THE INFLUENCE OF NETWORK SERVICE RELIABILITY ON CUSTOMER RETENTION

by

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A field study submitted to the UFS Business School in partial fulfilment of the requirements for the degree

MAGISTER IN BUSINESS ADMINISTRATION

in the

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

at the

UNIVERSITY OF THE FREE STATE

SUPERVISOR: Dr Jacques Nel

DATE: May 2013

DECLARATION

I declare that this field study hereby submitted for the Magister in Business Administration at UFS Business School is my own independent work, and I have not previously submitted this work, either as a whole or in part, for a qualification at another university or at another faculty at this university. I also hereby cede the copyright to the University of the Free State.

Mohato Seleke

ACKNOWLEDGEMENTS

I wish to praise my Lord in Heaven for having given me the courage to persevere thus far and for having provided me with the strength to see this mammoth responsibility through. I also want to acknowledge my sincere gratitude to:

- My wife, Regina, and my boy, Mahase, for the undying love and support when I felt I could not carry on any more.
- My supervisor, Dr Jacques Nel, for having afforded me the opportunity to try even when I felt I was not worthy of his time any more. I take full responsibility for any shortcomings or weaknesses that can be identified in this field study. You did whatever you could in order to assist, especially within the constraints that I put you through. I will forever appreciate your patience and understanding.
- Professor Torterella at the University of Rutgers in the United States – for the valuable input and guidance pertaining to the material in Chapter 3 and 4 of this study, especially on drawing a subtle but crucial distinction between network reliability and network service reliability, without which this study could not have achieved its objectives. I thank you very much for having found time in your tight schedule to clarify an otherwise technically challenging subject matter to a complete stranger. Blessings to you!
- Friends and colleagues who have stood by me throughout this long journey.

ABSTRACT

This study aims to determine the influence of network service reliability on customer retention. The study identifies the network services or applications commonly used by the average user on the Internet. A framework for the measurement of the reliability of these network services is developed for third-tier internet service providers (ISPs). Because ISPs have limited flexibility in competitively up scaling the capacity of their physical networks, designing and delivering compelling value proportions to different ISP market segments will largely depend on network service reliability. The ability of the ISPs to optimise scarce resources and maintain reliable services may be critical to their future survival.

The study was conducted based on the corporate customers of both Datacom and Comnet. The customers used leased line, fixed wireless or dial-up as service delivery infrastructure (SDI). A structured questionnaire was administered to a stratified random sample of 97 respondents. Network service reliability was measured using the accessibility, continuity and fulfilment (ACF) framework. Customer retention was predicted using multiple regression.

The study revealed that network service reliability positively influences customer retention. It was found that 64% of the variability in customer retention could be explained by the level of reliability of services offered over ISP networks. Furthermore, corporate customer service experiences were found to be impacted by the network service delivery infrastructure used to connect the customer. Leased lines appeared to provide the most reliable services compared to fixed wireless and dial-up. In addition, email, direct user-to-user and internet link access were found to be significant predictors of customer retention.

These findings demonstrate the importance of network service reliability to the future of third-tier internet service providers. The study therefore recommends the implementation of service quality improvement programs by the ISPs. The research also points to the need for further research in the area of network service reliability improvements in telecommunications.

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ATM	– Asynchronous Transfer Mode
ARP	– Address Resolution Protocol
BER	– Bit Error Rate
CQR	– Communications Quality and Reliability
CDMA	– Code Division Multiple Access
DPM	– Defects Per Million
CoS	– Class of Service
DNS	– Domain Name Service
ISP	– Internet Service Provider
FTP	– File Transfer Protocol
FDDI	– Fibre Distributed Data Interface
HTTP	– Hypertext Transfer Protocol
ICMP	– Internet Control Message Protocol
IP	– Internet Protocol
ISDN	– Integrated Services Digital Network
NNP	– Network News Transfer Protocol
NIS	– Network Information Service

POP – Point of Presence

SMTP – Small Mail Transfer Protocol

SNMP – Simple Network Management Protocol

TCP – Transmission Control Protocol

UDP – User Datagram Protocol

IETF – Internet Engineering Task Force

IPLC – International Private (Leased) Line Circuit

IEPL – International Ethernet Private Line

ITU – International Telecommunication Union

ITU-T – ITU Telecommunications Standardisation Sector

MPLS – Multi Protocol Label Switching

MTBF – Mean Time Between Failures

MTTR – Mean Time To Repair

NGN – Next Generation Network

NRIC – Network Reliability and Interoperability Council

CTLV – Customer Lifetime Value

CVP – Customer Value Proposition

PSTN – Public Switched Telecommunications Network

QoS – Quality of Service

ETSI – European Telecommunications Standards Institute

IXP – Internet Exchange Point

IEEE – Institute of Electrical and Electronics Engineers

VoIP – Voice over Internet Protocol

CHAPTER ONE: INTRODUCTION

1.1 Background

The global internet architecture is essentially made up of three different types of network service providers. At the top of the hierarchy are global transit providers (GTP) which both connect to each other and provide connectivity to regional transit providers. The regional transit providers (RTP) also connect to each other and make network access available to a third group – access providers – commonly referred to as internet service providers (ISP) that directly connect end-users. Traditionally, these ISPs have been licensed based on whether they operate their own access network directly to the end-user, and are thus called first-tier or Class A ISPs. They have also been licensed based on whether they only rely on the network infrastructure of others in order to provide access to their customers; in which case, they are referred to as third-tier or Class C ISPs.

In a competitive market for internet (data) services, this arrangement tends to put third-tier ISPs in a strategic disadvantage as the telecommunications sector continues to liberalise and open up competition of retail space to all classes of service providers. As a consequence, the ability of third-tier ISPs to grow and retain customers becomes increasingly more difficult.

1.1.1 Network access challenges for ISPs in Lesotho

The Kingdom of Lesotho started a phased liberalisation of the telecommunications sector in the year 2000, with the establishment of the independent industry regulator, i.e. the Lesotho Telecommunications Authority (now called the Lesotho Communications Authority, LCA). The Lesotho Telecommunications Act of 2000, together with Lesotho's ICT policy of 2005 in particular, accelerated this process. The liberalisation culminated with the end of Telecom Lesotho's exclusivity (monopoly) on international internet bandwidth in February 2008. According to the Lesotho Communications Authority (2009:6), the uptake and use of fixed line telephony increased 29 times, mobile telephony increased 19 times while internet connectivity showed significant improvements in businesses during this period. Also, there was proliferation and adoption of a wide range of cost-effective data communication technologies such as WIMAX, ADSL, CDMA and 3G/EVIDEO, dominated by the two network operators: Telecom Lesotho/Econet and Vodacom Lesotho. In the meantime, the internet market structure changed significantly to a more concentrated oligopoly. Since 2008, the two network operators have competed with each other on the international bandwidth, access networks as well as directly on end-user internet space against three third-tier ISPs. These ISPs mostly run leased lines, limited fixed wireless networks and dial-ups. Along with international bandwidth, these network services are, by law, rented by third-tier ISPs from the network operators. Significantly, leased lines and dial-up technologies are declining market segments which are undergoing severe substitution effects from fiber, 3G, ADSL and a range of wireless technologies that are entering the market. The result is an increasingly concentrated oligopoly.

1.1.2 Network service reliability and customer retention challenges for ISPs

High market concentration tends to lead to abusive conduct by dominant players. In the case of Lesotho, this abusive conduct manifests itself in different ways. These include denying ISPs access to essential services such as ADSL service delivery infrastructure and vertical foreclosure; whereby ISPs are charged higher bandwidth prices compared to retail customers of the network operators.

According to the causal view of structure-conduct-performance paradigm, structure and conduct determine performance (Baye, 2010:253). Increasing concentration and abusive conduct by network operators imply deteriorating performance outcomes for ISPs. The change in the internet market structure has also produced a differentiated pricing structure between the network operators and the ISPs. While network operators generally provide usage-based billing services, ISPs offer flat-rate pricing. This pricing model tends to encourage heavy data usage, resulting in major congestion on ISP networks. The result is slow download speeds, delayed email delivery and intermittent throughputs. Consequently, ISP networks may appear unreliable to consumers. It then becomes ever more difficult to retain unsatisfied customers. This is because customer satisfaction is a necessary – though not sufficient – condition for customer retention. As West, Ford and Ibrahim (2010:507) argued, retention drives customer lifetime value (CLTV), which is imperative for the survival of ISPs. Under these circumstances and against generally well-capitalised network operators, ISPs tend to find it difficult to compete effectively in order to satisfy, win loyalties of, and retain customers. This may also imply that a business model based on the scale and scope of the physical network may not be a sustainable option for ISPs.

1.2 Research question

The telecommunications industry has undergone tremendous changes in the past decade – ushering new technologies, faster speeds and a wide product choice for consumers. The regulation of the sector has, however, not always been able to keep up with the pace of change, and in some cases, this has led to highly concentrated market structures. The case in point is the internet market in Lesotho. Two network operators control both access networks and the international gateway. Their competitors (third-tier ISPs) are, by law, denied rolling out their own national networks or to operate an international gateway for cheaper internet bandwidth. They have to rent out the network from the two network operators. The network operators have restricted access to a wide range of modern network and services from ISPs, except fixed lines for leased lines and dial-up, and limited fixed wireless links in the city of Maseru.

As consequence, ISPs rely mostly on largely expensive and slow mode of connectivity for their customers, which seriously compromises the experience of users over their rented networks. In an attempt to retain customers, almost all ISPs use unlimited, flat-rate billing instead of a usage-based method that is deployed on competitors' networks. The purpose is to keep data costs low and predictable for consumers. However, this system has not resulted in growth in, or retention of customers. On the contrary, it has led to heavier network usage. The result is network overload, which leads to serious congestion, which further degrades the user experience. This puts the perceived reliability of the services running on the network at stake. On top of this, and because these products (leased line and dial-up) have reached a decline phase in their life cycle, customers are also migrating in large numbers to operator networks for substitutable products such as fiber, ADSL, WIMAX for leased lines and 3G/EVIDEO for dial-up. This acceleration in the loss of ISP customers creates a serious management dilemma.

On the one hand, ISPs may chose to invest more in order to increase the capacity of their physical networks. This option is, however, limited by the constraints imposed by the Lesotho Telecommunication Act of 2000 which limits ISPs from renting out network infrastructure or rolling out limited fixed wireless networks within Maseru CBD. Customer retention may still prove difficult, especially against faster and more affordable substitute technologies. On the other hand, ISPs may opt to concentrate more on *improving reliability of services* that are running over their physical networks. In particular, this option involves identifying and improving network service reliability factors that customers care about.

Thus, the research question is: What network service reliability factors must third-tier ISPs address in order to retain customers?

1.3 Objectives of the field study

1.3.1 Primary objective

The primary objective of this field study was to determine the influence of network service reliability on customer retention.

1.3.2 Secondary objectives

(a) To identify the measurement framework for network service reliability from literature.

(b) To identify network services that are commonly used by ISP internet users from literature.

(c) To test the influence of network service reliability on customer retention by means of an empirical study.

(d) To make recommendations on network service improvements to ISPs.

1.4 Research methodology

1.4.1 Study population

The study population consisted of corporate customers of two third-tier ISPs within a 15-km radius from Maseru Central Business District (CBD). The ISPs were Datacom (Pty) Ltd and Comnet Lesotho. This excluded individual internet subscribers of network operators or other service providers. The population was collected from the register of the Lesotho Internet Service Provider Association (LISPA) and aggregated by the researcher. This was easier to compile within a short distance, and thus, proved to be cost-effective for the researcher.

The study population was made up of only three types of internet connectivity options common to all ISPs, namely leased lines, fixed wireless and dial-up. This helped to provide strata made of distinct, homogeneous and exhaustive subgroups. The study population was made up of 198 organisations.

1.4.2 List of respondents

The respondents comprised customers who used leased line, dial-up or fixed wireless internet services. These were generally the only types of connectivity common to 3rd tier ISPs that were used for corporate customers during the time of this study.

1.4.3 Sampling

In this study, stratified random sampling was used. These strata were determined based on the proportional representation of each internet connectivity type in the population from the LISPA register. The strata were proportionally allocated as follows:

- Leased lines: 70.2%
- Dial-up: 12.1%
- Fixed wireless: 17.7%

The sample size of 97 organisations was determined by use a sample calculator at a 95% confidence level. The final stratification is shown in Table 1.1.

Table 1.1: Final stratification of two third-tier ISP connectivity types in Maseru CBD

Stratum	Population: 198	Sample size: 97
Leased Line	70.2%	68
Fixed Wireless	17.7%	17
Dial-up	12.1%	12
Total	100%	97

1.4.4 Data collection

The data was collected using a structured questionnaire with both closed- and open-ended questions. In order to improve quality and responsiveness, the questionnaire was targeted towards staff members who either held Information Communications Technology (ICT) qualifications and or acted as contact people for ICT-related queries at their work places. These staff members were understood to be in a position of providing 'representative' feedback on the perceived reliability of their internet services. They both provided in-house support and interacted with ISPs in troubleshooting internet problems. Their opinions were understood likely to be more informed about the overall service reliability than simply being a typical office user with no similar overall responsibilities at work. Also, they normally are the ones who provide a recommendation to management on whether contracts with ICT service providers should be renewed or not.

However, it normally took much longer to complete the interview due to the technical nature of the questionnaire. Further, some bias might have been introduced during clarifications. Significantly, it could be that the overall purpose of the study may have been compromised by failing to gauge the perceptions of the individual users on the reliability of the network services. This would have, however, necessitated stratified complex samples of individual users in each organisation. Subject to the time and budget constraints of the study, the responses were complete; and overall, they were considered adequate and comprehensive.

1.4.5 The questionnaire

The questionnaire was made up of five sections: A, B, C, D and E, using various measurement scales. The questionnaire is attached as Annexure A.

1.4.5.1 Layout

Section A: Demographic variables

This section covers demographic data such as type of organisation, age, gender, and the education level of the respondents.

Section B: Accessibility of internet services

The respondents answered questions relating to their perceptions about the reliability of accessing a particular network service at work over the past 30 days.

Section C: Continuity of internet services

The respondents answered questions relating to their perceptions about the reliability of continuing to use a particular network service at work, once connected at work, over the past 30 days.

Section D: Release/fulfilment of internet services

In this section, the respondents answered questions relating to their perceptions about the reliability of being able to log out or close off successfully a particular network service at work over the past 30 days.

