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## Overview of Cloud Computing Management

### Summary

This Recommendation is to identify the difference between cloud computing management and traditional telecom management, including the management activities and management objects, and the new management requirements from the point view of telecom operator, and to provide an overview and framework for the cloud computing management.

### Keywords

Cloud computing, Cloud service, Cloud resource, cloud computing management

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## 1 Scope

This Recommendation is to identify the difference between cloud computing management and traditional telecom management, including the management activities and management objects, and the new management requirements from the point view of telecom operator, and to provide an overview and framework for the cloud computing management.

## 2 References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

<a href="#">[ITU-T M.3010]</a>	<a href="#">Recommendation ITU-T M.3010(02/2000), Principles for a telecommunications management network</a>
<a href="#">[ITU-T Y.3011]</a>	<a href="#">Recommendation ITU-T Y.3011(01/2012), Framework of network virtualization for future networks</a>
<a href="#">[ITU-T Y.3501]</a>	<a href="#">Recommendation ITU-T Y.3501(05/2013), Cloud computing framework and high-level requirements</a>
<a href="#">[ITU-T Y.3510]</a>	<a href="#">Recommendation ITU-T Y.3510(05/2013), Cloud computing infrastructure requirements</a>
<a href="#">[ITU-T Y.CCDEF]</a>	<a href="#">Draft Recommendation ITU-T Y.CCDEF(06/2013), Cloud Computing Overview<del>Definition</del> and Vocabulary</a>
<a href="#">[ITU-T Y.CCRA]</a>	<a href="#">Draft Recommendation ITU-T Y.CCRA (06/2013), Cloud Computing Reference Architecture</a>

~~1) Draft Recommendation Cloud Computing Definition and Vocabulary (Y.ccddef), Geneva, June 2013~~

~~2) Draft Rec. Cloud Computing Reference Architecture (Y.CCRA), Geneva, June 2013~~  
~~— Y.3510(05/2013), “Cloud computing infrastructure requirements”~~

~~3) (Notes: check the recommendations number.)~~

## 3 Definitions

### 3.1 ~~3.1~~ Terms defined elsewhere:

~~(Notes: recommendations will be included in Section 2.Recommendation format.)~~

This Recommendation uses the following terms defined elsewhere:

**3.41.1 cloud computing [Y.CCDEF]: a paradigm for enabling network access to a scalable and elastic pool of shareable physical and virtual resources with on-demand self-service provisioning and administration.**

**3.1.2 virtual resource** [ITU-T Y.3011]: An abstraction of physical or logical resource, which may have different characteristics from the physical or logical resource and whose capability may be not bound to the capability of the physical or logical resource.

**3.1.1 cloud service** [Y.CCDEF]: one or more capabilities offered via cloud computing invoked using a declared interface.

**3.2-1.4 cloud service customer** [ITU-T Y.3501]: a person or organization that consumes delivered cloud services within a contract with a cloud service provider.

**3.3-1.5 cloud service provider** [ITU-T Y.3501]: An organization that provides and maintains delivered cloud services to be delivered and consumed.

**3.81.6 management function** [ITU-T M.3010]: The smallest part of a management service as perceived by the user of the service.

~~**3.4 cloud computing** [Y.CCDEF]: a paradigm for enabling network access to a scalable and elastic pool of shareable physical and virtual resources with on-demand self-service provisioning and administration.~~

~~**3.5 virtual resource** [ITU-T Y.3011]: An abstraction of physical or logical resource, which may have different characteristics from the physical or logical resource and whose capability may be not bound to the capability of the physical or logical resource.~~

**3.6-1.7 network element** [ITU-T M.3010]: An architectural concept that represents telecommunication equipment (or groups/parts of telecommunication equipment) and supports equipments or any item or groups of items considered belonging to the telecommunications environment that performs network element functions (NEFs).

~~**3.8 management function** [ITU-T M.3010]: The smallest part of a management service as perceived by the user of the service~~

## 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

*Editor's Note: To be extended*

## 4 Abbreviations and acronyms

<Include all abbreviations used in this Recommendation>

BSS Business Support System

CaaS Communication as a Service

CT Communication Technology

DaaS Desktop as a Service

EMS Element Management System

eTOM enhanced Telecom Operations Map

IaaS Infrastructure as a Service

IT Information Technology

NMS Network Management System

OSS Operation Support System

PaaS Platform as a Service

QoE Quality of Experience

SaaS Software as a Service

~~QoE Quality of Experience~~

TMN Telecom Management network

VDC Virtual Data Centre

~~OSS Operation Support System~~

## 5 Conventions

In this document, mandatory requirements are indicated by the use of the word “shall”. Desirable requirements are indicated by the use of the word “should”. Optional requirements are indicated by the use of the word “may” or “can”.

