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ADDIS ABABA UNIVERSITY
COLLEGE OF NATURAL SCIENCES
SCHOOL OF INFORMATION SCIENCE

**Impact Analysis of Desktop Cloud Computing in the
Case of Ethio Telecom**

LILY KEBEDE

July 2017

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Ethio Telecom**

**Thesis Submitted to the school of Graduate Studies of Addis Ababa University
in partial Fulfillment of the requirements for the Degree of Masters of science
in Information Science**

**BY
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Name and signature of Members of the Examining Board

Name	Title	Signature	Date
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_____	Advisor	_____	_____
_____	Examiner	_____	_____

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Dedication

This research is dedicated to my father Ato Kebede Daruneh and my mother W/ro Gebeyanesh Metaferia

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LIST OF ACRONYMS

AAA – authorization, authentication and accounting

AIP – Advanced intelligent peripheral

CAPEX – Capital Expenditure, Capital Expansion, Capital Exposition

CRBT – Coloring ring back tone

CSPs – cloud service providers

DVS – Desktop virtualization solutions

EC – Elastic computing

HDC – Huawei Desktop controller

IPCC – Internet Protocol call center

IT - Information technology

ITA – IT adapter

KPI – Key performance indicator

LAN - Local area network

LIC – License

LOG – loggetter

SAN – Storage area network

SC – soft client

SIM – Subscriber identity module

SLA – Service level agreement

SMS - short message system

SOHO/SME – small office home office/ small and medium enterprise

TC – thin client

TCM – thin client management

TDM – Time division multiplexing

UAP – Universal access platform

VC – Voucher card

VD – Virtual Desktop

VDC – Virtual desktop cloud

VLB – virtual load balancer

VM – virtual machine

WI - web interface

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Abstract

This research is undertaken to study the impact of cloud desktop computing which is implemented in ethio telecom customer service department. This analysis will help to compare the costs and benefits of Desktop cloud computing before implementing it to other section in ethio telecom. To do this, the thesis uses various research techniques, including questionnaire and interviews to the users, technical administrators and managers. From the data collected through both ways it was found that the old distributed pc based system has problems of speed, storage capacity, processor capacity, security, and management. This created employee dissatisfaction and customer were not getting quality service (support) when needed. Based on the finding from the users and the technical experts. This research found that desktop cloud computing has improved employees day to day problem like login logout problems, stack problems, un necessary heat and sound coming from the system units, security issue, management issue etc. One problem observed and also mentioned by the employees is network problem. In desktop cloud computing, since everything is carried up over the network if network is down all employees will stop their work which has a huge impact on the success rate of any call center. But as the study shows, network issue cannot be taken as negative impact of desktop cloud computing, since it was also one of the obstacles in the previous way of handling call center activities. Therefore the result of the study shows that Desktop cloud computing has brought many positive impact on call center service quality and work environment.

Chapter One

1. Introduction

1.1. Back ground

Telecom companies are the key sectors to facilitate communication and to support the fast growing IT industries and business. In this dynamic and fast growing environment of IT, telecoms should use the best ways of handling day to day tasks to give high quality service and also to satisfy their customers. Ethio telecom is the sole company in Ethiopia trying to give high quality service to its customers. For this reason many new projects are being done every year at high cost with vendors like Huawei and ZTE. One of the project done as a pilot was implementing Desktop cloud computing for customer service division. Ethio telecom expects that the challenges in the previous way of handling day to day tasks at call center will be totally removed.

The term ‘cloud computing’, which has been an Internet computing model started entering the public domain around 2006 when Amazon announced a limited public beta version of its Amazon Elastic Computing Cloud (EC2) system. It was only in 2006, when Google’s CEO, Eric Schmidt, (Rajkumar, 2008) described his company’s commitment to a new mode of computing called “cloud computing” that would be different from the “old client/server” computing business model largely invented by Oracle, that the term ‘cloud computing’ as a data service architecture on servers in a ‘cloud somewhere’ began to take off. Usually, the cloud computing is one of the new way to use the internet resources, by a dynamic cloud computing architecture, the resources of the cloud computing is also dynamically expanded and virtual. The desktop cloud is also one kind of cloud computing, it shows desktop service to the end user, it means that the operator just need one thin client which can be connected to the network to access the personal desktop.

Cloud computing separate the PC’s desktop environment from the PC hardware by cloud computing technology, and provide it as one remote desktop service. The computing and data of personal working environment are centralized on the central servers therefore, the computing and

resources on the central server are shared to all of the operators who are connected. The computing and resources of the central server are also dynamically expanded, managed and allocated. This will help to optimize the resources usage, and reduce the total capital expenditure, capacity expansion, exposition stamp show, and capital expansion (CAPEX). In virtual desktop computing, a major part of computation and storage components are shifted from the client device (e.g. desktop PC, laptop, PDA or smartphone) to the network. User applications are executed in a virtual desktop (VD) on a remote server and the client device only deals with user interaction and the presentation of the audiovisual output. When a user connects to the cloud service, the provider's service manager handles authentication, authorization and accounting (AAA) related functions and when access is granted, the user's virtual desktop is allocated to a host selected based on the available user protocol information. Therefore, the cloud service provider has a database with user protocol, derived from monitoring information, describing the resource requirements.

2. Motivation

The motivation behind this research is my interest to analyze how best the implemented desktop clouds as a pilot site at Ethio telecom customer service department. The results are used, to get and understand users' feedback, to see the challenges and the benefits of using the new desktop cloud computing. Moreover, I wanted to identify the gaps of using the desktop cloud and propose it for other divisions/departments or even organizations.

3. Statement of the problem

IT capital expenses typically include enterprise software licenses, servers and networking equipment which are more expensive and harder to forecast than routine IT operating expenses. With cloud applications, even though there is a need to build hardware, install software or pay dedicated software license fees, it makes managing those expensive infrastructures central. Adopting cloud services allows shift costs from capital to operational or from fixed to variable. Ethio telecom has installed a desktop cloud for its customer service on a pilot implement basis. Before going to other parts of its services the company needs to know whether it has benefited from the pilot in terms of technical, financial and security matters. Using cloud technology

enables a company to benefit from economies of scale. Moreover, the success of the cloud implementation depends on the existence of service oriented architecture at the level of the institution that offers the necessary infrastructure for cloud implementation. In developing cloud computing strategy and infrastructure, it is important to keep security in mind. It needs to understand which delivery models are appropriate based on security and trust requirements with connecting systems. Assessing the security requirements for any industries is very important. Therefore, in this study the cloud computing framework developed for customer service will be assessed from different points to see whether it supports secure and cost effective methods or not. However, developing desktop cloud-based applications requires new approaches. Without a well-defined strategy that supports Desktop Cloud Computing capabilities, migrating towards cloud has no sense from the financial point of view because it leads to high costs with reengineering of existent systems. But, to the best of the researcher's knowledge there is no research done on desktop cloud computing approach for Ethio telecom because the company started to shift to cloud computing technology recently in the past two years. Hence, the aim of this study is to access and answer the following research questions so that it will propose better ways of how to implement desktop cloud computing for all divisions of Ethio telecom.

1. What impact does Desktop cloud computing brought?
2. How is it secured?
3. How is using the current desktop cloud computing bring Technical advantage?

4. Objective of the study

4.1. General objective of the study

The general objective of the study is to analyze and assess the impact of the implemented Desktop cloud computing infrastructure and usage in Ethio telecom specifically in customer service division and based on the research findings either to address implementation gap or to indicate benefits of using desktop cloud computing and recommend for other Ethio telecom offices.

4.2. Specific objective of the study

- To Review different cloud computing related literatures to understand various cloud services.
- To examine the current Desktop cloud computing infrastructure and usage strategy and efficiency in Ethio telecom specifically customer service division.
- To explore benefits of desktop Cloud Computing in Ethio telecom.
- To examine the necessity of Desktop Cloud Computing for Ethio telecom.
- To identify and recommend future research directions for further investigation on the benefits of Desktop Cloud Computing for Ethio telecom company.

5. Significance of the study

Since Ethio telecom is new for Desktop cloud computing technology, assessing the deployed project is important to get what the company benefited and to compare the efficiency and the cost benefit difference by comparing with the previous way of handling day to day tasks. This will help Ethio telecom to apply a better way of using Desktop cloud computing technology to obtain efficient and effective way of using the technology.

6. Methods

6.1 Literature review

Several conceptual and empirical literatures are reviewed in order to have clear understanding of cloud computing and other related researches.

6.2 Questionnaire

In order to get valid data about how the current system is working, and compare it with how the old system used to work. The researcher prepared different questionnaire for different respondents. This respondents are:

- The users

- The administrators
- The manager

This helps to get different views and impacts of the new desktop cloud computing on the work as well as on Ethio Telecom in general.

6.3 Interview

Different audiences including users, project owners, developers and ICT directors are interviewed for better understanding of the current desktop cloud computing infrastructure, as well as the effectiveness and efficiency of service delivery. Accordingly purposive sampling technique is used. ICT directors from different advisors, coaches, supervisors, IT operation administrators, managers, and technical support teams from that division are interviewed.

7. Scope of the study

The scope of the study is limited to accessing the current call center desktop cloud computing system the cost benefit analysis and proposing to implement better way of using it to the whole Ethio telecom company only. This will help to know the advantages and disadvantages before implementing it to other divisions. To accomplish this the researcher compares the old system with the current the current Call center desktop cloud computing infrastructure.

8. Organization of the thesis

This paper is organized as follows chapter two provides a detailed literature review addressing most issues directly or indirectly to the research. In chapter three, the researcher presents the methodology, sampling techniques and data collection are briefly discussed. In chapter four the data collected and gathered through interviews, observation and questioner will be analyzed, described and summarized to gain clear understanding on the impact of desktop cloud computing

at Ethio telecom call center section Functions, benefits and major problems in shifting from the traditional way of using independent desktops and cloud desktop is briefly discussed. From the data collected through interviews, observation and questioner of the users and administrators, the researcher will gain and establish a meaning and understanding that assist to interpret the impacts, benefits gained from the new system .The researcher will go through analyzing and interpreting both the qualitative and quantitative data collected from different respondents. At chapter five the conclusion is discussed by summarizing the key findings as well as suggestions, recommendation and for future work is presented.

CHAPTER TWO

2. Literature review

2.1 Cloud computing

In order to analyze and evaluate desktop cloud computing which is implemented and giving service at Ethio telecom the researcher need to know and understand what Cloud computing by itself means. Experts in the cloud computing industry and providers give their own definition for the term cloud computing. Now a days it is receiving a great deal of attention, both in publications and among users, from individuals and government. Yet it is not always clearly defined. To get clear understanding let us see some of the definitions given to cloud computing.

“Cloud computing is the term which means storing and accessing data and programs over the internet instead of individual’s hard drive. Cloud computing is delivering on demand computing resource from applications to datacenters over the internet.” (Meenakshi N. Munjal, March 2015)

“Cloud computing is a subscription-based service where you can obtain networked storage space and computer resources.” (Lewis, 2010)

“A pool of abstracted, highly scalable, and managed computing infrastructure capable of hosting end-customer applications and billed by consumption” (Staten, March, 7,2008.)