Section E: Retention

The respondents rate the overall perceptions about the reliability of network services on a 7-point Likert scale and their likeliness to renew the current internet contract.

1.4.5.2 Measurement

Different measurement scales were used for various constructs in the study questionnaire. For instance:

- Type of organisation: categorical
- Gender: Binary, M = 1 for male and F = 0 for female
- Reliability (accessibility, continuity, Fullfilment): ratio – between 0 and 1
- Intention to renew contract (repurchase): interval – 7-point Likert from 1 = strongly disagree to 7 = strongly agree

The data was collected over a period of four days.

1.4.6 Data analysis

The data was analysed using PSPP – a free open source statistical software.

1.5 Ethical considerations

There is complete anonymity for both the internet service providers and their customers who are taking part in this study, in the analysis. The parties involved were advised about the nature of the research and that it is for purely academic purposes.

1.6 Limitations of the field study

The study covered only corporate customers of two Lesotho third-tier internet service providers from February to December 2012. It was only for customers that used leased lines, fixed wireless and dial-up services. It only covered organisations within a 15-km radius from Maseru CBD. Also, bias might have been introduced during clarifications. Significantly, perhaps the overall purpose of the study may have been compromised by failing to gauge the perceptions of the individual users on the reliability on the network services. This would have, however, necessitated stratified complex samples of individual users in each organisation.

1.7 Chapter layout

Table 1.2 below presents the outline of the field study.

Table 1.2: Field study chapters

Chapter	Title	Objective
1	Introduction	Background and objective of the study
2	Internet Service Provider Network Service	• Introduction to ISP network architecture • Identification of end-user services/applications running over the ISP network
3	Relationship between Network Service Reliability and Customer Retention	• Defining network service reliability • Identifying a measurement framework for network service reliability • Establishing a theoretical link between retention and network service reliability
4	Research Design and Methodology	• Provide a detailed description of the research procedure, including measurement technique
5	Research Results	• Presentation of the results of the field study
6	Findings, conclusion and recommendation	• Presentation of findings, recommendation and conclusion

1.8 Summary

This chapter provided the background on the role of regulatory barriers in the evolution of the structure of the internet market, conduct and performance of the competitors in Lesotho. These barriers have put third-tier ISPs on an uncompetitive long-run path against network operators regarding customer retention. It is argued that there are two strategic options facing ISPs: investing in expanding the capacity of the physical network or investing in improving the reliability of services running over their physical networks. The field study attempts to establish the extent of the influence of network service reliability on customer retention.

CHAPTER TWO: INTERNET SERVICE PROVIDER NETWORK SERVICES

2.1 Introduction

The purpose of this chapter is to provide an overview of the internet service provider (ISP) network. It is also to identify network services or applications that are commonly used by consumers on the network.

In order to provide the overview of the ISP network, the global internet architecture is depicted and described in detail. A brief description of Lesotho ISPs' network architecture is also discussed. Understanding the ISP network infrastructure is a prerequisite to understanding how network services or applications are then delivered to the end-user. The way these network services/applications are organised is analysed through the open system interconnection (OSI) reference model, also called the OSI model. The application layer of the OSI model provides the network services/applications that the network user directly interacts with. The chapter ends with the identification of commonly used network services/applications.

2.2 Internet service provider network architecture

An internet service provider (ISP) is a company that provides internet connectivity to government departments, non-governmental organisations, businesses and residential customers on a commercial basis. These internet service providers also connect to one another to create a web of global internet network architecture. The global internet network has been organised into a hierarchy with three layers.

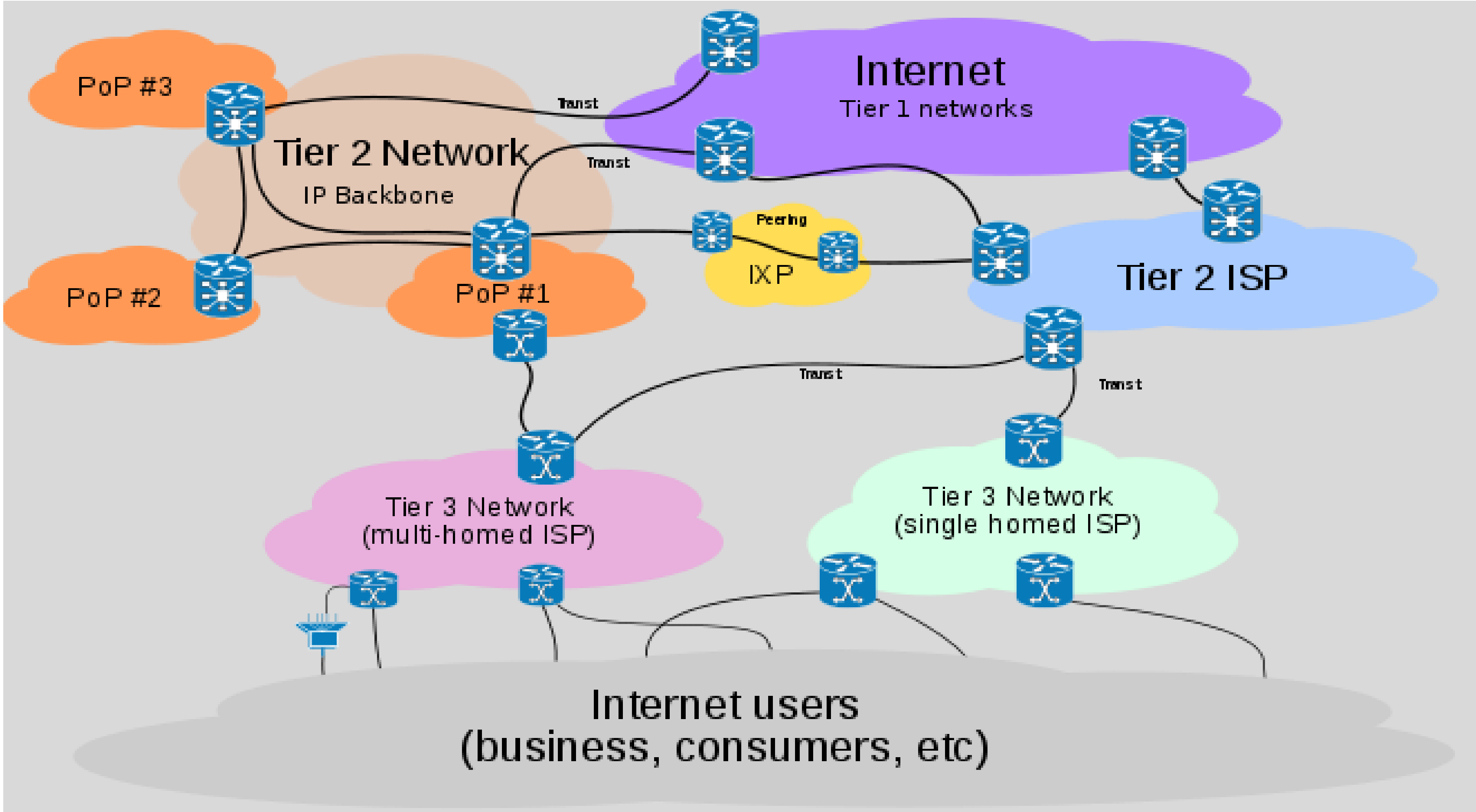
At the top of the global internet hierarchy are global transit providers or first-tier internet service providers. The global transit providers run their own international links to the internet and peer with other first-tier internet service providers. They also provide point-to-point connectivity to regional providers or second-tier providers through peering arrangements at internet exchange points (IXPs). According to Winther (2006:1), the first-tier providers, i.e. the global transit providers, peer or have a point of presence (POP) on more than one continent. They have access to the entire internet routing table through these peering relationships.

Also, they have one or two autonomous systems (AS) numbers per continent or, ideally, one AS worldwide.

The second layer on the global internet network hierarchy consists of regional transit providers or second-tier internet service providers that connect to first-tier service providers and to each other. This connectivity is enabled through either International private leased line circuits (IPLCs) or the international ethernet private line (IEPL) (Sgarson, 2010). Both first- and second-tier internet service providers make network access available to a third group of service providers commonly referred to as third-tier internet service providers or just ISPs that only connect to end-users. All the three categories of service providers offer direct end-user internet access in varying degrees, depending on market segment attractiveness.

Figure 2.1 below shows a simplified schema of global internet architecture, modified from Wikimedia (2010). This shows three hierarchies of internet service providers.

Figure 2.1: Global internet architecture



Source: Adopted from Wikimedia (2010)

In Lesotho, third-tier internet service providers connect to local second-tier network providers using rented leased lines called E1s in a point-point secure link. In order to retail their services to end-users, these ISPs use a combination of dial-up and leased lines, which they also rent. The only service delivery infrastructure they are allowed to roll out in the city is fixed wireless.

In summary, as Justin (2010) noted, first-tier ISPs have an exclusive command of network resources to deliver voice and data services. The second-tier ISPs operate more or less similarly, except that they may get a portion of their network from a tier-1 operator by way of peering. The third-tier ISPs (commonly just referred to as ISPs), on the other hand, rely fully on either first-tier or second-tier ISPs by piggybacking onto their network in order to provide access to their customers. As to how customers access and interact with ISPs will be the subject of the next section.

2.3 Network services/applications over the ISP network

2.3.1 The open system interconnection reference model

The International Organization for Standardization (ISO) began developing specifications for network communications from 1977-1978. In 1984, the Open system interconnection reference model (OSI Reference Model or OSI Model) was released. It is an abstract description for layered communications and computer network protocol design (framework architecture). With the OSI open system standards, a rigorously defined structured, hierarchical network model was introduced together with standard test procedures for error resolutions.

According to Microsoft (2002), the OSI model divides network architecture into seven layers. These layers are the application, presentation, session, transport, network, data link and physical layers, as shown in Table 2.1. The internet networking model, the TCP/IP was developed in cooperation with OSI at around the same time by the Institute for Electrical and Electronics Engineers (IEEE). It deals with aspects of networking related to physical cabling, connectivity, error checking, data transmission, encryption and emerging technologies.

Table 2.1 also shows the relationship between the two models.

The applications layer is the most important and relevant for the purpose of this study. It is where internet users interact with the internet network services and experience varying levels of their reliability.

Table 2.1: The stack of the open system interconnection model with TCP/IP model

OSI	TCP/IP
7 – Application Layer	Application Layer TELNET, FTP, SMTP, POP3, SNMP, NNTP, DNS, NIS, NFS, HTTP
6 – Presentation Layer	
5 – Session Layer	
4 – Transport Layer	Transport Layer TCP, UDP
3 – Network Layer	Internet Layer IP, ICMP, ARP, RARP
2 – Data Link Layer	Link Layer FDDI, Ethernet, ISDN, X.25
1 – Physical Layer	

Source: adopted from Varna Free University (2012)

The important features of the seven layers are described below.

Layer 7: Application

The application layer is the OSI layer closest to the end-user, which means that both the OSI application layer and the user interact directly with the software application, e.g. when users transfer files, read messages or perform other network-related activities. It provides the interface between end-user applications and communications software. The application layer functions typically include identifying communication partners, determining resource availability and synchronising communication. Network service reliability from the customer perspective is experienced at the applications layer level. This layer is the primary focus of this field study.

Layer 6: Presentation

The presentation layer takes the data provided by the application layer and converts it into a standard format that the other layers can understand. It establishes a context between the application layer entities, in which the higher-layer entities can use different syntax and semantics, as long as the presentation service understands both of them as well as the mapping between them. Furthermore, it deals with encryption, data formatting and compression. Finally, the presentation layer handles all transport and data delivery issues to other systems.

Layer 5: Session layer

The session layer controls the dialogue between the computers by establishing, managing and terminating the connections between the local and remote applications. The layer provides for full-duplex, half-duplex or simplex operation; and establishes check pointing, adjournment, termination, and restart procedures. The session layer is commonly implemented in an application environment that uses remote procedure calls.

Layer 4: Transport

This layer maintains flow control of data and provides for error checking and recovery of data between the devices. This means that the transport layer takes data coming from more than one application and integrates each application's data into a single stream for the physical network.

Layer 3: Network

The network layer determines the way that the data will be sent to the recipient computer. It provides the functional and procedural means of transferring variable length data sequences from a source to a destination via one or more networks while maintaining the quality of service requested by the transport layer. Logical protocols, routing, and addressing are handled here. It is also responsible for routing, addressing, and determining the best possible route. IP addresses are found at this layer.

Layer 2: Data link layer

The data link layer accepts packets of data from the network layer and packages the data into data units called frames. It is responsible for providing error-free transfer of data frames.

Layer 1: Physical layer

The physical layer is responsible for transmitting bits from one computer to another. It provides the bit encoding, represented by 0 or 1. It is a layer for connectivity medium number of pins on the network connectors such as passive and active hubs, terminators, cables, repeaters, transceivers and other similar ones.

2.3.2 Network services common to internet users

The application layer provides the basis for identifying network service/applications that internet users commonly interact with.

According to the Network Reliability Interoperability Council (2012:13), the end-users have five interrelated views of the internet, and all of them must be considered in devising a measure of network service reliability. Nielsen (2010) provides a snapshot of online activity in the US during 2010 in Figure 2.2.

