University of Neuchâtel

Masters Thesis

Analysis of Mobile Data Services and Internet in Switzerland, India and Tanzania

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A thesis submitted in fulfilment of the requirements for the degree of Master of Computer Science

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February 2013

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"Now that digital lifestyle devices, tablets, wireless phones, and other Internet appliances are beginning to come of age, we need to worry about Mobile Internet to these devices so that it is optimized for their computing capabilities."

Mike Davidson

UNIVERSITY OF NEUCHÂTEL

Abstract

Computer Science
Department of Computer Science

Master of Computer Science

Analysis of Mobile Data Services and Internet in Switzerland, India and Tanzania

by Ahmed SHAMS

Significant transformations are emerging in the telecommunications domain as the Internet, mobile industries, and network carriers are converging in providing mobile Internet and data transmission. Mobile phones are turning into multi-function computers with higher processing power and display capabilities and convincingly are becoming part of our daily lives. In these days, digital lifestyle devices are increasingly in need of Internet to enable optimized usage, hence setting the Internet as a backbone of communication system. Furthermore, the usage of mobile Internet has been tremendously increasing in this decade partly due to increasing number of mobile devices, availability of mobile broadband and increase of offered bandwidths.

This thesis focuses on various key players of mobile Internet including wireless service providers, mobile devices, API developers and mobile consumers. It covers three country case studies on the status of each of key players above. The country case studies were conducted in Switzerland, India and Tanzania. The report analyses mobile Internet data services and co-related services among players within the country. For instance, the report finds that Switzerland, India and Tanzania are on different points of the ICT development curve. However the study of mobile Internet services strongly indicates near future convergence of mobile Internet domain.

By performing in-depth research on Telecommunication and Communication domains, this thesis analyze the bridge connecting key players above. Furthermore, this work makes an effort to facilitate both the industrial and the academic communities in various ways to gain an insight into existing mobile wireless communications & network carriers, as well as mobile Internet services.

Acknowledgements

This Masters Thesis has been written as a partial fulfillment for the Master of Computer Science and Internet Technology degree in University of Neuchâtel. The work has been conducted as a deliverable for the eXscale Infolab project in the Department of Informatics in University of Fribourg.

First, I wish to express my sincere gratitude to Professor Philippe Cudré-Mauroux for the opportunity to work with him and to write the thesis under his guidance. He inspired me to start this very research. Obviously, this dissertation could not be written to its fullest without him, who was abundantly helpful and offered invaluable assistance, support and guidance.

I would also like to express my gratitude to The Swiss Government's Federal Commission for Scholarships for foreign students (FCS) for providing me the opportunity to pursue my masters studies in Switzerland. FCS provided financial means, domestic tours, cultural programs and other facilities. I owe the warmest thanks to FCS, without the contribution of FCS this research would not have been possible.

I would like to thank my family, friends, and fellow students for the support during my studies. To my dearest friends, thank you for the strength and wisdom you gave me during the course of my work. Finally, I wishes to express my love and gratitude to my beloved families; for their understanding and endless love, through the duration of my studies.

Neuchâtel, January 2013

Ahmed Shams

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Abbreviations

3G	**3**rd **G**eneration Technology
4G	**4**th **G**eneration Technology
AMPS	**A**dvanced **M**obile **P**hone **S**ystem
CDMA	**C**ode **D**ivision **M**ultiple **A**ccess
EDGE	**E**nhanced **D**ata **R**ates for **G**SM **E**volution
GPRS	**G**eneral **P**acket **R**adio **S**ervice
GSM	**G**lobal **S**ystem for **M**obile
HSDPA	**H**igh **S**peed **D**ownlink **P**acket **A**ccess
HSPA	**H**High **S**peed **P**acket **A**ccess
LTE	**L**ong **T**erm **E**volution
MIMO	**M**ultiple **I**input **M**ultiple **O**utput
MMS	**M**ultimedia **M**essage **S**ervices
MNO	**M**obile **N**etwork **O**perator
MVNO	**M**obile **V**irtual **N**etwork **O**perator
PPP	**P**urchasing **P**ower **P**arity
SIM	**S**ubscriber **I**dentity **M**odule
SMS	**S**hort **M**essage **S**ervice
UMTS	**U**niversal **M**obile **T**elecommunications **S**ystem
WAP	**W**ireless **A**ccess **P**rotocol
WiFi	**W**ireless **E**thernet
WiMAX	**W**orldwide **i**nteroperability for **M**icrowave **A**ccess

Mobile Operators

Popular Name	Mobile Operator's Company Name
Airtel	Bharti Airtel Ltd
Idea	Idea Cellular
Lebara	Lebara Group
MTS	Mobile TeleSystems
Orange	Orange Communications SA
Reliance	Reliance Industries Ltd
Sasatel	Sasatel Telecommunications
Smile	Smile Telecoms Holdings Ltd
Sunrise	Sunrise Communications AG
Swisscom	Swisscom AG
tiGO	MIC Tanzania Ltd
Vodacom	Vodacom Tanzania Ltd
Vodafone	Vodafone India
Yallo	Yallo Sunrise Communications AG Brand
Zantel	Zanzibar Telecom Ltd

Dedicated to myself

Chapter 1

Introduction

1.1 Introduction to this dissertation

In this era of technology and intelligent mobile devices, Internet remains to be the backbone of communications in daily activities. Internet enables digital devices such as Smartphones to be connected to the network to access resources and hence deliver the needy service to the end user such as data communications. The availability of Internet has been improved in homes and offices in developed countries such as Switzerland compared to developing ones like India and Tanzania. However, concerns arise when it comes to mobile Internet issues, where the user is only relying on one mobile network operator to continue providing broadband Internet services.

Traditionally, network operators have used simple flat-rate broadband data plans for wireless network Internet access. Critically important, nowadays, with the popularity of digital lifestyle devices such as Smartphones, and exponential growth of Apps, multimedia, and cloud computing. Service providers now take places in moving towards more intelligent and capable wireless technologies while also providing sophisticated pricing schemes, including dynamic pricing. One may witness a major change over which network resources are managed and the role of Internet in allocating these resources. As most of the network resources are only accessed and distributed among users only through Internet access, therefore, it is most likely one can inquiry the possibility of getting routed to Internet contents without being directly connected to the Internet access point.

This thesis reviews some of the well-known current broadband pricing schemes, their current realization in various consumer data plans in Switzerland, India and Tanzania, and discusses the understanding of consumer behavior toward digital lifestyle devices and mobile Internet. It also provides deep understanding of the consumer

needs, usage, change and relationships between various pricing ideas in broadband data plans and their corresponding countries.

By performing deep exploration on current state, benefits and challenges of mobile Internet and data transmissions, this work attempts to facilitate both the industrial and the academic communities in one way or another in understanding the existing literature, recognizing of mobile Internet services, development and performance of Internet industry in terms of penetration, tariffs and usage of Internet services in Switzerland, India and Tanzania.

1.2 Thesis Motivation & Background

Enormous number of researches have been conducted elsewhere on mobile data services adoption rates, the determinant factors, and models relevant to the particular market and cultural conditions [1]. Most of the past researches are basic on individual country or a common cultural environment. The author of this research work has done international studies on different environmental backgrounds. The current research reviews wireless technologies, network carriers, estimate the mobile Internet and data transmissions in wide range of international range, and then analyze the findings to provide recommendations to on-going number of researches including the offline browsing, ad-hoc networking and other mobile communications.

1.2.1 Author Motivation

The author has studied and lived for more than a year in Switzerland, India and Tanzania. Being in different countries in different continents, one is expecting a vast distance in similarity of culture and tradition among these countries. The author being a distributed systems specialist is fascinated with the mobile Internet services among the countries, and needs to gain an insight on how separate countries view mobile networks, how do they enable mobile Internet and the Internet usage among various consumers so he can better convey his passion and enthusiasm for the subject.

1.2.2 Motivation from Academic Research

Exascale Infolab in department of Informatics, Fribourg is conducting various projects focusing on new algorithms and infrastructures to store, manage and query very-large data sets. The lab is specialized in non-relational data such as multi-dimensional data. One of the currently running projects is to enable an offline website browsing system in mobile devices that will enable the access of Internet based contents but without being connected directly to the Internet. The project is enthusiastic to understand

the way different mobile operators handle the mobile Internet around the world from technical point of view to data plan marketing strategy.

1.3 Problem Definition & Objectives

The need for robust planning and research into the future of mobile Internet and broadband among digital lifestyle devices such as Smartphone and tablet computers creates large number of questions which demand answers. Are the current mobile data services optimize the computing capabilities of mobile devices? Which mobile data services will the mobile consumers adopt? Is there a way to access and share Internet contents without being connected directly to the Internet? Can the mobile industry and software developers merge to create an offline browsing systems or even deploy ad-hoc network among devices that will enable fetching and sharing of data among users hence a user continue to enjoy the access to the contents in need even though the user is unaware of Internet unavailability? The literature tells us more about the technologies, wireless standards and mechanism of networking of mobile devices. However there is little we know about the volume and speed of mobile Internet services around the world.

The current research addresses that problem by carrying out intensive data collection, performing data analysis, conducting a survey, and aggregate survey results alongside comparable research from different countries.

The fast pace of development of mobile phone industries, evolution in the mobile data services, and information technology in general, leads to turbulent changes in mobile consumer needs. Further, this adds to the urgency with which the research community must consider the problem of defining mobile device information access and networking.

This thesis dwells on:

Q1: How do wireless technologies, mobile Internet and mobile Internet data schemes in the world strive.

a) to accommodate data transfers and communications to mobile devices?

b) to enable mobile operators to provide Internet at optimized computing capabilities of digital lifestyle devices?

c) to provide an offline (Internet-free) mechanism for mobile web, Apps and data communications for mobile devices with no direct access of Internet?

The following research objectives were set in order to determine the efficiency and

effectiveness of mobile Internet and mobile devices:

O1: To perform deep study of mobile operators network technologies, baseline information on mobile Internet, and Internet data services in Switzerland, India and Tanzania.

O2: To work on factual statistics of the mobile Internet and data services in Switzerland, India and Tanzania including estimates of mobile Internet performance, usage and users.

O3: To collect, classify, analyze and document mobile Internet and data services among the above mentioned countries.

O4: To study Online versus Offline website browsing systems not limited to only offline services, mobile webs, data cache technologies, and offline Apps.

1.4 Scope of the Research

The research aims to cover all the Application Services Licensees in Switzerland, India and Tanzania. The research was therefore designed to cover all licensees mobile Internet providers around the world but due to constrain of time and space, the work solely features only the above three mentioned countries. The subject matter of the study was aimed to explore types of mobile Internet services provided by network operators, bandwidth capacity, penetration rate, network technologies, subscriber base and tariffs. However due to some limitation of time and space again, some of collected data, tariffs and other relevant references are not directly included in the analysis and therefore are excluded from this report.

The second part of this work discusses about the mobile consumer behavior, the research is focusing on understanding the consumer needs and usage changes with respect to digital lifestyle devices and mobile Internet usage. There are different ways to measure mobile Internet usage and different stakeholders have access to different data, as mobile Internet usage is dispersed between devices and networks. The research will rely on different customers in Switzerland, India and Tanzania. Data usage are collected using a simple online surveys and extracts from other relevant research works. However, the study shows that the usage of mobile Internet is basically the same through out the world with only minor differences on the type of services each individual concentrate on daily life activities.

1.5 Research Approach & Methods

First, a literature review is carried out to give an overview on the underlying technologies in Telecommunications domain. Several technologies and standards will be discussed. Furthermore, network mobile operators in three countries of Switzerland, India and Tanzania will be discussed in brief with their corresponding fact and figures. In addition, various mobile communication services in the areas of mobile operators are reviewed.

Second, data collection and classification is conducted to provide descriptive and presentative statistics on the mobile Internet and data plans in the above mentioned countries. The data collection includes cost, Internet data volume, validity of data, Internet network speed and the data schemes in general.

Third, an analysis of collected data from different sources including the mobile network operators to provide comparison of mobile Internet and Internet Data Plans among the above mentioned countries. The analysis is carried out in multiple tools including Excel, R (The R Project for Statistical Computing) and other proprietary methods.

Last, Survey questions were conducted through online web based tools and through other methods such as e-mail to emphases data collection in order to provide a rich collection of data so as to gain understanding of mobile consumer's behavior and mobile Internet usage patterns in Switzerland, India and Tanzania. The survey was kept short and brief to address specifically mobile operator's service, the mobile Internet. Participants were asked on average ten questions in various formats including multiple choices. The survey was conducted in above three countries from 15th July to 25th October 2012. One some occasions, some questions were dropped out and data not collected but this does not affect the overall size of collected data. Almost 84 users who are mobile consumers participated in the survey. To ensure a fair sampling of user behavior, a variety of mobile users were pre-selected. As being a developed countries compare to other two, Switzerland was offered a different survey in particular to India and Tanzania. While survey was entirely focusing on general mobile Internet, in Switzerland the survey was more interested in Smartphone users and usage merely because of its huge number in population. Online survey tools like SurveyMonkey website was used with other supplementary online services like social networks, group email and direct conversations with colleagues.

1.6 Thesis Structure and Features

This research project consists of seven chapters including the first Introduction chapter 1 and last Conclusion chapter 7. The remaining core five chapters are generally structured as shown in figure 1.1 including its features. The figure shows the arrangement and relationship between features of this thesis as they will be evolving throughout the stages from the first to the last chapter.

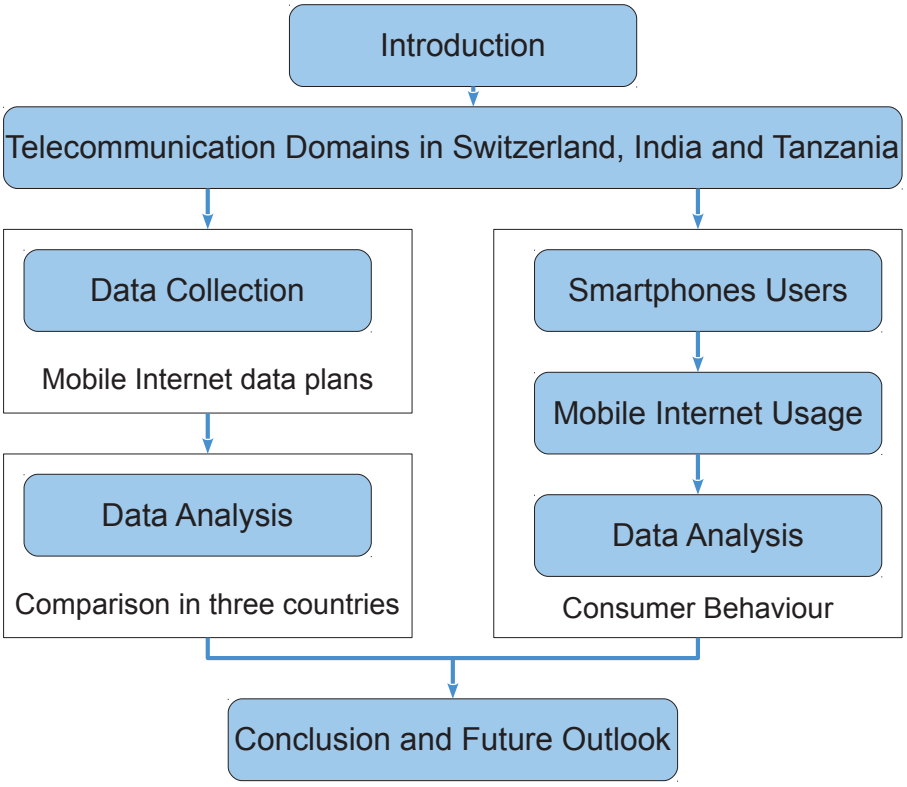


FIGURE 1.1: An overview of thesis structure and features.

Chapter 2. on page 9 provides background information about Telecommunication Domains in particular to wireless communications in three different countries Switzerland, India and Tanzania in three continents in the world. The domain discusses literature on mobile communications technologies and standards focusing on availability, access, and necessities to enable wireless mobile services to reach end-users. Internet data and mobile services are also described in this first part of chapter 2. The second part of Telecommunication Domains overviews mobile network operators profiles in all three countries. The overview focuses of statistical details of mobile operators, facts and figures. Chapter 2 concludes with description to services evolution within carriers including brief on value added services.

Chapter 3. on page 26 provides vital facts and figures about mobile Broadband and the Internet among three countries in both technical and marketing point of view. Various impacts of wireless technology and network developments such as evolution of mobile broadband, and data explosion are discussed. The chapter is not limited to above but further explores mobile data services, wireless substitution, traffic growth, and related issues. In addition, the chapter describes in lengthy various mechanisms for offline browsing system. The chapter mentions Google Gears and HTML 5 as part of offline-enabled content storage.

Chapter 4 and 5. on page 34 and 60 respectively focus entirely on mobile Internet data schemes among the three countries. The chapter exposes various of data plans in aspect to data fees, data size, surfing time, connection speed and customer segmentation. This section involves the means of data collections and further presentation of the data to offer comprehensive scope of data bundles around the globe.

Furthermore, chapter 5 analyze collected data plans and do comparison to generate results. The chapter discusses the objectives, measurement setup, trace data, analysis methods, and the measurement and analysis processes.

Chapter 6. on page 66 provides a slice of vast research field in understanding the mobile consumer around the globe together with digital lifestyle devices. This part of research is survey-based designed to gain insights into mobile smart devices, consumers, Internet usage, trends and future of mobile Internet usage.

Chapter 7. on page 85 which is the last and conclusive chapter provides a summary of the main research findings. In addition, the results are discussed, followed by author's recommendations and further research suggestions are presented.

1.7 Conclusion and Future Outlook

International mobile Internet and data services is an interesting and fast-moving area of academic research. Chapter one has laid a foundation path by which the researcher has contributed to the mobile Internet and data communications literature. The same path will enable the reader to gain an insight into this exciting field, with suggestions for the reader to go further, building on the current work with their own co-related or relevant research on Internet, mobile data or device networking and so on.

The obvious growth in demand for data, especially from mobile devices, is the consequence of magic work of Internet network and increasing number of handheld devices. Mobile Internet network, boosted by latest technology advances such as 4G/LTE is far more capable of solving data communications problems, However how far has the

current telecommunications domain achieved the same goal without dependence of online state of Internet? To address this issue, The research discusses the predominant mobile data services and identify challenges that must be met, particularly in realizing more innovative solutions such as enabling offline browsing systems with less dependence of continuous Internet.

The thorough process undertaken by this author leads to a reliable and valid suggestions and recommendation of the new and future relevant to topic projects. Understanding of mobile Internet data services around the world is the key role of this research, while providing some guidance for research throughout the Information and Communications Technology domain. Now that the overall structure and directive features of this thesis has been set up, chapter two will present a review of the literature on Telecommunications domains in Switzerland, India and Tanzania.