“A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers” (Fang, 2009)

“A style of computing where massively scalable IT-enabled capabilities are delivered as a service to external customers using Internet technologies.” (DC Plummer, December 22,2012)

Each of these researchers defined cloud computing more or less similarly according to their understanding of its functionalities. Although there was no unique definition or agreement about what precisely constituted cloud computing, it still offered a promising paradigm that could enable businesses to face market volatility in an agile and cost-efficient manner (Hassan, 2011). Regarding its relations to other pre-existing computing models, cloud computing can be used in principle to deliver computing services, including grid computing services, high-performance computing services to users over a network. This does not imply that cloud computing is a replacement for grid computing, high-performance computing, or any other pre-existing computing model. Instead, cloud computing should be thought of as a new business model that aims at service delivery in a highly scalable and highly flexible manner. The difference between cloud computing and other pre-existing computing models can be better demonstrated by ways of using the service and deployment models and its key enabling technologies of virtualization. The cloud makes it possible to access information from anywhere at any time. While a traditional computer setup requires being in the same location as data storage device, the cloud takes away that step. The cloud removes the need to be in the same physical location as the hardware that stores data. Cloud provider can both own and house the hardware and software necessary to run home or business applications. (Lewis, 2010)

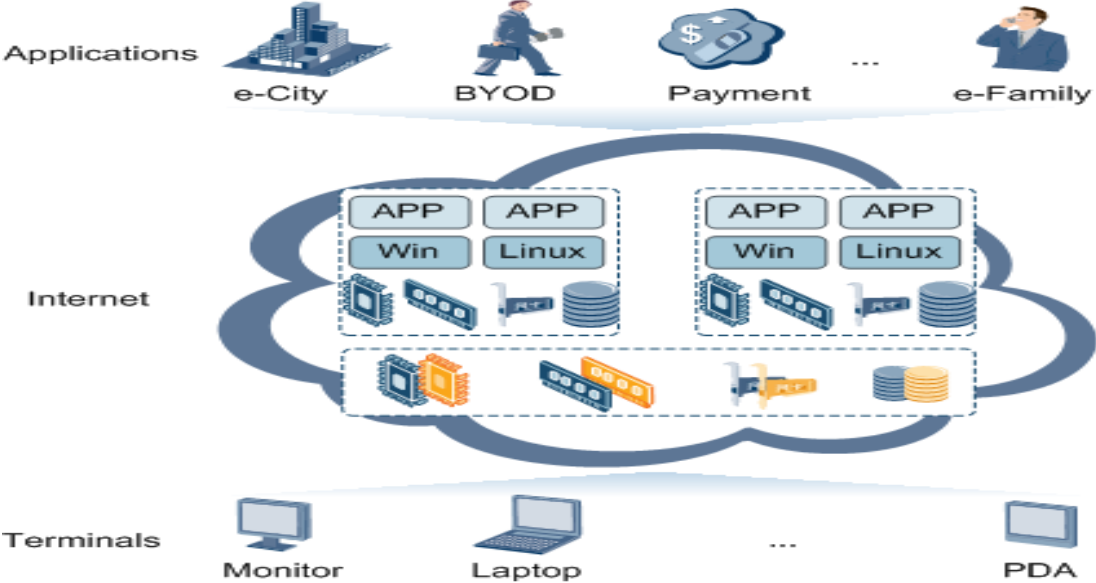


Figure 1 : Cloud computing (source Huawei Technologies co., Ltd)

2.2 cloud computing deployment models

There are different types of cloud services classified based upon the underlying infrastructure deployment model. The different infrastructure deployment models are distinguishing by their architecture, the location of the datacenter where the cloud is realized, and the needs of the cloud provider's customers. This deployment models are:-

- A. Public cloud
- B. Private Cloud
- C. Community Cloud
- D. Hybrid Cloud

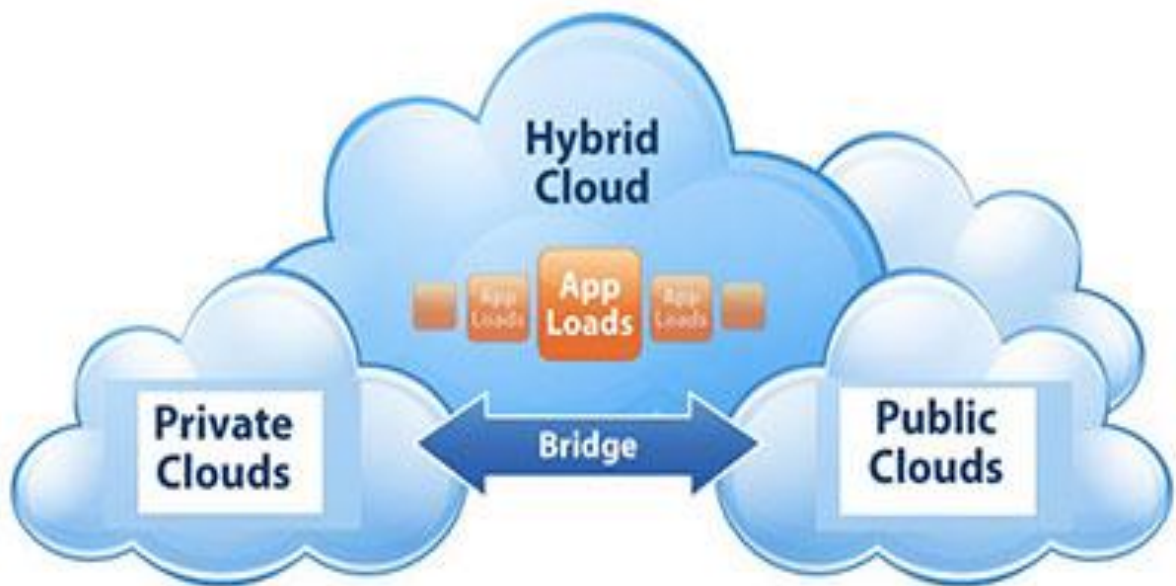


Figure 2: Cloud computing system deployment (source: cloud news daily <http://cloudnewsdaily.com/hybrid-cloud/>)

2.2.1. Public cloud

A public cloud can be accessed by any subscriber with an internet connection and access to the cloud space (Lewis, 2010). A public cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling Cloud services (Salama). Public cloud or external cloud as a cloud computing in the traditional mainstream sense, whereby

resources are dynamically provisioned on a fine-grained, self-service basis over the Internet via web applications/web services, from an off-site third-party provider who shares resources and bills on a fine-grained utility computing basis (Reddy, November, 2011). The cloud services are available for anyone to subscribe and to use in a pay-as-you-go manner. A public cloud customer can access these services over the internet from a third-party provider who may share computing resources with many customers. The public cloud model is widely accepted and adopted by many enterprises because the leading public cloud vendors as Amazon, Microsoft and Google, have equipped their infrastructure with a vast amount of data centers, enabling users to freely scale and shrink their rented resources with low cost and little management burden (B. Furht, 2010). Security and data governance are the main concern with this approach. Sharing applications and infrastructure with unknown co-tenants can lead to concerns over data security and data leakage. If a public cloud is implemented with performance, security, and data locality in mind, the existence of other applications running in the cloud should be transparent to both cloud architects and end users (Sewale, 2012). Indeed, one of the benefits of public clouds is that they can be much larger than a company's private cloud might be, offering the ability to scale up and down on demand, and transferring infrastructure risks from the enterprise to the cloud provider.

2.2.2. Private clouds

The Cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise (Salama). This indicates that private cloud is established for a specific group or organization and limits access to just that group it operates dedicatedly for a single organization. Private cloud infrastructure may be set-up On-Premise or off-premise and may be managed either internally or by third-party service providers. Private clouds offer highest level of security and control but are expensive. A private cloud is built for the exclusive use of one customer, who owns and fully controls this cloud. Additionally, there are variations of this in terms of ownership, operation, etc. The fact that the cloud is used by a specific customer is the distinguishing feature of any private cloud. A private cloud might be owned by the customer, but built, installed, and managed by a third party rather than the customer. The physical servers might be located at the customer's premises or sited in a collocation facility. A recently introduced alternative to a private cloud is a 'virtual private

cloud'. In such a virtual private cloud a customer is allocated a private cloud within the physical infrastructure of a public cloud. Due to the allocation of specific resources within the cloud the customer can be assured that their data stored on and processing is done only on dedicated servers (i.e., these servers are not shared with any other customer of the cloud provider). An example would be the NASA's Nebula Private Cloud which is an infrastructure-as-a-service implementation for scientific data and Web based applications. (Sewale, 2012)

2.2.3. Community Cloud

A community cloud is shared among two or more organizations that have similar cloud requirements (Lewis, 2010). The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, or compliance considerations) (CSA, 2009). In a community cloud, several enterprises with similar requirement can share their infrastructures, thus increasing their scale while sharing the cost (Wikipedia – Cloud Computing, 2010). Another form of community cloud may be established by creating a virtual data center from virtual machines instances deployed on underutilized users machines (Briscoe & Marinos, 2009). A community cloud provides many of the benefits of scale of the public cloud, while retaining greater control over compliance and data privacy

2.2.4. Hybrid clouds

The Cloud infrastructure is a composition of two or more Clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., Cloud bursting for load-balancing between Clouds) (Salama). In the Hybrid cloud, many enterprises would prefer to keep their critical data and applications within their own control to ensure security firewall, while hosting the less critical ones on a public cloud. Under this cloud deployment model users typically outsource non-business critical information and processing to the public cloud, while keeping business-critical services and data in their control (VenkateRao J. et.al. 2011). A hybrid cloud can be delivered by a federated cloud provider that combines its own resources with those of other providers. Thus hybrid cloud delivery model encompasses provisioning all components and services that are

required to deploy services (e.g. Hardware, network services, operating systems, databases, middleware, applications, and third party service provisioning). Hybrid clouds consist of a mixed deployment of private and public cloud infrastructures so as to achieve the maximum cost reduction through outsourcing whilst maintaining the desired degree of control over e.g. sensitive data by employing local private clouds. (Sewale, 2012)

2.3. Cloud computing features

There are four types of cloud computing features

- on demand
- Pay per use
- Rapid elasticity
- Maintenance and upgrading

2.3.1. on demand

To use computing resources on-demand is one of the most needed features for a large number of enterprises. One of its advantages is to eliminate the need for planning ahead, purchasing, and installing the resources they will require at some point in the future. This helps the user to avoid making an unnecessary investment in servers and computing resources. In addition when comparing cloud computing with the traditional model of owning the servers, cloud computing will help to avoid the costs of having underused resources. Consequences of this feature of on-demand computing resources are a lowering of the entry barriers to some business models, as software vendors can develop applications without thinking beforehand of provisioning for a specific number of customers and then bearing with the risk of greater success than planned, leading to the service not being available or, worse, having very few users and a large capital expense caused by purchasing resources that are very underutilized. (Sewale, 2012)

2.3.2. Pay-Per use

The other new aspect of cloud computing is application of usage based billing model. Users simply pay for the services they get while providers bear the costs of hardware and software provision. Pricing may vary depending on the time of day due to peaks in demand or varying

electricity costs and institutions may therefore carry out certain activities when costs are cheaper. (Sewale, 2012). Pricing is the process of determining what a service provider will receive from an end user in exchange for their services (C. Weinhardt, 2009). It is claimed that cloud computing success in the IT market can be obtained only by developing adequate pricing techniques. The pricing process can be as follows: fixed, in which the customer is charged the same amount all the time; dynamic, in which the price charged changes dynamically; or market-dependent, in which the customer is charged based on the real-time market conditions (Osterwalder, 2004). Fixed pricing mechanisms include the pay-per-use model, in which the customers pay for the amount they consume of a product or the amount of time they use a certain service.