## 6 ~~Introduction~~Concept and Background

Traditionally, Telecom operators are assumed to be Telecom Network and Telecom service providers. As the convergence of IT and CT industries and the introduction of cloud computing, cloud have become a new type of telecom infrastructure, traditional Telecom Operators not only have ~~not only applied~~ cloud computing technologies for the optimization of telecom service platforms and telecom support systems, but also have begun to deliver brand new cloud service to the service user.

As to the management of Telecom equipment, network and service, Telecom Industries have applythe mature TMN and eTOMstandard framework and technologies, and have invested huge amount of money in the construction of the EMS/NMS or BSS/OSS management system to realize the Telecom management functions.

The introduction of cloud computing has brought with new service patterns, new management objects and management requirements to the Telecom Operators. ~~To build an excellent ecosystem is the key to outweigh the competitor and obtain the competition advantage. Cloud computing ecosystem is quite different from the traditional communication ecosystem, and it is much more open that allows every roll to take active part in. Users are no longer satisfied with consuming the pre-defined service provided by Telecom Operator, and they would like to tailor their (Focusing on why we need cloud management?) servicesaccording to their own interests. And a service customer can be a service partner at the same time, whomay joined the process of service development, creation, and delivery. Telecom Operators are facing with the challenge to manage the highly-diversified service requirements and maintain the excellent QoE at the same time.~~

The great concern of cloud computing management from Telecom Operator’s point of view would be: How to meet the management requirements of cloud computing, and how to perform the cloud management based on the TMN/eTOM framework and the corresponding BSS/OSS management system. This document would provide an overview and framework for the cloud computing management from the point of view of Telecom Operator.

## ~~7—Scenarios of Cloud Computing Applications in Telecom Network~~

Notes: need more understanding about this and section9:

~~Cloud computing have been implemented in telecom network in the following ways:~~

—Reconstruction of telecom service platforms:

~~Cloud Computing may be introduced by telecom operator to reconstruct a shared underlying platform for telecom services such as SMS, MMS, WAP, etc. The shared cloud-based platform can greatly improve utilization rate of resource and smoothen the peak loads of difference services, and service can be agilely provided to Service Customer.~~

—Reconstruction of existing OSS/BSS system

~~Traditional OSS (Operations Support System)/BSS (Business Support System) platforms come from different manufacturers, and lack of unified maintenance, statistic and end-to-end data management because of separated construction. The implementation of cloud computing into the OSS/BSS can reduce the IT cost of the telecom operator and improve the centralized management efficiency.~~

—New service delivery over cloud infrastructure

~~Cloud computing brings with new service patterns, such as VDC (Virtual Data Centre), Virtual Desktop. Such service can be deployed directly over the cloud infrastructure and delivered to the CSC through Telecom Operator's network, which give telecom operators a good chance to integrate telecom network with cloud service so as to improve the customer's QoE, and to increase their shares of the business market currently dominated by IT vendors and Internet players.~~

## **8.7 Managed objects and activities of Telecom management introduced by cloud computing**

### **8.7.1 Managed objects introduced by cloud computing**

The introduction of cloud computing has brought with new Management Objects including:

- Virtualized resource: Cloud resource includes servers, storages, networks, and other hardware appliances, which is the basis of a cloud to support the upper layer of cloud services and applications. Virtualized resource can be regarded as a new type of network element (NE).
- Virtualization management middleware: Vendor-dependent Hypervisor, VMM or other third-party middleware which fulfil the function of resource virtualization and the cloud resource orchestration. The cloud hypervisor can be regarded as a new type of element management system (EMS).
- Cloud service: services basing on cloud computing technologies and infrastructure. Cloud service is defined in ITU-T Y. CCDEF as “one or more capabilities offered via cloud computing invoked using a declared interface”.
- Cloud Service ecosystem: Actors ~~besides other than~~ CSP and CSC, including cloud auditor, cloud broker, cloud service developer, partner/supplier to provide cloud infrastructure, cloud service and other applications, etc.
- Support environments and systems: development environment and test environment to assist and support the new service development and testing, and the BSS and OSS that fulfil the cloud computing management functions.