The material presented in this thesis report seeks to inform key players as well as researchers and API software developers keen on understanding ongoing worldwide developments in mobile Internet data services, and might help to shape a new research agenda in telecommunications domain.

Chapter 2

Telecommunications Domains

2.1 Background

Mobile network operators are amongst the most popular companies in our world today. Cellular network companies are well known to be serving billions today and get people around the world connected through voice, SMS, and data services. While most of Internet users around the globe are used to getting Internet connections at home, office or even in public premises, once the user is on move with his digital lifestyle device such as Smartphone, the user is completely depending on the mobile Internet from the mobile network operator to continue using online services accessible through the Smartphone. In most cases the high-speed broadband that users are getting used to while in offices and home, disappears suddenly once they are on a move. This research work takes a closer study on vital players in Telecommunications domain paradigm as shown in figure 2.1. Through out this report, each key player is discussed in lengthy while describing relationship between one player to another. Apart from defining key players, a case study on mobile network operators in Switzerland, India and Tanzania is thoroughly conducted to provide an understanding of mobile network services and their current status.

2.2 Defining Mobile Networks

Mobile network is a radio network distributed over land areas called cells, each cell is served by at least one fixed-location transceiver, known as a base station. In the mobile network, each cell uses a different set of frequencies from neighboring cells, to avoid interference and provide guaranteed bandwidth within each cell. In order to ensure none interferences, definition of rules and impose of standards prior

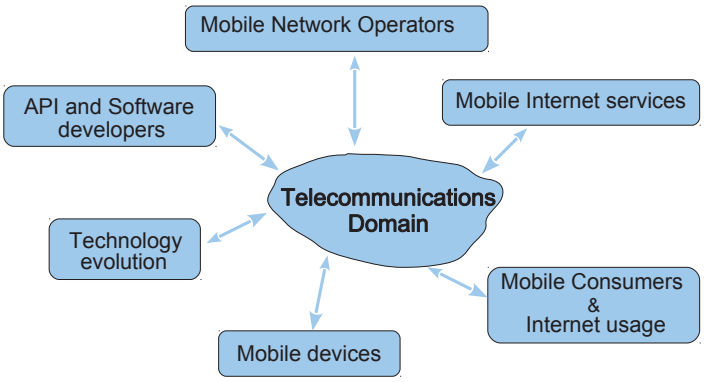


FIGURE 2.1: Key players in Telecommunications domain

to implementation of new technology is critical. There are various kinds of standards and technologies pertaining to each wireless generation. Roughly every decade new wireless network technology and infrastructure involving a change in the fundamental nature of the service, non-previous-compatible technology, higher maximum data rates, new frequency transmission bands, wider channel frequency bandwidth becomes available.

- First-generation, 1G

  Is the first wireless cellular technology that enabled analog mobile telecommunications back in the 1980s and continued for at least 10 years until being replaced by its successor 2G which is digital technology. 1G is well known for its cumbersome mobile phones with voice-only function and higher cost.

  Various network standard such as Nordic Mobile Telephone, NMT was used in Nordic countries and Switzerland. Others like C-450 was used in India and Tanzania. The technology behind 1G was the voice-only Advanced Mobile Phone System network on 800MHz. Which was basically the same as UHF radio signals. FDMA was involved to split the signals into number of channels. 1G could only handle a maximum of 395 mobile users per tower. The network standard was permanently shut down in 1999.

  1G download/upload speeds vary between 28kbit/s and 56kbit/s and at its peak, the network had about 2 million subscribers worldwide [2].

- Second Generation, 2G

  2G is the second generation technology in telephony and the first digital network operations from 1991. The introduction obviously overcame many of the issues with the AMPS network in 1G, including network congestion (increase number of users per tower) and security (via encryption). Apart from improved 1G features, 2G also offers other important features like: digital encryption for

security, Internet packet data called, SMS text messaging, multimedia messaging, caller ID and and also introduction of SIM card.

This digital network service is basically based on GSM standard with operating frequency of 900MHz in TDMA and later 1800MHz band. As GSM is severely limited in range especially when the user operates outside the network coverage, various standards CDMA, EDGE, Digital-AMPS, EGPRS, HSCSD were introduced to overcome these problems. Mostly important in the era are CDMA and EDGE.

CDMA, Code Division Multiple Access is a part of 2G as a replacement for mobile users who could receive a strong signal on AMPS, however outside GSM limited coverage. Code-based multiplexing enables extension of range by removing TDMA.

EDGE, stands for Enhanced Data Rates for GSM Evolution. GSM introduced a GPRS based packet data network in 2001, with a peak download speed of around 60kbps slightly higher than dial-up connection [2].

2G has following transitional: 2.5G, and 2.75G.

- Third Generation, 3G

  3G is typically branded as the revolution of mobile broadband, became function since 2001, operating on 2100MHz frequency band. 3G is well know for serving major metropolitan areas with coverage of more than 50% in most of large cities.

  The 3G standard utilizes a new technology called UMTS as its basic network architecture. This network combines particular features of the 2G network with some new technology and protocols like HSPA, CDMA, EV-DO, GSM EDGE-Evolution and WiMAX that enables faster delivery of data compared to 2G. This made 3G to be significantly faster and much improved than 2G.

  Several telecommunications companies around the world picked up 3G standards and started to market is as mobile broadband and opened the door to enormous mobile Internet services. 3G remains to be the most famous network generation in advertisements and in huge cities. However in most cases most of the companies do not meet the international technical standards of 3G (such as serving at least 256kbps) including those of reliability and data transfer speed. However, many companies also provide higher network speed than 256kbps.

  UMTS employs HSPA protocol as combination of HSDPA for downlink and HSUPA for uplink. While 3G is capable of streaming data at speeds up to 14.4Mbps, most of mobile devices are only capable of 7.2Mbps downlink. With

this breakthrough speed 3G enabled Internet broadband applications on mobile devices that were not previously available to mobile devices. Few to mention applications include: mobile TV, video streams and conference, Smartphone web-based application, GPS and other location-base services.

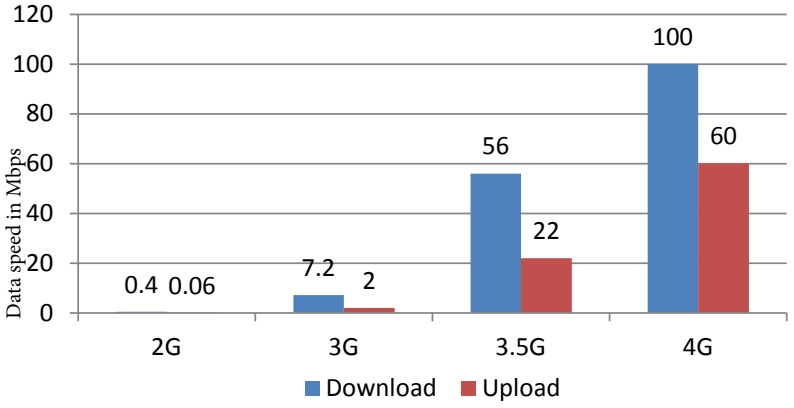
3G has following transitional: 3.5G, 3.75G and 3.9G.

- Fourth Generation, 4G

  4G is the latest wireless network technology, operational since 2006 but only made available in metropolitan cities, busy airports and selected populated areas. 4G network offers significantly faster speeds compared to 3G networks. The 4G network is based on LTE-Advanced, an upgraded LTE component in 3G Long Term Evolution and existing UMTS. Other services include HSPA+, Mobile WiMAX, and MBWA technologies This new network boosts maximum downlink speeds up to 100Mbps and uplinks of about 60Mbps, latency lowered to less than 100ms from 300ms, and significantly reduced network congestion [2].

  The standard promises mobile ultra-broadband Internet access. The generation will no doubt remain the backbone of developed countries mobile coverage, with LTE-Advanced serving in high density cities and populated areas effectively, the network allows creation of hybrid network using multi-mode and multi-frequency 4G devices that in future allow smooth transition between 4G and the next generation networks when on the move.

Figure 2.2 shows peak network speed experiences for each of existing network generation. A huge jump in speed is noted from 2G to 3G. These two are most common generations in the world with 2G covering about 80% while 3G spread up to 45% [3].



Source: 2012 International Telecommunications Union

FIGURE 2.2: Cellular network generations and their corresponding download/upload speeds

3G is the most common cellular generation used today in Switzerland, India and Tanzania. This enables satisfactory download speed of mobile Internet on the move but needs improvement. Several technologies and protocols have been added to enhance it results in transitional as 3.5G or pre-4G with obvious improved download and upload network speed. Table 2.1 summarized the cellular network generations and their corresponding protocols data transfer speeds.

TABLE 2.1: shows wireless technology that enable data communication and mobile Internet from Base Station to end users

Wireless Network Technologies				
Generation	Technology	Download	Upload	Availability
1G	AMPS	56Kbps	20Kbps	1980s - 1999
2G	GSM	128Kbps	60Kbps	1990s
2.5G	GPRS	128Kbps	60Kbps	1990s
2.75G	EDGE	384Kbps	60Kbps	1990s
	UMTS	384Kbps	64Kbps	2000s
3G	W-CDMA	2Mbps	153Kbps	2000s
	EV-DO	3.1Mbps	1.8Mbps	2000s
	HSPA 3.6	3.6Mbps	384Kbps	2000s
	HSPA 7.2	7.2Mbps	2Mbps	2000s
	WiMax	100Mbps	56Mbps	Today
Pre-4G	WiMax	100Mbps	56Mbps	Today
	HSPA+	56Mbps	22Mbps	Today
	HSPA 14	14Mbps	5.7Mbps	Today
4G	WiMax 2	100Mbps	60Mbps	2012+
	LTE Advanced	100Mbps	60Mbps	2012+

Source: 2012 International Telecommunications Union

Note: The download (to the user) and upload (to the Internet) data rates given on the table above are peak or maximum rates and end users will typically experience lower data rates.

2.3 In the Wake of Wireless Technologies

While most mobile users get high speed Internet connections at home, the office or even the local coffee shop with Wi-Fi, once the user is on the road those high speeds are no longer existing. 4G is the promise of future that real mobile Internet broadband can stay in touch. 4G denotes fourth-generation wireless, (The successor to 2G and 3G) wireless the stage of mobile communications that will enable high quality mobile Internet from Base Station to the mobile user. 4G can include services like IP-based voice, data, and high quality streamed multimedia on portable digital devices such as Smartphones. In Switzerland, Swisscom network operators have already moved

forward and implemented 4G while both Sunrise and Orange have plans to launch the full service in 2013 as they are in pre-4G currently. While in India in April 2012, Airtel has launched India's first 4G, most of online reports suggest that real 4G in India is still in far distant reach [4]. In Tanzania, Smile Telecom Holdings Ltd has launched the service in capital Dar es Salaam. The service is the first in Africa [5]. African countries seems to be overtaking developed countries into adopting new wireless technology for mobile phone users.

There are other network technologies associated with pre-4G. The technologies below are not considered as full 4G by the International Telecommunications Union.

LTE an acronym for Long-Term Evolution, is considered by experts as a natural successor to current-generation 3G technologies, in part because it is based on the GSM/EDGE and UMTS/HSPA networ to provide significantly faster data rates for both uploading and downloading. It is marketed as 4G LTE. Currently Swisscom is using LTE as one of its data services.

WiMAX is a wireless broadband access standard developed and maintained by the IEEE under the 802.16 designation. WiMAX can simply be thought as an extension of Wi-Fi wireless network. WiMAX is designed to enable pervasive, high-speed mobile Internet access on a wide range of devices, from laptops to Smartphones. The current implementation offers an downloads/upwards rates of 70Mbps and up to 45-kilometer ranges. WiMAX in future can provide portable mobile broadband connectivity across cities or even countries through a variety of digital devices. Vodacom in Tanzania and some handful operators in India are already using this new technology.

However, GSM network standards still dominate over 80% [6] of the mobile network markets worldwide, so it is only natural that most mobile operators will want to move to LTE and WiMAX, as basically are rooted on the same technology they have worked with for over a decade.

2.4 Mobile Network Operators Profiles

A Mobile Network Operator (MNO) is a provider of wireless communications services such as mobile telephony and mobile Internet broadband. MNO owns or controls all the constituents of the network that are necessary to sell and deliver services to an end user including radio spectrum allocation, fixed and wireless network infrastructures, marketing, billing, and provisioning computer systems, customer care provisioning and repair organizations [7]. Usually there are multiple MNOs within a given country around the world. In context of this case study, India has at least eight major

providers which is the highest followed by four in Tanzania and Switzerland has only three providers.

2.4.1 Mobile Virtual Network Operators

A mobile virtual network operator (MVNO) is a company that provides mobile phone services but neither own licensed frequency allocation nor the wireless network infrastructure in which uses to provide services to its clients. MVNO is legally connected to mobile network operator through business term agreements so as to gain wholesale access to network services, and then resell the services at its own set prices. MVNOs have become very popular among subscribers in developed countries such as Switzerland. In India, regulatory authorities are in process of allowing them to operate. Currently there are no MVNO in Tanzania but are legally allowed to operate as virtual network operators.

2.4.2 Switzerland

Switzerland has about 10 million mobile subscribers and a 130% penetration rate as of December 2011 [8]. Switzerland has one of the highest mobile phone penetration rates in Europe [9]. However, only three network operators exist in Switzerland as shown in the table below with corresponding subscribers and ownership.

TABLE 2.2: shows subscribers in Switzerland among the three major mobile operators

Switzerland Major Network Operators		
Operator	Subscribers (in millions)	Ownership (Major Share)
Swisscom	6.153	State-owned Swisscom
Sunrise	2.99	CVC Capital Partners
Orange Comm.	1.62	Apax Partners

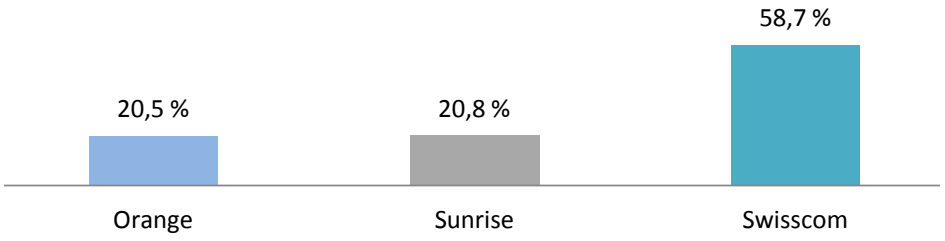
Source: Wikipedia trusted pages and mobile operators websites

- Swisscom: The mobile provider of former PTT Telecoms has been offering its services since 1993. It still has the best network coverage in Switzerland, and the most number of subscribers counting more than 6.153 millions [10], around 59% [11] value market share in mobile communications but also the most expensive services rates. Swisscom offers full range of products and services for mobile communications. The company invested massively in network infrastructure to ensure higher availability and accessibility of mobile Internet in the future.

- Sunrise : Established in 1998, is a brand of Sunrise Communications AG. Sunrise is the largest private telecommunications provider in Switzerland with offices in all main cities in Switzerland. Around 3 million customers use the products and services of Sunrise in the areas such as mobile Internet. The network of Sunrise, which is based on the GSM, EDGE, UMTS and HSPA+, connects up to 99% of the population to the mobile services with a transmission speed of up to 21 Mbit/s ready [12]. A high-fiber optic network with a total length of 10,000 km, enables the provision of high quality voice and data services throughout the country [12]. In Switzerland, Sunrise operates over 100 center. Sunrise Offers competitive rates but network coverage might be limited in remote areas of the country as many case-study mobile consumer have experienced.

- Orange Communications SA: Entered the Swiss telecommunications market in June 1999 as the third mobile operator. As of 2012, the mobile Internet provider is 100% owned by Matterhorn Mobile SA, a company under the indirect majority ownership of funds advised by Apax. Orange has a customer baseline of 1.6 million as a mobile market value of share of about 20% as per September 2012 [11]. It's vision is to become the preferred provider of high quality mobile and wireless communications services to the people of Switzerland. Currently, it has more than 89 Orange centers and 120 plus Orange points all over Switzerland. Various communications services are provided by Orange, not limited to, mobile telephony with over 99% population coverage mobile broadband with up to 42 Mbit/s download speed [13].

Figure 2.3 shows the market share of each MNO.



Source: Orange mobile operators websites

FIGURE 2.3: shows value share in network market in Switzerland for Orange, Sunrise and Swisscom

Switzerland is well known for its investment in technology and all the three companies have move forward to put in place mobile wireless technologies to enable smooth

connection and data communication. Table 2.3 shows Mobile operator's technologies at the moment.

TABLE 2.3: shows various kind of wireless technologies used by cellular operators in Switzerland

Switzerland Wireless Technologies	
Operator	Technology
Swisscom	GSM, GPRS, EDGE, UMTS, HSPA, HSPA+, DC-HSPA+, and LTE
Sunrise	GSM, GPRS, EDGE, UMTS, HSDPA, HSPA+, and DC-HSPA+
Orange Comm.	GSM, GPRS, UMTS, HSPA, HSPA+, DC-HSPA+

Source: Wikipedia trusted pages and mobile operators websites

Over the past decade, Switzerland wireless network has experience an up to date rapid change of technologies and standards. Mobile operators have always strive for better connectivity as shown in figure 2.4. The graph indicates rapid changes of technologies, consequently result in increase of mobile broadband.

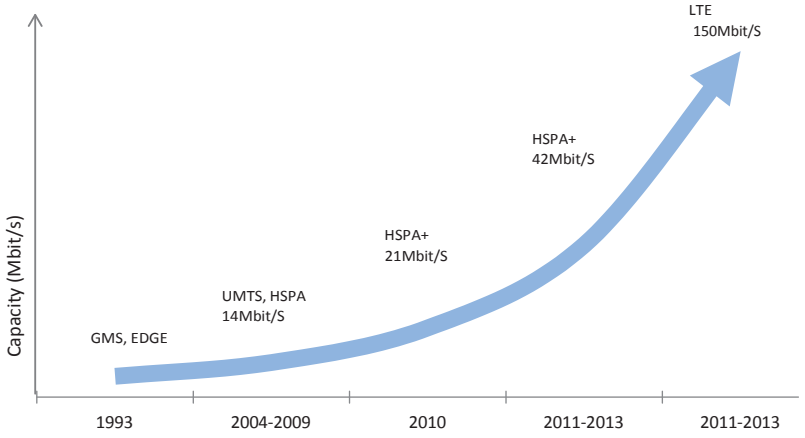


FIGURE 2.4: shows the evolution of Swisscom wireless network technology over a period of 10 years

MVNOs in Switzerland use the networks services of the above mentioned mobile operators. Switzerland has at least nine active virtual network operators such as M-Budget Mobile, CoopMobile and others as indicated in the table 2.4 with their respective real network operator. Some MVNO have two MNO.