2.3.3. Rapid elasticity

Originating from the field of physics and economics, the term elasticity is nowadays heavily used in the context of cloud computing. In this context, elasticity is commonly understood as the functionality of a system to automatically provision computing resources on demand as workloads change (Nikolas Roman Herbst). In this type of cloud service feature there is a service level agreement to be signed between the customer and the service provider. Based upon the specific of a service level agreement, the cloud provider scales up or down the resources that are provided to meet the customer's changing needs. This service level agreement must define the response time for the cloud provider to adapt to the customer's needs. Such an agreement is needed by the cloud provider, because the cloud provider does not in fact have infinite resources, so depending upon the service level agreement the cloud provider has to find a set of allocations of resources that satisfy the current demands of the aggregate of their users while meeting the various service level agreements of these customers - otherwise the service level agreement may specify a penalty that the cloud provider has to pay to each customer for not meeting the relevant service level agreement.

2.4. Cloud computing service model

Each cloud computing service model serves a specific function, giving users more or less control over their cloud depending on the type. When choose a provider, it is important to compare needs to the cloud services available (Lewis, 2010). The U.S. National Institute of Standards and Technology Laboratory definition of cloud computing describes three service layers (Mell,

2009): cloud needs will vary depending on how we intend to use the space and resources associated with the cloud. If it will be for personal home use, will need a different cloud type and provider than using the cloud for business. There are three types of cloud service models

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

These three types differ in the amount of control over information and conversely, how much we expect the provider to do for us the below subsection will briefly describe about each type.

2.4.1. Software as a Service (saas)

Software or an application is hosted as a service and provided to customers across the Internet. This mode eliminates the need to install and run the application on the customer's local computers. SaaS therefore alleviates the customer's burden of software maintenance, and reduces the expense of software purchases (Salama). A SaaS provider gives subscribers access to both resources and applications. SaaS makes it unnecessary to have a physical copy of software to install on devices. SaaS also makes it easier to have the same software on all of devices at once by accessing it on the cloud. In a SaaS agreement, there is least control over the cloud. The SaaS customer is an end-user of complete applications running on a cloud infrastructure and offered on a platform on-demand. The applications are typically accessible through a thin client interface, such as a web browser. Users are not allowed to customize the service but get access to a specific application hosted in the Cloud. Examples of SaaS implementations are the services provided by Google for office automation, such as Google Mail, Google Documents, and Google Calendar, which are delivered for free to the Internet users and charged for professional quality services. Examples of commercial solutions are Salesforce.com and Clarizen.com, which provide online CRM (Customer Relationship Management) and project management services, respectively (R. Buyya, 2009).

2.4.2. Platform as a Service (paas)

Platform as a Service PaaS system goes a level above the Software as a Service setup. Platform-as-a-Service solutions provide an application or development platform in which users can create their own application that will run on the Cloud. More precisely, they provide an application framework and a

set of API that can be used by developers to program or compose applications for the Cloud. PaaS solutions often integrate an IT infrastructure on top of which applications will be executed. This is the case of Google App Engine and Microsoft Azure, while other solutions, such as Manjrasoft Aneka, are purely PaaS implementations. Google App Engine is a platform for developing scalable web applications that run on top of data centers maintained by Google. It defines an application model and provides a set of APIs that allow developers to take advantage of additional services such as Mail, Data store, Memcache, and others (Salama) .

2.4.3. Infrastructure as a service (IaaS)

Infrastructure as a service also called Hardware-as-a-Service was coined possibly in 2006. As the result of rapid advances in hardware virtualization, IT automation and usage metering& pricing, users could buy IT hardware, or even an entire data center, as a pay-as-you-go subscription service. (L. Wang, 2008). An IaaS agreement, as the name states, deals primarily with computational infrastructure. In an IaaS agreement, the subscriber completely outsources the storage and resources, such as hardware and software that they need. As we go down the list from number one to number three, the subscriber gains more control over what they can do within the space of the cloud. The cloud provider has less control in an IaaS system than with a SaaS agreement.

What does this mean for the home user or business looking to start using the cloud? It means we can choose our level of control over our information and types of services that we want from a cloud provider.

2.5. Desktop cloud computing

Desktop computing has become a burden for IT departments. While it is essential for delivering necessary applications and services to end users, IT managers are encumbered by the tremendous amount of time, complexity, and cost inherent to managing and securing physical PCs. Furthermore, a progressively tech-savvy user base is becoming more frustrated by computers which don't have the flexibility and capabilities today's workforce has come to expect. While businesses have been aware of these issues for years, many are, only recently, reaching the tipping point for change. (How the Cloud is reshaping virtual desktops, NaviSite)

2.5.1 Advantage of Desktop cloud computing

Desktop Cloud Computing removes performance bottlenecks in desktop virtualization, while providing an easy-to-deploy, easy to manage, and flexible solution. How can V3 Systems enhance a VMware VDI deployment? V3's solution delivers three main benefits: Performance, Flexibility, and Scalability (What is Desktop Cloud Computing , www.v3sys.com).

- **Performance** V3 end users experience guaranteed speed increases from 2x – 8x that of a physical desktop. While traditional VDI deployments from other hardware vendors can be fast for the first few hundred users, performance bottlenecks quickly emerge under load and at scale. V3 guarantees every single user on an appliance gets the same performance, even under full load.
- **Flexibility** If already have a VMware environment in place, it's quick and easy to swap V3 appliances in place of other hosts for those users who need high performance desktops. V3 gives the flexibility to deliver a wide range of virtual desktop from 25 to 400 per appliance in order to best suit the needs. V3's architecture enables IT administrators to address their users' requests for flexible work styles.
- **Scalability** As your desktop requirements grow, simply add V3 appliances as needed without significantly upgrading your SAN. This unique to V3 advantage provides known up-front costs and predictable future scale-per-desktop costs, eliminating unforeseen and expensive storage infrastructure upgrades when scaling.
- **Manageability** Desktop Cloud computing provides enhanced and simplified IT management and maintenance capabilities through central administration of resources, vendor managed infrastructure and SLA backed agreements. IT infrastructure updates and maintenance are eliminated, as all resources are maintained centrally. The user enjoy a simple web-based user interface for accessing software, applications and services without the need for installation and an SLA ensures the timely and guaranteed delivery, management and maintenance of the IT services.

- **Reliability** With a managed service platform, Desktop cloud computing is much more reliable and consistent than in-house IT infrastructure. Most providers offer a Service Level Agreement which guarantees 24/7/365 and 99.99% availability. Organizations can benefit from a massive pool of redundant IT resources, as well as quick failover mechanism if a server fails, hosted applications and services can easily be transited to any of the available servers.
- **Instant ‘on’ experience** Users can stop working in one location, or on one device, and pick up where they left off seamlessly.
- **Device agnostic** Users can access their virtual desktops from an iPad, iPhone, iPod Touch and Android-based tablets and smartphones. They can also use thin clients, or extend the life of their current PCs for cloud access.
- **Desktop flexible** Desktops can be set up for different use cases, or groups of users, quickly and easily. The solution presents a variety of options to tailor performance and functionality to suit best, including performance, OS, features and applications.

2.5.2 Disadvantage of Desktop cloud computing

As cloud service providers take care of a number of clients each day, they can become overwhelmed and may even come up against technical outages. This can lead to business processes being temporarily suspended. Additionally, if internet connection is offline, accessing any of the applications, server or data from the cloud will not be possible. Also there are some disadvantages of the cloud computing:-

- **Security** Although cloud service providers implement the best security standards and industry certifications, storing data and important files on external service providers always opens up risks. Using cloud-powered technologies means the organization need to provide its service provider with access to important business data. Meanwhile, being a public service opens up cloud service providers to security challenges on a routine basis. The ease in procuring and accessing cloud services can also give nefarious users the ability to scan, identify and exploit loopholes and vulnerabilities within a system. For instance, in a multi-tenant cloud architecture where multiple users are hosted on the same server, a hacker might try to break into the data of other users hosted and stored on the

same server. However, such exploits and loopholes are not likely to surface, and the likelihood of a compromise is not great.

- **Vendor Lock-In** Although cloud service providers promise that the cloud will be flexible to use and integrate, switching cloud services is something that hasn't yet completely evolved. Organizations may find it difficult to migrate their services from one vendor to another. Hosting and integrating current cloud applications on another platform may throw up interoperability and support issues. For instance, applications developed on Microsoft Development Framework (.Net) might not work properly on the Linux platform.
- **Limited control** since the cloud infrastructure is entirely owned, managed and monitored by the service provider. Although this is not applied to ethio telecom which has a private cloud, it transfers minimal control over to the customer. The customer can only control and manage the applications, data and services operated on top of that, not the backend infrastructure itself. Key administrative tasks such as server shall access, updating and firmware management may not be passed to the customer or end user.

2.6. Overview of Call center

A call center is a physical place where customer and other telephone calls are handled by an organization, usually with some amount of computer automation. Typically, a call center has the ability to handle a considerable volume of calls at the same time, to screen calls and forward those to someone qualified to handle the cases, and to log calls. Call centers are used by mail-order catalog organizations, telemarketing companies, computer product help desks, and any large organization that uses the telephone to sell or service products and services

New technologies and different modes of delivery are changing the experience of customers and staff in the services sector. Call centers and Web-based methods of service are becoming the norm in complementing the traditional telephone, office and mail services (Bennington). In fact, it has even been argued that call centers might be the hub of successful customer relationship management strategies and the fulcrum of organizations (Mitchell, 1998). Advantages of call

centers Application of the technologies involved in call center operations can play a key role in accessing more customers, and in providing better quality services especially where additional or extended services become available (Walker and Craig-Lees, 1998). When high-contact (that is, in-person contact) services can be converted into low-contact services, through the use of technology, a number of benefits can result. First, and most obviously, customers can avoid attending the "service factory" (Lovelock, 1997). This leads to less cost and greater convenience for the customer. Second, the time taken for each transaction should be lessened due to less need for travel to office-based services; and, once connected to the call center, services should be provided relatively quickly due to the ability of the newer technologies to stream inquiries to unoccupied staff in different call centers, perhaps even in different parts of the country. Third, Services can be more readily provided in the language of the customer's choice, due to the ability to direct customer calls to specific locations. Fourth, it has been noted that some customers actually rate service quality of call center contact higher than they rate in-person contact (Driver and Johnston, 1998). For service organizations, these new technologies should facilitate greater effectiveness and efficiency (Prabhaker et al., 1997). More customers can be serviced at any one point in time

2.6.1 Ethio telecom Call center functions and success rate

Ethio telecom customers contact ethio telecom for complaint, enquiry, request, and feedback and so on. It functions using two access numbers 994 and 980. 994 is dedicated for residential and SOHO/SME customers to enquire any after sales issues. And 980 is dedicated for high class and key account customers for similar purpose. The means of contact so far is via phone and there is a plan to make it multiple channel like e-mail, sms, fax, web chat, e-care contact center very soon. All activities of the contact center are managed system wise all KPIs are managed and controlled system based in three sites. Those are Legehar, TPO, Oid Airport this helps the company to analyses reasons for calling, and identify customers' needs and create trouble tickets for incidents that are not in first call. Some of the reasons customers to call and the success rate are shown in the below charts.