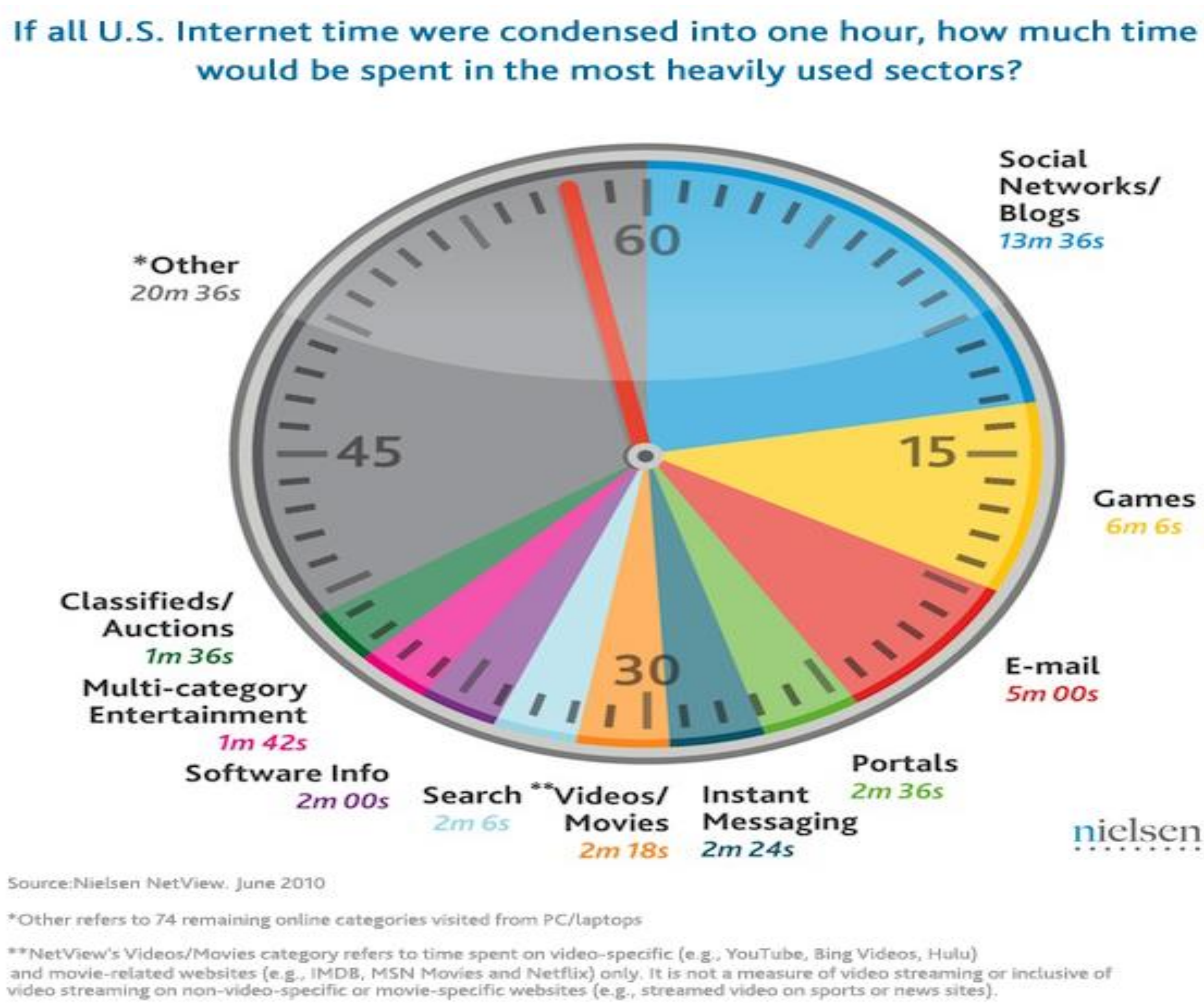


Figure 2.2: What users do online

The five common internet network services are discussed below.

2.3.2.1 Download of web pages and other files from leading websites

Most internet use by the general public consists of end-user web browser access to major web servers and streaming-media servers run by large-scale enterprises such as Google.com, Amazon.com, Yahoo.com and MSN.com. Downloading from leading websites is the most common use of the Web by the general public. According to Garibian (2013), in 2012, approximately 2.4 billion people worldwide used the Web, recording some 2.7 billion Facebook likes and 175 million tweets (through the Twitter social networking site) per day. At the same time, about 4 billion hours of video was viewed via YouTube.

Although there are many websites in the world, the majority of end-users spend most of their time on an extremely restricted number of major sites. At all times, and especially at times of major national events, web traffic tends to concentrate on leading sites. The Network Reliability Interoperability Council (2012:14) argues that it is safe to assume that the availability and performance of these websites is often perceived by the general public to being the same as the performance of the Web as a whole.

2.3.2.2 Email service

The other main use of the Internet by the general public is the exchange of email. Oxford Dictionaries (n.d) defines email as a message distributed by electronic means from one computer user to one or more recipients via a network. According to Garibian (2013), 144 billion emails were sent per day in 2012, of which 68.8% were spam emails. Most people spend more time dealing with email than any online activity (Nielsen, 2010).

The actual email exchange is handled by large-scale server systems inside internet access providers such as Telkom, Vodacom, AOL and Google. The end-users simply connect to their own ISP to upload and download email to and from their mailboxes. Performance is not expected to be instantaneous, and email exchange is extremely resilient, retrying over many hours until the email goes through. There are no guarantees of delivery.

The email server sends and receives an email from other email servers on the Internet at frequent intervals; it resends over a period of hours or days, if the initial attempts failed. Email delivery is not guaranteed, but users are normally notified if a delivery attempt to the destination mailbox has failed. Although the end-users are told when the email is successfully uploaded to his/her local email server, he/she is not usually told when that local email server has successfully sent his/her email to the destination email server.

According to the study of email reliability by Microsoft Corporation, Padmanabhan, Ramabhadran,Agarwal, and Padhye (2006:2) cite the work of Afergan and Beverly(2005), which showed that, of 1468 mail servers across 571 domains, there were significant instances of silent email loss, with 60 out of the 1468 servers showing an email loss rate of over 5%. Many other servers exhibited a modest but still non-negligible loss rate of 0.1-5%. The study found instances of emails delayed by more than a day, which might not be much better than email loss from a user's point of view. Also, Argawal, Padmanabhan and Joseph (2006:6) found that in one company, approximately 90% of incoming emails are dropped even before these hit the user mailboxes.

2.3.2.3 Instant Messaging and other server-based real-time technologies

Business Dictionary (n.d.) defines instant messaging (IM) as a web browser feature or facility provided by some websites that allows two or more people to exchange "live" typed messages over the internet. Instant messaging can be a much more efficient way to communicate with others than sending multiple emails back and forth. It has become a useful communication tool among friends, co-workers and businesses with their clients. It is an efficient way of real-time communication that enables message, file and presence transfer over the Internet. Businesses can benefit from IM as it is a cost-effective alternative for teleconferences as it reduces phone call bills and the need for meeting rooms and travel. Instant messaging applications in common use include Yahoo Messenger, Windows Live Messenger, Skype and WhatsApp. Instant messaging is also an example of real-time internet application.

In all of these applications, performance, as seen by the end-user, depends both on the underlying performance of the network connections between the servers and the end-users, and on the performance of the servers themselves. End-users are very sensitive to performance of these real-time applications; any failures or performance degradations are instantly noticed. Indeed, many of the end-user software packages already measure communication quality, both to tune their own operation to the available communications characteristics and to alert the end-users when performance has degraded beyond acceptable limits. According to Weber, Beck and König (2012:6), individuals are more likely to select and make use of the instant messaging applications in business, if they can be able to access them from any place and at any time. The nature of the modern work environment of globally distributed teams is for employees to participate in conference calls across different time zones and countries.

2.3.2.4 Direct user-to-user communications (peer-to-peer)

Peer-to-peer communication involves communication of one or more computers on the network *without the need for a central server*. The purpose of peer-to-peer communication is normally to share files on one or more of these computers on the network. Examples include business-to-business order processing using specialised protocols, communications with smaller websites, peer-based computing, and many other applications often using specialised protocols as well as peer-based networking such as Napster and some types of gaming. Instantaneous, reliable performance is usually expected.

Measurement of direct user-to-user communications should therefore be considered as one indicator of internet performance, and the network service reliability indicator should be measured as perceived by the users.

2.3.2.5 The internet link/connection uptime

The “last mile” is the service delivery infrastructure (SDI) link between an end-user and the ISPs. The link can be a leased line, frame relay, ISDN, DSL, cable modem, dial-up modem, or satellite link, along with the supporting equipment at the ISPs. In Maseru, and for the purpose of this study, the “last mile” links are leased line, fixed wireless and dial-up. The emphasis in this study is on the protocols and applications that enable connection to the ISP network to be established. If this connection is unavailable to the end-user, i.e. if there is an "access network failure", the entire internet seems to be down for that end-user. Therefore, it is possible that the availability of the "last mile" link should also be a factor in the calculation of the overall perceptions of reliability of ISP network services/applications.

2.4 Summary

In summary, the global internet infrastructure is organised into a hierarchy of three layers. The last layer is made up of third-tier ISPs, commonly referred to as just ISPs. The OSI-TCP/IP stack provides the data transmission mechanism across the ISP network. The application layer on the OSI-TCP/IP stack controls the protocols which handle many end-user services/applications on the network. Of these services/applications, the most commonly used are identified as:

- Web application (browsing and downloads)
- Email application
- Direct user-to-user application (peer-to-peer)
- Server-based real-time &Instant Messaging applications
- Link/access applications

The reliability of these services/applications, individually and collectively, impacts the end-user's perception of network service reliability. The next chapter provides the definition and theoretical overview of network service reliability and its association with customer retention. The hypotheses to be tested are laid out in detail in next chapter.

CHAPTER THREE: RELATIONSHIP BETWEEN NETWORK SERVICE RELIABILITY AND CUSTOMER RETENTION

3.1 Introduction

The purpose of this chapter is to provide a theoretical association between network service reliability and customer retention.

The concept of *network service reliability* will be explained in detail. A distinction between network service reliability and network reliability will be drawn, including the difference in the measurement approaches. Drivers of customers' retention are then discussed. The chapter then comprehensively deals with the influence of network service reliability on customer retention. The discussion ends with model development by the formulation of hypotheses.

3.2 Network reliability

The International Telecommunications Union (2006:1) defines reliability as "The ability of an item to perform a required function under given conditions for a given time interval''. In other words, reliability can also be seen as the persistence of quality over time. In this definition, an item may be a circuit board, a component on a circuit board or all its subtending network elements. Torterella (2005:1) has defined network reliability essentially as the reliability of network "tangibles". These are the physical network components and the entire network itself. It is about the reliability of the service delivery infrastructure (SDI).

The reliability of the network infrastructure is important to equipment manufacturers, network operators and the economy at large. Today's businesses are more and more dependent on their information technology (IT) infrastructure, and invest millions of rands in special equipment in order to increase the reliability of these systems (Rusu & Smeu, 2010:238). Increasingly, much of the infrastructure is now being considered critical for both the economic development and general functioning of modern societies (Zhang, Ramirez-Marquez, & Sanseverino, 2011:661). This infrastructure has become the primary enabler of commerce, meteorology and warfare applications, amongst others. As Lin and Yeh (2011:1175) have argued, the reliability and survivability of this infrastructure can have a substantial impact on the *quality of data and information* being transmitted. Survivability in this context implies the ability of a network to maintain or restore an acceptable level of performance during network failures by applying various restoration techniques, mitigation, or prevention of service outages from network failures by applying preventative techniques (ETSI, 2005:15). Network survivability also does appear to be a function of network reliability. From the service provider's perspective, solutions to reliability – hence survivability challenges – lie in two primary areas: robust network engineering and network architecture.

Figure 3.1 depicts a framework that informs network survivability design in order to meet and deliver superior customer value, and simultaneously provide a cost-effective network solution. It demonstrates the design considerations for network survivability. According to ETSI (2005:17), the considerations are grouped into prevention and mitigation/masking strategies. Prevention strategies either prevent the occurrence or reduce the frequency of occurrence of network node and link failures due to technology failures, environmental incidents, procedural errors, and traffic overloads. When the prevention strategies are not sufficient to satisfy the market expectations of service reliability, then mitigation and masking strategies are used. These include hardware duplication, automatic software failure recovery, network protection, diverse routing, and site duplication. While these will enhance network performance metrics, they however involve more costly outlays.

The challenge to the service provider, then, is how to implement a design that improves network reliability and survivability while delivering *service attributes that are important* to various customer classes at the lowest network cost (Golash, 2006:161). These important service attributes (service dimension from Figure 3.1) define the core of *customer value proposition* to different market segments serviced by the ISPs. To capture user perceptions of the quality of service, the service dimension includes the concept of service failures for a given service and is monitored with service metrics included in service level agreements (SLAs). For example, a 50 seconds network outage may result in a VoIP failure, but go unnoticed by an email service. If consumers in a given market segment value email service substantially more than VoIP, it may not be prudent to invest more on improving VoIP service. Thus, it is the customer value proposition that should drive further investments, informed by specific, yet evolving network service needs per market segment.

Logically, the service providers can only be able to deliver reliable and guaranteed performance at a lower cost if they are familiar with service reliability issues that different consumer classes are concerned about (Johnson, Kogan, Levy, Saheban & Tarapore, 2004:48).

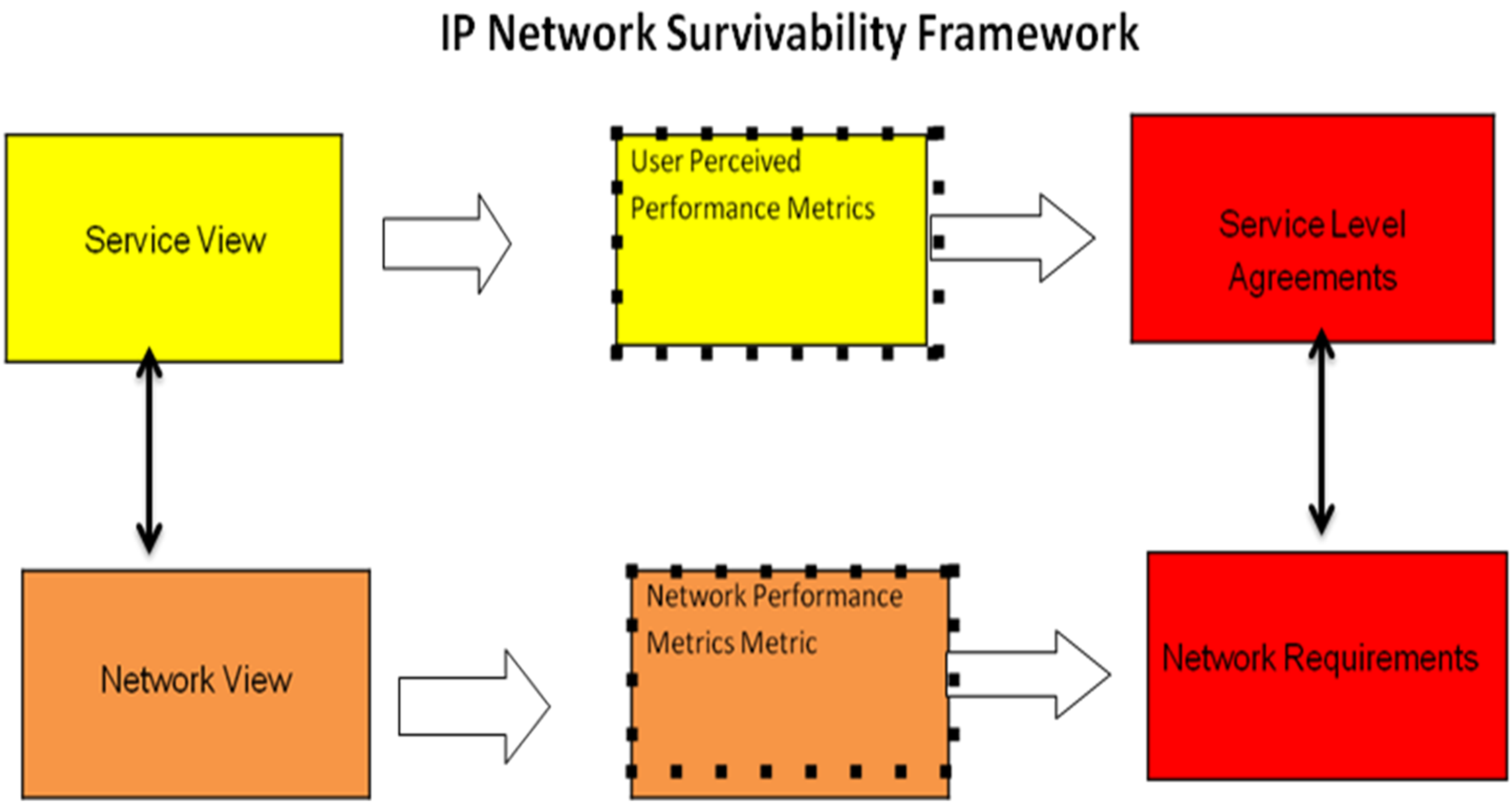


Figure 3.1: IP network survivability framework

Source: Adopted from ETSI (2005)

3.3 Measurement of network reliability

The methodologies for assessing reliability of network infrastructure fall into two primary categories, namely the reliability of the entire network system on the one hand, and component reliability, on the other hand.