MVNOs are well known for offering good mobile services rates compared to those three giants, however most of MVNOs are biased to only GSM and fewer use UMTS technology which is slow network speed. This is one of drawbacks as being virtually operating service provider hence pay the price for various issues including connectivity and network coverage.

TABLE 2.4: shows 9 service providers using the services of 3 major mobile network operators

Mobile Virtual Network Operators		
Operator	Technology	Network Carrier
M-Budget Mobile	GSM, UMTS	Swisscom
Coop Mobile	GSM	Sunrise
OrangeClick	GSM, UMTS	Sunrise, Orange
Yallo	GSM	Sunrise
Cablecom	GSM	Sunrise
MobilZone Net	GSM, UMTS	Orange
Salut!-Mobile	GSM	Orange
LycaMobile	GSM	Orange
Lebara Mobile	GSM	Orange

Source: mobile operators websites

2.4.3 India

India is one of the country after China that has world's largest cellular phone network and satellite mobile network operators measured by number of subscribers (and by proportionate subscribers, if the company has shares and assets in other operators). India has at least eight major network operator companies with four among them having more than 100 million subscribers. Bharti Airtel, Idea Cellular, Reliance Communications, and Vodafone are considered to be giant network operators in the world terrestrially as shown in table 2.5.

TABLE 2.5: shows major network operators in India with the corresponding number of subscribers

India Major Network Operators		
Operator	Subscribers (in Millions)	Owernership (Major Share)
Airtel	185.92	Bharti Enterprises
Reliance Comm.	154.11	Reliance ADAG
Vodafone	152.46	Vodafone India
Idea Cellular	115.66	Aditya Birla
BSNL	96.28	State-owned
Tata DoCoMo	87.83	Tata Teleservices
Aircel	66.6	Maxis Communications
Uninor	42.14	Unitech Wireless

Source: Wikipedia trusted pages and mobile operators websites

- Airtel: Bharti Airtel Limited is an Indian telecommunications services company headquartered at New Delhi. It operates in 20 countries across South

Asia, Africa and the Channel Islands. Airtel has GSM network in all countries, providing 2G, 3G and the latest 4G services depending upon the area of operation or country. Airtel is the world's fourth largest cellular network company with over 261 million subscribers across 20 countries as of August 2012 [14]. It is the largest cellular service provider in India, with over 180 million subscribers as of 2012. Airtel is the third largest in-country mobile operator by subscriber terrestrially, behind only China Mobile and China Unicom [15]. Airtel is a major mobile Internet provider in India, being equipped with the most recent technology.

- Reliance: Reliance Communications was established in 2004, a daughter of the Reliance Group, as of 2012 Reliance has over 150 millions subscribers and 15th largest cellular operator in the world. Reliance Communications is using 3G for its network services however expecting to invest into 4G as well. Currently Reliance is only operator who provides up to 28 Mbit/s speed in India with its 3G MIMO technology. The company has successful launched LTE as 4G network recently. Reliance Communications owns and operates the worlds largest next generation IP enabled connectivity infrastructure, comprising over 2,77,000 kilometers of fiber optic cable systems in India, USA, Europe, Middle East and the Asia Pacific region [16].

- Vodafone: Vodafone India is another large mobile network operator in India, owned by Vodafone Group, with parent company Vodafone International Holdings BV. It has more than 150 million customers as of May 2012. Vodafone offers both GSM services on prepaid and postpaid schemes as other companies. It has a good presence through out major cities in India. Vodafone has not yet lauched 4G network services but planed to spend considerable sum of money to expants its 2.75G and 3G services within the country [17].

- Idea: Idea Cellular was born after the merging of two Telecom Companies, Tata Cellular and Birla-AT&T in India. The company has enjoyed its presence in India and has already passed the barrier of 100 million subscribers. Ideas 3G service is currently available in the among telecom circles in 14 cities. Idea currently supports up to 21.1 Mbit/s over 2G speeds of 256 kbit/s. However, different handsets support different speeds, from 384 kbit/s to 21.1 Mbit/s. Speeds also depend on the 3G plan and or recharge that users opt for [18].

India mobile operators always put forward the implementation of new network technology. The country is well know for its 2G, 3G and now 4G network services. Table 2.6 provides a list various of standards and technology offered by major companies in India.

TABLE 2.6: shows various standards and technologies used by major network operators in India

Network Technologies in India	
Operator	Technology
Airtel	GSM, EDGE, HSPA, TD-LTE
Reliance Comm.	CDMA, EVDO, GSM, HSPA, WiMAX
Vodafone	GSM, EDGE, HSDPA
Idea Cellular	GSM, EDGE, HSPA
BSNL	GSM, EDGE, HSDPA, HSPA+, CDMA, EVDO, WiMAX
Tata DoCoMo	GSM, CDMA, EVDO, EDGE, HSPA+
Aircel	GSM, EDGE, HSDPA
Uninor	GSM, EDGE

Source: wikipedia trustage pages

Though many network providers in India are thought of as small operators due to their capacity and number of subscribers. Table 2.7 shows operators with less than 20 million subscribers but higher than a million. These operators are less popular and only known in few states. Some experts are even considered them to be running as MVNO in similarity to Switzerland ones.

TABLE 2.7: shows small sized network operators in India with less than 20 million subscribers and limited technologies

India Smaller Network Operators		
Operator	Technology	Subscribers (in millions)
MTS	GSM, EVDO	14.01
Videocon	GSM, GPRS, EDGE	4.45
MTNL	GSM, HSDPA, CDMA	5.1
S Tel	GSM, GPRS	3.54
Loop Mobile	GSM, EDGE	3.02
Ping Mobile	GSM	1.15

Source: Wikipedia trusted pages and mobile operators websites

2.4.4 Tanzania

Tanzania has mainly two fixed-line operators which are TTCL and Zantel and eight operational mobile networks, with four additional players licensed under a new converged regulatory regime. There are three major mobile operators which are Vodacom, Bharti Airtel, and TiGO. Statistics has shown the mobile market broke the 60% penetration barrier at the end of 2011, with over 20% growth of annual subscriber. The year was marked by a price war which inflicted heavy subscriber losses on the smaller operators in 2012 as my migrated to major companies [19].

The Tanzania telecommunications market has been characterized by huge growth in mobile markets which contrasts with relative stagnation in the fixed line sector. The market is very competitive with at least three major network operators that almost offer similar services. Below is the brief overview of the cellular companies.

- Vodacom: Vodacom Tanzania Limited is Tanzania's leading cellular network offering GSM communication services to about 10 million mobile customers across the country. Vodacom Tanzania is a daughter company of Vodacom Group (Pty) Limited in South Africa which is also a daughter of Vodafone Group UK. The majority share portion of 65% is owned by Vodacom Group (Pty) Limited [20]. Vodacom Tanzania has deployed various wireless technologies, thereby enhancing its services and positioning itself as the leader in mobile communication in Tanzania. For mobile international connectivity and remote communication solutions. Vodacom Tanzania makes various technologies available to its subscribers, both individuals and corporate as indicated in coverage in table 2.8

TABLE 2.8: shows various technologies deployed by Vodacom Tanzania and coverage

Vodacom Communications Technology	
Technology	Coverage (per population)
GSM	75.82% countrywide
GPRS	75.82 countrywide
EDGE	50% in selected cities
3G with HSDPA	40% in 15 major cities
WiMAX	70% in 5 major cities

Source: vodacom Tanzania mobile operators website

- Airtel: Airtel Tanzania was established in October 2001 and is Tanzanias second largest mobile Internet provider after Vodacom. Airtel Tanzania Ltd. operates

as a subsidiary of Zain Africa B.V and Tanzanian government owns about 40% of total share. Airtel and has about 5.7 million subscribers in Tanzania [21]. The MNO is well known for its innovative strategies in the telecommunication sector. Airtel Tanzania subscribers enjoy the access to the only network that allows them to roam in East Africa at the same local. GPRS is the main technology in Airtel providing services such as mobile Internet, broadband, SMS/MMS services, and prepaid and postpaid plans. The company has recently announced major intentions to boost up its telecommunication market in rural areas, together with some new new attractive offers to its customers especially in mobile Internet area.

- tiGO: MIC Tanzania Limited is the oldest wireless Telecommunications company in Tanzania with 13.6% market share in the country. MIC Tanzania Limited, well known as tiGO, has changed different business names over years, First was known as Mobitel when it started to offer mobile telecommunication services in Tanzania, changed to Buzz when the company started to use GSM network in 2001. From 2006 onwards, the MNO is popular known as tiGO. Millicom International Cellular is the major shareholder of the company [22].

  tiGO has heavily invested in GSM in its netowk infrastructure. As from 2008, tiGO's GSM network was made up of not less than 750 base stations with the ability to serve a no less than 1000,000 simultaneous subscribers, and covered more than 50% of the total population in Tanzania [23]. Table 2.9 shows the technologies and coverage in Tanzania mobile operators.

TABLE 2.9: shows various technologies deployed by MNOs in Tanzania and their coverage

Tanzania Communications Technology and Coverage			
	Coverage (per population)		
Technology	Vodacom	Airtel	Tigo
GSM	75.82% countrywide	67.32% countrywide	52.15% countrywide
GPRS	75.82% countrywide	67.82% countrywide	57.82% countrywide
EDGE	50% in selected cities	70% in selected cities	70% in selected cities
3G with HSDPA	40% in 15 major cities	20% in 12 major cities	10% in 7 major cities
WiMAX	70% in 5 major cities	NIL	NIL

Source: Journals and media press releases

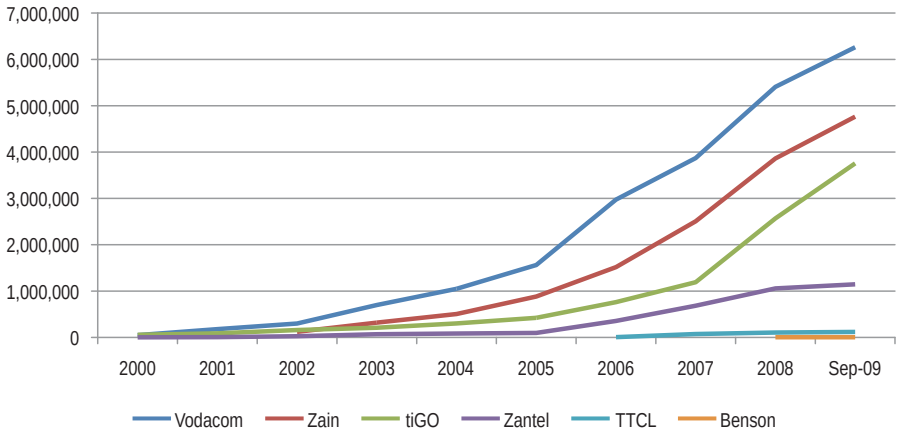
The new converged licensing regime has brought a large number of new players into the market. The introduction of third generation 3G, mobile services and wireless

TABLE 2.10: shows small cellular companies licensed into Tanzania mobile market. The table shows corresponding technologies deployed and number of subscribers

Tanzania Smaller Mobile Operators		
Operator	Technology	Subscribers (in millions)
ZANTEL	GSM	0.987
TTCL Mobile	CDMA	0.112
Benson Informatics	CDMA	0.004
Sasatel	CDMA	0.02
MyCell	CDMA	not available yet
Excellentcom	GSM	not available yet
Egotel	UMTS	not available yet
Rural Netco	CDMA	not available yet
SmileCom	CDMA/ LTE	not available yet

Source: Journals and media press releases

broadband networks is boosting the mobile Internet sector which has been impeded by the low level of development of the traditional fixed-line network. There are other small companies that can be thought of as MNVO. These companies operate efficiently only on major cities as shown in table 2.10. Tanzania mobile subscribers has increased exponentially for the past ten(10) years, with Vodacom being the leader of network services. Figure 2.5 shows the increase of number of subscribers by operators in Tanzania. Following the launch of 3G mobile broadband services, the mobile



Source: Tanzania Communications Regulatory Authority (TCRA)

FIGURE 2.5: shows Tanzanian mobile subscribers by operators

networks are becoming the countrys leading Internet service providers on depending heavily on installed private infrastructures. However, an installed optical fiber, a national infrastructure will soon boost the view of mobile Internet in Tanzania.

2.5 Services Evolution within Carriers

Mobile operators around the world are obviously in competing edge from technical point of view to micro-services provided to the mobile users. There are many major competing domains not only limited to technology and basic services. Value Added Service, (VAS) is a new challenging service for many mobile providers that are striving to conquer the open market of products and services. The challenge is to develop and deliver new VAS that will help operators differentiate their brands and maintain revenue growth, at a time when they are also being forced to find new ways of cutting costs. Mobile operators are in shape of changing their product and services as shown in figure 2.6.

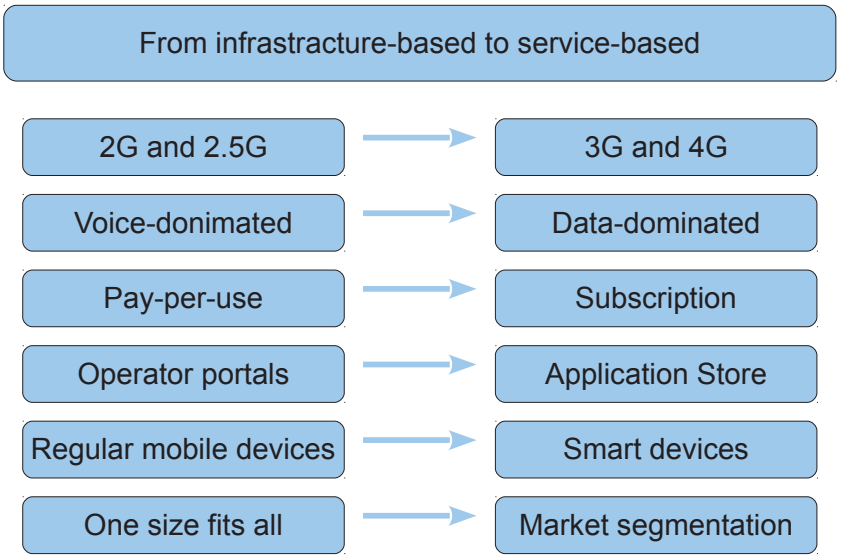
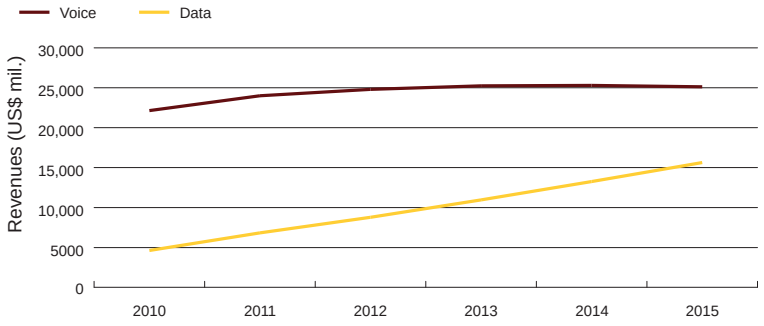


FIGURE 2.6: Mobile services development

The figure shows that MNO are shifting from infrastructure-based systems to service-based carriers. This means that less investment on all-in-one infrastructures, but major expansion of products and services. For example, MVO would rather provide market segmentation of service to individual customers rather than tailor only one mobile data plan that fits all customers.

As a result, MNOs have been established continuous plans towards managed network operations in order to enable operators to focus their resources on core activities and develop new business models. Now, by rethinking key aspects of service delivery, such as portal and device management, operators are able to address their goals of competitive differentiation and revenue growth while also managing VAS in mobile data services.

In India, where voice and SMS services remained predominant over years compared to mobile Internet, but in term of revenue, mobile Internet has shown a significant impact in revenue in last few years while the revenue of basic services such as voice and SMS remains the same, mobile data revenue has always been in a consistency uprise. Figure 2.7 shows voice Vs data revenue in competing India market.

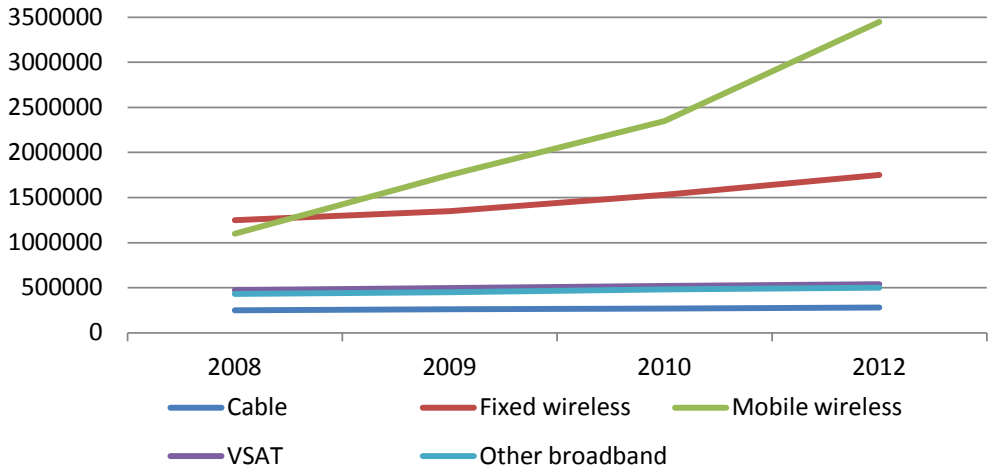


Revenues (US$ mil.)	2010	2011	2012	2013	2014	2015
Voice	22,152	24,002	24,807	25,251	25,298	25,126
Data	4,634	6,831	8,780	10,961	13,259	15,627

Source: Informa Telecoms and Media

FIGURE 2.7: India: voice vs data revenue as an indicator of shift from infrastructure-based to services-based in network operators.

In Tanzania, mobile Internet is far out pacing other types of media. Internet users are daily increasing and majority of them opt for mobile wireless broadband Internet while there is almost a steady number of users in fixed infrastructures.Even though Tanzania's fixed telecommunication infrastructures is stagnant but the statistical data shows there is a major revenue and activities in mobile wireless compared to others as indicated in figure 2.8



Source: Tanzania Communications Regulartory Authority

FIGURE 2.8: Tanzania: the figure shows various type of media for accessing Internet in Tanzania. The leading access is through mobile wireless infrastructures.