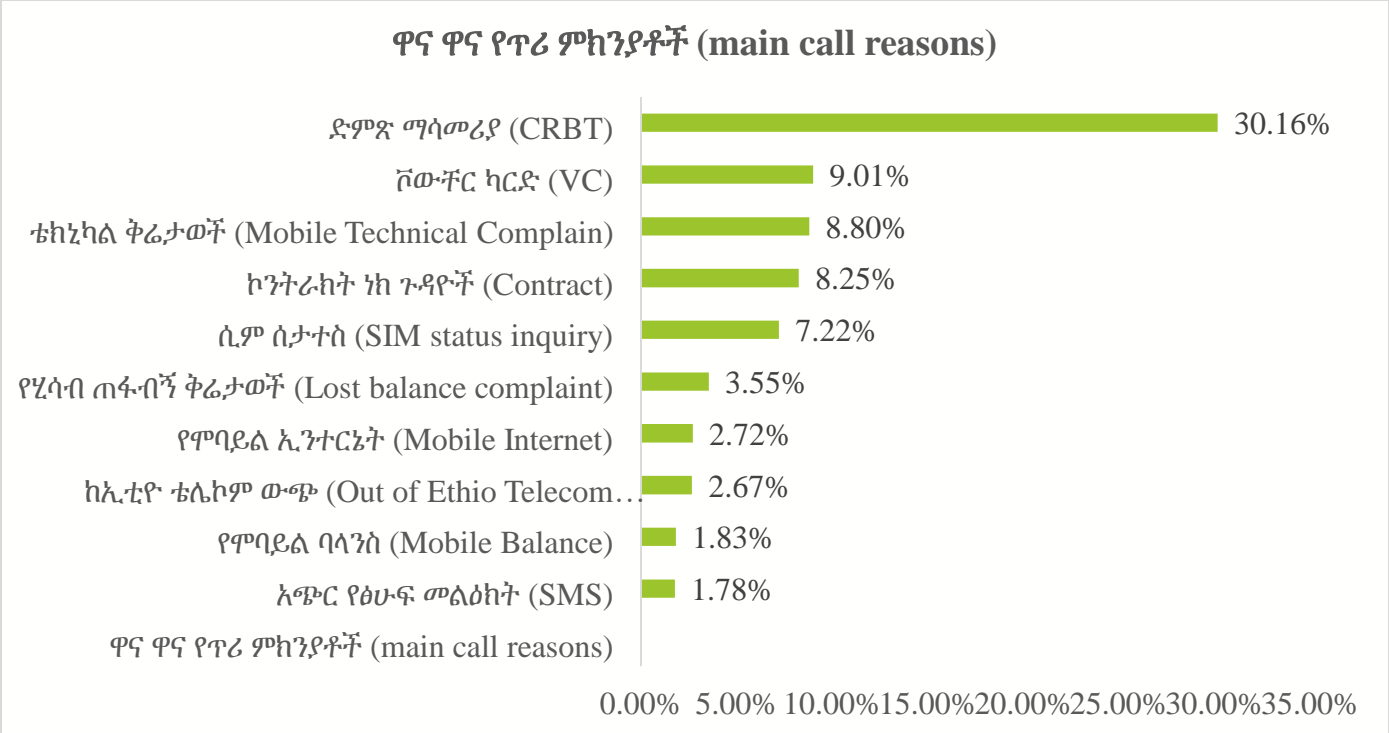


Chart 1 : Call reasons (source Ethio telecom call center data).

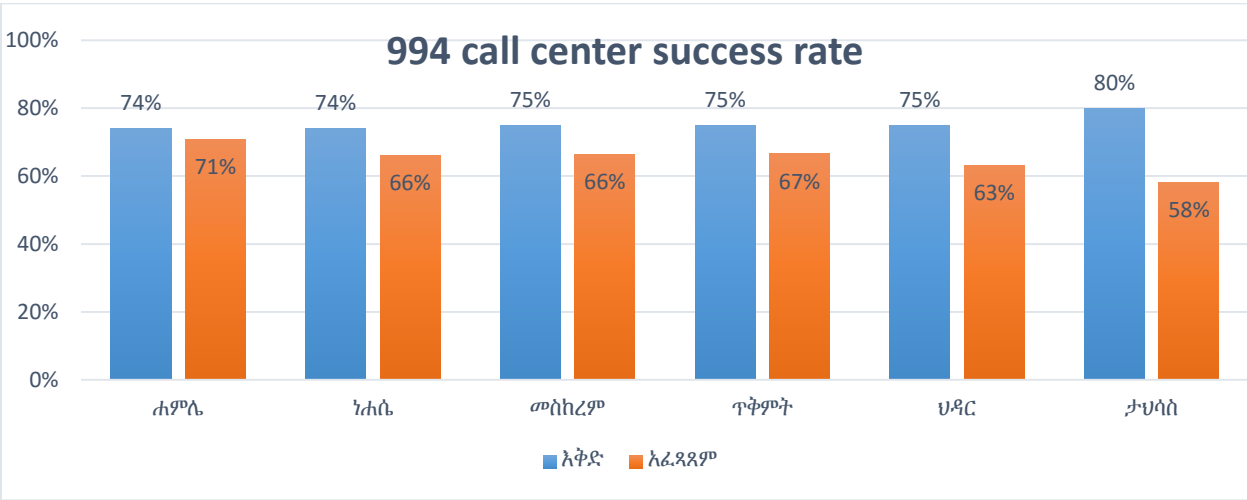


Chart 2: Call center success rate (source Ethio telecom call center data)

2.7 Call Center Desktop cloud computing

Operators of a call center use a desktop cloud to handle a large number of incoming and outgoing calls. Using customized thin clients or existing PCs, costs on maintaining the client hardware are substantially reduced. A cloud-based call center supports calls from the local area network (LAN) and supports the remote work mode of operators. The remote login speed and usability of clients are considerably improved, and service continuity is ensured. Because the application system is deployed in a centralized way and managed effectively and securely, operators cannot take away users' information without permission. This prevents information disclosure and helps make an efficient and profitable call center. Ethio telecom call center desktop cloud solution allows deploying a universal access platform (UAP) or advanced intelligent peripheral (AIP) in a regular desktop cloud system. It also supports time division multiplexing (TDM) and IP transport

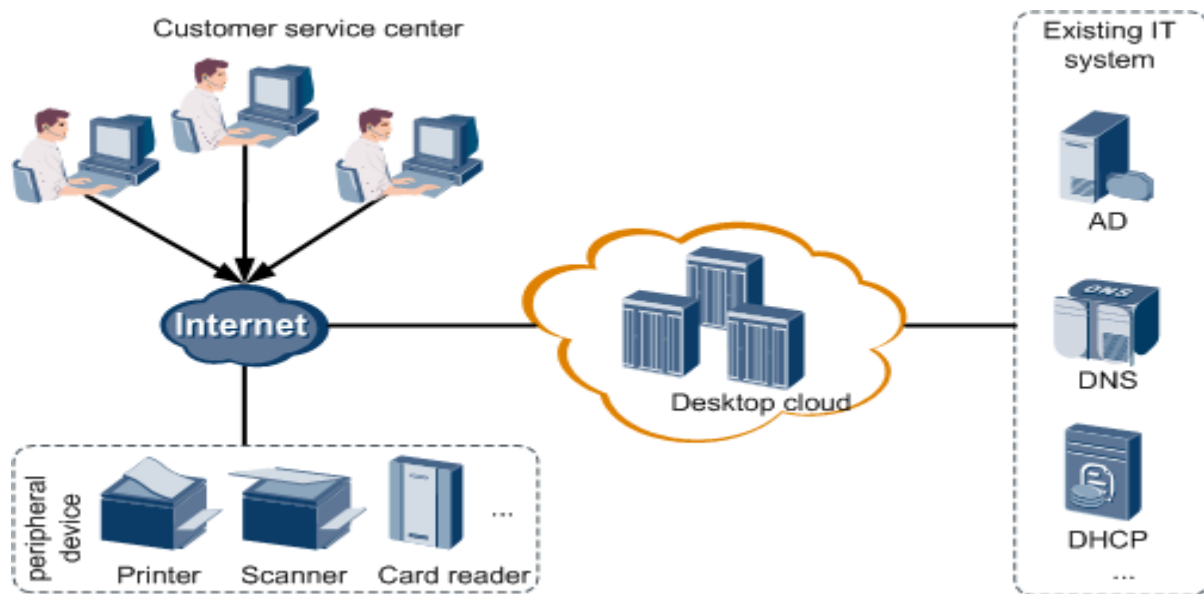


Figure 3 : Fusion Cloud Desktop solution used for the customer service center

2.6.1. Advantages of Call Center Desktop cloud computing

- Use of existing devices

A cloud-based customer service center can use its existing IT system. With centrally deployed and managed peripheral devices, users are provided with plug-and-play experience.

- Rapid deployment

The customer service center will push software to virtual machines (VMs) using the cloud platform. This enables quick installation and deployment of software, helping enterprises launch new services as planned.

- Self-service system

Users in an enterprise can use a self-service system deployed on the desktop cloud to access provided services without the need for authentication and to print the service list

2.6.2 Technical features

Multiple VMs that have the same operating system share the same master mirror. As shown below in the figure. The master mirror can be upgraded and maintained. Each VM saves differentiated virtualization mirrors.

60% storage cost is reduced.

It takes only **12 seconds** to create a single linked clone of VM.

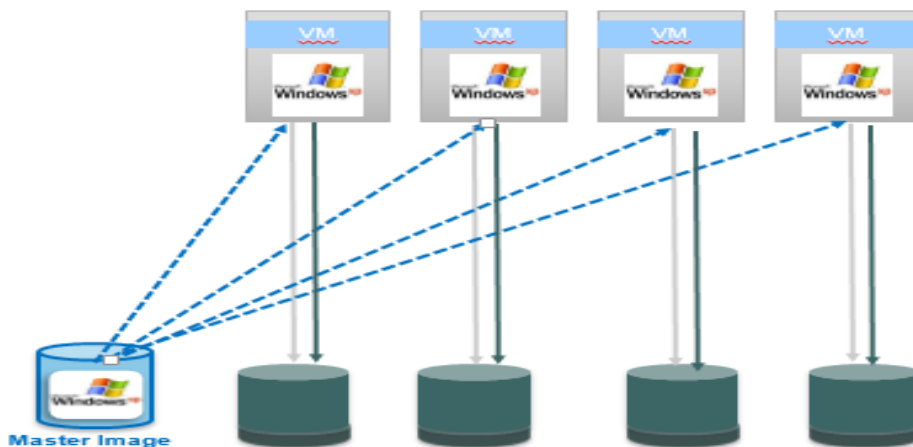


Figure 4 : System Disk Linked Clone of VMs (source from the project doc)

- **Reduced network reconstruction costs**

Only 2 Mbit/s management network bandwidth is required between branches and the headquarters. In case of remote access, high bandwidth is required.