Various studies recommend different methods for computing the reliability of network systems as a whole, from a simple case, to more complex multistate network models. On the network systems side, the focus has been mainly to improve the efficiency and overall performance of the entire network. Lin (2011:61) evaluated network reliability based on three attributes, namely variable capacity, lead time, and cost of transmission across the network. The evaluation calculates the probability that the given amount of data can be sent through the network subject to both time threshold and budget constraint. This probability is treated as a performance index to measure the reliability of a complex multistate system like IP-based telecommunications networks run by ISPs. Other performance indices techniques have also been suggested that look at system-wide reliability.

Zhi-Hui, Zeng-Ping and Jiao (2011:2523) have developed a reliability model based on fault-tree analysis for wide area network protection. The model derives three reliability indices based on network attributes. Each index is then computed based on sequential Monte Carlo simulation. It adopts the idea of static handling; takes into account faults of components and repairs them, and overcomes several disadvantages of analytical methods, such as complicated calculation and weak adaptability. In order to further improve the efficiency of the exact methods for calculating reliability, Cancela, El Khadiri and Petingi (2011:845) proposed a polynomial-time algorithm for estimating constrained network reliability parameters. The method specifically improves upon the recursive factorisation approach based upon Markowitz’s edge decomposition, and yields substantial computational gains. Konak and Smith (2011:430) synthesise a range of other methods to come up with a bi-objective genetic algorithm to design reliable two-node connected telecommunication networks. It develops a reliability measure that utilises an exact reliability calculation using factoring, Monte Carlo estimation procedure using sequential construction, and network reductions.

On the other hand, some studies, however, have concentrated exclusively on the reliability of network components. A faulty network link or component has the potential of compromising the integrity and cost-effectiveness of the system even if network redundancy is built in. While adding redundant network components increases the reliability of a network, it, however, also increases the cost substantially (Benyamina, Hafid, Gendreau & Maureira (2011:1631). The critical component in this regard is the building block of electronic circuits, namely semiconductors. Ibrahim and Beiu (2011:538) have demonstrated the reliability challenges that arise with increasing miniaturisation on nano-scale components in semiconductors. Ibrahim and Beiu (2011:538) devised an electronic design automation (EDA) tool that can predict the reliability of future massive nano-scaled designs with very high accuracy. The tool improves the accuracy of the calculation of reliability of the individual devices, the applied input vector as well as the noise margins. It can also be used to estimate the effect on different types of faults and defects, and to estimate the effects of enhancing the reliability of individual devices. Furthermore, Kim and Kim (2011:3561) proposed a reliability model for a superconducting fault current limiter (SFCL), which is a new alternative in limiting the fault current increasing in a network. Fault current in networks is one of the not so insignificant sources of failure.

Furthermore, most of the reliability computations or models essentially seek to improve a traditionally popular network reliability metric called defects per million (DPM). This metric assesses the availability of IP-based telecommunications networks. DPM metrics are computed for the access portion of IP networks based on observed failures and related network outage measurements. According to CQR (2000), the DPM concept is extended to include Predicted DPM through relationships with traditional measures of component reliability such as mean time between failures (MTBF). Predicted DPM relates component reliability of new network elements, based on emerging technologies, to network reliability expectations and goals from a service provider's perspective. In practice, service providers typically aim for 99.999% network access or availability. The concept of DPM can also be extended to services, as will be shown later.

Finally, the complex multistate networks such as IP-based telecommunications network consist of a source node, a sink node, and some independent failure-prone components in between the nodes (Ming, Zhigang & Hong-Zhong, 2007:811). The components can work at various capacity levels. Many real-life network systems can be modelled as stochastic-flow networks with each branch having capacities with a probability distribution, and at various times can fail completely, partially or not at all. Thus, from a service providers' perspective, network reliability can be defined as the probability that a specified flow (data or voice) can be transmitted through the network successfully (Lin & Yeh, 2010:539). More importantly, network reliability is a subset of quality management. Nonetheless, network reliability has to be emphasised. It is the reliability of a physical network and its physical components.

3.4 Network service reliability

Network service reliability is defined as the reliability of services/applications on the network. While network reliability deals with the reliability of the physical network and its components, as discussed above, network service reliability focuses on services/applications offered over the network. These are the services/applications on the application layer of the OSI-TCP/IP stack. Because reliability is the persistence of quality over time, the passage of time in the definition of reliability is also important.

The fundamental concept in the reliability theory is the failure time of a system and its covariates (Korhjian, Ma, Mittinty, Yarlagadda & Sun, 2009:1). It deals with mean time to failure (MTF) and mean time to repair (MTR) in order to derive availability estimates of equipment and network systems (Conrad, LeClaire, O'Relly & Uzunalioglu, 2006:57). Typically, these failures are classified either as breakdown failures or performance failures. A breakdown failure (or catastrophic failure) is one in which no further functionality of product or service is possible without some overt effort to recover from the failure (Torterella, 2005:7). In contrast, a performance failure (soft failure or parametric drift failure) is an instance of one or more performance criteria not being met even if a breakdown failure has not occurred. While this type of failure does not make the equipment unavailable, they do prevent the completion of the performed actions (Dai & Levitin, 2007:783). The challenge, then, becomes how to translate these measurable network conditions into measurable service conditions. While some of this translation is network design specific, Figures 3.2 and 3.3 provide the gate flow framework that maps how the network conditions eventually impact on the services consumed by the user (ETSI, 2005:27). It depicts the relationships between conditions in the network and how they can propagate to a customer impact.

Technically, a service is made up of transactions. A transaction can be made up of multiple IP packets. Packets can be repeated, or even lost in some applications, without significant effect to the transaction. This depends on how the underlying protocols manage these issues, and whether the *customers are tolerant to the conditions that result*. However, excessive repetition or dropped transactions can affect any service. From a customer's perspective, service failure can occur when the QoS/SLA/CoS metrics are not met. It can also occur when general customer expectations go beyond QoS/SLA/CoS, or because interfacing equipment is not tolerant of some network conditions, as shown on the gate flow diagram in Figures 3.2 and 3.3.

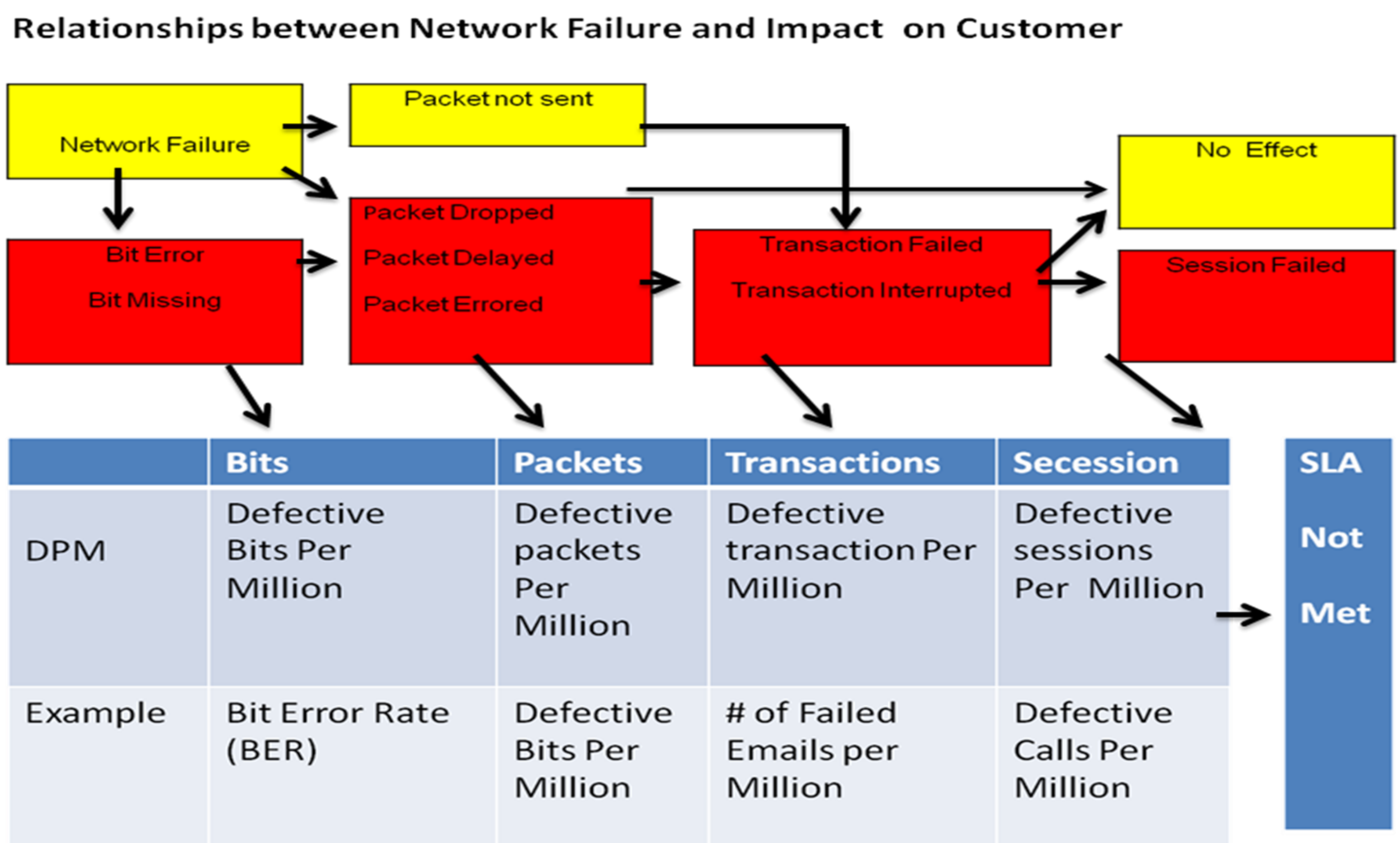


Figure 3.2: The gate flow process

Source: ETSI (2005)

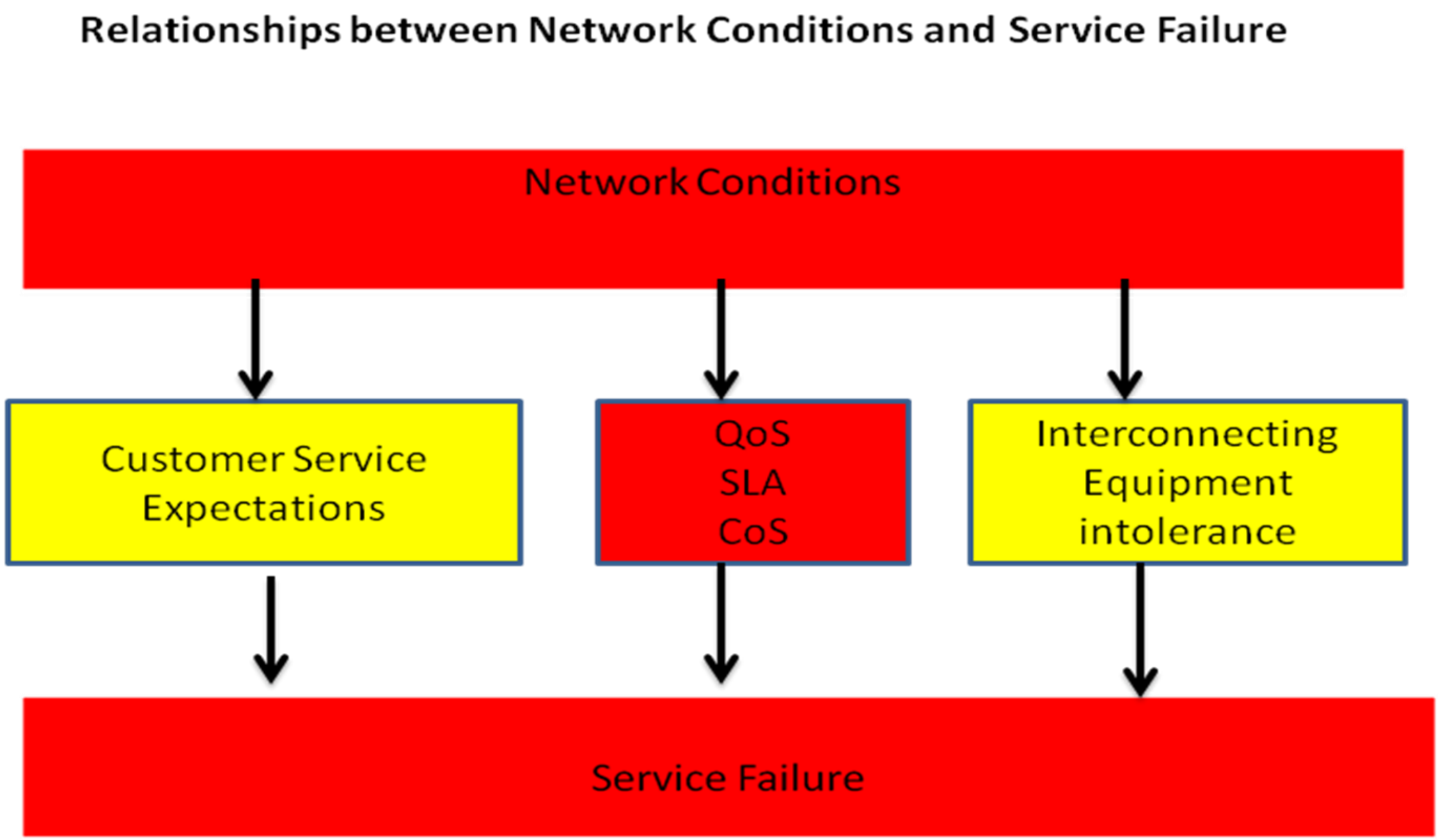


Figure 3.3: The gate flow process (continued)

Source: ETSI (2005)

Potentially, from a service provider's view, there are different user groups, each using a different transaction set, and each transaction set having a different DPM target. The framework for measuring network service reliability (expressed in DPM or percentage) is outlined below.