Chapter 3

Mobile Broadband and the Internet

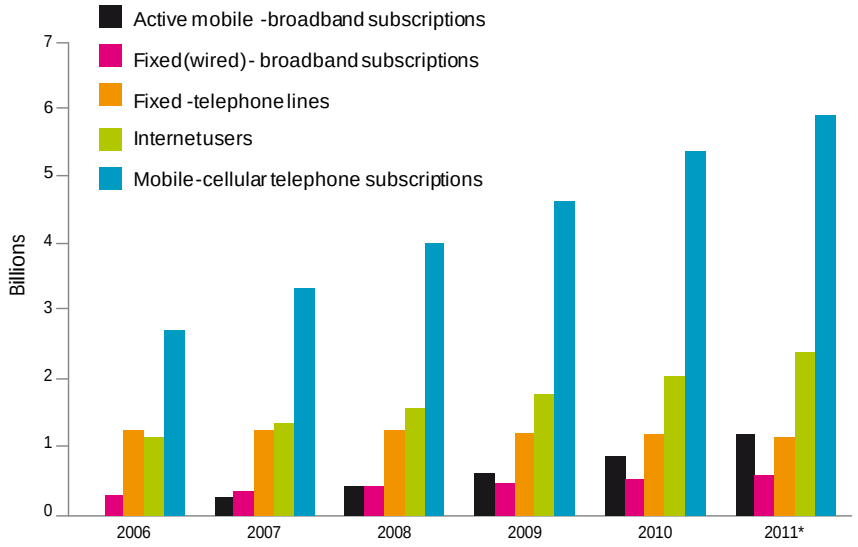
3.1 Evolution of Mobile Broadband

Mobile broadband is simply a coined marketing term for wireless Internet access through a mobile device such as mobile phone. Mobile broadband was technically born after atleast Telecommunication manufacturers, mobile phone industries, integrated-circuit makers have worked on joint connection in the GSM Association to realize the built-in support for mobile Internet access technology on laptops and other mobile devices [24].

In 2002, a huge barrier to mobile broadband was the coverage the cellular networks can provide. In many areas end users will not be able to achieve the peak speeds advertised due to coverage limitations. Furthermore, there are concerned issues with connectivity, network capacity, quality of service, and mobile network operators overall lack of experience with mobile data traffic [25].

The number of mobile broadband subscriptions grew to 500 million during 2010, and this number will likely to double before the end of 2011, according to Telecommunications equipment provider, Ericsson who deliver technology and services to network operators worldwide. Ericsson predicted that the majority of wireless subscription is on Asia at about 400 million followed by Western Europe with about 200 million subscription. The growth of digital lifestyle devices such as Smartphones and tablets has been a main contributor to the increase in mobile broadband adoption, as has consequence on the rise of app usage and mobile Internet services. Figure 3.1 shows the number of Internet subscribers around the globe for the past five(5) years. Ericsson announce that, Mobile data traffic is still growing rapidly, therefore predicted

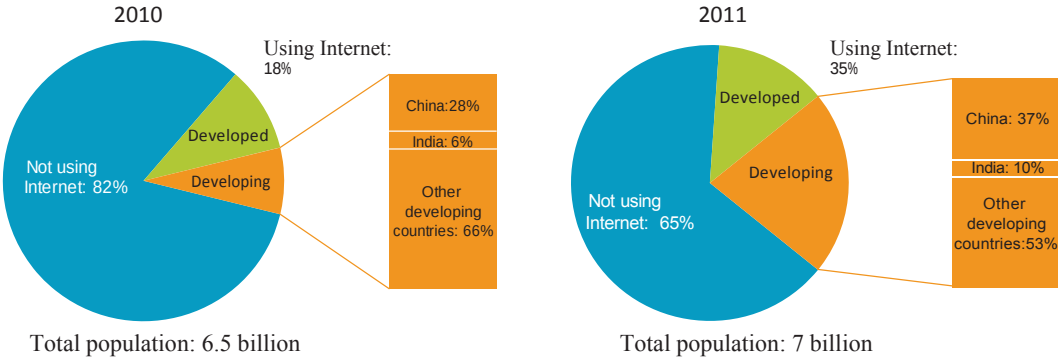
that the traffic had tripled in one year. The growth of the Internet broadband around the globe has been indicated in figure 3.3.



Source: 2012 International Telecommunications Union

FIGURE 3.1: shows the number of Internet subscribers in the World for the the past five(5) years.

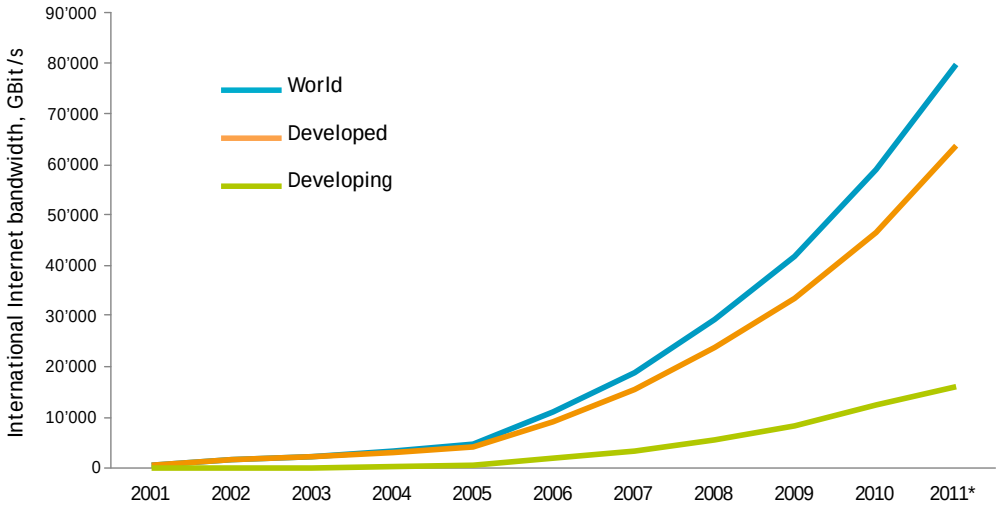
The world is home to seven(7) billion people, one third of which are using the Internet. 45% of the worlds Internet users are below the age of 25. While over the last five years, developing countries have increased their share of the worlds total number of Internet users from 44% in 2006, to 62% in 2011. Today, Internet users in China represent almost 25% of the worlds total Internet users and 37% of the developing countries Internet users. Figure 3.2 shows the improvement of Internet availability and sharing in 2006 and 2011 around the globe [3].



Source: 2012 International Telecommunications Union

FIGURE 3.2: shows the share of Internet users in the total population between 2006 and 2011.

With 5.9 billion mobile-cellular subscriptions, global penetration reaches 87%, and 79% in the developing world. Mobile-broadband subscriptions have grown 45% annually over the last four years and today there are twice as many mobile-broadband as fixedbroadband subscriptions [3]. Furthermore, active mobile broadband subscriptions will top 3.8 billion by 2015, according to Ericsson, with 4G networks, e.g, HSPA, CDMA and LTE networks driving 95% of those subscriptions [26].



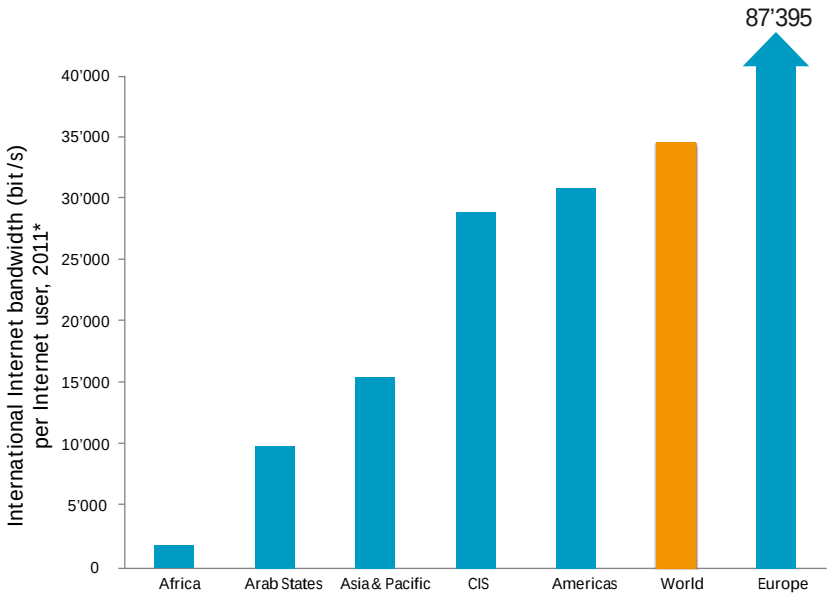
Source: 2012 International Telecommunications Union

FIGURE 3.3: shows the rate of growth of Internet broadband in the world for the past ten(10) years.

3.1.1 Data Explosion

Speaking of growth of Internet broadband which is a key factor for providing high-speed Internet access to a growing number of Internet subscribers has grown exponentially over the last five years, from 11000 Gbit/s in 2006, to approximately to 80000 Gbit/s in 2011. In term of comparison of bandwidth in around the world countries, disparities between regions in terms of available Internet bandwidth per Internet user remain, with on average almost 90000 bit/s of bandwidth per user in Europe, compared with 2000 bit/s per user in Africa [26]. Figure 3.4 shows the International Internet bandwidth to the individual user.

International Telecommunications Union, ITU has showed that in 2011, 90% of the world's population lived in areas covered with 2G network, while 45% lived in areas with covered by 2G and 3G networks [3]. Further details about generation network were covered in section 2.2 on page 9.



Source: 2012 International Telecommunications Union

FIGURE 3.4: shows the International Internet bandwidth per individual user in the World.

3.2 Wireless Substitution

With emerging mobile digital lifestyle devices and other mobile Internet appliances, the world wide population is driven toward fascinated wireless Internet broadband. In many developing countries including India and Tanzania, fixed telecommunication infrastructures are stagnated and majority of Internet users are mobile users. Switzerland has also recorded a higher demand of mobile broadband to its Smartphone users due in part to Apps distribution.

As the Internet finds its way into our mobile devices which are becoming part of daily life, transforming the devices to even performing complex tasks initial meant only for PCs. As of today, featured phones and Smartphones are competing with fixed Internet based systems. However, wireless Internet is knowns for its unreliabilities, unstable and slower network speeds, security and complexity issues. However these problems do not seem to slow down the wireless substitution, even though most of mobile users do experience online and offline states all the times especially when on outdoors, basement and other isolated or confined areas.

3.3 Online and Offline Services

In mobile communications paradigm, a device is termed to be online as long as exists in a state of Internet connectivity, while offline simply refers to a state in which

the device is disconnected from any third part agent hence restricted from Internet access.

To meet the required of being online, a functional device should at least satisfy one of the following conditions:

- Being as part of the Internet with access
- Being under direct control of another online device
- Being associated with another online system(s)
- Available on real-time use and up to date

Otherwise, a mobile device that does not meet any of conditions above is termed to be offline [27].

Computing devices like laptops and Smartphones are important devices in nowadays society. They enable four kinds of data transfer mentioned earlier as to facilitate or enhance communications, information seek, entertainment and m-commerce via Internet access. It is obvious that without Internet, these computing devices become less useful in aspect to above activities. Data services are only meaningful as long as digital devices stay online. Any disruption of mobile broadband risks the user to loose connectivity and hence failure of any on-going process such as sending mails, fetching information and browsing.

Now that digital lifestyle devices, tablets, wireless phones, and other Internet appliances are beginning to come of age at higher penetration power and spread over every part of the world. It is right time to provide an understanding of current state of mobile Internet to these devices. Currently, many stakeholders including Google and other software developers are striving to building a bridge between offline and online states. The core idea is to create a system that will enable transparency among offline devices to appear as they have been online and connected through out.

As Internet is a valuable resource right now, few vital questions arise. How efficiently one can maintain data services such as offline mail and browsing without real time Internet access? Can hidden data stores provide adequate data to offline users? Is it possible to enable data sharing between online and offline mobile devices? The below sections takes a closer look on offline web and Apps storage technologies including Google gears and HTML5.

3.4 Offline Browsing System

Typically, web pages are not meant to be viewed if a user enters an area of no Internet connectivity, such as in a remote outdoors, basement or in speedy transport

such as in train. This is due to environment constrains of mobile device as poor connectivity arise when changing location. While it is nearly impossible to guarantee a stable network connection, it is very possible to enable offline browsing mechanisms for both PCs and mobile devices. This approach solves the problem by introducing offline webpage storage. There are enormous number of web-based mechanisms and web servers that provide offline services with enabled support to hand-held devices. Various middle-wares between the original web content server and mobile browser or Apps have been proposed in past and implemented for generally mobile devices with intention to: 1. Enable access of predefined web information with no Internet 2. Provide offline data storage and cache on mobile devices as long-term storage and 3. Improve local Database, Web server and Geolocation services to sustain offline environment [28].

In this section, Google Gears and HTML 5 are introduced as part of offline browsing system for mobile devices.

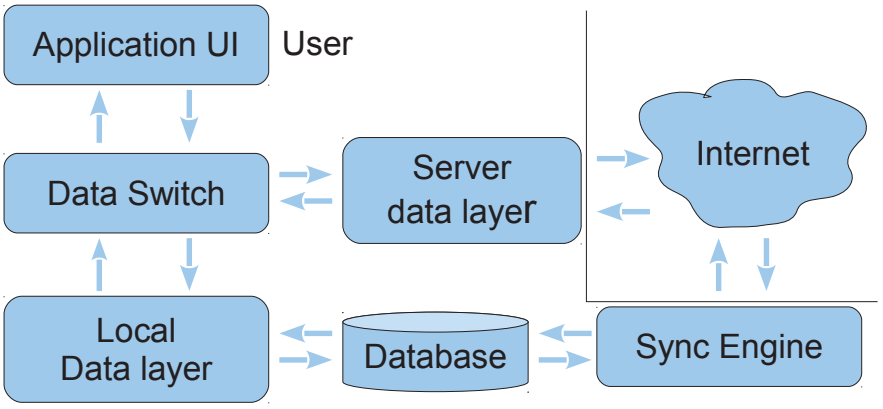
3.4.1 Google Gears

The giant Google Gears is one of solutions of Offline webpage storage which supports Web applications to be executed offline, on PC and mobile device. Webpages can be locally stored in the browsing device while in presence of a fairly good connection environment. Thereafter, offline webpages are made available using Google Gears support when comes a poor quality in connection.

Google Gears introduced five major components as a protocol intended to be used as middleware between user interface of mobile device and the Internet. These components reside in mobile device an an Integral part of operating system, browser or App.

- A local Database component, which can store data locally. It is powered by SQLite ideal for small memory of mobile devices and as an integral part of an App also.
- An execution engine component, which execute threads by Javascript code and synchronize with the Internet.
- A local Server component, which caches and serves App resources such as HTML, JavaScript, and images.
- A user interface component, which resides on App and allows web applications interactions with the mobile device.
- A Geolocation module, which allows mobile device to be detected geographically by web applications. This pinpoint the location of the user [29].

With the Google Gears support enabled device, Smartphone can store and serve App resources locally, store data locally through SQLite, and run asynchronous JavaScript to improve App reaction. Google Gears establishes architecture as shown in figure 3.5, updates are done by means of background continuous synchronization between local data server and Internet web server.



Source: Google Gears API

FIGURE 3.5: shows the architecture of Google Gears with major components.

Initially the giant Google Gears had proposed and taken measures to support offline web browsing, but was terminated on late 2011 and removed from Google products including Gmail and Chrome. However, offline mode support for Gears still remains as an open source and other web servers such as Gearsmonkey for Mozilla Firefox web browser can still work as support of Google Gears.

3.4.2 HTML 5 for Mobile Devices

HTML 5 is the markup language that provides offline web browsing, local database content storage for speedy cached resources, reduced server load and GeoLocation API tools for developers. HTML 5 enables code embed in Apps hence does not necessary require a web browser to work. Typically, HTMLS 5 intentions are the same as that of Google Gears. However a simple text file called Cache manifest is required in HTML 5 to enable offline support, this is achieved by specifically documenting to contents to be cached like pages, images, and other files. Precisely, cache manifest informs the mobile browser on which files to cache from the web server. Cache manifest comprises of three sections: 1. Cache Manifest: It is a header that lists cache files upon first download. 2. Network: Another header list that does not cache anything listed on it. and 3. Fallback: Provide and exist protocol is webpage is not accessible [27].

Below is an example of cache manifest in HTML 5:

```
CACHE MANIFEST
# 05-02-2013 version1.0
/theme.css
/companylogo.gif
/main.js

NETWORK:
login.asp

FALLBACK:
/html/ /offline.html
```

In this particular code, the manifest lists caches CSS, GIF and JavaScript files, while login.asp file is specified not to be cached. Fallback gives details about offline.html file to be used in case other html files are not reachable. Last, the comment line is used to update the cache manifest [30].

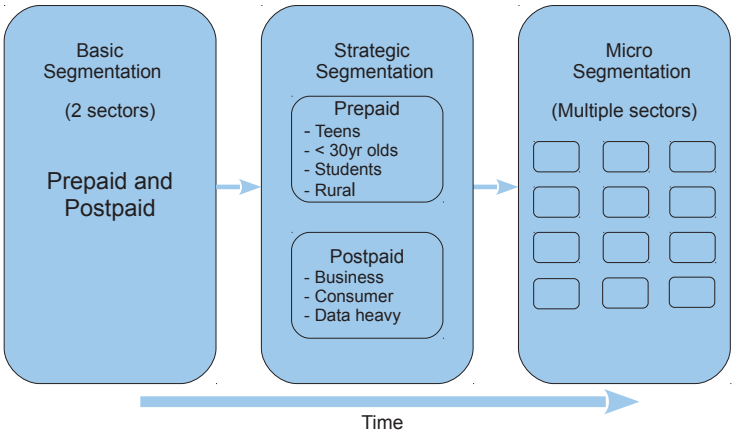
For mobile users and areas that experience inadequate Internet connectivity like India and Tanzania, even in part of Switzerland community, there is also possibility of offline information storage like the eGranary Digital Library that comprises huge collections of educational resources. Numerous emerging organisations are in state of developing or have already developed flash memory chips with embedded resource collections for offline usage. These services are intended for mobile devices like Smartphones and tablets.

Chapter 4

Mobile Internet Data Schemes

4.1 Market Segmentation

Mobile operators are well know in deploying market segmentation as their marketing strategy. It involves dividing a broad target market into subsets of consumers who have common needs of services as well as common applications for the mobile broadband. Depending on the specific characteristics of the data plans, mobile operators divides subsets of services into various criteria such as age, location, and level of income. Figure 4.1 provides an overview of market segmentation for mobile broadband for predominant mobile subscription schemes names as prepaid and postpaid and other related adopted marketing strategies in accordance to mobile data services in relationship to consumer market demographics in Switzerland, India and Tanzania.



Source: Survey questions and study of mobile subscribers

FIGURE 4.1: Market segmentation

The first block shows a basic segmentation of predominant prepaid and postpaid plans, there-after the plans are further divided according to the various criteria of

mobile consumers. Study shows that most of users below the age of 30 and with low income prefer prepaid plans while users who operate businesses and have higher income prefer to have postpaid plans. Data plans are further divided into small cells to ensure that each customer fit in.