➤ **Optimal experience**

Local resources (including servers, storage devices, network devices, virtualization platforms, and desktop management systems) are provided for branches. Users locally access the desktop cloud system, ensuring good service experience. In addition, local access is not affected even when the network between branches and the headquarters is interrupted.

➤ **Unified O&M management**

VDIs of branches and the headquarters are centrally managed and maintained, ensuring **standards compliance** of desktops the below figure shows how it is constructed.

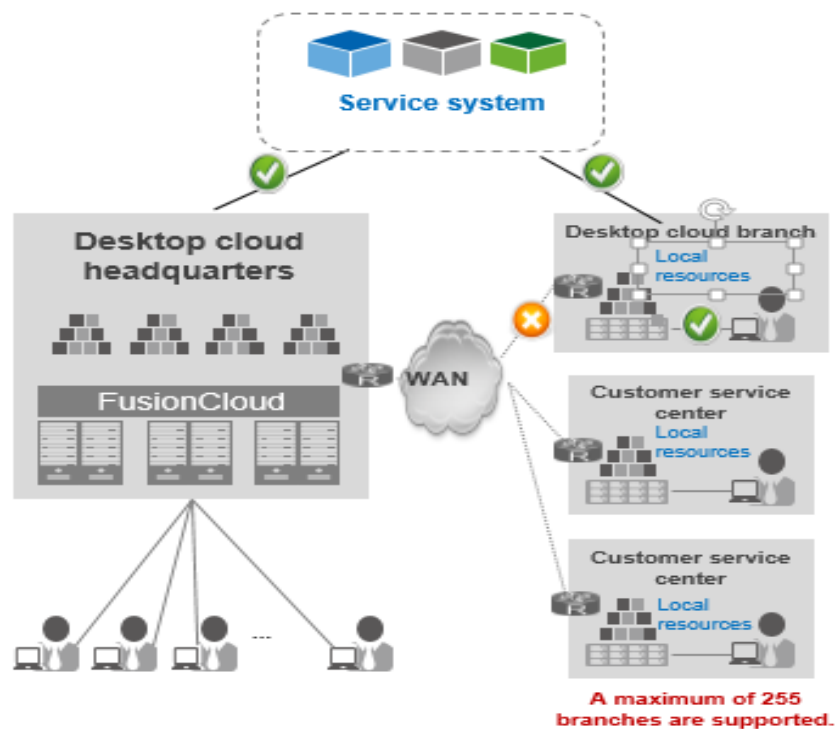


Figure 5 : Distributed Hardware Architecture: Local Access of Branches (source from project management section document)

2.7. Related work

Many efforts has been done to change the previous way of doing IT related works with cloud computing technology. Some of the researches related to this effort are Open Flow for Resource Placement of Virtual Desktop Cloud Applications (Calyam P. e., 2013). This research was conducted at the University of Missouri. Popular applications such as email, photo/video

galleries, and file storage are increasingly being supported by cloud platforms in residential, academia and industry communities. The next frontier for these user communities will be to transition ‘traditional desktops’ that have dedicated hardware and software configurations into ‘virtual desktop clouds’ that are accessible via thin-clients. In their research, they describe an intelligent resource placement framework for thin-client based virtual desktops. The framework leverages principles of software defined networking and features a ‘unified resource broker’ that uses special ‘marker packets’ for: (a) “route setup” when handling non-IP traffic between thin-client sites and data centers, (b) “path selection” and “load balancing” of virtual desktop flows to improve performance of interactive applications and video playback, and to cope with faults such as link-failures or Denial of- Service cyber-attacks. In addition, the researchers detail their framework implementation within a virtual desktop cloud (VDC) setup in a multi-domain Global Environment for Network Innovations (GENI) Future Internet test bed spanning backbone and access networks. They present empirical results from their experimentation that leverages Open Flow programmable networking, as well as perfSONAR instrumentation-and-measurement capabilities for validating the framework in GENI under realistic settings. The results demonstrated the importance of scheduling regulated measurements that can be used for intelligent resource placement decisions. The output of their work also show the feasibility and benefits of using Open Flow controller applications for path selection and load balancing between thin-client sites and data centers in VDCs.

The other related work done to see the effectiveness of cloud computing was Cost-Benefit Analysis of Cloud Computing versus Desktop Grids (Kondo, 2009). Adoption of cloud computing platforms and services by the scientific community is in its infancy as the performance and monetary cost-benefits for scientific applications are not perfectly clear. This is especially true for desktop grids (aka volunteer computing) applications. They compare and contrast the performance and monetary cost-benefits of clouds for desktop grid applications, ranging in computational size and storage. The researchers also address the following questions: (i) what are the performance tradeoffs in using one platform over the other? (ii) What are the specific resource requirements and monetary costs of creating and deploying applications on each platform? (iii) In light of those monetary and performance cost-benefits, how do these platforms compare? (iv) Can cloud computing platforms be used in combination with desktop

grids to improve cost effectiveness even further? They examine those questions using performance measurements and monetary expenses of real desktop grids and the Amazon elastic compute cloud.

The researchers determined the cost-benefits of cloud computing versus volunteer computing applications. They calculated VC overheads for platform construction, application deployment, compute rates, and completion times. They found that in the best-case scenario, hosts register at a rate of 124 cloud nodes per day. The researchers found that the ratio of volunteer nodes needed to achieve the compute power of a small EC2 instance is about 2.83 active volunteer hosts to 1.

They detailed the specific costs of a large and small VC project. The researchers find that monthly VC project costs range between 5K-12K, and startup costs range from 4K to 43K. If cloud computing systems are to replace VC platforms, payper-use costs would have to decrease by at least an order of magnitude. With these performance and monetary cost-benefits in mind, they compared the two platforms and find that at least 1404 volunteer nodes are needed before VC becomes more cost effective in terms of cents per FLOP. Nevertheless, the cost of a 1000-node cloud will exceed that of VC system after three days. They also find that 4 months on EC2 with 1000 nodes can support over a year of SETI@home.

The researchers also examined the size of a cloud platform sustainable by VC costs. With 12K per month, SETI could purchase a maximum of 2 TeraFLOPS sustained over a month with High CPU instances. They also consider hybrid approaches where a VC server is hosted on a cloud to lower the start-up and monthly costs. The savings ranges between 40-95% depending on resource usage. In general, if bandwidth needs do not exceed 100Mbit and storage needs are less than 10TB's, hosting a server on a cloud is likely cheaper than conducting a project on one's own. Server bandwidth on cloud is particularly expensive. The researchers have made available online their Excel file so that scientists can determine themselves their own project cost benefits. Also, to allow users to quickly and easily deploy a BOINC server on EC2, they have created an Amazon Machine Image (AMI) with a BOINC server pre-installed and configured.

The other related research done was a benchmarking toolkit for thin-client based virtual desktop environments (Berryman, 2010). There is a very fast recent advances in thin client devices and the push to transition users' desktop delivery to cloud environments this will eventually transform how desktop computers are used today. This research was done to measure and adapt the performance of virtual desktop environments is a major challenge for "virtual

desktop cloud” service providers. In this paper, the researchers present the “VDBench” toolkit that uses a novel methodology and related metrics to benchmark thin-client based virtual desktop environments in terms of scalability and reliability. The researchers also describe how they used a VDBench instance to benchmark the performance of: (a) popular user applications (Spreadsheet Calculator, Internet Browser, Media Player, Interactive Visualization), (b) TCP/UDP based thin client protocols (RDP, RGS, PCoIP), and (c) remote user experience (interactive response times, perceived video quality), under a variety of system load and network health conditions. So that results can help service providers to mitigate overprovisioning in sizing virtual desktop resources, and guesswork in thin client protocol configurations, and thus obtain significant cost savings while simultaneously fostering satisfied customers. In their work, the researchers presented a virtual desktop performance benchmarking toolkit viz., “VDBench,” which is used to simulate thin client user activity profiles and analyzes resource consumption characteristics.

The toolkit uses a combination of novel methodologies to automate scalability testing of server side hardware and reliability measurement of the network utilization of multiple display protocols using slow-motion benchmarking at different network health conditions. This research is unique as it is one of the few studies investigating the impact of increasingly constrained memory and network health conditions on the performance of various application tasks in a virtual desktop cloud environment. In contrast to slow-motion benchmarking studies previously conducted, the researchers used server-side monitoring of the network to characterize the level of bandwidth required in order to deliver an optimal user experience under non-ideal network health conditions. The study also investigated the CPU utilization in a variety of application tasks. By combining these CPU characterizations with memory and thin-client bandwidth related metrics, they were able to circumscribe the kind and amount of resources required to deliver adequate performance (i.e., satisfied user experience) for both individual applications as well as entire user groups. With the use of these benchmarking methodologies and metrics developed in the VDBench toolkit, service providers looking to deploy thin-clients based virtual desktop clouds will be able to greatly reduce the amount of costly guesswork and overprovisioning commonly encountered in this domain.

The other research done was on Efficient Resource Management for Virtual Desktop Cloud Computing (Deboosere L. V., 2012). In virtual desktop cloud computing, user applications are executed in virtual desktops on remote servers. This brings great advantages in terms of usability. The concept of virtual desktop cloud computing is very attractive for several reasons, for example, lower client hardware investments are required, end-user is no longer bothered with regular updates and often difficult installation and configuration of applications or anti-virus software, lower IT management costs for companies thanks to central management of desktops and applications. Furthermore, since the processing power of servers in the network is used, virtual desktop cloud computing enables access to advanced applications (e.g., computer aided design (CAD) applications) from any device, for example from a tablet PC. Mobile users would no longer need to use restricted mobile versions of their applications and resource utilization; however, handling a large amount of clients in the most efficient manner poses important challenges. Especially deciding how many clients to handle on one server, and where to execute the user applications at each time is important. The research shows that assigning too many users to one server leads to customer dissatisfaction, while assigning too little leads to higher investments costs. The below figure shows the system architecture to support remote desktops in a cloud.

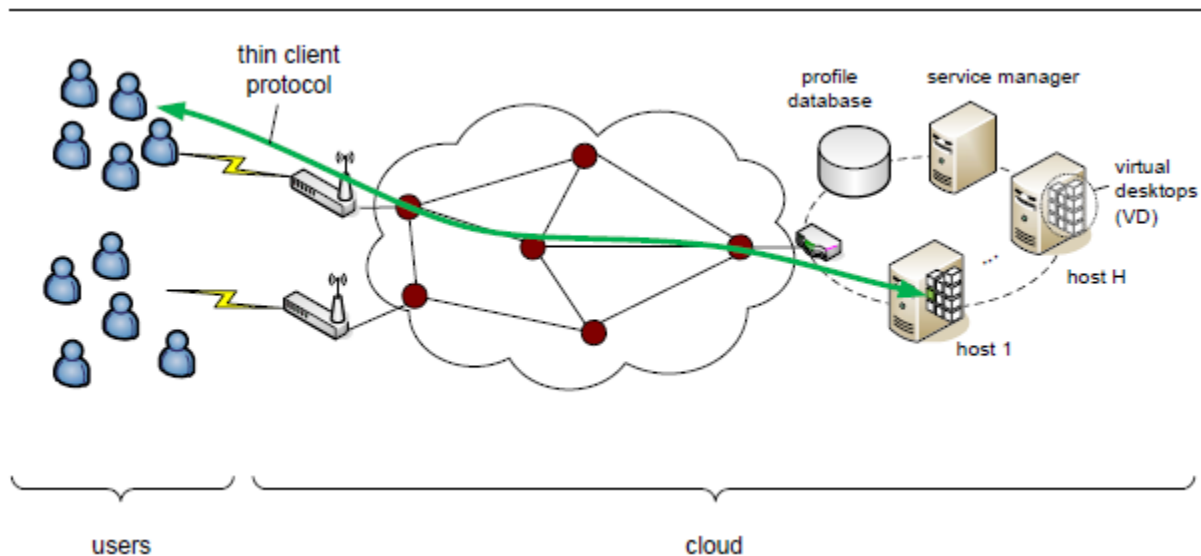


Figure 6: System architecture to support remote desktops as a cloud service

The researchers study different aspects to optimize the resource usage and customer satisfaction. The results of the paper indicate that the resource utilization can increase with 29% by applying the proposed optimizations. Up to 36.6% energy can be saved when the size of the online server pool is adapted to the system load by putting redundant hosts into sleep mode. In virtual desktop computing, a major part of computation and storage components are shifted from the client device (e.g. desktop PC, laptop, PDA or smartphone) to the network. User applications are executed in a virtual desk top (VD) on a remote server and the client device only deals with user interaction and the presentation of the audiovisual output.