### **8.7.2 Management activities introduced by cloud computing**

The Management activities of cloud computing are categorized as fulfilment, assurance and billing. Activities concerned with the cloud service fulfilment are as followings:

- Administer cloud infrastructure and virtualization environment, and manage the readiness of cloud service delivery, including the readiness of peer cloud service provider.
- Provision ~~of~~ point of contact, administer user account and privilege.
- Define and publish product catalogue for customer to subscribe.
- Receive and followup customer's service order, including SLA terms negotiation and dealing with customer requests.
- Manage the Allocation of cloud resource, including the inter-cloud resource of peer CSP.
- Manage the cCreation and activation of cloud service instance, including inge the integration of service capacity of peer CSP. (Notes. Done by management or control?)
- Provision ~~of~~ cloud service instance to the cloud service customers.

Activities concerned with the cloud service assurance are as followings:

- Perform continuous cloud resource status monitoring, capture events and data about resource capacity, resource usage, etc. :-
- Perform continuous service status monitoring, define service quality metrics and the way that metrics are captured, gather quality metrics and constantly monitorservice quality.
- Monitor and manage the peer provider cloud servicesstatus to ensure that they meet agreed SLA targets
- Proactivelydetect, identify and report problems of cloud resource and service.
- Receives trouble ticketsand support requests from cloud service customers.
- Following the process of problem solution to repair cloud trouble and restore cloud service performance.
- Handle the reporting and resolution of problems of peer cloud service provider.
- Inform the process and result of problem handling or request handling to the cloud service customers.

Activities concerned with the cloud service billing are as followings:

- Manage the Collection of ~~the~~ resource/service usage records.
- Generate billing information ~~and~~ or an invoice for charges.
- Processing of payments.
- Resolve billing problems.
- Handling the billing and settlement with the peer cloud service partner.

### **87.3 Mapping of the cloud computing management functions ~~activities~~ to the eTOM framework**

~~The OSS and BSS acronyms have been used by Telecom Operators in the context of providing Telecom services. As cloud service delivery is similar with traditional telecom services, which is provided to massive service users over a network, the existing OSS/BSS concept and management function can be applied to the cloud environment to fulfil the management of cloud resource and service. From the point view of Telecom Operator, it is a good solution to enhance the traditional Telecom OSS/BSS to cloud OSS/BSS.~~

~~According to the recommendation of CCRA, the OSS/BSS should support:~~

- ~~— Support of the Cloud Service Provider's business, handling requests from Cloud Service Customers and also requests from roles within the Cloud Service Provider organization;~~
- ~~— Support the provision of services of customers, assisting the operations staff and providing usage information to the business support system;~~
- ~~— The operational support system links effectively with the business support system in support of processes such as billing and in the handling of change requests.~~

~~According to the CT-CCA (cloud computing architecture), Cross-Layer Functions include a series of functional components to provide supporting capabilities including:~~

ITU-T REC. Y.CCRA provides a high level overview of the cloud computing Reference Architecture components organized by means of the layering framework (see figure 1). This figure describes the cloud architecture in terms of a set of cloud functional components. A functional component is a functional element of the cloud computing Reference Architecture which is used to perform an activity or some part of an activity.