In order to gain an insight into value-worthiness of mobile Internet services in three countries with different economy levels, The Law of One Price has been suggested to be used in information analysis in economic point of view. The below section describes briefly the Purchase Power Parity and the Big Mac Index as the law of one price.

4.2 Purchasing Power Parity

Purchasing power parity, (PPP) is an economic theory and a technique used to determine the relative value of currencies, estimating the amount of adjustment needed on the exchange rate between countries in order for the exchange to be equivalent to each currency's purchasing power. It provisionally asks how much money would be needed to purchase the same goods and services in two countries, and uses that to calculate an implicit foreign exchange rate as to provide the answer. Using that PPP rate, an amount of money thus has the same purchasing power in different countries [31].

On the other hand there exists a Law of One Price, although it may seem as if PPP and the law of one price are the same, there is a difference between them, the law of one price applies to individual services whereby PPP applies to the general price level. If the law of one price is true for all services then PPP is sort to be true also. However, when discussing the validity of PPP, some argue that the law of one price does not need to be true exactly for PPP to be valid. If the law of one price is not true for a certain commodity, the price levels will not differ enough from the level predicted by PPP. The purchasing power parity theory states that the exchange rate between one currency and another currency is in equable state when their domestic purchasing powers at that rate of exchange are equivalent [31].

4.2.1 Big Mac Index

Big Mac Index is an example of one measure of law of one price denoting the vivid example of purchase power parity. It is popularized by The Economist, a weekly published International economic magazine owned by The Economist Newspaper Ltd. Big Mac Index takes a glance at the prices of similar Big Mac burger in McDonald's

restaurants in different countries. By determining the currency value, the index should give a guide to the direction in which currencies should move. The Big Mac Index is presumably useful because it can be used to compare the prices of the same product offered in different countries such as mobile broadband and data plans in this study. Apart from government regulations such as tax and the availability of technologies in a given country, still Big Mac Index has a room for usefulness [32].

Big Mac Index shows that for 50 US Dollars, a consumer can buy 7 burgers in Switzerland, 30 burgers in India and around 25 in Tanzania (taking reference to its neighbor Kenya). Provisionally, this bring the economic assumption that the price of 1 burger in Switzerland is equivalent to 30/7 burgers in India which is around 4 and 25/7 burgers in Tanzania which is approximately 3 burgers [32].

In this research work, the reader can provisionally consider the mobile operate tariff of 1 Swiss Frank, (CHF) is equivalent to 200 Indian Rupee, (INR) and also equivalent to 4500 Tanzanian Shillings, (TZS). This comparison will be used throughout the report and data analysis unless otherwise specified.

4.3 Pricing Strategies

Generally speaking, mobile broadband data plans can be divided by their subscription type most commonly prepaid and postpaid, and other yearly-based subscription business model for borrower subscribers such as 'abonnement'. The sub-section begins with a brief discussion of prepaid and postpaid plans and their predominance in all parts of the world including Switzerland, India and Tanzania. Abonnement is also a common pricing practice in Switzerland as will be explained in this chapter too.

4.3.1 Prepaid and Postpaid Schemes

Prepaid schemes are those in which a consumer pays for data usage in advance prior to start of data service. Prepaid is first pay then served. Many mobile operators offers a fixed flat rate which is expensive such as 1USD for every 1MB of data for subscribers who have no data plans, while on other hand, in postpaid schemes, a mobile consumer is billed accordingly to monthly usage at the end of the billing cycle. Postpaid is first served then pay.

By examining the standard mobile subscriptions for the major mobile operators in three countries, the observation shows prepaid and postpaid schemes are predominant marketing strategies and customer segmentation. Account for purchasing power

parity, it is noted that data plans in different countries have similar broadband nature but significantly differ in cost and pricing strategies, as found in data analysis and in various related researches like [33]. Data analysis shows large variation in cost of mobile data per month against the number of mobile broadband subscribers in each country in relation of course to each mobile operator. Study observed that there is a huge difference in cost for 1GB of mobile data. Additionally, countries of Africa such as Tanzania and India in Asia tend to prefer prepaid plans, while postpaid plans dominate in Europe such as Switzerland.

Furthermore, explicitly study shows the correlation between prepaid mobile broadband data plans and lower per capita Gross National Incomes (GNI). In general case, countries with a lower GNI per capita tend to have prepaid plans as the dominant subscription mode. This observation may be partly explained by studies examining the popularity of prepaid voice call plans in lower-income groups. Study found a strong correlation between the availability of prepaid plans for voice calls and adoption rates of mobile telephone subscribers, which is confirmed by number of researches. indeed, Donovan and Donner's study attributes this correlation to cost-conscious consumers desire to control their expenditures. Their study of mobile broadband availability in Africa focuses exclusively on the availability of prepaid data plans, indicating their importance for mobile broadband adoption in Africa [34].

Within the Switzerland, prepaid data plans have gained popularity due to their lower, shorter-term financial commitment and relative simplicity compared to postpaid usage-based pricing plans with data plans. However, Switzerland has attractive offers to its subscribers in long term of mobile consumption. Switzerland has moved into the new era of marketing strategy in which mobile services including voice, SMS and data are combined together as sold as one service. This strategy has resulted in huge turn out with massive numbers of subscribers shifting from prepaid to postpaid schemes. In addition, many subscribers in Switzerland are becoming borrower subscribers, a popular scheme called 'abonnement' as described below.

4.3.2 Abonnement

Abonnement is the subscription business model in market segmentation where a customer must pay a subscription price to have access to the mobile products and services. Basic services includes voice, SMS and mobile broadband, Switzerland operators have moved further to even provide digital lifestyle Smartphones withing the subscription contract. This is precisely defined as product borrower strategy, since a mobile user acquire a new mobile device as product with other operator services

and must retain the subscription for at least two years. Abonnement provides a subscription for basic access or minimal service plus some additional charge depending on usage. A basic telephone service pays a pre-determined fee in monthly use basis, but may have extra charges for additional services such as long-distance calls, directory services and over usage of mobile Internet. In most cases, mobile broadband is offered free-of-charge for a predefined data volume limit. This seems to be a shift of data services in Switzerland as more mobile users are changing into abonnement plans. All the major mobile operators Swisscom, Sunrise and Orange provide the above subscription.

Swisscom, for example, provides a typical example of abonnement in its marketing strategies, it offers the customer a choice of mobile phones including Smartphones for registration fees of only 1 CHF and then enrolled in subscription term of either one or two years service plan. In meantime, the customer will be subjected to bill payment at the end of each month. Swisscom abonnement is called NATEL Infinity as shown on table 4.1. The abonnement is equipped with unlimited national voice, SMS services and unlimited surfing but with corresponding speed limits. Table 4.2 shows a simple data subscription plan without commitment to new phone or other mobile services such as voice and SMS.

TABLE 4.1: shows Swisscom abonnement NATEL Infinity offered by Swisscom as a one or two year(s) subscription plan with a new mobile phone of customer's choice.

NATEL Infinity: Speed-Based Bundles		
Fee in CHF	Speed	Validity in days
59	0.2Mbit/s	30
75	1Mbit/s	30
99	7.2Mbit/s	30
129	21Mbit/s	30
169	100Mbit/s	30

Source: Swisscom operators website

Orange is offering almost the same abonnement like Swisscom but with more criteria customized to fit the individual customers, for example, customers can choose from a wide range of voice services from 20 minutes of airtime to unlimited calls within Switzerland. Table 4.3 shows tariffs and features of abonnement subscription with limited voice but unlimited SMS and surfing. Mobile Internet is offered at 3G speed. While, table 4.4 shows Orange abonnement with unlimited voice services, SMS and 3G speed-limited data plans.

TABLE 4.2: shows Swisscom abonnement equipped with only data subscription. Voice and SMS services are charged separately. Abonnement is offered by Swisscom as a one or two year(s) subscription plan with a no new mobile phone for customers.

Swisscom: Speed-Based Bundles		
Fee in CHF	Speed	Validity (in days)
9	1Mbit/s	30
29	7.2Mbit/s	30
49	21Mbit/s	30
69	100Mbit/s	30

Source: Swisscom operators website

TABLE 4.3: shows abonnement offered by Orange as a one or two year(s) subscription plan with a new mobile phone of customer's choice and unlimited SMS services.

Orange: Volume Based Bundles		
Fee in CHF	Volume	Validity in days
35	1GB	30
55	3GB	30
70	5GB	30

Source: Orange operator's website

TABLE 4.4: shows abonnement offered by Orange as a one or two year(s) subscription plan with a new mobile phone of customer's choice and unlimited voice.

Orange: Volume Based Bundles		
Fee in CHF	Volume	Validity in days
95	1GB	30
115	3GB	30
130	5GB	30

Source: Orange operator's website

Based on age criteria, almost all operators in Switzerland implement age-based customer segmentation. Orange for example offers abonnement for customers under the age of 27 years old regardless of their professions. Basically, there is a reduction of 10 CHF in all the tariffs with all other features remaining the same as normal abonnement. Table 4.5 and 4.6 show the abonnement for under 27 years customers with unlimited and limited voice respectively.

Sunrise provides one of their own simplest abonnement subscription tailored for different customers. The abonnement comprises of unlimited nation voice services, SMS and unlimited surfing but at pre-defined speed as indicated in table 4.7. Sunrise has

TABLE 4.5: shows abonnement offered by Orange to customers under 27 years old with a new mobile phone of customer's choice and unlimited SMS services.

Under 27 years: Volume Based Bundles		
Fee in CHF	Volume	Validity in days
25	1GB	30
45	3GB	30
60	5GB	30

Source: Orange operator's website

TABLE 4.6: shows abonnement offered by Orange offered to customers under 27 years old with a new mobile phone of customer's choice and unlimited voice services.

Under 27 years: Unlimited Voice		
Fee in CHF	Volume	Validity in days
85	1GB	30
105	3GB	30
120	5GB	30

Source: Orange operator's website

other abonnements which are quite similar to above mentioned abonnements from both Swisscom and Orange, see in tables 4.8 and 4.9.

TABLE 4.7: shows Sunrise abonnement offered to different customers with a new mobile phone of customer's choice and unlimited voice services.

Sunrise: Unlimited Voice, SMS, Volume		
Fee in CHF	Speed	Validity in days
59	1Mbit/s	30
79	7.2Mbit/s	30
115	21Mbit/s	30

Source: Sunrise operator's website

There are other abonnements offered by Switzerland MNO's with more or less features but will not be mentioned here directly as the change of those features does not affect much the nature of their genuine data plans as mentioned above. The above abonnement are presented as indicative tool to demonstrate the concept of abonnement subscription in Switzerland. In general, abonnement do vary in their features from a basic type with limited voice, SMS and mobile data to unlimited services. Customers have choice to select their subscription type with respect to voice, SMS and mobile data services. Furthermore, mobile data are either given in unlimited volume with pre-fixed upper limit speed or with limited-volume at 3G speed.

TABLE 4.8: shows Sunrise abonnement offered to different customers without a mobile phone but includes unlimited calls, SMS in Switzerland and unlimited data volume services except for the first 2 bundles which are thereafter throttled to 256kbps.

Sunrise: Without a new phone		
Fee in CHF	Volume	Validity (in days)
30	500 MB	30
45	500 MB	30
75	unlimited	30
110	unlimited	30
190	unlimited	30

Source: Sunrise operator's website

TABLE 4.9: shows Sunrise abonnement offered to different customers with a new mobile phone of customer's choice including unlimited voice services, SMS in Switzerland and unlimited data volume except for 500 MB bundles which are throttled to 256kbps after limit.

Sunrise: With a new phone, data bundles		
Fee in CHF	Volume	Validity (in days)
45	500 MB	30
65	500 MB	30
90	unlimited	30
120	unlimited	30
200	unlimited	30

Source: Sunrise operator's website

This report covers adequately mobile data plans offered by Switzerland MNO's and MVNO's. Data plans are fully described in section 4.4 on page 42.

4.3.3 Data Features

Mobile operators divide mobile broadband into three features to enable fair use among subscribers and also to enhance traffic congestion control. Data features includes data volume limits, download/upload speed limits and time validity as shown in figure 4.2 as a set up of a typical scenario of traffic congestion mechanism and data features. Data volume limits are further divided into monthly basis or daily/weekly limits. Again, there are over usage penalties incurred when a user surpass data volume limit. The penalty can either be shifting into slower speed or higher charges apply per data volume over usage. Few MNO disconnect the user from Internet access as a penalty.

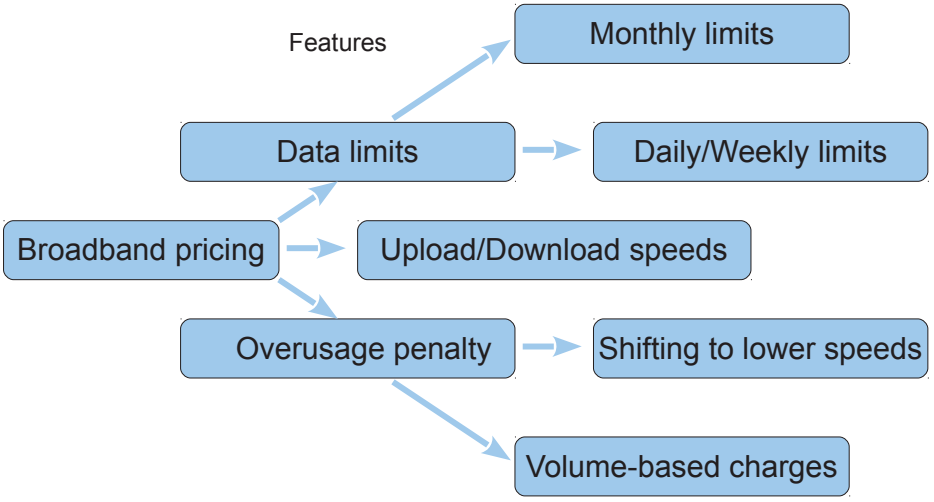


FIGURE 4.2: shows mobile data plan features and congestion control mechanisms

4.4 Data Plans

Data plans are made up of data features. Typically, there are about three data features as explained above which are data volume, data network speed (download-/upload), and data time validity, These features are combined together to tailor different data plans. The combination is usually done inclusive of one or two features at a time hence allowing rooms to create a huge number of data plans.

- Data Volume is the simplest and the most basic data plan in which only mobile data volume is given priority out of respect of data speed. Data volume alone usually expires in no less than 30 days typically, some extend to 60 and 90 days or more in general.
- Data Volume-Time is offered at pre-defined data volume allocated to be used within the pre-defined time window from the time of activation of data plan. Volume-Time based are provided with no regard to speed limits. Their attractive feature is huge data volume and high speed of download/upload.
- Data Volume-Speed based is the data plan at fixed value of both data speed and data volume. With volume and speed fixed, data time validity is left open and a user is allowed to keep the data space as long as it takes as it will not expire in future.
- Time-Speed based Data Time-Speed based is another type of mobile data plan in which user have unlimited data volume with unlimited surfing capabilities, that is data volume is ignored but at the limit of pre-defined speed and time.

4.4.1 Switzerland's Data Plans

Information and data have been collected from mobile operators websites, portals and brochures. The following reference were consulted in a continuous period of three(3) months to ensure correct and up to date data are collected and documented. Sources included but not limited to Swisscom, Sunrise, Orange Switzerland, Lebara, and Orangeclick mobile operator's websites. The website links to the corresponding data sources are mentioned in Appendix C on page 97 of this report.

4.4.1.1 Swisscom Data Plans

Swisscom mobile operator marketing strategy is strongly focusing of long term subscription with customers commitment into the data plan for about one or two year(s) time. Swisscom provides new mobile devices including Smartphones, unlimited voice services and SMS services as explained in section 4.3.2. However, postpaid subscription without a long term commitment still exist as shown in the table 4.10.

TABLE 4.10: shows a postpaid subscription mobile data plan without any voice or SMS services offered by Swisscom.

Swisscom: Speed Based Bundles		
Fee in CHF	Speed	Validity in days
39	1Mbit/s	30
49	7.2Mbit/s	30
69	21Mbit/s	30
89	100Mbit/s	30

Source: Swisscom operators website

4.4.1.2 Sunrise Data Plans

Sunrise mobile data plans are basically predominant for committed customers in one or two years time as explained in abonnement on section 4.3.2 on page 37. Still, there are prepaid data plans also as indicated in tables 4.11 and 4.12.

TABLE 4.11: shows Sunrise Data Speed based plans offered at 256kbps speed. The data is constantly streamed at moderate speed.

Sunrise: Prepaid Speed Based Bundles		
Fee in CHF	Speed	Validity (in days)
1	256kbps	1

Source: Sunrise operator's website

TABLE 4.12: shows Sunrise Data Speed based plans offered at 3G network connection speed. The speed is throttled to 256kbps when data surpass allocated volume.

Sunrise: Prepaid Volume Based Bundles		
Fee in CHF	Volume	Validity (in days)
7.5	250 MB	30
19	1 GB	30

Source: Sunrise operator's website

4.4.1.3 Orange Data Plans

Orange mobile operator as other Switzerland MNO focuses more on postpaid and abonnement mobile subscription data plans. There is little they offer to subscribers with prepaid characteristics. Basically, Orange charges 2 CHF for unlimited surfing for a period of one day at 3G speed or higher, however if the user consumes more than 500 MB of data, Orange throttle the speed just to 256kbps to ensure all the customers get the same quality of service as a mechanism of traffic congestion control. Table 4.13 shows the prepaid data bundles as offered by Orange. On other hand, there is

TABLE 4.13: shows data Volume-Time offered at 3G speed. The bundles are offered as prepaid subscription at high speed by Orange. The user is shifted into slower speed of less than 256kbps for over usage of allocated volume of 500 MB.

Orange: Prepaid Volume-Time Based Bundles		
Fee in CHF	Volume	Validity (in days)
2	500 MB	1
10	500 MB	7
20	500 MB	14
30	500 MB	30

Source: Orange operator's website

postpaid service as shown in table 4.14 with unlimited surfing at higher speed for the whole month. The table indicated more various data bundles as postpaid service.

4.4.1.4 MVNO Data Plans

The main operators have their own prepaid and postpaid offers but budget resellers such as Lebara and OrangeClick whichare Mobile virtual network operators win handful number of customer due to their lucrative offers including international services of voice, SMS and data. Tables 4.15 and 4.16 shows mobile data plans of Lebara, table 4.17 for Orangeclick, and 4.18 for Yallo.

TABLE 4.14: shows Orange Data Volume offered at 3G speed. The bundles are offered as postpaid subscription at high speed. Upon usage of allocated volume, the user pays an addition of 0.1 CHF for every 1MB.