The other work done is PC vs. Thin Client. Economic Assessment (Fraunhofer, 2007). In this research the researchers compare managed pc unmanaged pc and thin client by doing this they have founded many advantages of using thin client. Some of this advantages is for the environment, and the budget, is that the service life of thin clients - 60 months - is much longer than that of traditional personal computers (36 months). IT produces around 600 million tons of CO2 a year, accounting for 2% of global emissions (Fraunhofer, 2007). To offset this would need around 60 billion trees. This is why pressure is growing on companies and the IT industry. Originally a cost factor, environmental protection is now coming to the fore as an argument in its own right: (Fraunhofer, 2007). Aspects like employee productivity (see above), boot time - the time before the user can work productively - and electricity consumption are relevant to the customer. Based on a customer scenario, a study by the Fraunhofer Institute also indicated significant cost savings as shown in the below figure.

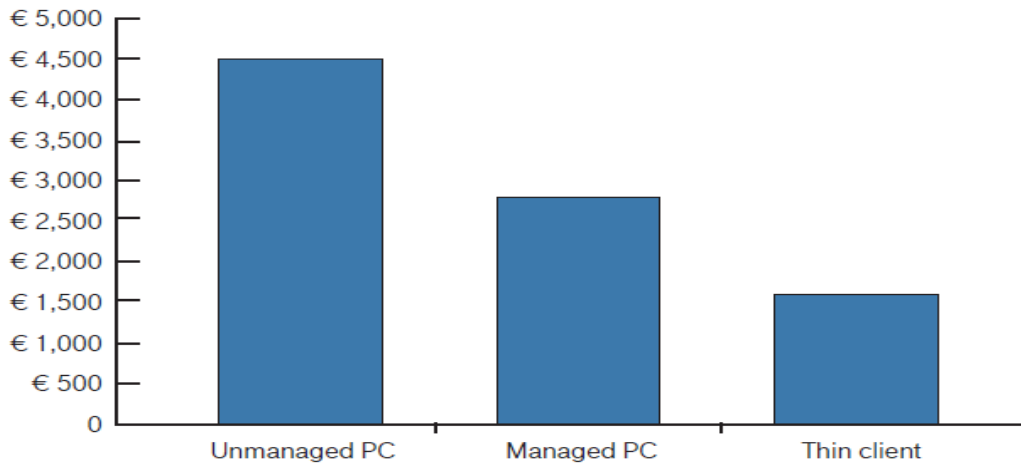


Chart 3: PC vs. Thin Client. Economic Assessment. (Source: Fraunhofer, thin client economic assessment)

The other work done on cloud computing is A Cloud Computing Framework for Ethiopian Banking Industry (Abera, May 2013). In this research the researcher studies the overall system architecture and its elements that form collaborative Cloud infrastructures in banking sectors, and best practices on cloud-based service implementations from the early adopter banks in the world also explored on the study.

The researcher also studies the advantages of cloud computing for banking sectors, the limitations of current ICT usages in EBI were briefly discussed in the researcher’s paper. Also, an alternative solution to the current ICT utilizations limitations in EBI is given. The study proposed Hybrid Cloud Computing model. The result shows that the proposed cloud computing service framework can have a capabilities for reducing IT investment cost and management complexity, efficient IT utilization for delivering banking services and improve collaboration among partners.

CHAPTER 3

METHODOLOGY

3.1. INTRODUCTION

The focus of this thesis is to analyze and find the impact of Desktop cloud computing at Ethio telecom. This helps to identify the challenges and issues of the previous way (using standard desktops) of handling call center activity and also the new implemented desktop cloud computing impact to the work, to know user perspective about desktop cloud computing and what they were expecting from the system. To do this it requires the use of an appropriate research methodology to gather the necessary information for accurate analysis of the situation. Research designs are plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. Research designs are types of inquiry within qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research design.

To conduct this research and achieve the specific and general objectives of the study and answer the research questions, the following methods are used. Survey method is selected because the broad area of survey research encompasses any measurement procedures that involve asking questions from respondents. A "survey" can be anything from a short paper-and-pencil feedback form to an intensive one-on-one in-depth interview. Therefore qualitative research method is applied in this research.

4.2. Research Approaches

Quantitative Designs

In natural sciences and social sciences, quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques. The objective of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships. During the late 19th and throughout the 20th century, strategies of inquiry associated with quantitative research were those

that invoked the post positivist worldview and that originated mainly in psychology. These include true experiments and the less rigorous experiments called quasiexperiments (see, an original, early treatise on this, Campbell & Stanley, 1963). An additional experimental design also applied behavioral analysis or single-subject experiments in which an experimental treatment is administered over time to a single individual or a small number of individuals (Cooper, Heron, & Heward, 2007; Neuman & McCormick, 1995). One type of non-experimental quantitative research is causal-comparative research in which the investigator compares two or more groups in terms of a cause (or independent variable) that has already happened. Another nonexperimental form of research is the correlational design in which investigators use the correlational statistic to describe and measure the degree or association (or relationship) between two or more variables or sets of scores (Creswell, 2012). These designs have been elaborated into more complex relationships among variables found in techniques of structural equation modeling, hierarchical linear modeling, and logistic regression. More recently, quantitative strategies have involved complex experiments with many variables and treatments (e.g., factorial designs and repeated measure designs). They have also included elaborate structural equation models that incorporate causal paths and the identification of the collective strength of multiple variables.

Survey research

Provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population. In essence, survey researchers ask the participants (who are often called respondents in survey research) to report directly on their own thoughts, feelings, and behaviors. It includes cross sectional and longitudinal studies using questionnaires or structured interviews for data collection with the intent of generalizing from a sample to a population (Fowler, 2008). The term survey is often used to mean 'collect information.' This method is used for this research of impact analysis of desktop cloud computing at ethio telecom.

Qualitative Designs

Qualitative research is a form of social inquiry that focuses on the way people interpret and make sense of their experiences and the world in which they live. The historic origin for qualitative research comes from anthropology, sociology, the humanities, and evaluation. Books have summarized the various types, and complete procedures are now available on specific qualitative inquiry approaches. For example, Clandinin and Connelly (2000) constructed a

picture of what narrative researchers do. (Moustakas, 1994) discussed the philosophical tenets and the procedures of the phenomenological method; (Charmaz, 2006), (Corbin and Strauss 2007), and Strauss and Corbin (1990, 1998) identified the procedures of grounded theory. Some Advantages of qualitative research are:-

- In depth examination of phenomena
- Uses subjective information
- Not limited to rigidly definable variables
- Examine complex questions that can be impossible with quantitative methods
- Deal with value-laden questions

Due to the characteristic of the research which is impact analysis, qualitative research method is used for this research.

4.3 Methods of Data collection

Questionnaire: The focus of questionnaire is to identify the impacts of desktop cloud computing from different perspectives, whether they would like such a system and how beneficial it would be to them. The scope of the questionnaire included assessing people's knowledge on desktop cloud usage, assessing people's observations and reservations about the service platform. The questionnaire also aimed at obtaining information about people's opinions on what the factors are that are hindering the effectiveness of desktop cloud computing in call center. And also, obtained information about the services or features desired, and what would facilitate the wide acceptance of the system as a convenient alternative in ethio telecom.

Interview: Here, person-to-person interviews with some respondents with special knowledge, such as technical supports (technical administrators), finance experts and many others, were conducted in order to gain a professional perspective about the impact of desktop cloud computing.

Observation: Observation method is used by researchers in a variety of ways. It provides researcher with ways to check for nonverbal expression of feelings, determine who interacts with whom, grasp how participants communicate with each other, what the work environment looks like and check for how much time is spent on various activities (Jopp, 1996). Participant

observation allows researchers to check definitions of terms that participants use in interviews, observe events that informants may be unable or unwilling to share when doing so would be impolitic, impolite, or insensitive, and observe situations informants have described in interviews, thereby making them aware of distortions or inaccuracies in description provided by those informants. Observation as a method is to develop a holistic understanding of the phenomena under study that is as objective and accurate as possible given the limitations of the method

3.3.4. Literature review

Extensive literature review is conducted about the impact of desktop cloud computing being used at different parts of the world and its associated challenges and prospects. Information from published and unpublished sources including journals, textbooks, periodicals, government publications, the internet as well as reports and official documents from ethio telecom served as secondary sources of data.

3.4 Sampling

Defining the target population is an important step in designing a research. A non-probability sampling techniques was used in this research. A core characteristic of non-probability sampling techniques is that samples are selected based on the subjective judgment of the researcher, rather than random selection (i.e., probabilistic methods), which is the cornerstone of probability sampling techniques. Non probabilistic sampling is chosen for this research, because respondents require specific technical knowledge as well as financial information to answer the questions. Legehar site was chosen and questionnaires were distributed to direct users of the system and the managers. The total population of legehar site advisors is 300, technical supports 6 and managers are 4. The samples of respondents (30 respondents for questionnaire from the users, (advisors) and 10 respondents for expert's interview (technical supports plus managers) actually represent the population who are either users or non-users of the system. The questionnaires consist of open ended and close ended questions and were used in order to have a proper understanding, accurate and genuine information of the subject matter; the open-end questions allow respondents to give their opinions. Table 1 shows the questionnaire and interview sample number from the whole population.

	Total population	Sample from the population	Remark
Questionnaire	300	30 for questioner	Users (advisors)
Interview	300	10 for interview	Technical support 7 Managers 3

Table 1: Total population and sample size

3.4.1 Data Collection Methods

Data for the study was collected from both primary and secondary sources because using multiple sources of data reduces the peculiar biases of each one. The primary data sources that exist are observations, personal interview and questionnaires where secondary data can be conducted from different sources

3.4.2 Primary Data collection

The research applies survey method.

- Respondents: sample from the population
- Mode: *Questionnaire, observation and Interview*
- Method: *Qualitative*

3.4.3 Respondents

- **The users** in this research there are three groups of respondents, the users who are the first vulnerable to see the benefit and the disadvantage of the new desktop cloud system, they also can compare with the previous way of handling day to day tasks.
- **The technical administrators(technical support)** the administrators are the one who keep the system up and running 24/7 before ethio telecom changes to desktop cloud computing and after implementing it, therefore the researcher finds key areas of impact on the overall process of the system which helps to do the analysis.