3.5 Network service reliability measurement

A service is measured in terms of transactions performed. That is to say, a service is a collection of transactions. Thus, a *transaction becomes a 'unit of service'* (Eslambolchi, 2012:15).

Because services are transaction-based, *unreliability then becomes the probability of an unsuccessful transaction* (Hoeflin & Mendiratta, 2006:1). This probability is reported as a defects per million (DPM) metric or sometimes as a percentage.

According to Torterella (2005:8-10), a transaction goes through three phases. First, the transaction has to be initiated successfully. This shows the accessibility of the service. Second, the transaction should continue to completion uninterrupted. The phase is continuity. Third, the entire transaction should be completed and closed off to the satisfaction of the user without undue delay or disruption. This satisfactory closure and successfully execution of the entire transaction is called fulfilment.

Torterella (2005:10) defined each of the three phases more formally as follows:

(a) Service accessibility

Definition: *Service accessibility* is the ability to initiate a transaction in service, when desired. Theoretically, this probability can be calculated as:

P(t) := P{a transaction is successfully established I an attempt is made at time t}

Service accessibility, so defined, is from the point of view of the user of the service – not of the provider of the service. This is most often cast in the form of some average value of service accessibility, where the average and/or some group of service users are taken over time.

(b) Service continuity

Definition*: Service continuity* is the successful continuation of a successfully initiated transaction to its completion. Theoretically, this probability can be calculated as:

> P(*t,h*) := *P*{a transaction of duration *h* continues uninterrupted until completion at time (*t*+*h)* I transaction was established at time *t*}

This is a conditional probability because a transaction that is not initiated cannot be interrupted. Again, service continuity, so defined, is from the point of view of the user – not the provider of the service.

(c) Service fulfilment (release)

Definition: *Service release* is the concept of being able to successfully disconnect a transaction when it is completed. Theoretically, this probability can be calculated as:

> P(*t,h*) = *P*{a transaction of duration *h* is successfully released at time *t*+*h* | *a* transaction was established at time *t* and no service continuity failure has occurred}

This is a conditional probability because a transaction that is not initiated, or has been interrupted and cannot be completed. Again, service fulfilment, so defined, is from the point of view of the user – not the provider of the service.

In practice, the CQR (2000) suggests the DPM be computed as follows:

> Service Unreliability (DPM) = 10^6 * (1-Transaction Success Ratio),

Where,

> Transaction Success Ratio = (Number of successful transactions/Number of attempted transactions) =
>
> (Number of successful attempts/Total Attempts) * (Number of successful transactions during continuity phase/Number of successful accesses) * (Number of successful service releases/Number of successful continuities)

The DPM is a quality-based unit of measure that can also be applied to a wide range of service metrics. In particular, it can be applied on the IP backbone to measure port availability for accessibility measurements. The Telecommunications Authority of Mauritius implemented the framework in 2010 (ICTA, 2010:23). The framework provides the user's perspective of reliability characterised by accessibility (A), continuity (C) and fulfilment (F) ACF framework. In conclusion, Torterella (2005:3) summaries user perception of network service reliability as follows:

> "The user's expectations of service reliability vary from application to application ... users in turn have expectations about reliability of the service(s) they pay for and rarely, if at all, think about the provider's service delivery infrastructure. These customers care about whether they can access the service they purchased when they want it. They care about whether they can complete a transaction without interruption, once it has begun, and whether they can successfully close the transaction when they are finished. They care about whether the quality of the transaction meets their expectations whenever the transaction occurs. These are all reliability issues, pertaining to services: proper functioning of the service during the time it is offered by the service provider (its 'design lifetime'). To repeat: once a service is offered, service reliability deals with the repeated successful delivery of experiences (or transactions) in that service as time passes."

This serves to reinforce that network service reliability is about the reliability of the service as perceived by the user – not from the service provider's point of view.

3.6 Customer retention

3.6.1 Background

The concept of customer retention has been studied extensively. This quality of interaction manifests itself in both actual and perceptive responses of customers to their experience with the service. The actual responses can either be *actual repurchases* or actual share of purchase relative to other service providers. The perceptive or behavioural responses capture the customer's *intentions* for repurchase or willingness to refer others. These customer responses are driven by cumulative effect that their needs have been met over time. The needs are met when service providers are able to offer strong customer value propositions that address unique customer preferences. The cumulative effect is satisfaction with and commitment to the internet service provider.

This section addresses the relevance of customer value proposition, satisfaction and relationship commitment as drivers of customer retention.

3.6.2 Customer value proposition

Business Dictionary (n.d.) defines customer value proposition as a concise, persuasive statement at the heart of a marketing strategy about a product or service. It provides a compelling reason why a customer would benefit from the purchase or renewal of an internet contract. Investopia (2012) goes on to state that customer value proposition is actually about why a customer should buy a service or product.

Customer value proposition rationalises investments in both capital and human assets in the pursuit of capabilities that are vital for meeting unique customer or segment needs. Central to the concept of customer value proposition is the delivery of value, seen from the customer's perspective. The idea is to emphasise that a customer's problem would be solved, and that value to the customer is being added in the process. It tries to draw a clear contrast with the competitors, and the appeal is directed at the customer's decision-making drivers. There is also a purpose of the customer value proposition. It is couched in a language that a satisfied customer would use to express their experience with the service quality, highlighting the benefits derived from such interaction (MarketingProfs, 2012).

The implication is that ISPs need to find out what are the most pressing and specific reasons why customers need to continue consuming services on their networks. The customer value proposition should address superior *few elements* that matter, delivering great performance, and communicating it in a way that reflects a thorough understanding of the consumer/customer's priorities.

Industry developments, in recent years, have relied on the NABC (Need, Approach, Benefit, Competition) framework that was developed by Carlston and Wilnot in order to construct a customer value proposition. According to Stanford (2006), the NABC comprises four fundamentals that define an ISP's value proposition:

- **<u>N</u>eed:** What are ISPs' clients' specific needs when using an internet service? A need should relate to an important and specific client or market opportunity, with market size and end customers clearly stated.
- **<u>A</u>pproach:** What is the ISPs compelling solution to the specific client's need?
- **<u>B</u>enefits:** What are the client benefits of the ISP's approach? Each approach to a client's need results in unique client benefits such as low internet cost, high network performance or quick response. Success requires that the benefits be quantitative and substantially better – not just different.
- **<u>C</u>ompetition/alternatives:** Why are an ISP's benefits significantly better than the competition? Everyone has alternatives. ISPs must be able to tell their clients why their solution represents the best value. To do this, ISPs must clearly understand their competition and their client's alternatives.

The answer to most of the above questions lies in what customers consider to be the most important network service reliability issues facing them. This will provide the basis for constructing viable customer value propositions.

3.6.3 Customer satisfaction

The foregoing discussion on customer value proposition highlights the importance of identifying unique customer needs by an ISP. These unique needs enable service providers to effectively segment both current and potential customers based on specific value propositions across segments. As Grewal, Citrin and Chandrashekaran (2012:2) have argued, a tight value proposition to a very homogeneous target market brings with it a *higher customer satisfaction*. According to Ma and Ding (2010:131), a well targeted and delivered customer value readily improves satisfaction. Satisfied customers tend to be loyal, a basis of retention. It is, therefore, important to look at the drivers of loyalty itself.

Customers demonstrate their loyalty in various ways, and there is no consensus regarding the definition of loyalty (Yanamandram & White, 2007:1). While retention may practically be measured by actual or intended repurchases, customer loyalty is a more complex phenomenon that includes other properties rather than just the behavioural construct of repeat purchasing. Conceptually, Yanamandram and White (2007:1) define loyalty as:

> • "behavioural conceptualisations: which conceive 'loyalty' purely in terms of revealed behaviour – such as repeat purchase behaviour, proportion of purchases, sequence of purchases, and share of market;
>
> • attitudinal conceptualisations: which conceive 'loyalty' in terms of whether people like the brand, feel committed to it, recommend it to others, and have positive beliefs and feelings about it relative to competing brands; and
>
> • combined behavioural and attitudinal conceptualisations: which conceive 'loyalty' in terms of both attitudinal and behavioural dimensions."

This field study uses behavioural conceptualisation as a construct of retention for repurchase intentions (intention to renew an internet contract). The relationship management literature mostly covers two drivers of loyalty, namely satisfaction and relationship commitment.

First, as noted above, customer satisfaction is a precursor to customer loyalty. Customer satisfaction refers to the overall positive evaluation of service performance by the user built over time. It is backward-looking (Gustafsson, Johnson & Roos, 2005:210). Satisfaction also mediates the effects of product quality, service quality, and price or payment equity on loyalty. In a service context, the overall satisfaction is similar to the overall evaluations of service quality (Gustafsson *et al*., 2005:210). Furthermore, Chiou (2004:645) found that perceived value leads to overall satisfaction and loyalty by ISP subscribers. Earlier, Mittal and Kamakura (2001:131) had demonstrated that there is a strong effect of customer satisfaction on repurchase behaviour. The actual or intended purchases, however, come under threat with dissatisfied customers. As Yanamandram and White (2007:1) argued, *how* customers react to dissatisfaction is the crucial issue for marketing managers. Ultimately, the buyer's actions, and how the service provider reacts to those actions, determine whether that customer is retained. Logically, these actions are triggered by events in the broader business environment (situational triggers), or direct performance of the network service itself (reactional triggers) (Ross, 2002:193).

On the one hand, situational triggers may lead to a customer concluding that the product or service no longer reflects their needs. This may require new customer value propositions by the service provider. In telecommunications, situational triggers may be represented by the need to replace or remove a type of service or subscribe to a different type of service. This is the situation of most third-tier ISPs in Lesotho who are experiencing high churn rate due to better alternatives in the market offered by the network operators.

On the other hand, reactional triggers are those critical incidents of deterioration in perceived performance before purchase, during purchase, or during consumption; it redirects a customer's attention to evaluate present performance more closely, which may put customers on a switching path (Roos, 2002:199). This suggests that either a situational or a reactional trigger affects the relevance of prior-performance information when predicting retention. Gustafsson *et al*. (2005:211) conclude that, faced with a situational trigger, customer satisfaction as an overall evaluation of prior performance may become less relevant to the prediction of retention. Similarly, because customers in a reactional trigger condition are actively experiencing service reliability issues, they may focus on present or future performance. Waiting to observe how an ISP addresses the service problem, these customers may put less rather than more stock in prior performance, as measured by overall customer satisfaction. On the basis of these arguments, the study contests that the ISPs' customers are mostly on a reactional trigger, and this a basis for predicting repurchase, than looking back at past performance of service providers. The questionnaire in Annexure A uses a 30-day time span to assess current performance and future intentions to then renew the internet contract.

3.6.4 Relationship commitment

Relationship commitment is another important driver of retention. Relationship commitment is divided into two, namely affective commitment and calculative commitment. Affective commitment is created through personal interaction, reciprocity, and trust; and calculative commitment is created through switching costs (Gustafsson *et al*., 2005:210). Due to the intensity of competition and regulatory changes, it has become increasingly difficult for ISPs in Lesotho to rely on calculative commitment in order to sustain relationships with customers. As the bargaining power of customers increase, it becomes even more difficult to enforce or design contracts with onerous switching barriers. Hence, affective commitment appears to be increasingly the only viable option in building long-term relationship and customer retention.

3.7 Model development

3.7.1 Background

The foregoing discussion in sections 3.5 and 3.6 dealt with the concepts of network service reliability and customer retention, respectively. As an attribute of service quality, reliability is then related to satisfaction, loyalty, and retention. The purpose of this section is to develop a theoretical link between this network service reliability and customer retention.

3.7.2 Relationship between service quality and network service reliability

Defining and giving proper context to service quality and network service reliability underpins this study. The Institute of Purchasing and Supply (2012:13) defines quality as conformance to specifications or performance. It states that reliability is a subset of quality. Reliability is the persistence of quality over time. To be considered reliable, a product or service should have features or attributes that enable it to function satisfactorily within a given time period. The network should be able to maintain an acceptable level of performance. It represents the frequency of availability of the network services over a given time period. Put differently, service quality is about narrowing the gap between the consumer's *perceptions* of the service as they experience it and *expectations* of what the service should be (Parasuruman, Seithaml & Berry, 1988:14). It involves measuring perceptions and expectations separately in order to understand customer assessment of the dynamics of service quality over time (Parasuruman, Seithaml & Berry, 1993:146). Currently, perceived quality is measured using the SERVQUAL questionnaire. It is an overall evaluation of a product by the consumer, and in many important respects, it is generally a global value judgement.