Orange: Volume Based Bundles		
Fee in CHF	Volume	Validity (in days)
10	300 MB	30
20	1000 MB	30
49	unlimited	30

Source: Orange operator's website

TABLE 4.15: shows Lebara Data Volume-Time offered at 3G speed. The bundles are offered as prepaid/postpaid subscription at high speed. Upon usage of allocated volume, the user pays an addition of 0.1 CHF for every 1MB.

Lebara: Volume Based Bundles		
Fee in CHF	Volume	Validity (in days)
4.9	120MB	30
14.9	1000MB	30

Source: Lebara operator's website

TABLE 4.16: shows Lebara Data Volume offered at 3G speed. The bundles are offered as postpaid subscription at high speed. Upon usage of allocated volume, The user is shifted into slower speed of less than 32kbps for over usage of allocated volume

Lebara: Volume-Speed Based Bundles		
Fee in CHF	Volume	Validity in days
14.9	1000MB	30

Source: Lebara operator's website

TABLE 4.17: shows Orangeclick Data Volume offered at 3G speed. The bundles are offered at 10 CHF less for users under 27 years of old. Upon usage of allocated volume, The user is shifted into slower speed of less than 128kbps for over usage of allocated volume, except for the first bundle which is unlimited for one day time

Orangeclick: Volume Based Bundles		
Fee in CHF	Volume	Validity (in days)
5	unlimited	1
19	1000MB	30
49	5000MB	30

Source: Orangeclick operator's website

TABLE 4.18: shows Yallo Data Volume offered at 3G speed. The bundles are offered at prepaid service subscription. Upon usage of allocated volume, The user is disconnected from the Internet access however can renew the prepaid data plan

Yallo: Prepaid Volume Based Bundles		
Fee in CHF	Volume	Validity (in days)
6	150 MB	30
12	500 MB	30

Source: Yallo operator's website

4.4.2 India's Data Plans

Information and data have been collected from mobile operators websites, portals and brochures. Due to limitation of space and time, only mobile data plans from a single state of Maharashtra including Mumbai metropolitan, the business hub of India are documented in this report. This method does not affect entirely the intended study of data plans in India as there is only slightly technical variation of data plans in comparisons to other states. The difference is merely based on geographical location and state-wise companies operation. The following reference were consulted in a continuous period of at least three(3) months to ensure correct and up to date data are collected and documented. Sources included but not limited to Airtel India, Vodafone India, Reliance, Idea and MTS mobile operator's websites. The website links to the corresponding data sources are mentioned in Appendix C on page 97 of this report.

4.4.2.1 Airtel India Data Plans

Despite Airtel being the major mobile operator in India, it has only handful number of mobile data plans compared to its competitors. Basically Airtel has divided its market segmentation into two categories of prepaid and postpaid subscription and each is either offered at lower speed of 2G/3G or higher speed of pre-4G/4G as indicated in tables 4.19, 4.20, 4.21, and 4.22 show data bundles offered by MTS.

4.4.2.2 Reliance Data Plans

Reliance provides mobile broadband for both mobile phones and usb devices as modem to other devices. Reliance has recently boosted its speed into newer network technologies. Customers of reliance can choose from various mobile data plans as indicated in tables 4.23, 4.24, 4.25, and 4.26 show data bundles offered by Reliance.

TABLE 4.19: shows Airtel Data Volume offered at 2G and 3G speed. The bundles are offered as prepaid subscription at the speed of 2G. The user pays a penalty fee of 0.4 INR per MB for over usage of allocated volume.

Airtel: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
53	140 MB	7
101	300 MB	30
252	1 GB	30
451	2 GB	30
749	4 GB	30
1495	10 GB	30
948	unlimited at 2G	30
3000	30 GB	30

Source: Airtel operator's website

TABLE 4.20: shows Airtel Data Volume offered at 4G LTE speed. After usage of allocated volume, speed is throttled to 128kbps. The user does not pay penalty fee for over usage.

Airtel: Volume Based Bundles		
Fee in INR	Volume in GB	Post usageSpeed
999	6	128kbps
1399	9	128kbps
1999	18	128kbps
2999	30	128kbps

Source: Airtel operator's website

TABLE 4.21: shows Airtel Data Volume offered at 3G speed. The bundles are channeled at 3G network speed. The user pays a penalty fee of 0.4 INR per MB for over usage of allocated volume.

Airtel: Volume Based Bundles		
Fee in INR	Volume in GB	Validity (in days)
100	300 MB	30
250	1 GB	30
450	2 GB	30
675	3 GB	30
1500	10 GB	30

Source: Airtel operator's website

TABLE 4.22: shows Airtel Data Volume provided at 2G speed. The bundles are offered as prepaid subscription at slow speed. The user pays a penalty fee of 0.4 INR per MB for over usage of allocated volume.

Airtel: Volume-Based Bundles		
Fee in INR	Volume in GB	Validity (in days)
5	25 MB	1
14	75 MB	3
25	0.200 MB	7
46	300 MB	15
52	500 MB	15

Source: Airtel operator's website

TABLE 4.23: shows Reliance Data Volume-Time offered at 3G speed. The bundles are channeled at high speed before the limit. The user get speed throttled into 64kbps for over usage of allocated volume.

Reliance: Volume-Time Based Bundles		
Fee in INR	Volume	Validity (in days)
98	1 GB	2
153	750 MB	7
173	1 GB	7
255	1 GB	7
449	2 GB	7
650	3 GB	7
800	5 GB	15
1099	10 GB	30
1500	12 GB	30
3000	30 GB	30

Source: Reliance operator's website

TABLE 4.24: shows Reliance Data Volume offered at 3G speed. The bundles are channeled at high speed before the limit. The user get speed throttled into 64kbps for over usage of allocated volume.

Reliance: Volume Based Bundles		
Fee in INR	Volume in GB	Validity (in days)
100	300 MB	30
199	750 MB	30
250	1 GB	30
450	2 GB	30

Source: Reliance operator's website

TABLE 4.25: shows Reliance Data Volume offered at 3.5G speed. The bundles are channeled at high speed before the limit. The user get speed throttled into 64kbps for over usage of allocated volume.

Reliance: Volume Based Bundles			
Fee in INR	Volume	Speed Thereafter	Validity (in days)
750	5 GB	64kbps	30
950	10 GB	64kbps	30
1200	15 GB	64kbps	30

Source: Reliance operator's website

TABLE 4.26: shows a data plan from Reliance including combination of Voice, SMS and Data Volume offered at 3G speed. The bundles are channeled at high speed before the limit. The user get speed throttled into 64kbps for over usage of allocated volume.

Reliance: Volume Based Bundles			
Fee in INR	Volume	Voice (in minutes)	SMS
199	50 MB	300	50
499	100 MB	1000	600
2499	5 GB	3000	3000

Source: Reliance operator's website

4.4.2.3 Vodafone India Data Plans

Vodafone provides very simple data plans of three kinds, whicha are prepaid, postpaid subscription and combination of Voice, SMS, Data services as indicated in tables 4.27, 4.28, and 4.29.

TABLE 4.27: shows a data plan offered by Vodafone in prepaid subscription with 3G network speed. The user get penalty fee of 2 INR for over usage of set up volume limit.

Vodafone: Volume-Time Based Bundles		
Fee in INR	Volume	Validity (in days)
26	250 MB	1
44	150 MB	7
102	300 MB	30
251	1 GB	30
850	3 GB	30
898	5 GB	30
1250	5 GB	30
1501	10 GB	30

Source: Vodafone operator's website

TABLE 4.28: shows a data plan offered by Vodafone in postpaid subscription with 3G network speed. The user get penalty fee of 2 INR for over usage of set up volume limit.

Vodafone: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
100	300 MB	30
200	500 MB	30
250	1 GB	30
450	2 GB	30
650	3 GB	30
850	5 GB	30
1250	8 GB	30
2500	12 GB	30

Source: Vodafone operator's website

TABLE 4.29: shows a data plan offered by Vodafone in prepaid subscription with 3G network speed. The user get penalty fee of 2 INR for over usage of set up volume limit.

Vodafone: Voice, SMS and Volume-Based Bundles				
Fee in INR	Volume	Voice (in minutes)	SMS	Validity (in days)
502	500 MB	500	500	30
1002	1 GB	1000	1000	30

Source: Vodafone operator's website

4.4.2.4 Idea Data Plans

Idea offers wide choices of data plans including unlimited browsing for fixed transmission speed. Idea tries to cover all the possibilities of tailoring mobile data plans to suit different individual and as consequence Idea has presented a well working fair usage policy and traffic congestion control. For example, for 950 INR a user gets a speed up to 21Mbps from 0 to 6 GB, then from to 8 GB the speed is throttled at 128kbps, furthermore reduced to just 40kbps after 8 GB of usage. Tables 4.30, 4.31, 4.32, 4.33, 4.34, and 4.35 indicate precisely Ideal data bundles in action.

4.4.2.5 MTS Data Plans

Sistema Shyam TeleServices Limited (MTS) is a small mobile operator with less than 20 million subscribers. MTS can be considered as MVNO in India. It is an Indian subdivision of Russian Mobile TeleSystems telecommunication company. MTS provides both prepaid and postpaid mobile services in major cities like Mumbai with high speed of 3G. It offers a prepaid base tariff of 2 INR per MB. The rest of data

TABLE 4.30: shows a data plan offered by Idea in prepaid subscription with 2G or 2.75G network speed. The user get penalty fee of 3 INR for over usage of set up volume limit.

Idea: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
103	300 MB	30
169	1 GB	7
199	600 MB	30
249	1 GB	30
349	1.5 GB	30
449	2 GB	30
599	3 GB	30

Source: Idea operator's website

TABLE 4.31: shows a data plan offered by Idea in prepaid subscription with 3G or pre-4G network speed. The user get penalty fee of 3 INR for over usage of set up volume limit.

Idea: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
749	4 GB	30
849	3 GB	60
1249	4 GB	90
1499	10 GB	30
2499	12 GB	90

Source: Idea operator's website

TABLE 4.32: shows a data plan offered by Idea in prepaid subscription with 3G or pre-4G network speed. The speed is then throttled to 40kbps for over usage of set up volume limit.

Idea: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
751	3 GB	30
951	6 GB	30
1501	8 GB	30

Source: Idea operator's website

TABLE 4.33: shows a data plan offered by Idea in prepaid subscription with 2G or 2.75G network speed. With penalty of 0.3 INR per MB for over usage of set up volume limit.

Idea: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
100	300 MB	30
200	600 MB	30
250	1GB	30
350	1.5 GB	30
450	2 GB	30
599	3 GB	30
750	5 GB	30
850	6 GB	30
1250	10 GB	30

Source: Idea operator's website

TABLE 4.34: shows a data plan offered by Idea in prepaid subscription with 3G or pre-4G network speed. With penalty of 0.3 INR per MB for over usage of set up volume limit.

Idea: Volume Based Bundles		
Fee in INR	Volume	Validity (in days)
599	3 GB	30
750	5 GB	30
850	6 GB	30
1250	10 GB	30

Source: Idea operator's website

TABLE 4.35: shows a data plan offered by Idea in prepaid subscription with 3G or pre-4G network speed. The speed is then set up to 128kbps but with unlimited data volume.

Idea: Speed Based Bundles		
Fee in INR	Speed	Validity (in days)
950	256kbps	30
1500	256kbps	30

Source: Idea operator's website

plans are indicated in tables 4.36, 4.37, and 4.38 show data bundles offered by MTS.

TABLE 4.36: shows MTS Data Volume based bundles. The bundles are offered as prepaid subscription at the speed of 3G and pre-4G. The user pays a penalty fee of 0.5 INR per MB for over usage of allocated volume.

MTS: Volume Based Bundles		
Fee in INR	Volume in GB	Validity (in days)
348	2 GB	30
375	2.5 GB	30
490	4 GB	30
498	4 GB	30
647	6 GB	30
798	6 GB	30

Source: MTS operator's website

TABLE 4.37: shows MTS Data Volume-Time based bundles. The bundles are offered as prepaid subscription at the speed of 2G and sometimes 3G.

MTS: Volume-Time Based Bundles		
Fee in INR	Volume in GB	Validity (in days)
96	2	1
348	2	7
490	4	30
698	4	60
998	6	90
1798	9	180

Source: MTS operator's website

TABLE 4.38: shows MTS Data Volume based on either day or night time. The bundles are offered as postpaid Internet contract at speed of 3G.

MTS: Volume Based Bundles		
Fee in INR	Volume in GB	Validity (in days)
444	3	30
499	8 Day + 15 Night	30
749	15 Day + 20 Night	30

Source: MTS operator's website

4.4.3 Tanzania's Data Plans

Information and data collected from mobile operators websites, portals and brochures. The following reference were consulted in a continuous period of at least three(3)

months to ensure correct and up to date data are collected and documented. Sources included but not limited to Vodacom Tanzania, Airtel Tanzania, tiGO, Zantel, and Sasatel mobile operator's websites. The website links to the corresponding data sources are mentioned in Appendix C on page 97 of this report.

4.4.3.1 Vodacom Tanzania Data Plans

Vodacom Tanzania provides predominant prepaid data plans and with new postpaid plan for employees especially in private firms. The company tailored data plan suits many individual users but does not over wide area of choices, for example, there is lack of Volume-Speed data plan in which a user can keep his/her allocated volume space for future use. Tables 4.39, 4.40, and 4.41 show data bundles as offered by Vodacom Tanzania.

TABLE 4.39: shows Vodacom Tanzania Data Volume-Time based bundles. The bundles are offered as prepaid subscription at the speed of 3G and pre-4G. The user pays a penalty fee of 120TZS per MB for over usage of allocated volume.

Vodacom: Volume-Time Based Bundles		
Fee in TZS	Volume	Validity
250	25 MB	1 day
450	50 MB	1 day
700	100 MB	1 day
7500	500 MB	7 days
10000	750 MB	7 days
15000	1 GB	7 days
30000	2 GB	30 days
70000	5 GB	30 days
200000	20 GB	90 days
750000	100 GB	365 days

Source: Vodacom Tanzania operator's website

TABLE 4.40: shows Vodacom Tanzania Data Speed-Time based bundles. The bundles are offered as prepaid subscription at the speed of 2G and sometimes 3G.

Vodacom: Speed-Time Based Bundles		
Fee in TZS	Speed	Validity
500	256kbps	1 day
1000	256kbps	7 days
30000	256kbps	30 days

Source: Vodacom Tanzania operator's website

TABLE 4.41: shows Vodacom Tanzania Data Volume based bundles. The bundles are offered as postpaid Internet contract at speed of 3G and pre-4G.

Vodacom: Volume Based Bundles		
Fee in TZS	Volume	Overusage Fee
2000	50 MB	150 TZS/MB
8000	500 MB	151 TZS/MB
15000	1 GB	152 TZS/MB
20000	5 GB	153 TZS/MB

Source: Vodacom Tanzania operator's website

4.4.3.2 Airtel Tanzania Data Plans

Airtel Tanzania provides various data plans segmented into different categories based on data volume, speed, and validity time or the combination of any of the two categories as shown on the tables 4.42, 4.43, 4.44, and 4.45 below. Airtel generally has data plans that covers almost all the data features but they have poor congestion control mechanism. The MNO does not offer over usage of data volume in most of the plans and the user will be cut of Internet access after exhaustion of allocated data volume.

TABLE 4.42: shows Airtel Tanzania Data Volume based bundles. The bundles are offered as for both prepaid and postpaid subscription at the speed of 3G and pre-4G.

Airtel: Volume-Based Bundles			
Fee in TZS	Volume	Validity	Cost in TZS/1MB
1500	25 MB	30 Days	100
6000	150 MB	30 Days	100
10000	250 MB	30 Days	100
12000	500 MB	30 Days	100
15000	1 GB	30 Days	75
25000	2 GB	30 Days	75
30000	3 GB	30 Days	75
45000	5 GB	30 Days	75
70000	8 GB	30 Days	75
140000	15 GB	30 Days	75

Source: Airtel Tanzania operator's website

4.4.3.3 tiGO Data Plans

tiGO offers mainly two data plans based on the speed. The slow bundles at 2G and the fast speed at 3G. For 2G connection, beyond the allotted data volume, tiGO allows

TABLE 4.43: shows Airtel Tanzania Data Volume-Time based bundles. The bundles are offered as for both prepaid and postpaid subscription at the speed of 2G and sometimes 3G.

Airtel: Volume-Time Based Bundles		
Fee in TZS	Volume	Validity
3000	200 MB	1 day
7500	500 MB	7 days
10000	1 GB	30 days
28000	2 GB	30 days
30000	4 GB	7 days
35000	4 GB	30 days
75000	7 GB	60 days
100000	15 GB	60 days
150000	30 GB	60 days

Source: Airtel Tanzania operator's website

TABLE 4.44: shows Airtel Tanzania Data Volume-Speed based bundles. The bundles are offered as for both prepaid and postpaid subscription at limited speed.

Airtel: Volume-Time Based Bundles		
Fee in TZS	Volume	Validity
3000	200 MB	1 day
7500	500 MB	7 days
10000	1 GB	30 days
28000	2 GB	30 days
30000	4 GB	7 days
35000	4 GB	30 days
75000	7 GB	60 days
100000	15 GB	60 days
150000	30 GB	60 days

Source: Airtel Tanzania operator's website

TABLE 4.45: shows Airtel Tanzania Data Time-Speed based bundles. The bundles are offered as for both prepaid and postpaid subscription at limited speed and limited short time.

Airtel: Time-Speed Based Bundles		
Fee in TZS	Speed	Validity
200	256kbps	60 Minutes
500	256kbps	24 Hours
10000	256kbps	7 Days
30000	256kbps	30 Days

Source: Airtel Tanzania operator's website

an additional 50 MB throughout the bundle's lifetime, presumably at a throttled speed like Airtel's Time based bundles. This slow data plan is shown in table 4.46. For 3G connection, beyond the alloted data volume, tiGO keeps the user connected throughout the package lifetime but speed will be throttled to 2G connection. Data bundles for this plan are shown in table 4.47.

TABLE 4.46: shows tiGO Tanzania Data Volume-Time based bundles. The bundles are offered as for as only prepaid subscription at low speed of 2G network.

tiGo: Volume-Time Bundles		
Fee in TZS	Volume	Validity
450	25 MB	1 day
700	35 MB	1 day
2500	125 MB	7 days
4500	250 MB	7 days
9000	450 MB	30 days
15000	1280 MB	30 days

Source: tiGO Tanzania operator's website

TABLE 4.47: shows tiGO Tanzania Data Volume-Time based bundles. The bundles are offered at high speed of 3G and 3.5G.

tiGo: Volume-Time Based Bundles		
Fee in TZS	Volume	Validity
3000	200 MB	1 day
7500	500 MB	7 days
30000	4 GB	7 days
10000	1 GB	30 days
28000	2 GB	30 days
35000	4 GB	30 days
75000	7 GB	60 days
100000	15 GB	60 days
150000	30 GB	60 days

Source: tiGO Tanzania operator's website

4.4.3.4 Zantel Data Plans

Zantel's data plans are all combined into one simple volume-time based data plan that does not carry any additional bandwidth within their given lifetime. Once the data is used up, the user must subscribe again to avoid the nominal fee of 150 TZS per MB rate. Table 4.48 shows the only one data plan offered by Zantel.