- **The management** from cost efficiency and effectiveness point of view managers provide a higher level of report on the impact of the system

CHAPTER 4

Data Analysis and Results

4.1 Introduction

This chapter presents the analysis of data and discusses the results of the study obtained from the questionnaires that were distributed to respondents, observation and interviews conducted in studying the impact of desktop cloud computing in Ethio telecom.

4.2 Respondents Demographic Characteristics

The frequencies were used to determine how often respondents made a certain response in answering questions, and allows general information about the information collected to be analyzed. The demographic detail shows gender, age, education, and occupation.

4.2.1 Gender

Gender is an important variable in the adoption of technology. Out of the 30 contact center advisor respondents that took part in the questionnaire study, 18 were male and 12 of them were female. From 10 technical interview respondents, 7 were male and 3 of them were female. Hence more male employees are using and supporting the old and the new system than females as indicated by Table 2.

Gender	Frequency	Percentage
Male	25	62.5%
Female	15	37.5
Total	40	100%

Table 2 Gender of Respondents

4.2.2 Age

Age is a key variable that influences the ability and capacity of people to embrace new technology, events or conditions to understand the difference in depth from experience and different life challenges. Respondent's age determines his/her interest in adopting new technology and comparing it with the old methods of handling daily tasks. As shown in Table 2,

customers within the age group 26-35 formed the majority of respondents willing to explore the impact analysis of the new services; the least group being those of 46-55 and above 55 age group. The age frequency distribution is shown in Table 3.

Age	Frequency	Percentage
20-25	4	10%
26-35	32	80%
36-45	4	10%
46-55	0	0%
Above 55	0	0%
Total	40	100%

Table 3 Age of Respondents

4.2.3 Level of Education

Education is a crucial variable that helps in the understanding and application of basic concepts, principles and regulations. Most of the respondents had attained some level of tertiary/university education. Table 4 shows the level of education of respondents. As indicated in Table 4, 10 % of the respondents indicated they had up to Diploma level education. The Majority of the respondents (70%) were Degree holders while 20% have MA/MSc.

Level of education	Frequency	Percentage
Diploma	4	10%
Bachelor	28	70%
Masters	8	20%
Doctorate	0	0%
Other	0	0%
Total	40	100%

Table 4 Level of Education of Respondents

4.2.4 Field of study

The field of study distribution of the respondents differs from one another. Field of study matters in the views of the respondents Table 5 reflect that the highest number respondents are computer science graduates (52.5%) which helps to get the impact of the system from technical point of view. The second highest percentage of respondents are management graduated this also helps to see it from management point of view. Engineering respondents are 10% and these are from the technical teams which were participants and supporters of the system. They have both the older and the new system experiences. The remaining percent of respondents are from different field such as economics. Table 5 shows the field of study distribution.

Field of study	Frequency	Percentage
Management	12	30%
Engineering	4	10%
Computer science	21	52.5%
Other	3	7.5%
Total	40	100%

Table 5 Field of study distribution of respondents

4.3 Findings

Questionnaires were distributed to 30 respondents which are direct users of the system within targeted groups. Interviews are conducted with 10 respondents, where 7 of them are technical experts and 3 are technical managers *who* responded positively towards the impact of desktop cloud computing. Table 6 shows the distribution also all the questionnaire and interview questions are attached in the Appendix.

Group	Questioners	Interview Questioners
Experts	0	10
Users	30	0
Total	30	10

Table 6 Questionnaires and Interview Distributions

4.3.1. Findings from Users

Questionnaires were distributed to respondents within targeted groups at Legehar contact center. The respondents include any employee who has worked both with the old pc based and the new desktop cloud system at the call center. The reason for choosing Legehar site is because only legehar site has implemented cloud desktop computing as a pilot test. Therefore, the need to go to other ethio telecom contact center sites is not found to be necessary. Several questions were constructed based on the objectives of the research work. All the 30 respondents confirmed that the new desktop cloud computing system is much better than the old one in minimizing work load. The reasons they give for choosing the new system is described in detail below.

➤ ***In terms of speed***

The new cloud system is fast to login if network is okay, to open the window, to open the different applications which are installed to serve the customers. Therefore they are able to give services for more customers than the previous one. The older system had very low speed to operate and takes long time to login and also sometimes freezes which is related to capacity issue.

➤ ***In terms of user satisfaction***

The respondents feedback related to user satisfaction is positive towards desktop cloud. Due to the speed and faster login logout time they stated that they are using their time appropriately to serve the customers. But in the previous pc based system, since the desktops sometimes gets, or becomes busy, unable to logging and logout quickly making users unable to handle the expected number of customers. Due to this advisors were not able to handle as many customers as expected from them which is a measurement in there KPI there was a rush to maintain there KPI without considering the customers satisfaction or service quality.

➤ ***In terms of storage***

The respondents are very excited about the storage capability of the new system. When compared to the older system, desktop cloud computing has solved storage capacity issue since all the data is stored centrally in the server (storage). Whereas in the old pc based system, all data need to be stored on local hard drive. This used to make the system very slow and also there was space problem.

4.3.2. Findings from the technical and management teams

Expert professionals are those people in charge of managing, deploying and supporting the new desktop cloud services. From the interviews conducted with these experts, it has been understood that as long as Network is okay the service is better than the old pc based systems. As the respondents said even if it needs finance to build the system the outcome they get in terms of employee and customer satisfaction is beyond measure. One thing they raise as a problem is network issue. The system is shifted to cloud desktops but the network infrastructure is not yet upgraded. In desktop cloud computing the thin client serves only as VGA. Nothing is operated on the individual thin client. Instead the network is the medium connecting the thin clients with the server and which brings all the applications and the data to the advisor. Therefore, even though desktop cloud computing has got many features that can increase efficiency and effectiveness, due to network problem they are sometimes facing problems that can decrease the systems efficiency and effectiveness.

4.3. Data analysis from the Interviews

This section presents analyzing of the data from the interviews conducted. Valuable information and documents were provided by the experts during the interviews to expatiate on answers relevant to the questions posed. The interviews were semi structured. The interview questions began with a range of questions related to the technical and financial aspects of the new and the old systems. The data is analyzed in the following sections covering the issues of financial, security, performance and work environment impacts.

➤ *In terms of management*

The respondents stated that compared to the old pc based system, desktop cloud computing can be managed easily by using fusion computing and fusion access centrally. In fusion access they can manage ITA, VM status, active directory, DNS, DB, license, HDC, loggeter and so on. It is also possible to see how many users are currently online and how many are offline.

➤ *In terms of Finance*

All the 10 experts interviewed confirmed that even if the cloud desktop computing has initial investment cost compared to the old pc based system, the advantages in customer and employee satisfaction, service quality and consistency are greater than its cost. In the last pc based system there was desktop, processor, dividers, maintenance team (human resource)

cost. Also the new system saves power since there is no processor, RAM, CPU are not within the thin clients but inside the servers centrally stored in the data center.

➤ ***In terms of Work environment***

The respondents affirmed that the working environment after deploying desktop cloud computing is very attractive and neat. This is due to the absence of dividers, processors and electric circuits on the ground. Moreover, since there is no heat coming out from the processor the room temperature is moderate which helps the employees to be in a good mood and concentrate on their work.

➤ ***In terms of Maintenance time***

Compared to the old system the frequency of incident or failure occurring at work is very low because it is managed centrally and the system administrator can manage all the clients' health at the same time. The old desktop based systems were different model desktops, mouse, monitor, processor capacity and storage capacity. This created many problems to occur on daily basis. Thus it takes a lot of time to fix the problems and requires different kinds of skills for the different platforms. This makes the time needed to fix the incident longer and it is a tiresome activity which is a challenge for the technical support.

➤ ***In terms of capacity***

When compared to the old pc based system the new desktop cloud system has got bigger and expandable capacity. This capacity includes number of thin clients (TC). For example, the license purchased up to now is for 1651 TC but the system can support up to 50,000 TC. Therefore whenever it is needed ethio telecom simply purchase license and more employees can work at the same time by configuring everything once on the fusion computing management. Moreover RAM and CPU capacity for each TC is flexible and can be adjusted (increased or decreased) as needed.

➤ ***In terms of technical advantage***

The technical respondents stated that the desktop cloud computing has got many technical advantages over the pc based system. One advantage is that when a new user is added, there is a need to individually configure pc, assign IP, install software, and install different applications,

antivirus and so on. But in the desktop cloud system simply by using fusion computing the system administrators can create a virtualized hardware, software, storage, network in batch to create a template. Available for Multiple end user and accessible via a web browser, Independent platform and No need to install the software on individual PC's. The below is some description about how it works.

- **IPCC:** Cloud use Fusion Sphere solution, which provides virtualisation capabilities that aggregate and present the host hardware, including CPU/Memory/NIC/Storage to virtual machines, as a normalized set of resources.
- **CPU:** Fusion Sphere virtualization solution allows a single physical processor core to behave like two or more logical processors. Fusion Compute hosts manage processor time intelligently to guarantee that load from VMs is spread smoothly across processor cores in the system.
- **Memory:** Fusion Compute virtualizes guest physical memory by adding an extra level of address translation. The VMM for each virtual machine maintains a mapping from the guest operating system's physical memory pages to the physical memory pages on the underlying machine.
- **NICs:** Fusion Sphere uses Distributed Virtual Switch (DVS) to provide network connectivity to hosts and virtual machines. Virtual machines use vNICs of port groups on the DVS, and port group use one or more physical NICs to handle their network traffic.
- **Storage:** Fusion Sphere uses data store to aggregate storage resources, Fusion Compute provides host-level storage virtualization, which logically abstracts the physical storage layer from virtual machines. A virtual machine uses virtual SCSI controllers to access virtual disks, and each virtual disk resides on a data store that is deployed on physical storage. Figure 7 shows how the virtual desktop management and access control communicate to facilitate the task which makes the management, the configuration and maintenance easy.