Within the context of network services, the International Telecommunications Union (2012) defines service quality as the collective effect of service performances that determine the degree of satisfaction of a consumer of the service. This also puts the centrality of a customer's perception of a delivered service as the overarching objective of service quality. The CQR (2012), the subcommittee of the IEEE on communications network quality, distinguishes between network reliability and network service reliability. It defines network reliability as the 'availability of end-to-end functionality for customers, or ability to experience failures or systematic attacks without impacting customers or operations'. The definition recognises the overlap between service reliability and network reliability. Significantly, it also provides for customer perspective in the definition of network reliability. It is imperative for ISPs to identify network performance or reliability issues that impact customer service and develop customer value propositions (CVP) that are consistent with evolving service needs**.**

3.7.3 Relationship between network service reliability and customer satisfaction

Service quality generally improves customer satisfaction. Specifically, service reliability – a component of service quality – adds value to the customer, real or perceived. On the study of the internet industry in Australia, Chiou (2004) found that perceived value leads to overall satisfaction and loyalty by ISP subscribers. This may also imply satisfaction with service reliability levels including the speed and ability to recover from network service outages (or failures) timeously. Satisfaction with recovery efforts positively influences loyalty intentions as Sousa and Voss (2009:834) have noted. In addition, Adapa (2011:5) examined the frequent use of internet banking by Australian consumers using factor component analysis. He concluded that understanding service attributes that customers value is a prerequisite to regular and continued service use. This also goes to the heart of customer value proposition.

However, satisfaction does not necessarily lead to retention. Nonetheless, retention should be the ultimate goal of every business. In fact, as Reichheld (1996:17) stated, many business surveys revealed that between 60% to 80% of customers who had terminated services had actually claimed on a survey just prior to leaving that they were satisfied or very satisfied. It has been identified that 68% of customers change service providers because they experience the service provider as disinterested or indifferent (American Society for Quality, 2012). Similarly, in a business-to-business defection study by Earl, Matti, Khan and Williams (2010:878), they showed that despite their claims of satisfaction, customers admittedly still tend to defect. Therefore, while it may be evident that customer satisfaction is a necessary condition for customer retention, it is by no means sufficient.

3.7.4 Relationship between network service reliability and customer loyalty

Loyalty results in repurchases – actual or intended. In a study of customer retention in the Greek internet market, Evangelia, Desyllas, Baxti, Eygeniou, Katseli, Tsara and Ravonikou (2009:35) used repurchase intentions and word-of-mouth as proxies for loyalty. Evangelia *et al*. (2009:35) concluded that, amongst others, service quality positively influences loyalty and customer retention. Another internet market study by Ian (2005:7), on keeping existing and new customers happy, emphasised service quality (and price) as a significant factor by broadband subscribers, including customer service and connection interruptions (service reliability).

There are, however, studies that argue that, in fact, there is a wide range of factors influencing customer loyalty in general. For instance, loyal subscribers are less likely to be influenced by defections that happen within their networks according to Irit and Barak (2011:24-38). Furthermore, Chen and Hitt (2002:255), in their investigation of switching costs and customer retention in internet-enabled businesses, advocated that properly designed switching barriers positively affect loyalty and retention. Chen and Chin (2007:1-10) include corporate brand image while emotional and demographic characteristics such as age are also considered important determinants of loyalty (Victor *et al*., 2010:32). Amongst others, Kuusik (2007:3) further argued that trust is also key to customer loyalty.

In the final analysis, it appears that customer loyalty is driven by many different factors. The extent of the influence of a stable, reliable network service on customer loyalty in the competitive ISP markets is yet to be determined. Also, on the balance, it appears evident that customer loyalty is a necessary and sufficient condition for retention.

3.7.5 Relationship between network service reliability and customer retention

Superior network service reliability and service are crucial to keeping customers loyal. Loyal customers are easier to retain. Retention builds customer lifetime value – a key measure of profitability and sustainability. Previous studies have shown that it is costlier to retain customers in mature or declining market segments such as leased lines and dial-up. This is where third-tier ISPs compete. The customer acquisition-retention cost ratio shifts with market or product life cycle continuum. Under these circumstances, unreliable networks may as well mean serious market and financial loss for ISPs. The case in point is noted by Connors and Worthen (2011) regarding a recent massive network outage at Research in Motion (RIM), the maker of BlackBerry Messaging, which exacerbated the loss in market capitalisation and corporate customers. This highlights the centrality of network reliability for network service providers, in particular, ISPs. Thus, it is crucial in many important respects.

First, service quality in the ISP markets has become a major concern (i.e. after price) with subscribers lately. Applying data mining techniques to predict customer defections within an internet service provider network, Khan, Jamwal and Sepehri (2010:9) concluded that, in the internet market, service quality has implications for retention. Customers do defect in large numbers. For instance, Hughes (2012) reported that defection rates in the telecommunications industry in the United States averaged between 10% and 67% per year. While price is still an important consideration, customers consider reliability of service among the most significant predictors of their loyalty (Rousen, Ramzi & Mohamed, 2010:886).

Second, the purpose and the manner in which the ISP network service is used by the subscriber also has a bearing on retention. This is supported by a study done by Madden, Savage and Coble-Neal (1999:195) on the Australian ISP market, which found that email use for work-related purposes was likely to lead to defections if network was unreliable, and browsing for fun showed no significant impact on retention. Madden *et al*. (1999:195) concluded that, for an ISP, service reliability and the manner in which the service is used is the most important non-price factor in retention. In a study of the telecommunications industry in Nigeria, Omotayo and Joachim (2008:26) argued that if retention is also not managed properly, loyalty may also be lost, reinforcing that service reliability improves loyalty – a necessary and sufficient condition for customer retention. Overall, it appears that the reliability of the network service ultimately leads to customer retention.

3.7.6 Hypotheses development

The foregoing discussion demonstrates an association between network service reliability and customer retention. Therefore, the following hypotheses are formulated to address the primary objective of the study, based on Cooper and Schindler (2011:462).Customer retention is measured by repurchase intentions:

- H1: There is a positive association between repurchase retentions and reliability of the email applications.

This hypothesis tests the association between the reliability of email applications and customer retention as measured by repurchase intentions.

- H2: There is a positive association between repurchase retentions and reliability of the web applications.

This hypothesis tests the association between the reliability of web applications and customer retention as measured by repurchase intentions.

- H3: There is a positive association between repurchase intentions and reliability of the instant applications.

This hypothesis tests the association between the reliability of server-based real time &instant messaging(IM) and other server-based real-time applications and customer retention as measured by repurchase intentions.

- H4: There is a positive association between repurchase intentions and reliability of the user-to-user (peer-to-peer) applications.

This hypothesis tests the association between the reliability of user-to-user (peer-to-peer) applications and customer retention as measured by repurchase intentions

- H5: There is a positive association between repurchase intention and reliability of the link/access applications.

This hypothesis tests the association between the reliability of link/access applications and customer retention as measured by repurchase intentions.

3.8 Summary

Reliability is the persistence of quality over time. Network service reliability is about the reliability of OSI-TCP/IP stack application layer services/applications as perceived by the user. Network service reliability is measured using an ACF framework. It is expressed in DPM or as a percentage. Reliability is also an attribute of service quality. Quality has a positive impact on customer retention. The concept of customer value proposition states that customers are retained when their unique needs are met, and become satisfied with a service. Affective commitment also sustains customer retention. Finally, the literature review seems to show that network service reliability positively influences customer retention as measured by repurchase intentions.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

The primary objective of the field study is to determine the influence of network service reliability on customer retention. In this chapter, the procedure on implementing the ACF framework in order to measure network service reliability is outlined. The second section covers multiple regression which is used to predict customer retention, and the final section deals with the research methodology.

4.2 Telecommunications network service reliability measurement

The ACF framework is derived from the general framework. The ACF deals exclusively with the network services reliability metrics of the general framework. According to CQR (2000), the ACF should be constituted in a matrix form as in Table 4.1.

Table 4.1: The ACF framework matrix

	Breakdown Failures	**Performance Failures**
Service Accessibility	• No response at all • No response to an input • Failure to connect	• Delayed response • Incorrect response • Partial response • Incorrect destination
Service Continuity	• Premature termination • Unacceptable performance	• Performance threshold not met • Degraded performance
Service Release/fulfilment	• Inability to end a transaction • No confirmation	• Delayed release • No confirmation of a transaction • Billing error

Source: CQR (2000); Torterella (2005)

As was argued in Chapter 3, service is measured in terms of transactions. That is to say, a service is a collection of transactions. Thus, a *transaction becomes a 'unit of service'*

(Torterella, 2005; Eslambolchi, 2012:15). Because services are transaction-based, reliability is equivalent to the probability of a successful transaction (Torterella, 2005; Hoeflin & Mendiratta, 2006:1). This probability is estimated by a defects per million (DPM) metric. The CQR (2000) stated that the unit of measurement for IP-based services should be transactions based on defects per million (DPM), a standard metric used extensively in engineering reliability. This was followed by ETSI (2000) for European Union countries. In part one of Torterella (2005:1-16) and part two of Torterella (2005:17-34), the theoretical basis for an ACF framework and the use of DPM as a metric was provided. The Mauritius Information and Communications Authority has been trying to implement the ACF framework (ICTA, 2010:23). Finally, Eslambolchi (2012:15) advised on practical guidelines on implementation. The DPM is calculated based on the "defective" observations of a transaction of the total observations during access, continue and release stages per application. The general formula is:

DPM = (d/N) x 10^6. This is applied to all DPM calculations

Where,

d = number of defective transactions

And,

N = total transactions

The transition of a transaction from the phases of accessibility, continuity, and fulfilment is a random process. It is not known in advance at what time or phase the transaction will fail.

More formally,

Let T_i = Future lifetime of a transaction of OSI application layer starting at phase i.

Then, T_i is a random variable continuously distributed on the interval from accessibility to fulfilment phase.

Now,

$F_i(t) = P(T_i \leq t)$ is a distribution function of T_i, and,

$S_i(t) = P(T_i > t) = 1 - F_i(t)$ is a survival function of T_i. This presents the probability of a transaction starting at phase i surviving to phase t, for $t > i$.

$= P(T > i+t \mid T > i)$, $T = T_0$ (Conditional Probability, see Chapter 3)

$= P(T > i+t) \div P(T > i)$

$= S(t+i) \div S(t)$

Also, it can be shown that the probability of surviving to phase (s+t) after starting at phase i is given by multiplying

- The probability of surviving to phase t, and
- The probability of then surviving for a further phase s (Institute of Actuaries, 2001:6-8). This assumes independence, implying that the failure of a transaction is independent of stage or phase. Failure can occur due to the degradation of the underlying service delivery infrastructure (SDI) regardless of the phase or stage.

This is an important result for computing service (applications) reliabilities below.

The following steps incorporate the recommendations on computing DPM.

<u>STEP ONE</u>

<u>Specify the internet service (application)</u>

In this study, five application layer applications commonly consumed by an average internet user are considered, namely:

- Web applications (browsing and downloads)
- Email applications
- Direct user-to-user applications (peer-to-peer)

- Server based real-time &instant messaging applications
- Link /access applications

STEP TWO

Define end-user's transaction

This is a unit of service to be observed in this study. This transaction is categorised as either defective or successful depending on the user experience with the five application layer applications commonly consumed by an average internet user considered.

Table 4.2: DPM transactions

Transaction	Service (Layer 7 application)
Browse – internet	Web applications (browsing, downloads, etc.)
Get-or-open email	Email applications
Do teleconferencing or gaming	Direct user-to-user applications
File transfer or Work on server	Server-based real-time &instant messaging) applications
Connect	Link/access applications

STEP THREE

Define a defective transaction

A transaction can either be defective or successful. Also, it goes through three distinct phases in the ACF framework, namely access, continue and release/fulfilment.

Table 4.3: Defective transactions

Transaction	Defective		
	Access	Continue	Release/fulfilment
Browse – internet			
Get-or-open email			
Do teleconferencing or gaming			
File transfer or Work on server			
Connect			

STEP FOUR

Decide on measurement approach

There are two types: active or passive measurement approach. The active approach provides user perspective of service reliability. The passive approach collects data from network equipment logs that was captured during service failures.

In this study, the active measurement approach that collects data based on user perceptions of the services is used. The sampling method is stratified random sampling detailed below.

STEP FIVE

Develop sampling plan and data collection

The sampling plan and data collection procedure is detailed below.

STEP SIX

Do DPM calculations

In practice, DPM calculations are performed for each service (applications) of interest.

Table 4.4: DPM of five IP services

DPM	Service (Layer 7 application)
$DPM_w = R_w$	Web applications (browsing and downloads)
$DPM_e = R_e$	Email applications
$DPM_d = R_d$	Direct user-to-user applications
$DPM_f = R_f$	Server-based real-time & instant messaging applications
$DPM_c = R_c$	Link/access applications

Where,

$DPM_w = R_w = DPM_{wa} \times DPM_{wc} \times DPM_{wr}$

= unreliability of application_w (Elslambolchi, 2012:16)

And,

DPM_{wa} = DPM of web applications during accessibility phase

= P{‘*browse-internet’* transaction is successfully established │an attempt is made to connect/access}

= Proportion of (successful accesses/total attempts to connect/access)

= $P(w_a)$. This is estimated by questionnaire.

DPM_{wc} = DPM of web applications during continuity phase

= P{‘*browse-internet’* transaction continues uninterrupted until completion │transaction to connect/access was successfully established}

= P(‘*browse-internet’* transaction access/connection is established successfully AND continues uninterrupted until completion)/P(‘*browse-internet’* transaction access/connection is established successfully)

= $P(w_c \text{ AND } w_a)/P(w_a)$

= Proportion of (Number of successful transactions during continuity/Number of successful accesses). This is estimated by questionnaire.

DPM_{wr} = DPM of web applications during release/fulfilment phase

= P{‘*browse-internet’* transaction is closed successfully │transaction to connect/access was successfully established with no discontinuity}

= P(‘*browse-internet’* transaction access/connection is established successfully AND continues uninterrupted until closed)/P(‘*browse-internet’* transaction continued successfully)

= P(w_c AND w_f)/P(w_c)

= Proportion of (Number of successful service releases/Number of successful continuities).This is estimated by questionnaire.

The iterations are repeated for each application_i of {1,2,3,4,5}, and phase_j of {a,c,f}.

Also,

DPM_{ij} = Transaction Defective Ratio = (Number of defective transactions/ Number of attempted transactions), (CQR, 2000).

4.3 Customer retention measurement

Customer repurchase intention is measured by multiple regression given by,

$LCR_i = \beta 0 + \beta 1 R_1 + \beta 2 R_2 + \beta 3 R_3 + \beta 4 R_4 + \beta 5 R_5 + \epsilon i,$

where,

LRC_i = intention to renew contract measured, on a 7-point Likert scale as shown on the attached questionnaire.