TABLE 4.48: shows Zantel Tanzania Data Volume-Time based bundles. The bundles are offered as for both prepaid and postpaid subscription at limited speed possibly 3G at major cities

Zantel: Volume-Time Based Bundles		
Fee in TZS	Volume	Validity
1000	40 MB	1 day
3000	150 MB	1 days
7000	300 MB	7 days
15000	750 MB	30 days
40000	2 GB	30 days
90000	5 GB	30 days
140000	8 GB	60 days

Source: Zantel Tanzania operator's website

4.4.3.5 Small MNO Data Plans

Small mobile operators in Tanzania are trying to conquer the mobile market by offering very competitive mobile data plans. Table 4.49 and 4.50 shows data bundles offered by Sasatel Communication and Smile Telecommunications respectively.

TABLE 4.49: shows a small MNO called Sasatel in Tanzania telecommunication market. The bundles are offered as for as only prepaid and postpaid subscription at a speed of 3G network.

Sasatel: Volume-Time Based Bundles			
Fee in TZS	Volume	Speed	Validity
1000	40 MB	EVDO 3.1 Mbps	24 hours
5000	200 MB	EVDO 3.1 Mbps	7 days
7500	1.5 GB	EVDO 3.1 Mbps	7 days
10000	300 MB	EVDO 3.1 Mbps	30 days
30000	2.5 GB	EVDO 3.1 Mbps	30 days
40000	1 GB	1 X Data 153 Kbps	90 days
120,000	4 GB	EVDO 3.1 Mbps	90 days
325000	12 GB	EVDO 3.1 Mbps	90 days

Source: Sasatel Tanzania operator's website

4.4.4 Conclusive Overview

This chapter is entirely dedicated to mobile data plans offered by various MNOs in Switzerland, India and Tanzania. Numerous data plans and associated data features have been documented and precisely categorized according to their pricing schemes. As pointed on section 4.3.3, mobile broadband pricing is typically categorized into

TABLE 4.50: shows another small MNO called Smile in Tanzania offering Volume-Time based data plans. The bundles are given at high speed of 3G and 3.5G.

tiGo: Volume-Time Based Bundles		
Fee in TZS	Volume	Validity
3000	200 MB	1 day
7500	500 MB	7 days
30000	4 GB	7 days
10000	1 GB	30 days
28000	2 GB	30 days
35000	4 GB	30 days
75000	7 GB	60 days
100000	15 GB	60 days
150000	30 GB	60 days

Source: Smile Tanzania operator's website

two parts: Data volume limits and Data transfer speed. Mobile users in all countries are subjected to limited data volume to be consumed within a month in most cases. On average, MNO decisively set 500MB, 1GB and 2GB of data as basic options for mobile consumers. The issue of data transfer speed also takes a huge impact on how users browse, download or upload contents. As noted, increase of data volume is triggering higher cost white offered at the same speed. But increase of data transfer speed not only increase the cost but reduce the data volume limits. In most cased, unlimited data volumes are only given at slower speeds of 2G sometimes rarely at 3G, while full 3G and pre-4G data streams have limits on data volume.

It has been noted that most of MNO set the data validity typically for 30 days from the activation day. Mobile users who consume all of their data slot within this validity window are subjected to over usage penalties which are bears huge cost for individual 1MB of data or significantly throttle the data transfer speed.

Data Volume based plans still prove to be the most simplest, and most common among both MNOs and mobile users. Majority of mobile users are willing to pay for data volume and careless about transfer speed and time validity. However, almost all MNO offers other data plans including Data Volume-Time based, Data Volume-Speed based and Time

Chapter 5

Study of Mobile Data Plans

5.1 Challenges in Mobile Data Services

Mobile operators are obviously running not without challenges and issues in mobile data services over the next few years coming from wide range of areas as mentioned on figure 5.1.

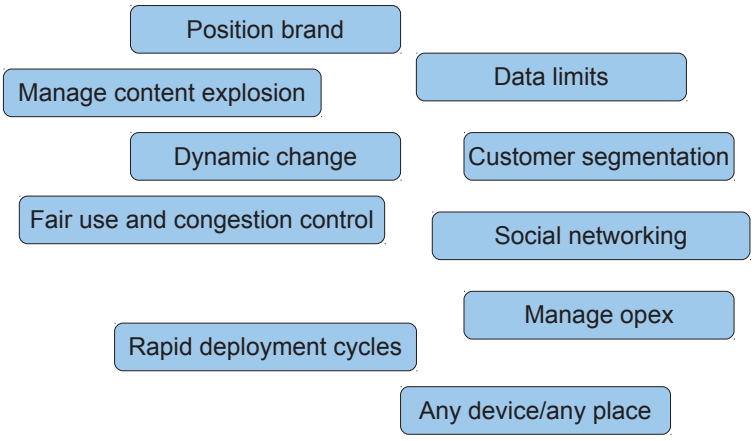


FIGURE 5.1: Challenges: Current major issues and demanding tasks that network operators should address in future is to enable truly ubiquitous of mobile data services to mobile devices.

They key concern seems to be how to cope with dynamic change, that is understanding new services such as social networking, lauching new services withing increasingly rapid deployment cycles, and managing operational expenditures. Positioning the operator's data brand in a complex and changing ecosystem is also one of challenges and align this to satisfy the need of tighter customer segmentation in order to address the wide and huge range of new services to offer, that is managing the data content

explosion. Managing mobile broadband is important as to ensure any device/ at any place get access to the operator's services. At the same time keeping a fair usage of mobile Internet and traffic congestion control.

5.2 Closer Look at Data Plans

In Switzerland, mobile Internet is dominated with abonnement data plans as described in previous chapter. All major operators provides mobile services that include a package of new mobile device, voice, SMS and mobile Internet services as indicated in figure 5.2, in term of fee and network speed for unlimited data volume in time window of one month. The figure also shows the cost of unlimited data volume for only mobile Internet without a new mobile phone but with separate cost for voice and SMS service. Aggregated data shows optimistic data plan in which mobile subscribers can be provided with same services as offered by the most expensive service scheme right now. In contrast to network speed, figure 5.3 shows data aggregation

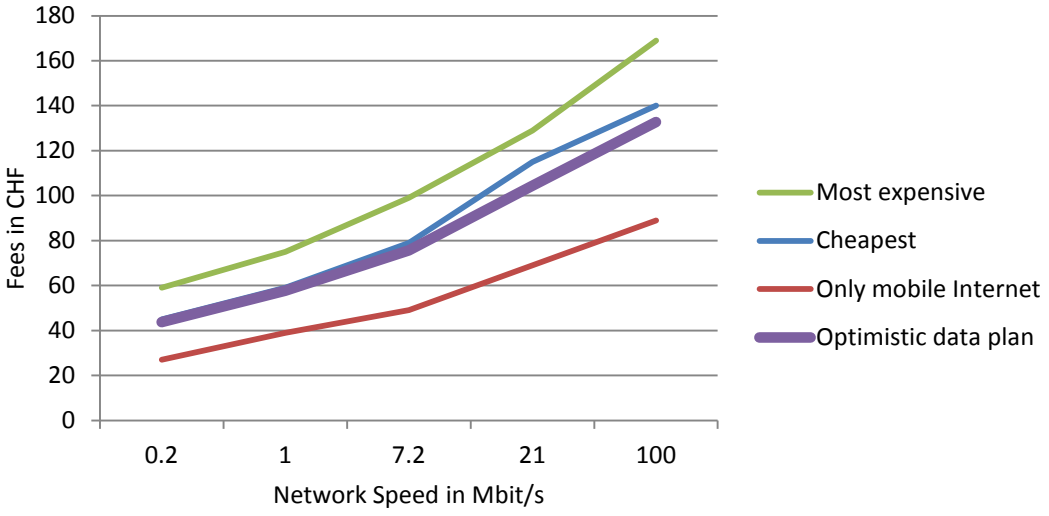


FIGURE 5.2: shows cost of abonnement data plans in term of network speed at unlimited data volume. Optimistic data plan is the projected abonnement that can be offered in near future with same services as the most expensive scheme right now.

for data volume based abonnement with the optimistic data plan.

Currently, India and Tanzania are very slow in marketing abonnement subscriptions, however it is picking up at fast speed as Smartphones are proving to be expensive devices to be purchased at once, hence most subscribers would prefer a committed subscription of one or two years as in Switzerland. India and Tanzania both lack means security means such as permanent address and national ID to ensure that

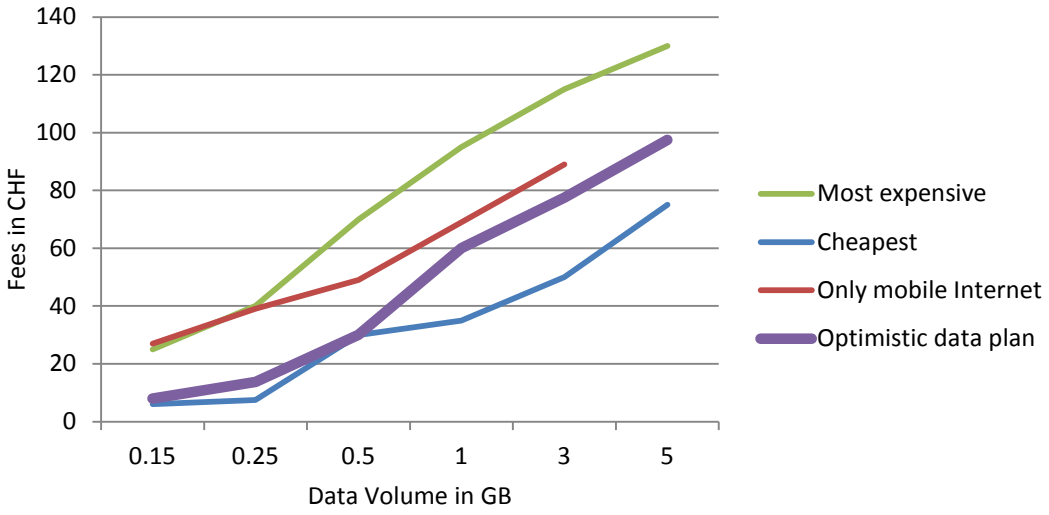


FIGURE 5.3: shows cost of abonnement data plans in term of data volume either throttled speed thereafter or additional extra charger per MB of exceeded data limit. Optimistic data plan is the projected abonnement that can be offered in near future with same services as the most expensive scheme right now.

subscribers committed to the program can eventually pay for the services. Hence, abonnement is limited to only government employees and service personnel who are guaranteed by their employers. Furthermore, some of postpaid data plans resemble the characteristics of abonnement. Figure 5.4 shows optimistic abonnement that can be launched in India as well as Tanzania with same services as in Switzerland and still subscribers will flock to make a purchase.

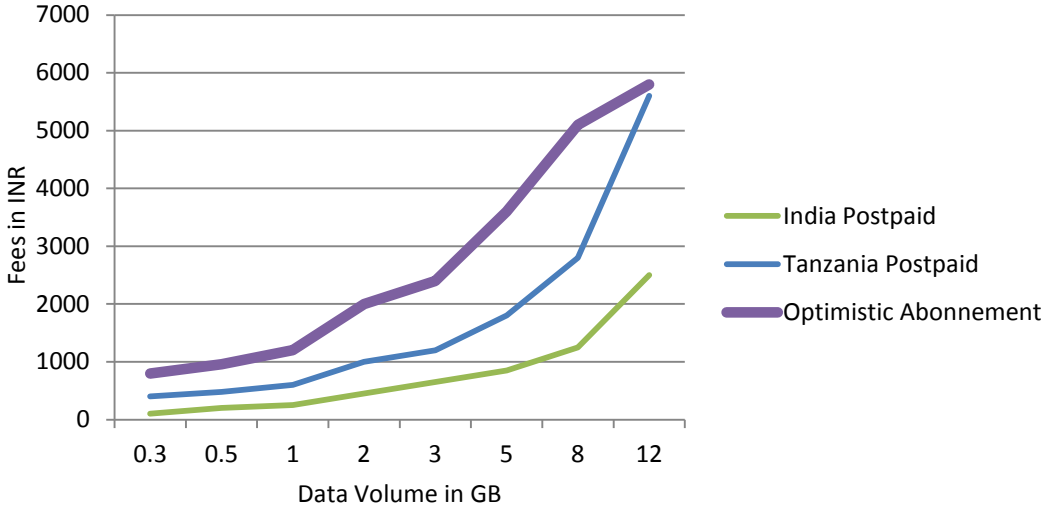


FIGURE 5.4: shows optimistic data plan that can be marketed in both India and Tanzania and still offer same services as in Switzerland.

In comparison of mobile data services only, data was aggregated to produce an average for data volume and network speed which is currently available in market. Table 5.5 provides an overview of current fees and data volume as offered in 2G, 3G and pre-4G network speeds. This shows the expectation of the mobile subscribers expenditure to the corresponding services.

Overview of Mobile Data Plans

Fee in CHF	Fee in INR	Fee in TZS	Volume in GB	Speed
6	50	700	0.15 on 7 days	2.5G
7.5	75	6000	0.25	2.5G
10	100	10000	0.3	2.75
12	200	12000	0.5	2.75
20	250	15000	1	3G
29	450	27000	2	3G
35	650	35000	3	3G
49	850	70000	5	pre-4G
79	1500	100000	10	pre-4G

FIGURE 5.5: shows overview of average-out tariff and data volume for validity of 30 days in three countries.

5.2.1 Converging of Data Plans

Converging of mobile data plan is the concept at which the quality and quantity of mobile data plans around the world come together to a single value with the same quantity and quality provided by mobile operators in different countries regardless of in term of single priced value. This work analyzed mobile broadband and simulated the cost of mobile data plans in both Switzerland and Tanzania. Figure 5.6 and 5.7 show the cost of unit MB of a data plan in USD to the cost of total data bundle. The graphs show that Switzerland has few data plans compared to Tanzania. The single dot in the graph represent an individual data plan. Switzerland is proved to be having fewer data plans and most of subscribers are not in prepaid mode compared to postpaid and abonnement customers. In Switzerland, regular customers spends on average more than 40 USD per month and enjoys high speed Internet with almost unlimited data volume, this is indicated in the nature of data plans in the graph, as dots tend to 0 CHF value in term of costs per MB. There are quite high number of dots that approach a 0 mark on y-axis after 20 USD. This means the mobile broadband is becoming stable and with unlimited data volume at higher speed. The more the tariff of data bundle the more less expensive the cost per MB of that bundle. On another way, Tanzania is sharing almost the same nature of the graph, but well noticed that

Tanzania has quite many number of data plans compared to Switzerland. More than two-third of data plans are priced below 40 USD with limited data volume, only data bundles worth more than 40 USD per month offers unlimited or higher volume data bundles. The graph shows that most of subscribers prefer prepaid schemes and notably no much of pronounced abonnement plans. However as the study was kept up to date, fewer data plans that are above 60 USD are more tailored with the nature of abonnement data plans. India lies exactly in middle between Switzerland and Tanzania.

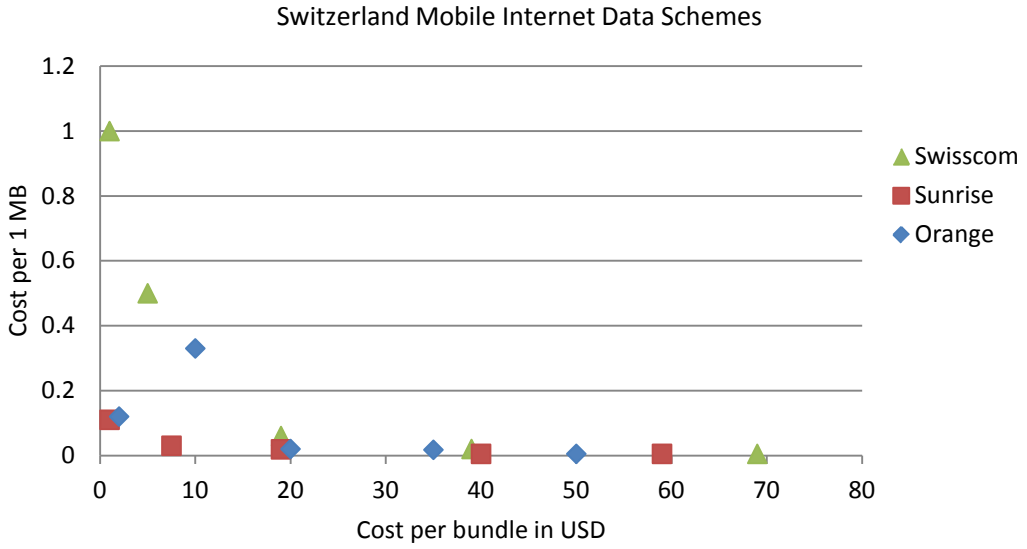


FIGURE 5.6: shows Switzerland mobile data schemes.

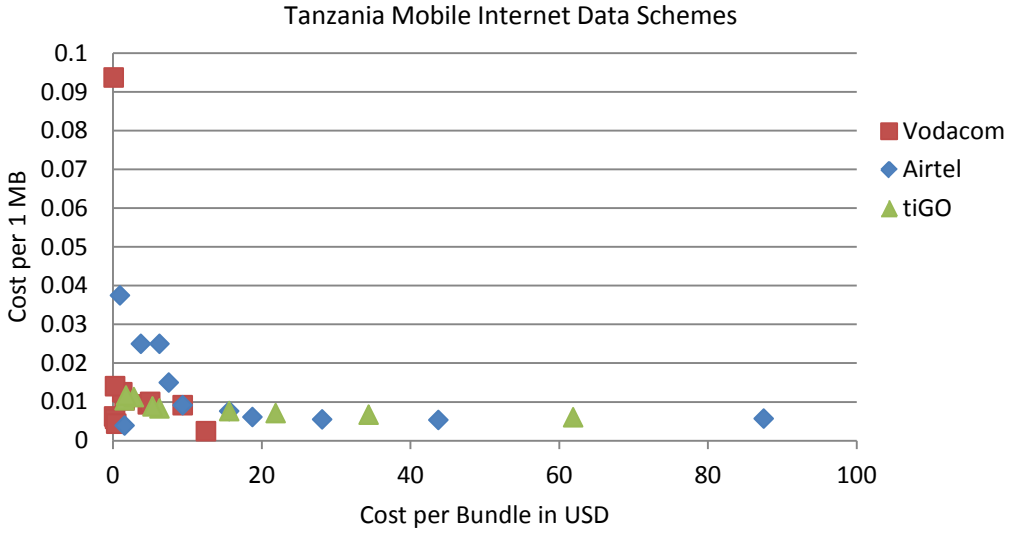


FIGURE 5.7: shows Tanzania mobile data schemes.