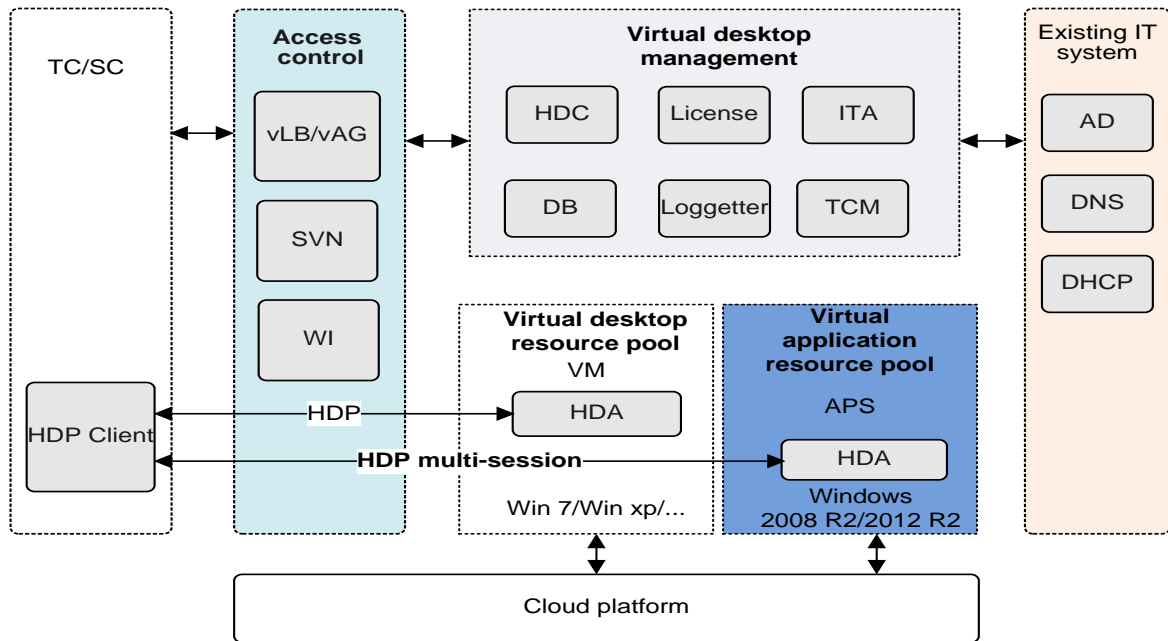


Figure 7 : Logical Architecture of Fusion Access (ethio telecom call center desktop cloud architecture)

➤ *In terms of security*

Data is stored centrally and can be accessed from any of the thin clients hence the data is now more secure than before. Because in the pc based system, if one pc is crashes or is corrupted then the probability of getting the data back may not be possible. But now since the data is stored centrally it is possible to get it back at any time when needed. The other security mechanism used in the new system is a firewall installed between the thin client and the Huawei Desktop controller. Figure 8 shows the security mechanism used to protect their data.

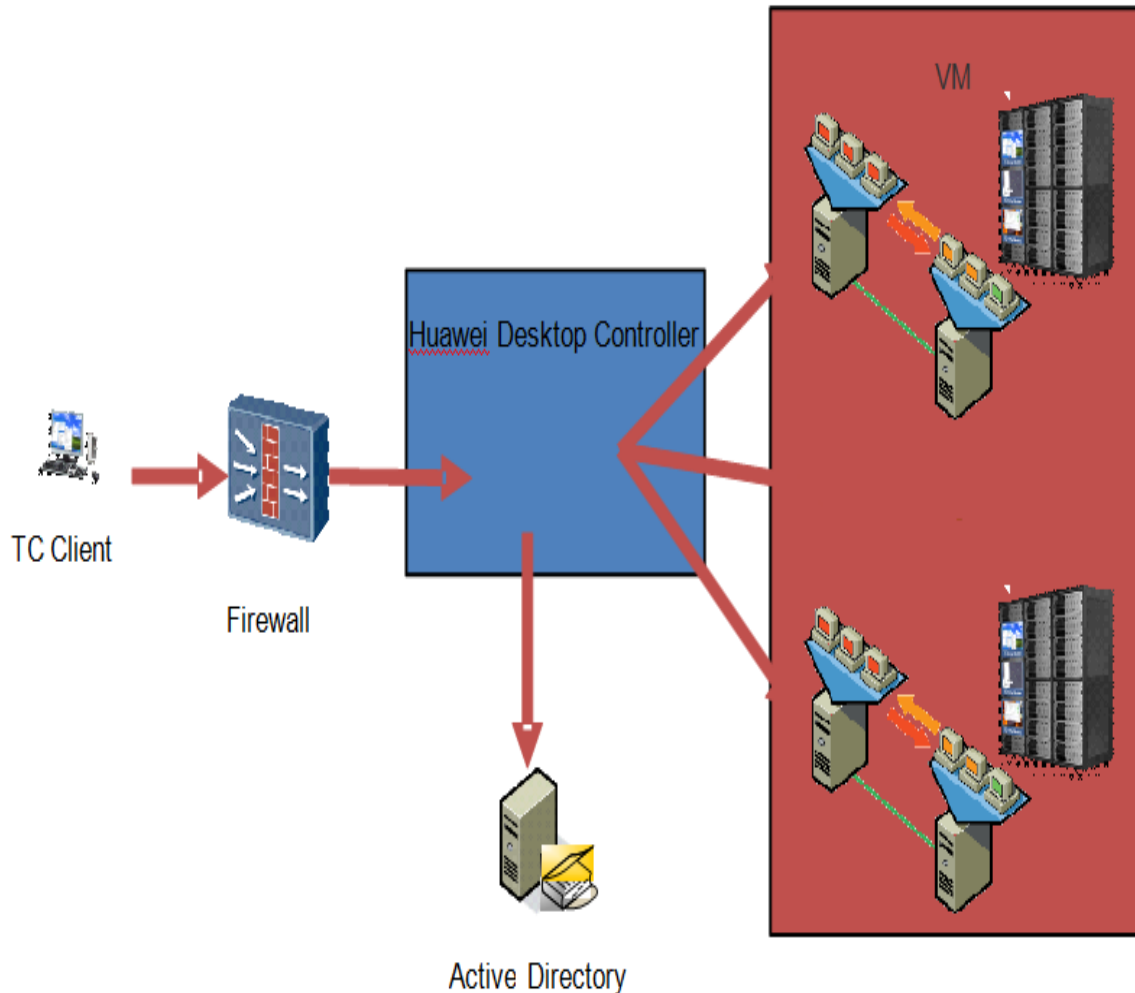


Figure 8: Security used for Call Center Desktop cloud computing (from the call center desktop cloud documents)

➤ ***In terms of Scalability and flexibility***

The constant change that the workstation and the environment are exposed to is a major time and cost factor for companies. This is particularly striking when new departments are set up. Thin clients offer clear advantages here. They can be configured quickly and made available as workstations in the minimum time. The programs and data reside on central servers, so no local installation and configuration is needed. Updates and the implementation of new applications are also simple to perform centrally, making them available immediately to all users. To compare and generalize the output in short, it is described in the table below.

Metrics	Distributed desktops	Desktop cloud
<i>speed</i>	Very low	High
<i>management</i>	Distributed	Centralized
<i>user satisfaction</i>	low	High
<i>storage</i>	Limited	Unlimited
<i>Finance</i>	Expensive	Expensive
<i>Work environment</i>	Uncomfortable	Calm
<i>Maintenance time</i>	longer	Very short
<i>technical advantage</i>	Configuration per PC	Centrally configured
<i>capacity</i>	Limited	Expandable
<i>Security</i>	Partially secured	Highly secured
<i>Scalability</i>	Takes time and energy	Easily Scalable

Table 7: Comparisons based on focused metrics

CHAPTER 5

5.1 Conclusions

The objective of this research was to analyze and assess the impact of the implemented desktop cloud computing and usage in ethio telecom specifically in customer service. To answer the general and specific objectives of the research survey method was used. From questioners, interviews and observation conducted and analyzed, the research concluded that, in the previous way of handling day to day tasks in call center the following problems were raised over and over again. These includes the issue of performance, data security vulnerability, high O&M costs, Resource inflexibility, power consumption, network inconsistency, storage capacity, speed , unable to login and logout , high power consumption and management problem.

But after implementing the new desktop cloud computing system most of the issues raised in the distributed pc based system are solved. Some of the positive effects of desktop cloud is the low power consumption of thin clients is the low level of noise and heat given off, the use of processors optimized for high performance and low consumption, the absence of a hard disk, high speed, enable fan less devices to be produced. In many cases, this increases the wellbeing and productivity of staff. Which increases the quality of services in many ways which was one of this research' main s questions.

Therefore we can conclude that using desktop cloud computing has many advantages and postive impacts. In this analysis which is made for ethio telecom , the research shows that contact center has get many advantages from the technology and its employees are enjoying it.

5.2 Recommendations

In spite of the fact that desktop cloud computing has initial financial investment, This research finding shows, compared to the many advantages that we get from using desktop cloud computing, the researcher recommend all ehtio telecom and also other organizations who have large number of employees working together in the same office to use this technology.

5.3 Future work

The researcher believes the outcome of this thesis will serve as inspirations for future works in the following areas:

- Readiness assessment on ethio telecom entrant network infrastructure to use desktop cloud system
- End to end simulation of Desktop cloud computing system through development of high end prototypes.
- Developing virtualized network for the desktop cloud system of call centers.

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APPENDIX

**ADDIS ABABA UNIVERSITY
COLLEGE OF NATURAL SCIENCE
SCHOOL OF INFORMATION SCIENCE**

The aim of the study in general and these questionnaires and interview in particular is **to know the impact of desktop cloud computing in the case of Ethio telecom .**

The research is undertaken as academic requirements **for the Degree of Master of Science in Information Science.** It also examines the impact level and the required desktop cloud computing and gives recommendations based on the final result of this research.

Please assist me in giving correct and complete information to present a representative finding. Finally, I confirm you that your response will be kept confidential and only used for academic purpose. Thank you in advance for your kind cooperation and dedicating your time

Sincerely

Lily kebede

Section 1 please mark “X ” on the given dash (——) to each of the question related to your personal profile

1. Your age group?

1, 20-25—— 2, 26-35 —— 3, 36-45 —— 4, 46-55—— 5, Above 55 ——

2. Sex

1, Male —— 2, Female ——

3. Educational status

1, Diploma——

2, Bachelor ——

3, Masters ——

4, Doctorate——

5, if Other, Please Specify—————

4. Field of study

1, Management——

2, engineering ——

3, computer science ——

4, if other, Please specify—————

5. The division that you are currently working in Ethio telecom

1, Information system ——

2, customer service ——

3, if other, please specify—————

6. Your current job title (position)

1, Staff ——

2, supervisor——

5, if other, please Specify—————

7. Your work experience in Ethio telecom

1, less than 5 years — 2, 5-10 years — 3, 11-15 years — 4, greater than 15 years ——

Section 2 please mark “X” in the box given to each of the question related to your work.

8. Have you worked with the previous method of handling day to day tasks at the call center?

1. Yes

2. No

9. If your answer for question Number 8 is yes, which one is better for you?

The previous one, why?

The new Desktop cloud computing, why?

10. Do you compare the new desktop cloud with the old one in minimizing work load?

11. How efficient is the new cloud system compared to the old one? (Efficiency in terms of time and effort)

12. Do you recommend desktop cloud computing for other sections at ethio telecom?

Yes, why? And which sections?

No, why?

13. Do you have any other comments, questions, or concerns?

Semi structured interview guide questions

1. Do you think implementing cloud desktop has financial impact? If yes how?
2. What is the technical advantage of implementing desktop cloud computing?
3. Is the current call center cloud computing secure? If yes, what are the security methods which are implemented to secure data?
4. Does the current call center cloud computing is efficient than the older method? If yes how?
5. Is the Desktop cloud computing easily manageable? If yes how?
6. Is the Desktop cloud computing easily maintainable? If yes how is it different from the Desktop pc based system?
7. Do you see any difference on the working environment after implementing Desktop cloud? If yes please mention it. For example in terms of efficiency, customer service, employee satisfaction, service availability, system resilience, system scalability system elasticity system utilization, service response time (delay) etc...

DECLARATION

I declare that this thesis is my original work and has not been presented for a degree in any other university.

Signature

Date

This thesis has been submitted for examination with my approval as university advisor.

Dereje Teferi (PhD)