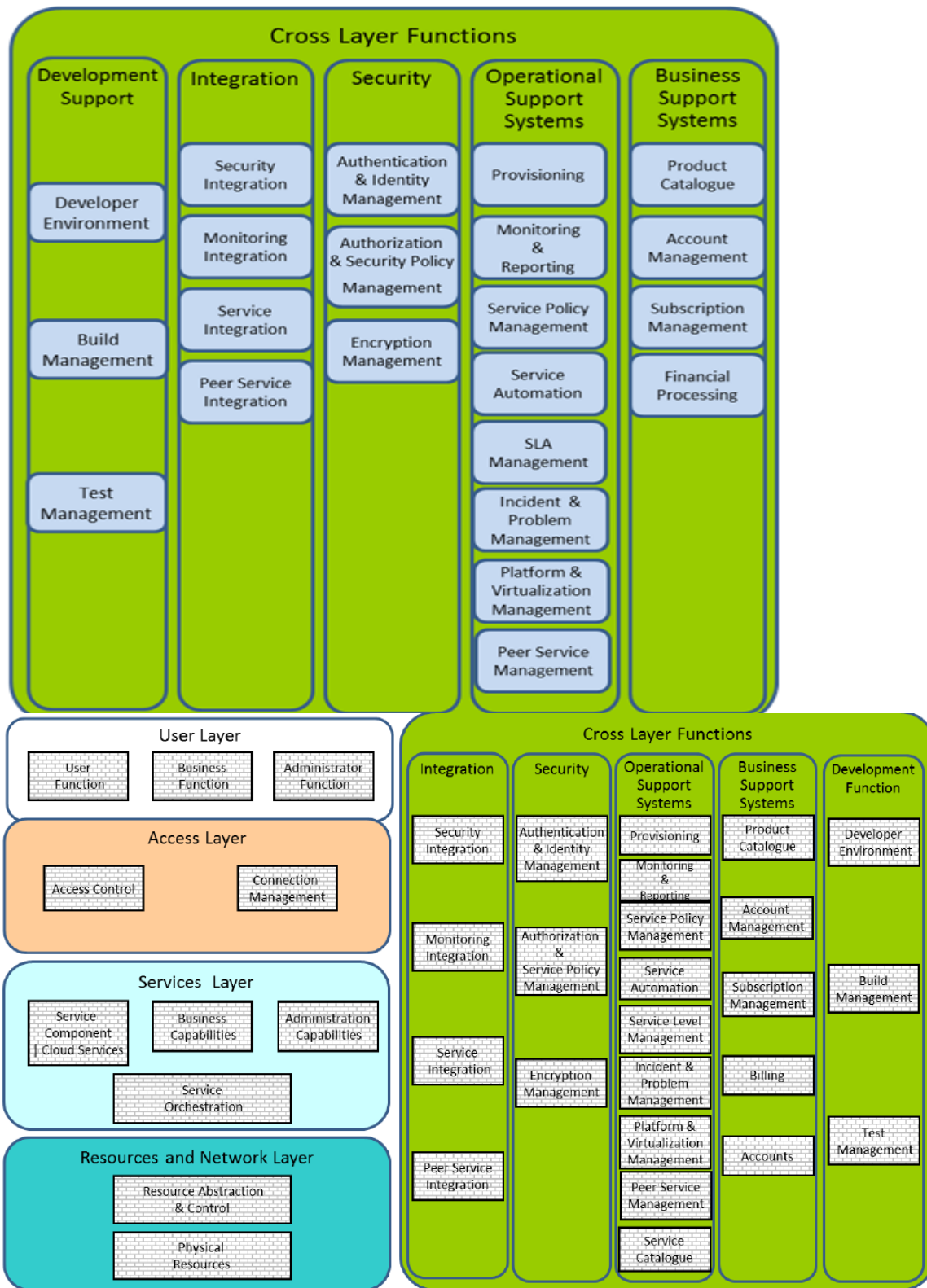


Figure 1-Functional components of the Cloud computing Reference Architecture

There are five function groups in the Cross Layer Functions. Three of them are belongs to cloud computing management function: Operational Support Systems, Business Support Systems and Development functions.

In order to illustrate the relationship between the cloud [computing](#) management functions and the existing telecom management frameworks, the ~~following~~ figure ~~2-try to~~ maps the [cloud computing management functions](#) ~~above Cross-Layer functional components~~ into the eTOM framework as below:

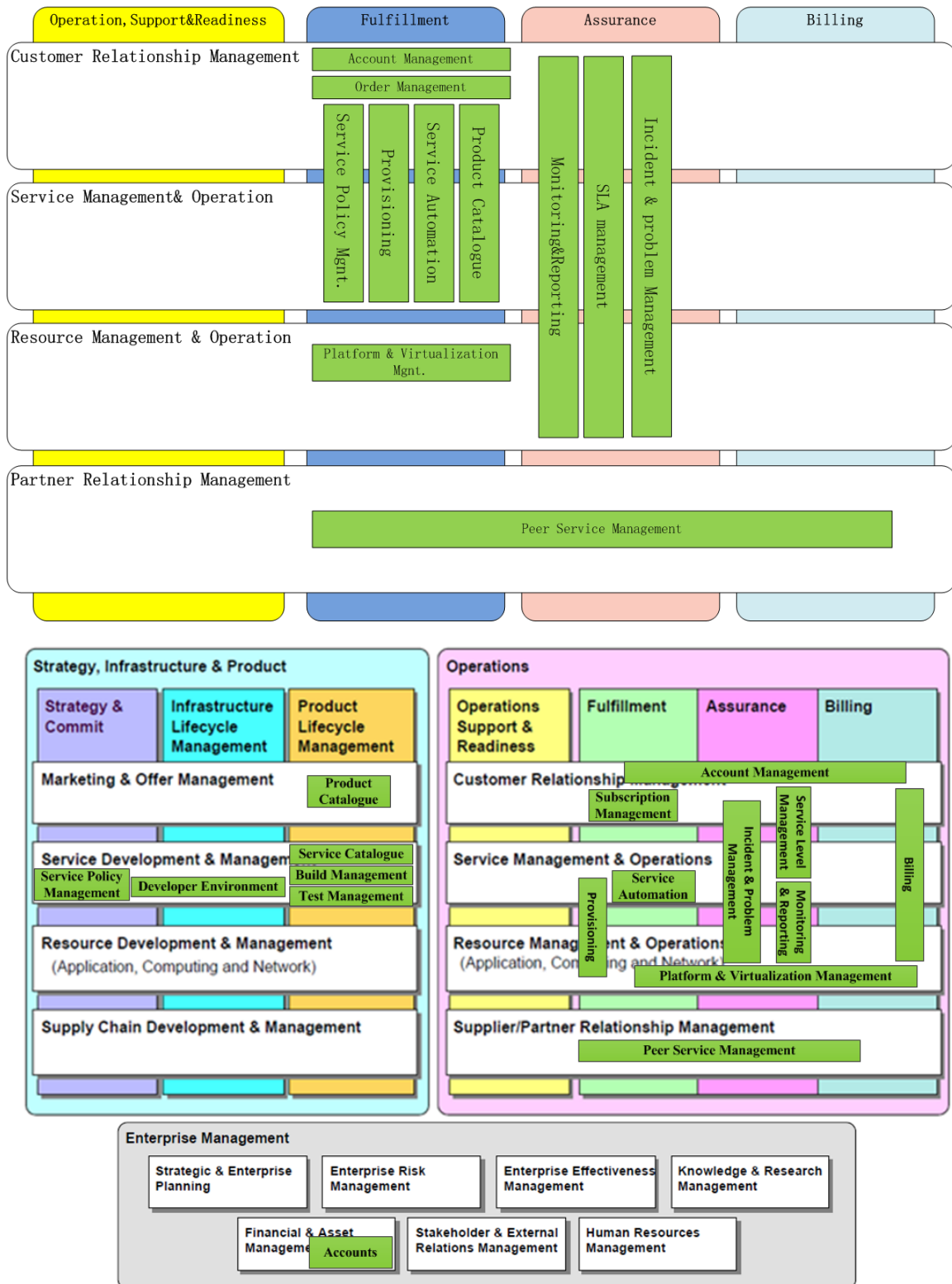


Figure 2-Mapping cloud computing management functions to eTOM framework

All the cloud computing management functions can be mapped to one or some management processes in eTOM framework, so we can reference the layering management framework of eTOM when we design the cloud computing management framework.

## **98 Management requirements from Telecom Operator's perspective**

English problems? Optional, mandatory? From the perspective of Telecom Operators, the following management requirements should be considered:

- ~~It is required~~ It is required ~~to~~ to fulfil holistic management of cloud infrastructure and cloud service within the existing Telecom management framework. ~~For the purpose of cloud computing services to work effectively, both the Telecom BSS/OSS and the cloud management functions/systems should cooperate and function properly to apply the holistic management over the cloud resource, cloud service and telecom network.~~
- ~~It is required~~ It is required ~~to~~ to realize E2E service quality management: E2E service quality management is vital when telecom service is deployed over the cloud infrastructure. Telecom-class services demand for high availability, high security, and excellent service experience (such as short response times, high service success rate). ~~When telecom services resides on the cloud infrastructure,~~ Telecom Operators need to apply a well control over the new management objects such as the virtualized resource and middleware, for the purpose of ensuring end to end telecom service quality and customer's experience.
- ~~It is required~~ It is required ~~to~~ to enhance telecom network control and ~~automation~~ automation ~~.(Notes: need details.)~~ E2E cloud service management demands for the efficient and effective telecom network control. ~~Although cloud platforms and applications can be built or developed by any vendors,~~ Telecom operators ~~operate~~ own the access and network facility via which cloud service customers ~~can~~ access and consume cloud services. As is defined in ITU-T Y.3510, Network resources (e.g. bandwidth, number of ports, network addresses) are required to be scalable, and adapt dynamically to the traffic generated by cloud services. ~~It is~~ It is ~~Telecom operator's duty to provision self-managed and on-demand network capability to meet various requirements from cloud service /application/cloud user, and to apply dynamic control and adapt its configuration (including network bandwidth, protocols, codecs and security mechanism) over the Telecom network on the direct request of cloud service/application or cloud service customers.~~
- ~~It is required~~ It is required ~~to~~ to fulfil more effective customer relation/partner relationship management. ~~In the closed telecom system, customers passively consume the services deployed by the NO/SP, and have no chance to tailor his service or control the process of service provision. Nevertheless, in the open cloud system, Comparing with the user of telecom service, cloud service customers take more active parts in the service process including service development, service customization and service provisioning. The boundaries of different roles become illegible. Service user can also be a service provider (service developer) at the same time, that is, the numbers of service provider/supplier/service partner have increased dramatically. Meanwhile, service customer/ service partner can have more control over the service ecosystem than before, and they can vote with their feet if they are unsatisfied with the service ecosystem. Telecom operators are facing with much more complicated customer relationship management and partner relationship management and needs to maintain a good ecosystem allowing every party to play his role.~~

## 10.2 Cloud computing management framework

Figure 3 presents a high level framework of cloud computing management, by depicting the layered functions of cloud computing management of one cloud service provider, who can also be a telecom operator/telecom service provider at the same time. The cloud management framework also demonstrates the relationship and interfaces between cloud computing management functions and the cloud computing functions, cloud computing management functions and telecom management network and BSS/OSS, cloud computing management functions and the peer cloud service provider's cloud computing management functions.