This is subject to a set of Gauss-Markov conditions for error term ϵi,namely:

- All have mean zero: E(ϵi)=0 for all *i*,
- All are uncorrelated: Cov(ϵi,ϵj)=0 for every *i≠j*,
- All have the same variance: Cov(ϵi)=σ2 for all i.

And,

the covariate set $R = \{ R_1, R_2, R_3, R_4, R_5, \}$, R_i *ϵ(0,1)* is composed of network service reliabilities for five different applications commonly used by average internet users.

The problem of multicollinearity, due to heterogeneity of covariates, is greatly reduced by stratified random sampling made of homogenous strata of leased line, dial-up, and fixed wireless customers.

The data is collected on a structured questionnaire meant to cover the success or failure of transactions during accessibility, continuity, and fulfilment phases of the five applications as well as gauge customers' intention to defect. A detailed questionnaire is attached as Annexure A. The detailed questionnaire sections were discussed in Chapter 1.

- Customers score service reliability of the five different applications. This provides a basis for computing probabilities of failure of transactions at each of the three phases. From here, each application reliability is estimated.

- Customers provide an indication of their intention to renew the internet contract or not, based on their perception of applications reliability. This provides the basis for estimating repurchase intention/contract renewal.

4.4 Overview of research design

4.4.1 Population

This section summarises the detailed methodology in Chapter 1.

The study population was made up of 198 corporate customers of two 3rd tier ISPs within a 15-km radius from Maseru Central Business District (CBD). This excludes individual internet subscribers of network operators or other providers.

The study population consisted of only three types of connectivity options that are common to all ISPs, namely leased lines, fixed wireless, and dial-up. The strata are distinct, homogeneous and exhaustive subgroups.

4.4.2 List of respondents

The sampling frame comprised customers that had a leased line, dial-up or fixed wireless internet service.

4.4.3 Sampling

In this study, stratified random sampling was used. These strata were determined based on the proportional representation of each internet connectivity type in the population from the LISPA register. The strata were proportionally allocated as follows:

- Leased lines: 70.2%
- Dial-up: 12.1%
- Fixed wireless: 17.7%

The sample size of 97 organisations was determined by use a sample calculator at a 95% confidence level.

4.4.4 Sample size

The overall sample size was made up of 97 organisations.

4.4.5 Data collection

The data was collected using a structured questionnaire with both closed- and open-ended questions. In order to improve quality and responsiveness, the questionnaire was targeted towards staff members who either held Information Communications Technology (ICT) qualifications and or acted as contact people for ICT-related queries at their work places.

4.4.6 Data analysis

The open source PSPP software is use to do data analysis The software possesses most basic analytical features on a modern commercial statistical software. It is free and easy to install and use.

4.5 Summary

Network service reliability is measured using the ACF framework and multiple regression is used to predict customer retention. The data was collected form 97 organisations in the form of a structured interview. The PSPP open source statistical package was used to analyse the data.

CHAPTER FIVE: RESEARCH RESULTS

5.1 Introduction

This chapter presents and discusses the results of the field study. There were all together 93 fully completed questionnaires. The other four were partial filled in, with data missing on percentages of 'service fulfilment' for leased line customers. The incomplete records were later rectified using predictive replacement of observed values in the leased line subsample.Altogether,97 responses were ultimately analysed.

Because the study was exclusively focused on corporate users, not individual private internet users, the direction and emphasis of the discussion is on network service reliability over leased lines, fixed wireless and dial-up internet. As was noted in chapter one and four , the perceptions expressed in the study responses are understood to be 'representative' of the organisation in question, not necessarily of the individual interviewed.

The purpose of this chapter is to present two sets of results. The first set of results deals with descriptive statistics. Descriptive statistics provide the frequency tables and cross-tabulations on demographics ,network service reliabilities, and likeliness of customer retention. The second set of results covers hypothesis testing and model fitting. They indentify significant variables in network service reliability, and the extend of the influence of network service reliability on customer retention. The conclusion summarises the findings of the study.

5.2 Descriptive statistics

The data analysis was done using PSPP,a open source statistical package. Table 5.1 below provides the demographic profile of respondents. A total of 97 respondents filled in the questionnaire, of which 78 were males and 19 were females. Close to 60% of respondents 58.7%(50.5%+8.2%) fall within the youth age bracket at 35 years and below. While the Table 5.1 reveals a full 69% of the people doing IT-related jobs at their workplace hold at least a bachelor's degree, it also shows that only 17.5% of them having been at current their position for more than 12 years.

Table 5.1: Demographic profile of respondents

Variable		Count	%
Company	Public company	6	6.2%
	Close corporation	0	0%
	Private company	29	29.9%
	Sole Proprietary	6	6.2%
	NGO	24	24.7%
	Government department	32	33.0%
Total Number of employees	Public company	570	14.9%
	Close corporation	0	0%
	Private company	380	10.0%
	Sole Proprietary	50	1.3%
	NGO	384	10.0%
	Government department	2432	63.7%
Internet contract	Leased line	68	70.1%
	Fixed wireless	17	17.5%
	Dial-up	12	12.3%
Gender	Male	78	80%
	Female	19	20%
Age(years)	18-24	8	8.2%
	25-35	49	50.5%
	36-46	27	27.8%
	46>	13	13.4%

IT-related qualification(Y/N)		56	57.7%
		41	43.3%
Highest qualification	Certificate	2	2.1%
	Diploma	28	28.9%
	Degree	40	41.2%
	Honours	7	7.2%
	Postgraduate diploma	3	3.1%
	Masters	17	17.5%
	PhD	0	0%
Years in position	<1 year	3	3.1%
	1-5 years	51	52.6%
	6-11 years	26	26.8%
	12>	17	17.5%

Cross-tabulations were also used to provide further insights into the relationship between various variables. Table 5.2 shows relationship between internet contract type and staff complement.

Table 5.2 : Contract type by staff complement

	Total staff complement	Leased line	Fixed wireless	Dial-up
Government department	2432	30	2	0
Public company	570	6	0	0
Closed corporation	0	0	0	0
Private company	380	12	11	6

Sole propriety	50	0	0	6
NGO	384	20	4	0
Total	3816	68	17	12

The staff complement in the organisation seems to indicate the type of internet contract the organisation will have. For instance, 94%(30/32) of government departments internet contracts were leased,100% of public companies contracts were leased lines and 83% of NGO contracts were leased lines. Sole proprietary with the smallest number of employees entirely depend on dial up for their office internet needs.

The performance of different services on the ISP network also depends on the underlying service delivery infrastructure(SDI),Torterella(2005:8). Table 5.3 below shows distribution of the customers by their repurchase intention(to recommend contract renewal) by internet contract type or service delivery infrastructure.

Table 5.3: Contract type by repurchase intentions

	Leased line	Fixed wireless	Dial up	Total
Strongly agree	22	5	1	**28**
Agree	12	4	2	**18**
Slightly agree	8	2	0	**10**
undecided	17	2	5	**24**
Slightly	3	1	1	**5**
Slightly disagree	1	1	2	**4**
Strongly disagree	5	2	1	**8**
Total	68	17	12	**97**

From Table 6, It is evident that 58%(58/97) of internet customers would *at least* slightly agree to recommend the renewal of the internet contract. Of the 29%(28/97) that strongly agree to recommend renewal, a majority 78%(22/28) hold leased line contracts, followed by fixed wireless at 18%(5/28) and dial-up at 4%(1/28)).Also,62%(42/68) of all leased lines and 65%(11/17) of all fixed wireless contracts intend to recommend a renewal, compared to only 25%(3/12) of dial customers.

The results ,firstly, reflect the potential for high customer attrition with *42%(*41/97) either *ambivalent or at least slightly disagreeing* to the recommend contract renewal. This is in line with Hughes(2012) showing churn rates to be between (10-67)% annually in the telecommunications industry. Secondly, while many more fixed wireless customers show an intend to renew, the *intensity* of the desire to renew is mostly found in leased line customers. This may mean that, for those leased line customers satisfied with the service, loyalty is very high. As a service delivery infrastructure, leased lines are reputed for stability and reliability, comparatively better than fixed wireless and dial-up. Internet customers consider reliability among the most significant predictors of their loyalty, Rousen *et al* (2010:886). If there is an "access network failure," the entire internet seems to be down for the end-user. Therefore, it is possible that the availability of the "last mile" link should also be a factor in the calculation of the overall availability of the Internet, Network Reliability Interoperability Council(2012:13).Compared with 59%(10/17) for fixed wireless and 8%(1/12) for dial-up, 72%(49/68) of leased line customers at least slightly agree that ,overall, network services were always successful. Of those who strongly agree,76%(13/17) use leased lines as opposed to 18%(3/17) for fixed wireless and 6%(1/17) for dial-up as shown in Table 5.4.

Table 5.4: Contract type by service accessibility

	Leased line	Fixed wireless	Dial up	Total
Strongly agree	13	3	1	**17**
Agree	26	4	0	**30**
Slightly agree	10	3	0	**13**
undecided	11	3	4	**18**

Slightly	4	1	3	**8**
Slightly disagree	4	3	3	**10**
Strongly disagree	0	0	1	**1**
Total	68	17	12	**97**

The pattern is more pronounced on the ability of customers to continue with the service once they had established a successful connection. Majority 74%(50/68) of leased line customers at least slightly agree that they always were able to successfully go on with their online activities without disruption compared with 65%(11/17) for fixed wireless and 42%(5/12) for dial-up. The same pattern was observed on the perceptions of fulfilment after the use of service.

Table 5.5: Contract type by service continuity

	Leased line	Fixed wireless	Dial up	Total
Strongly agree	21	5	0	**26**
Agree	23	5	3	**31**
Slightly agree	6	1	2	**9**
undecided	9	1	4	**14**
Slightly	3	2	1	**6**
Slightly disagree	6	3	1	**10**
Strongly disagree	0	0	1	**1**
Total	68	17	11	**97**

Overall, the results indicate that service delivery infrastructure appears to have major impact on customer service reliability experience over the IP network. Because service accessibility is adversely affected by congestion, unreliability can occur as a result of *traffic loads higher than those of which the network is capable* even when all network elements are operating properly. In addition, when *one or more network elements is in a failed state*, more congestion could be produced by a given traffic load than would have been produced with that same load had these network element(s) been working properly. This is true of both circuit-switched networks and packet networks. Therefore, service accessibility decreases when network elements fail, other things(like traffic loads) being equal. The decision to place service accessibility at a given level is based partly on customer satisfaction considerations and partly on economic consideration.

5.3 Hypothesis Testing

Hypothesis testing seeks to establish the extend of the influence on network service/applications reliabilities on customer retention. The significance level is 0.05.For the alternative hypothesis to be accepted, the calculated significance should be 0.05 or less. As Table 5.6 inidicates,H1,H4 and H5 were accepted and H2 and H3 were rejected.

Table 5.6: Hypotheses testing results

	Hypothesis	**B**	**Significance**	**Decision**
1	There is a positive association between email applications reliability and repurchase intentions	1.41	0.05	Accept
2	There is a positive association between web applications reliability and repurchase intentions	0.6	0.49	Reject
3	There is a positive association between server-based real time & instant messaging(IM) applications reliability and repurchase intentions	0.02	0.98	Reject
4	There is a positive association between user-to-user(peer-to-peer) reliability and repurchase intentions	4.23	0.00	Accept
5	There is a positive association between link/access applications reliability and repurchase intentions	1.53	0.05	Accept

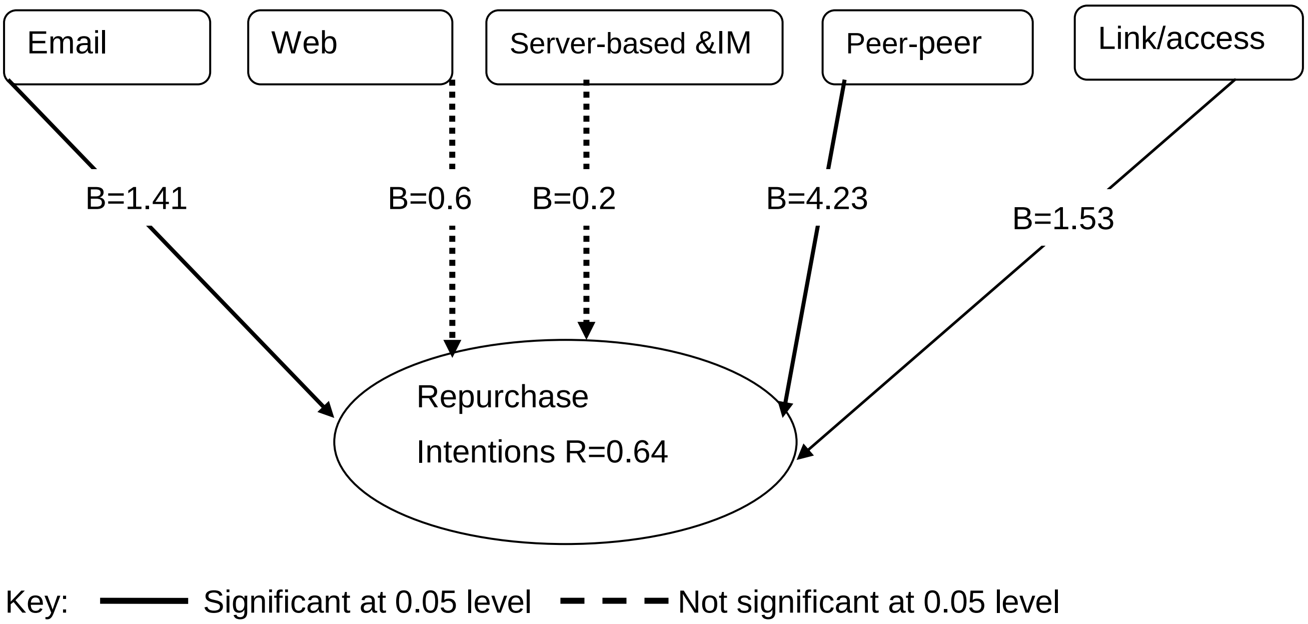
The acceptance of H1 that implies that the more reliable the corporate email service, the more likely it will lead to repurchases(contract renewal). This is consistent with Madden, Savage and Coble-Neal(1999:195) finding on the Australian ISP market, who found that email use for work-related purposes was likely to lead to defections if network was unreliable. This is because, as Garibian(2013) reports, email has become the most commonly used internet service. Most people spend more time dealing with email than any online activity, Nielsen(2010).This may explain why an unreliable email service may lead to customer defections.

