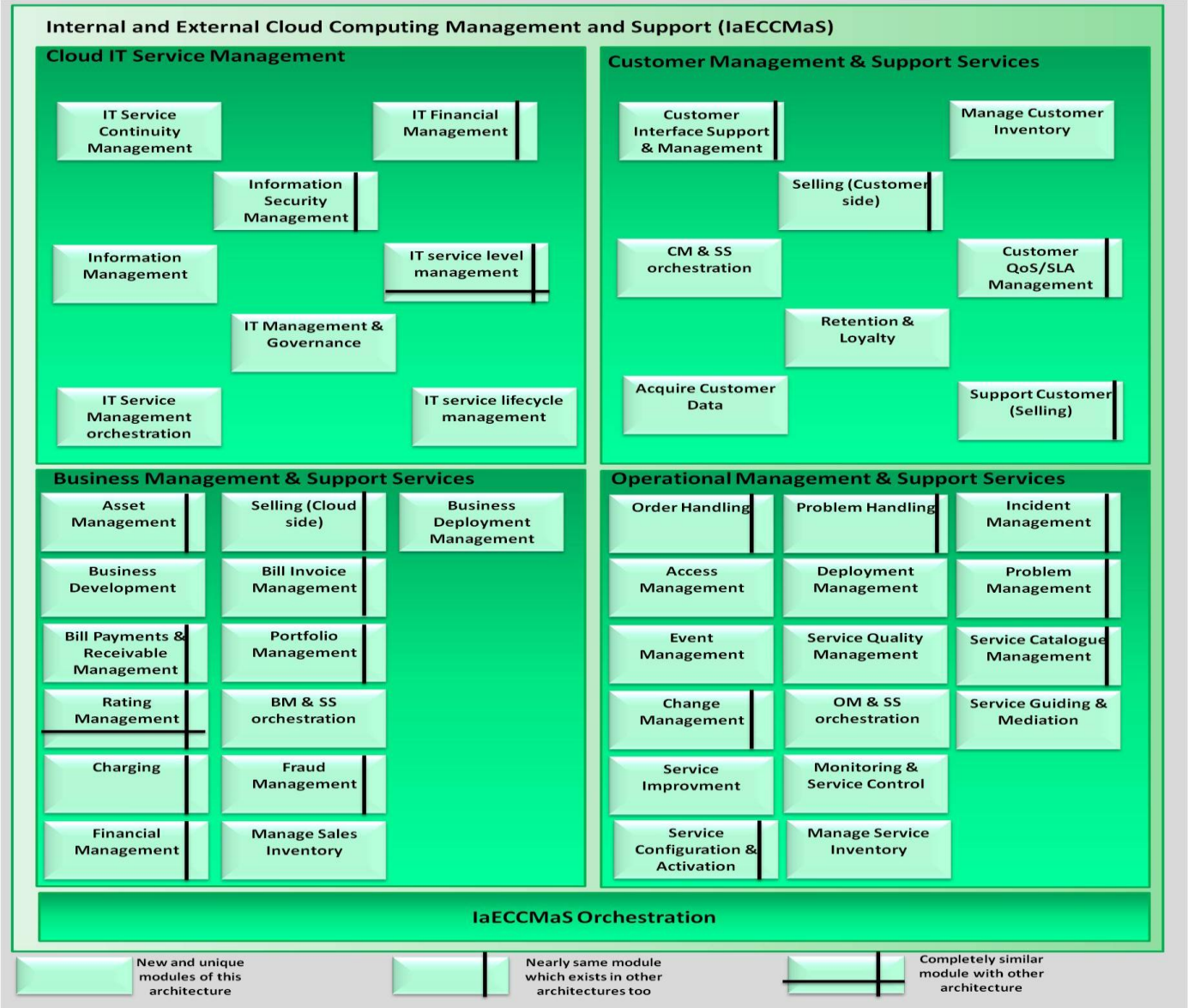

Figure 4: Internal and External Cloud Computing Management and Support components

cloud environment, establish affordable financial procedure of cloud IT service, budgeting, manage IT service lifecycle and IT service level, etc.
Information Management process is specific process of cloud environments which manage information that later will be used in reporting and financial processes.