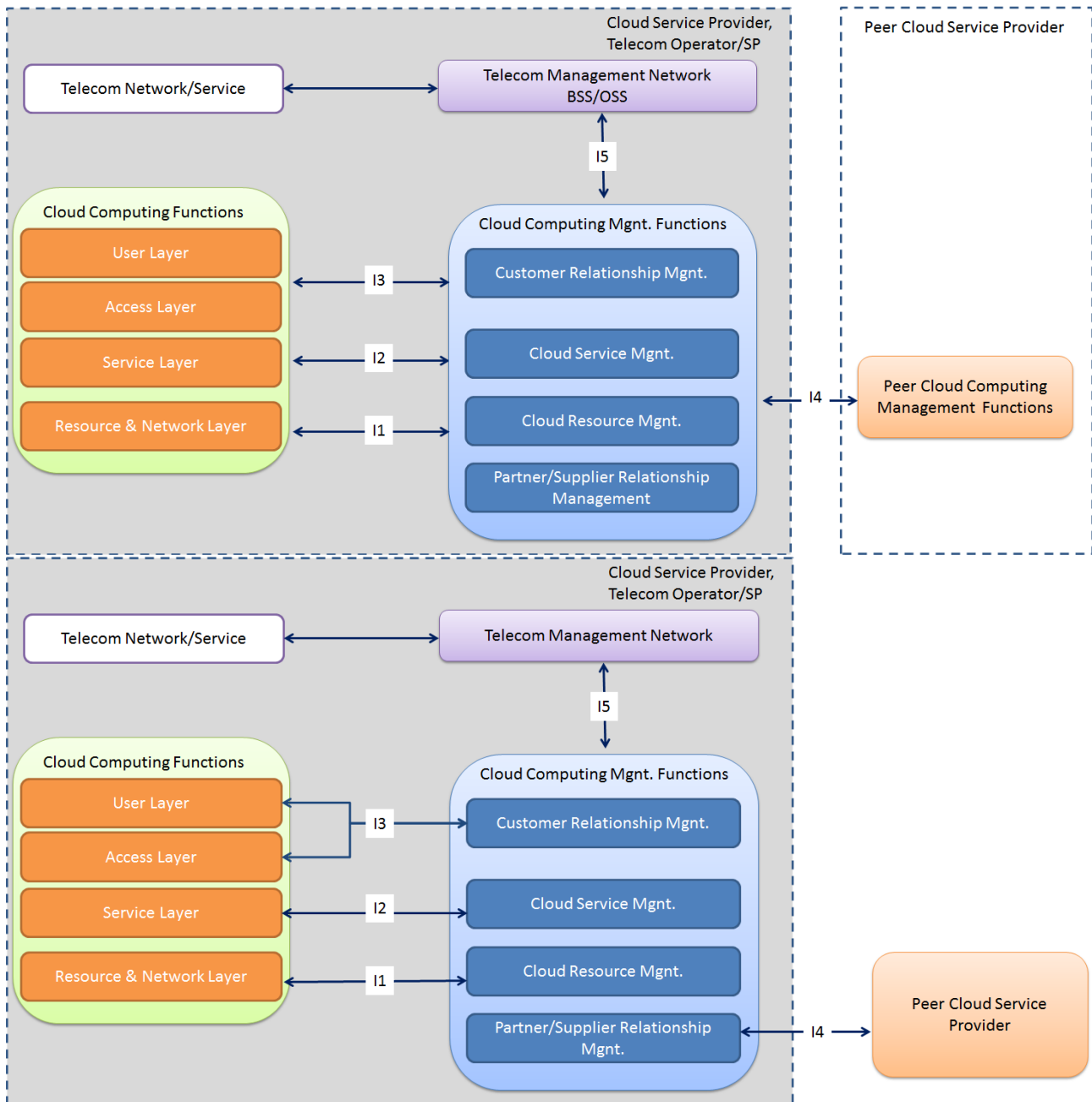


Figure 3 cloud computing management framework

(Notes: interface between what in details?)

The layered cloud computing management functions support the management requirements of cloud computing to provision, operate and administer cloud resource and services,

and ~~consists~~ ~~comprise~~ of customer relationship management, cloud service management, cloud resource management, partner/supplier relationship management.

- Customer relationship management: Function sets to support the acquisition, development and retention the relationship with customers. Manage the account of cloud service user, receiving service order and manage the process to fulfil the order. Provision self-service functions, receiving and manage customer's service request, interchange information with customer such as the order and trouble status. The customer relationship management function sets fulfil the corresponding management of user layers and access layers cloud computing functions through interface 3 (I3 in Figure 3).
- Cloud service management: Functions sets to support the cloud service delivery and management, which are accountable for cloud service delivery such as product catalogue and service instance management, and cloud service operation such as service monitoring and problem handling and the assurance of the service quality. The cloud service management function sets fulfil the corresponding management of service layers cloud computing functions through interface 2 (I2 in Figure 3).
- Cloud Resource management: Functions sets to support the management of virtual and physical cloud resource to meet the cloud service requirements, and are responsible for maintain the status of cloud infrastructure and can support the cloud resource monitoring, provisioning, orchestration, metering the resource usage for charging and billing, manage the cloud resource to meet service SLA targets. The cloud resource management function sets fulfil the corresponding management of resource layers cloud computing functions through interface 1 (I1 in Figure 3).
- Partner/Supplier relationship management: Function sets to support the inter-cloud management functions with the peer cloud service providers, including inter-cloud service integration and delivery, intermediation, problem handling, validating billing and authorizing payment, as well as monitoring and manage the service quality of suppliers and partners. This part of management functions are fulfilled through interface 4 (I4 in Figure 3). Partner/Supplier relationship management function sets also support the relationship management with the roles including cloud service developer, cloud service auditor, cloud service broker so as to maintain and develop a healthy cloud ecosystem.

Cloud computing management functions needs to be integrated and cooperate with TMN (OSS/BSS) through the interface 5 (I5 in Figure 3) to fulfil the following functions:

- From the perspective of cloud service automation and quick service provisioning, the end to end cloud computing service delivery require TMN (OSS/BSS) to apply control over the telecom network (IP network and equipment), in order to realize the network automation and meet customer's requirements such as bandwidth, protocol, access types and quality assurance.
- From the perspective of end to end Telecom service assurance, cloud computing management functions should ~~be integrated into and~~ cooperate with the existing TMN (OSS/BSS), so that Telecom Operator can fulfil the holistic monitoring and ~~XX in support of~~ configuration of on cloud resources, infrastructure including resource usage and resource performance along with the monitoring and configuration of Telecom service which resides on the cloud.

In order to fulfil the inter-cloud service functions, cloud computing management functions need to cooperate with the peer CSP's cloud computing management functions:

- Perform the cloud service fulfilment in the case of peering, federation, intermediation, aggregation and arbitrage.

- Monitor and manage the peer provider's resource and services to ensure that they meet agreed SLA targets.
  - Tracking of usage of peer provider's resource and service for the purpose of billing and settlement.
-