The rejection of H2 and the acceptance of H5 presents an interesting insight of web use at work. Madden at el(1999:195) had found that web browsing for hobby(non work related) showed no significant impact on customer retention. This may imply that while work-related access(H5) is still available, corporate users are unlikely to terminate internet contracts.

The rejection of H3 and the acceptance of H4 provides another insignt.According to Weber,Beck and Konig(2012:6), individuals are more likely to select and make use of the instant messaging applications at in business if they can be able to access them from everyplace and at every time. Because the high cost and generally degraded quality of ISP internet services in Lesotho, it may be possible that corporate users are not yet able to make the full potential of these services.Instead,work-related information and file sharing is done by users on their corporate networks.

Overall, the rejection of H2 and H3 means that the positive association between repurchase intentions and the reliability of the web and other served based real time applications ,including instant messaging is not supported. The model results are displayed in Figure 5.1 below.

Figure 5.1:Hypothesis results in model format



Since only three variables were significant, the two other variables were dropped and the model rerun. There is a positive linear association between repurchase intention and network service reliability, with an R Squared = 0.64.This means that 64% of the variation in the intention to renew internet contract is attributed to reliability of email service, direct user to user communications(Pee-to-peer) and link/ access.

5.4 Summary

The results of the field study demonstrate that the type and size of an organisation influence the choice of internet contract. Bigger organisations in terms of staff complement such as public companies and government departments prefer far more reliable internet connection. Leased lines were used by 94% of government departments,100% of public companies contracts, and 83% of NGO.

The type of internet contract also has a strong influence on the repurchase intentions. Most customers on leased line display strong intentions to renew their contracts ,while dial up and fixed wireless users are largely ambivalent. The results reveal that 58% of internet customers would *at least* slightly agree to recommend the renewal of the internet contract. Of the 29% that strongly agree to recommend renewal, a majority 78% have leased line contracts..

The study also finds that 64% of variation in repurchase intention can be explained by network service reliability, with their reliability of email service, direct user to user communications(Pee-to-peer) and link/ access having significant positive impact. The positive impact of the web and Instant messaging is not supported by the study.

CHAPTER SIX: FINDINGS,CONCLUSION,AND RECOMMENDATION

6.1 Introduction

The purpose of the study was to determine the influence of network service reliability on customer retention. Network service reliability is about the perception of the user of the services running on the network. Madden, Savage and Coble-Neal(1999:195),manner in which the service is used is the most important non-price factor in customer retention.
In this chapter, the main findings are presented and discussed for each hypothesis tested and conclusions.

6.2 Main Findings

Finding: Email reliability is a significant predictor of customer retention for corporate users.

The study findings reveal that the reliability of email service/application at work sigficantly influences customer retention for corporate customers. For a point increase in email reliability, the customer intention to renew in the internet contract grows by 1.41.The importance email reliability for corporate users is supported by other findings such as Madden(1999:195).

It is concluded that ISPs need to optimise email performance both on client side and on their service delivery infrastructure side.

Finding: Reliability of the link/access to the internet is a significant predictor of customer retention for corporate users.

Rousen,Ramzi,and Mohamed(2010:886) argued that while price is still an important consideration, ISP customers consider reliability of service among the most significant predictors of their loyalty. An unreliable link to the internet compromises the reliability of most all services/applications that depend on the internet for functionality such as email. What is surprising about this finding is that corporate customers do not rate it as the most significant reason for renewing contracts.

It can be concluded that ISPs network operations centres(NOCs) should be able to monitor in real time the link availability for corporate customers. While most ISPs already have systems in place for doing this, most of the time the approach is not proactive. Internet service providers tend to use these systems primarily to capture or log system failures. A pro active approach will require, amongst others, full time manpower on the NOC.

Finding: Direct-user-user communication reliability is the most significant predictor of customer retention for corporate users.

Direct user-to-user communication(peer-to-peer) appears to be a significant predictor of customer retention for corporate customers. Keeping other variables constant, direct-user-to-user communication increases customer retention by 4.23 point per unit increase in reliability. This is probably because users tend to rely more corporate data network than ISP network for this type of communication, especially where ISP bandwidth capacity is small and congested.

The conclusion is that ISPs should take a more proactive role in helping clients design and implement peer-to-peer systems within their corporate data networks with proper security controls. The purpose is to further reduce the load on ISP bandwidth and to provide more information security by keeping communication private without having to rely on the public internet medium.

Finding: Network service reliability explains 64% variability in customer retention

The study finds the network service reliability explains 64% of variability in customer retention. This supported by Madden(1999:195) in arguing that the manner in which the service is used has become the most important non-price factor for ISP customers. Evangelia at el(2009:35) concluded that, amongst others, service quality positively influences loyalty, and customer retention. Ian(2005:7) emphasized service quality as a significant factor by broadband subscribers, including customer service and connection interruptions. While price is still an important consideration, customers consider reliability of service among the most significant predictors of their loyalty, Rousen,Ramzi,and Mohamed(2010:886).

6.3 Recommendation

The primary objective of the study was to determine the influence of network service reliability on customer retention.

The findings of the study reveal that 64% of the variability in customer retention can be explained by the reliability of three services. These are email, peer to peer and link/access. Because they command little regulatory flexibility in installing own service delivery network infrastructure, ISPs should concentrate on reallocating both financial and manpower resources specifically geared towards *optimising only these services that customers care about.* This means, assuming the validity of the results, redefining customer value propositions for different customer segments to address any and all issues relating to the performance of email, user-to-user communication and link access protocols.

The practical recommendation for the management of ISPs is the adoption and implementation of a service improvement program that addresses specifically the three priority service/application areas. In order to generate performance baselines, the recommend procedure is as follows:

a)Set service reliability requirements: ISPs should conduct a rapid assessment of their customer service perceptions based on three priority applications. From the rapid assessment survey of their customers,ISPs should be able to compute service reliability benchmarks.

b)Design for service reliability framework as outlined in the methodology section of this study.

c)Configure of the SDI and system reliability benchmarks to determine how to meet service

reliability goals through SDI and system design.

d)Monitor and evaluate the achievement of service reliability goals by collecting relevant customer data from system logs in NOC and regularly survey the customers.

The program can be implement in line with other quality improvement programs and standards, including ISO 28000.By concentrating on delivering value where it matters, ISPs may be able to keep their customers content.

6.4 Limitation of the Study

Sampling and Data collection: The survey responses were collected from ICT personal or those who perform related function in the organizations. They answered the survey questions to provide 'representative' perceptions of the organisation. An ideal way to collect this data would be to directly administer the questionnaire to a random sample within each organisation. The challenge,however,is that decisions to recommend the termination or renewal of internet contracts are normally done by ICT managers or those in charge of ICT. This means that it may as well be less insightful to gather the data from everyone in the organisation, including those with peripheral influence on the fate of internet contracts.

The survey questions: The survey questions tended to take far longer to answer by respondents due to their mostly technical nature.Sometimes,this had involved the interviewer providing long-winded explanations that may have introduced bias in the way the questionnaire was answered. Or in the alternative, respondents confusing concepts,eg direct user to user with email. It is possible that some respondents may have interpreted questions related to these two concepts the same way. The technical nature of the questions also limits the wider applicability of the survey instrument to wider audience or individual internet users.
Finally, this study was conducted in a third world country.This means that some of the technological and regulatory constraints imposed on ISPs in Lesotho are not readily applicable to other developing and developed markets.

6.5 Future Research

The study was undertaken within the context of third world country in Southern Africa. The conclusions drawn may not be readily adaptable to other developing or advanced economies.However,potential areas for improvement include designing and testing a user friendly data collection instrument in order to be able to capture the user perceptions of network service reliability without inadvertently introducing bias. Furthermore, ACF framework needs to be improved to make easier for service providers to implement network service reliability measurements.Finally,network service reliability theory still needs further development on designing and configuring the SDI infrastructure so that ISPs and other telecommunications service providers can provide a growing array of communications and information services independent of the access and transport networks. This is the very essence of network service reliability.

6.6 Conclusion

The field study has indentified the services/applications commonly used by internet users. The ACF framework was identified and implemented to measure the reliability of these services as perceived by the users. The study found that email, direct-user-user applications and internet are links are significant predictors of customer retention.Overall,it is found that network service reliability has a positive influence on customer retention. By implementing service improvement as recommded,ISPs can focus on the a few service/applications that customers care about. In this way they can be able to deliver value to their customers while saving on bandwidth and network capital costs.

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ANNEXURE A

University of the Free State Business
School
Bloemfontein

3rd September 2012

To whom it may concern

Sir/Madam

Re: MBA Field Study: THE INFLUENCE OF NETWORK SERVICE RELIABILITY ON CUSTOMER RETENTION: A STUDY ON THIRD-TIER INTERNET SERVICE PROVIDERS IN LESOTHO

Please find attached the questionnaire for my MBA field study. The questionnaire covers general questions about the perceptions regarding the reliability of internet services. It is part of the requirement to be fulfilled in completing the MBA degree. It is strictly for academic purposes and the responses will treated anonymously.

It is estimated that the questionnaire will take at most 10 minutes to complete.

For any questions or clarifications, please do not hesitate to contact me at**:**

Seleke.mohato@gmail.com or +266 62997232

Thank you in advance.

Yours Sincerely,

MOHATO SELEKE

Study Questionnaire

This questionnaire has five sections A , B , C , D and E. Please answer all questions.

SECTION A: **Demographic Variables**

1.1: Describe the type of your organisation

☐ Public company

☐ Closed Corporation

☐ Private Company

☐ Sole propriety

☐ Non-Governmental Organisation (NGO)

☐ Government Department

1.2: How many employees does your organisation have?

………………………………..

1.3: What type/s of internet technology contract does your organisation have?

☐ Leased line

☐ Wireless

☐ Dial-up

1.4: Indicate your gender

☐ Male

☐ Female

1.5: What is your age?

………………………

1.6: Do you hold any IT-related qualifications?

☐ Yes

☐ No

1.7: If the answer in 1.6 above is YES, indicate your highest IT-related qualification?

☐ Certificate ☐ Postgraduate Diploma

☐ Diploma ☐ Masters

☐ Degree ☐ PhD

☐ Honours

1.8: If the answer in 1.6 above is NO, indicate your highest qualification, e.g. diploma

☐ Certificate ☐ Postgraduate Diploma

☐ Diploma ☐ Masters

☐ Degree ☐ PhD

☐ Honours

…………………………..

1.9: How many years have you been in this position?

…………………………..

SECTION B: **Accessibility of Internet Services**

2.1: In your opinion, what percentage of all first attempts to access the email service by employees at work were successful in the last 30 days?

……………………………

2.2: In your opinion, what percentage of all first attempts to access web pages and other files from the Internet by employees at work were successful in the last 30 days?

……………………………….

2.3: In your opinion, what percentage of all first attempts to access instant messaging and other server-based real-time technologies by employees at work were successful in the last 30 days?

…………………………………

2.4: In your opinion, what percentage of all first attempts to access the direct user-to-user communications (excluding email) by employees at work was successful in the last 30 days.

. ………………………………….

2.5: In your opinion, what percentage of all first attempts to access other online resources by employees at work was successful in the last 30 days?

………………………………….

SECTION C: **Continuity of Internet Services**

2.6: In your opinion, once you had access, what percentage of the email service by employees performed satisfactorily without being disconnected or disrupted at work in the last 30 days?

……………………………………

2.7: In your opinion, once you had access, what percentage of the downloads of web pages and other files from the Internet by employees performed satisfactorily without being disconnected or disrupted at work in the last 30 days?

…………………………………….

2.8: In your opinion, once you had access, what percentage of the instant messaging and other server-based real-time technologies by employees performed satisfactorily without being disconnected or disrupted at work in the last 30 days?

……………………………………..

2.9: In your opinion, once you had access, what percentage of the direct user-to-user communications (excluding email) by employees performed satisfactorily without being disconnected or disrupted at work in the last 30 days?

………………………………………

3.1: In your opinion, once you had access, what percentage of the connections to other online resources by employees performed satisfactorily without being disconnected or disrupted at work in the last 30 days?

………………………………………

SECTION D: **Release/Fulfilment of Internet Services**

3.2: In your opinion, once done with the service, what percentage of the email services were ended, disconnected, or closed successfully by employees at work in the last 30 days?

……………………………

3.3: In your opinion, once done with the service, what percentage of the downloads of web pages and other files from the Internet by employees were ended, disconnected, or closed successfully at work in the last 30 days?

…………………………….

3.4: In your opinion, once you are done with the service, what percentage of the instant messaging and other server-based real-time technologies services by employees were ended, disconnected, or closed successfully at work in the last 30 days?

………………………………

3.5: In your opinion, once you are done with the service, what percentage of direct user-to-user communications (excluding email) services by employees were ended, disconnected, or closed successfully at work in the last 30 days?

……………………………….

3.6: In your opinion, once you are done with the service, what percentage of connections other than online resources services by employees were ended, disconnected, or closed successfully at work in the last 30 days?

………………………………

SECTION E: **RETENTION**

3.7: Overall, the internet services are always accessible. Tick one.

☐ 1= strongly disagree

☐ 2= disagree

☐ 3= slightly disagree

☐ 4= undecided

☐

5= slightly agree

6= agree

7= strongly agree

3.8: Overall, the internet services are never disrupted. Tick one.

1= strongly disagree

2= disagree

3= slightly disagree

4= undecided

5= slightly agree

6= agree

7= strongly agree

3.9: Overall, the internet services always close off successfully after usage. Tick one.

☐ 1= strongly disagree

☐ 2= disagree

☐ 3= slightly disagree

☐ 4= undecided

☐ 5= slightly agree

☐ 6= agree

☐ 7= strongly agree

4.1: Would you recommend the renewal of the current internet contract? Tick one.

☐ 1= strongly disagree

☐ 2= disagree

☐ 3= slightly disagree

☐ 4= undecided

☐ 5= slightly agree

☐ 6= agree

☐ 7= strongly agree

4.2: Finally, based on the overall reliability of the internet services, would you renew your current internet contract?

☐ yes

☐ no

-END-

THANK YOU