IT Service Management orchestration processes are responsible to orchestrate all type of information, processes and anything related to IT process with other cloud components. Cloud IT team roles interact with this component directly.

4.1.3.2. Customer Management & Support Services Component

All type of processes and services which are related to manage and support customers and there interactions and interfaces in cloud environment will be located in this component. Figure 4 shows the components of these processes.
Most of processes in this component are taken from eTOM framework.
These processes and services are generally responsible to manage customer inventory, monitor and report customer service usage,

capture and record all customer data, manage customer interfaces, etc.
Selling (Customer side) processes are responsible of performing all type of sales operations related to client services in order to better quality of service.
Support Customer (Selling) processes are responsible to performing all type of operations related to customer charging, payment and financial functions.
Customer Management & Support Services orchestration processes are responsible to orchestrate all type of information, processes and anything related to customers with other cloud components. All roles but cloud service consumer interact with this component directly or indirectly.

4.1.3.3. Business Management & Support Services Component

All type of processes and services which are related to manage and support business services in cloud environment will be located in this component. Figure 4 shows the components of these processes.
Most of processes in this component are taken from eTOM and ITIL frameworks.
These processes and services are generally responsible to manage all financial and non-financial assets in cloud environment, account rating, decision about development of services, financial and charging activity related to business in cloud, develop service portfolio, manage bill payment and receivable, prevent fraud, manage sales inventory, etc.
Business Management and Support Services orchestration processes are responsible to orchestrate all type of information, processes and anything related to business with other cloud components.
Selling (Cloud side) processes are responsible to performing all type of sales operations related to business and have strong interactions with Selling in customer's component. Cloud Business team roles interact with this component directly.

4.1.3.4. Operational Management & Support Services Component

All type of processes and services which are related to manage and support services operations in cloud environment will be located in this component. Figure 4 shows the components of these processes.

Most of processes in this component are taken from eTOM, ITIL, IBM and Microsoft frameworks.
These processes and services are generally responsible to accepting and issuing customer orders, verifying orders, receiving trouble reports from HelpDesk and resolve it, manage service inventory, administer service improvement, service mediation, service activation, manage provided services and available in near future, supporting services by manage incident, problem, event, change, etc.
Operational Management & Support Services orchestration processes are responsible to orchestrate all type of information, processes and anything related to operational business with other cloud components. All roles specially cloud communicator and analyst interacts with this component directly.

4.1.4. Orchestration Component

Orchestration component is responsible to orchestrate all type of information processes and anything related to orchestration processes which exist in other components, roles, etc.
As should be mentioned that, orchestration include any notifications, change formatting, reporting activities between components through orchestrations processes in other components.

5 CONCLUSIONS AND FUTURE WORKS

Moving towards service oriented architecture and reach organizations with service oriented structure, is one of the major goals of organizations. In addition standard structures are very critical for modern organizations and most of them are deploying approved and standard frameworks such as eTOM, ITIL, etc. for the

purpose of their internal and external structure Synchronous with these changes, today's cloud computing is the subject of ongoing discussion of societies and organizations.

Large organizations are migrating to cloud when they use cloud services and even sometimes, costly operations departments have been outsourced to cloud which is on the contrary of cloud philosophy while imposing affordable usage of services Therefore cloud architecture would be important to achieve the goal and thus there are several reference architectures exist for cloud.

Integrating any new architecture with existing well-known frameworks and best practices might be considered as an affordable effort to transform and help organizations in choosing cloud with confidence.

In this paper, a new cloud computing architecture proposed whilst based on integration of current frameworks and best practices. In this architecture, the first step was to combine the best components of the existing architectures, frameworks and best practices in order to provide a favorite new service layer and bold IT and business in this layer to achieve organizations satisfaction and improve cloud management. Later we augmented few other modules to enrich the architecture to cope with the requirements in real world.

Future research in this area is ongoing by the authors and will be focused on details of architectures components and outcomes will be published soon.

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