5.3 Ideal Universal Data Plan

The study work shows it is pretty safe to project mobile data plans into a single value worthing the same quantity and quality. This means the subscribers in near future will have access to new digital lifestyle devices including Smartphones and tablet computers with full enabled capabilities as intended to mobile devices so to optimize their computing capabilities. While individual countries even developed countries have unique pricing mechanisms and prices of telecommunication services such as telephony, cable and satellite TV, but mobile broadband and specifically in sense o mobile data plan are showing a progress into forming a unique universal data plan or in other words a standardized data plan that is customized to enable both group of subscribers and individual mobile consumers a vast area of services that enables user to extract the full power of mobile devices.

Chapter 6

Understanding Mobile Consumers

6.1 Defining Mobile Data Services

A mobile data service allows a mobile application to gain access to the contents of a Web server through a Web service. To create a mobile data service, in a simple scenario, one needs to create a client server mechanism in which mobile device here acting as client will send request and fetch contents from the web server. This mechanisms completes the need of mobile communication to enable mobile data accessibility.

Merely speaking, there are atleast four types of mobile data services (categorized only by the author's point of view).

- Type 1. Mobile Commerce:
  This includes commerce and financial activities not limited to only: buying goods/tickets, content purchase and delivery, mobile banking, online banking, money transfer, marketing and advertisement, and third party payment.
- Type 2. Communication Medium:
  This includes services not limited to only: E-mail, newsletters, personal letters, magazines, SMS and MMS, mobile chatting, and push-and-pull communications.
- Type 3. Information:
  This includes information seeking services not limited to only: news, weather, sports, stock market info, shopping info, schedules, product info, maps, location-based info.
- Typer 4. Entertainment:
  Including wide range of activities among mobile phone users, not limited to only: downloading games, graphics,cartoons, music, betting, ring tones, adult content.

In order to give a reader a comprehensive understanding of mobile data services, below is the further elaboration of above types of mobile products and services available in this era.

6.1.1 Type 1: Mobile Commerce

Mobile Commerce, casually known as m-Commerce, means new mobile applications and data services that are becoming accessible by mobile devices, of course with Internet capabilities. The data type involves new network technologies, data services and business models. It is completely different from traditional electronic based commerce performed on desktop computers. Mobile phones impose different restrictions compared desktop computers. However, they also open the door to new way of dealing with commerce issues with a slew of not existing before applications and services. Mobile commerce is obvious advantageous as it follows the user's whereabouts, and already handy to initiate and complete a purchase or payment.

6.1.1.1 Mobile Purchase

This e-commerce enables merchants to accept orders from customers electronically, through the customer's mobile device. The purchase made with mobile device is the same as on the counter with the exception only on delivery. In some cases, it is possible for the merchant to deliver the item electronically, rather than post mailing to the customer. Nowdays, many merchants provide mobile websites over which are specially customized for the mobile devices which typically have smaller screen and limited user functionalities.

6.1.1.2 Mobile Ticketing

A new means of purchasing a ticket without traditional means of making reservations calls, and queues. Tickets can now be directly purchased from merchants website or application and sent to mobile phones using a variety of technologies. Later, users are capable of using their tickets, by presenting their virtual ticket receipt. Mobile ticketing service can also be used for the distribution of vouchers and gift cards. A customer presenting a mobile device with one of virtual ticket sales point and receives the same benefits as if with the traditional ticket.

6.1.1.3 Content Purchase and Delivery

Purchase for mobile contents are becoming part of our lives nowadays, it usually consists of services such as purchase of ring-tones, wallpapers, games or even application for mobile phones. The content purchase for mobile phones are even converging to

enable all in one service installed into a single device. Once the mobile broadband download speeds of 4G networks are available, purchase of contents such as movie will be possible in a matter of seconds.

6.1.1.4 Mobile Money Transfer

Mobile money transfer is simply another new means of transferring money from one subscriber to another in the same network operator. Mobile money is loosely used to refer to money stored using the SIM in a mobile phone as an identifier as opposed to an account number in conventional banking. Notational equivalent is in value issued by an entity by MNO and is kept in a value account on the SIM within the mobile phone that is also used to transmit transfer or payment instructions, while corresponding cash value is safely held elsewhere, normally in a bank. The balance on the value account can be accessed via the mobile phone, which is also used to transmit instant transfer or payment instructions.

6.1.1.5 Mobile Banking

Banks and other financial institutions use mobile commerce to enable their customers to gain access to account. Customer can now view account information, make transactions, such as purchasing stocks, remitting money and other co-related activities. Mobile banking is proving more popular in Tanzania now, as almost all major commercial banks have launched services, including application to enable mobile banking for its customers.

6.1.1.6 Mobile ATM

A new kind of commerce in which mobile operators enable network to support cash-in and cash-out without the need of traditional banking system. With the introduction of this service for the non-banked, it is an efficient way to roll out and manage distribution networks for money.Mobile ATM have been customized particularly to connect to mobile money platforms and enable bank grade ATM services.

6.1.1.7 Mobile Marketing and Advertising

In the context of mobile commerce, mobile marketing and advertising refers to the modern means over which marketing campaigns and advertisements are sent to mobile devices. Many companies have hinted that there is a significant better response from mobile marketing campaigns compared to ones from traditional campaigns. In other hands, Auctions are also experiencing major shift from traditional means into mobile auction campaign.

6.1.2 Type 2: Communication Medium

There are basically two categories of communication media, whicha are physical and mechanical media. While physical media refer to channels where the person who is talking can be directly seen and heard by the audience such as in meetings, video conferences and viral communication, mechanical media is everything that in not as above which means written or electronic channels for passing message from one part to another.

6.1.2.1 SMS and MMS

One of the first communication services offered my MNO with the 2G network technologies. SMS enables individual to exchange short text messages, while MMS enable even a multimedia message such as a photo or map. One of the advantages of SMS and MMS is that they are fast to draft and transmit.

6.1.2.2 E-mail

E-mail is a one of popular channel for the daily communication between two individuals or to defined groups. It is suitable mainly for up-to-date, simple and clear messages, E-mail is an important supplement to meetings and also to the Intranet community. Various messages such as invitation to and agenda for meetings can with advantage be sent out with e-mail prior to the meeting.

6.1.2.3 Personal Letters

Nowdays, it can be justified that most of mobile phone users have an e-mail account and use their phones to access their personal letters and can reply. Mobile devices with large screen and with high Internet speed has enabled a friendly interaction with personal e-mails.

6.1.2.4 Intranet

The Intranet is another types of communication channel and work tool for a closed circuit community, Intranet has enabled mobile devices to be connected together and hence support the flow and distribution of newsletters and other related messages among the group members. This channel enables members to receive up to date communication while not necessary need to be at their communication desks.

6.1.3 Type 3. Information

Information seeking activities comprises a wind range of mobile usage among mobile consumers. It is arguably possible the most data service of mobile devices is

information access center. Mobile devices with the Internet and application install capabilities such as Smartphones are always subjected to information seeking. Mobile user are randomly and continuously access websites specifically to fetch information about news, weather updates, stock/stock market, foreign exchange, public transport schedules, shopping and discounts, schedules, sport news and fixtures, product and services informations, maps, and location-based information.

6.1.4 Type 4. Entertainment

Mobile entertainment comprises a wide range of activities associated with mobile devices and users. The data service is in rapid expand and can include purely leisure activities such as music or music related activities like watching videos, movies, cartoons and adult content. Other include downloading games for both single/multi-players, communications related activities like social media, networking, chatting, instant messaging, and even Twitter, and activities which could also be defined as in type1: commerce like shopping.

6.2 Models of Mobile Payments in m-Commerce

The previous section defined mobile data services including mobile commerce which is by far the most vital data service as it connects with global economy for both digital and physical goods. It is quite obvious that mobile payment is advantageous compared to other means of money transaction. Mobile payment are fast, easy, cost effective, time saver and provides same level security as using computers or even better compare to other methods. Switzerland, India and Tanzania are all exercising mobile payment and factual statistics shows rise in numbers. According to Jupiter Research, mobile payment transactions values for both digital and physical goods will exceed 300 billions USD in next five years with comprise of 50% of the total handsets available then [35]. This section describes in details typically four models that enable mobile payments.

6.2.1 SMS Based Payment

A very simple method of transaction payment in which a mobile user sends money or payment request through a simple SMS text message or sometimes short code. In Tanzania, four MNO have so far launched mobile money platforms and they include Vodacom (M-PESA), Airtel (Airtel Money), Tigo (Tigo Pesa)and Zantel (Z Pesa). Pesa is swahili word which means money. These providers support SMS platforms to accomplish a transaction. For example; [PIN code] SEND [amount to send] [recipient

phone number] to short code 565 sends money to another user in which changes will be done to his mobile wallet. India has the same access channel to transact but lags behind Tanzania in term of popularity. Switzerland is sluggish in implementation of SMS based payments especially from one user to another. This is hindered by existing infrastructures such as abundant banks and online banking payment platforms. However MNO in Switzerland allows users to pay via SMS for online Apps. In this way a user sends SMS to purchase an App which is charged on phone bill and confirmation is done by SMS too.

This transactional payment has been popular in Europe before, but overtaken by direct mobile web payments while Africa has taken it far to involve enormous payment services such as user-to-user, personal banking, mobile wallet and utility bills payment.

While SMS use is pervasive, the shortcoming of the systems is that, a user has to recall the right keywords and sequence to accomplish a given transaction. This can prove frustrating when users failed to memorize, forget or mistype keywords or even if the sequence is wrong. In addition this method is exposed to security threats and poor reliability. It is also hard to solve disputes on committed transacts. [36].

6.2.2 Direct Mobile Payment

Another mobile payment method that consumer is provided with mobile billing option after online purchase. In the checkout interface, the user provides authentication by PIN number followed by One-Time-Password. Is this way, the mobile phone account is charged for the purchase. This method is an alternative payment method with no requirements of online banking such as PostFinance or credit/debit cards, thus enable bypassing the above hindrances altogether. This type of mobile payment method is prevalent and popular in India. Switzerland also offer the same services for online payments for some vendors. The method is secure, convenient, easy and fast proven.

6.2.3 Mobile WAP Payment

is a technical standard for accessing information over a mobile wireless network. Web based payment called WAP (Wireless Application Protocol) is simply a method that technically provide access of information over MNO. This enables and facilitate the user to use featured phones or Smartphone to connect to the Internet and complete a given transaction. WAP does link users smartcards and the correspondings. It is becoming a common means of payment in Tanzania and India that mobile network operators allow users to pay for WAP Payments directly from their mobile phone

bill as with standard SMS payments. This method is also available in Switzerland's MNOs and is the oldest means of payment from mobile devices [37].

6.2.4 Near Field Communication Payment

Near Field Communication also called NFC payments are a growth area in the field of mobile payments. NFC enabled phones communicate with each other and with NFC enabled points of sale by using radio frequency identification. The mobile phones are not necessarily have to be in contact with the point of sale to transfer information, in this case perform payment. However, they need to be close enough to each other within four inches to enable information transfer.

NFC enabled devices can be used in payment systems as well as mobile devices are concerned in commerce which is similar to credit cards. NFC in addition allows mobile payment to replace or supplement current conventional systems. Taking for instance, a mobile user can use Google Wallet to store money, later can use mobile device to commit a payment at NFC enabled coffee shop. NFC is used in some countries in Asia like China and Japan. In Europe too Germany is leading user [37].

In summary, it is a technology that can facilitate rapid ticket payment for public transports, boost social networking, and enhance multi-player mobile games.

6.3 Change in Mobile Data Services

Type 1, 3 and 4 mobile data are heavy users of Mobile Internet. These are all together grouped as mobile Internet for now, while type 2 is not depending on Internet and is direct linked to mobile operators services and portals such as Messaging and Operator Services as shown in table 6.1. Apps distribution belongs to type1, 3 and 4, while Mobile e-mail to type 2.

TABLE 6.1: shows global and main mobile data content

Mobile Data Services			
Current		Future	
Messaging	35%	Mobile Internet	29%
Mobile Internet	17%	Social networking	28%
Operator Services	14%	Messaging	26%
Music	15%	Mobile e-mail	26%
Apps distribution	9%	Apps distribution	19%

Source: Survey 2012

Table 6.1 gauges the opinions about the main mobile content shift as a respond from survey questions which were asked to rate a number of activities from 1 to 5 in terms of their importance to their daily use, with 5 being the most important. The results indicates that messaging is currently viewed as the most important data type globally, while other services, including mobile Internet and operator services, lagging behind. Further, opinion mining was performed for the next two years time. In this case, mobile Internet, social networking, messaging, and mobile e-mail all scoring at relative high points indicating a shift in type of mobile data contents in next few years.

6.4 Defining Mobile Devices

A mobile device is a small, hand-held computing device, typically having a display screen with touch input and/or a miniature keyboard and weighing less than pounds 1 kg. Apple, Samsung, HTC, and LG are just a few examples of the many manufacturers that produce mobile devices. A hand-held computing device has an operating system (OS), and can run various types of application software, known as Apps. OS includes iOS by Apple, Android by Google and Windows by Microsoft. Most hand held devices are also equipped with WI-FI, Bluetooth and GPS capabilities that can allow connections to the Internet and other Bluetooth capable devices such as an automobile or a microphone headset. Early pocket sized mobile devices were introduced in the late 2000s and have been increasingly produced and purchased all over the world. Switzerland is the leader in consuming mobile devices compare to both India and Tanzania. Mobile devices includes featured phones, Smartphones, tables computers, and other personal digital assistant (PDA). Mostly notable in mobile devices is that the input and output are often combined into a touch-screen interface. Smartphones are popular amongst users due to their size, mobility and telecommunication capabilities. Also, for users who wish to use some of the powers of a conventional computer in environments where carrying one would not be practical. In most cases, this report refers mobile devices as Smartphones and featured phones unless otherwise stated.

6.5 Mobile Internet Usage

Mobile Internet growth is the growth of the Internet when accessed via a mobile device such as Smartphone. Through the use of mobile Internet as a service reached by mobile devices, the world has seen some quite changes in past decade and more changes are predicted in the future. In fact, mobile phone connections are increasing

more rapidly than purchases of any other consumer product, according to study research by Tomi Ahonen [38]. Below are just few consequences as the impact of combined Smartphones and mobile Internet.

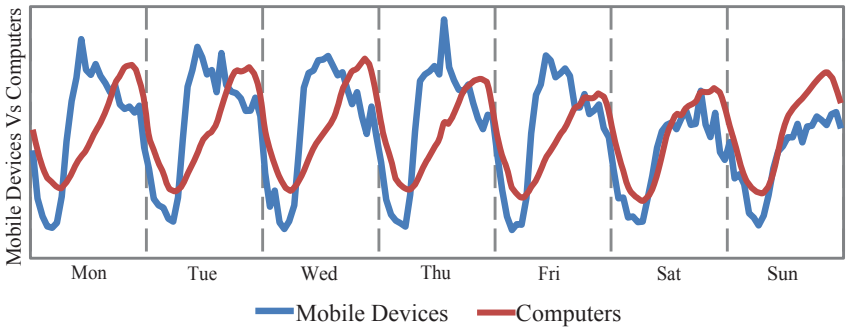
- Smartphones have become an integral part of our daily lives. Smartphone penetration has risen to more than 100% of the population in some parts of the world and these smartphone owners are becoming increasingly reliant on their devices. Over half of the users with Smartphones access the Internet every day and most never leave home without it.
- Smartphones have played a major role in transforming consumer behavior. Mobile search, video, app usage, and social networking are prolific. Smartphone users are multi-tasking their media with close to 100% using their phone while doing other things such as streaming songs.
- Smartphones obviously help users to navigate the world. Appearing on smartphones is critical for local businesses. More than two-thirds of smartphone users look for local information on their phone and almost all users take action a result, such as visiting the searched place or contacting the business.
- Smartphones have significant changed the way consumers shop or make purchase. Smartphones are critical shopping tools with almost all users having researched a product or service on their device at least once. Smartphone research influences buyer decisions and purchases across channels. However very few users have made purchase from their Smartphone.
- Smartphones facilitate advertisers to get connected with consumers. Mobile advertisements are noticed by all Smartphones users who have access to Internet. Smartphones are also a critical component of traditional advertising as more than half have performed a search on their smartphone after seeing a traditional advertisement.

The next part below will explains in figures and facts the above mobile Internet usage in Switzerland, India and Tanzania. Keeping it clearly stated that Switzerland is a developed country among the three, the study in Switzerland's mobile Internet usage was based entirely on Smartphone users and usages because of its large number of these mobile devices in population compared to India and Tanzania were a general study was conducted.

6.5.1 Switzerland

Switzerland has moved or is fast moving from physical mobility to mobile devices. It is transforming into Smartphone usage with iPhones and other Smartphones brands

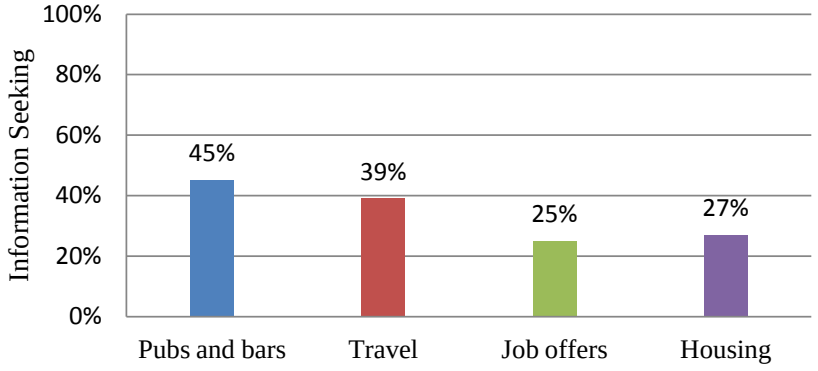
like Samsung. Around 3 million inhabitants have a Smartphone. This figures reaches 80% among the teens of 15-19 years old. Of all the Smartphones, 55% are iPhones and only 36% are Android. Switzerland is one of the top countries in terms of Smartphone usage. As of 2012, Switzerland has a higher penetration rate of 43% among users with mobile devices and 2nd highest only after USA with 44%. Figure 6.1 shows the competition among mobile devices and computers on every day use in response to same activities that are done on mobile devices.



Source: Online Internet survey and Ipsos-Google study 2012

FIGURE 6.1: shows percentage of Switzerland mobile user in term of types of information seeking or searching

In Switzerland, 56% of Smartphone owners access the Internet every day from their device, mobile has become an indispensable part of daily lives. Fore example, up to 41% of Smartphone users access to a website search for at least once a day, figure 6.2 shows the types of contents that most users do search [39].

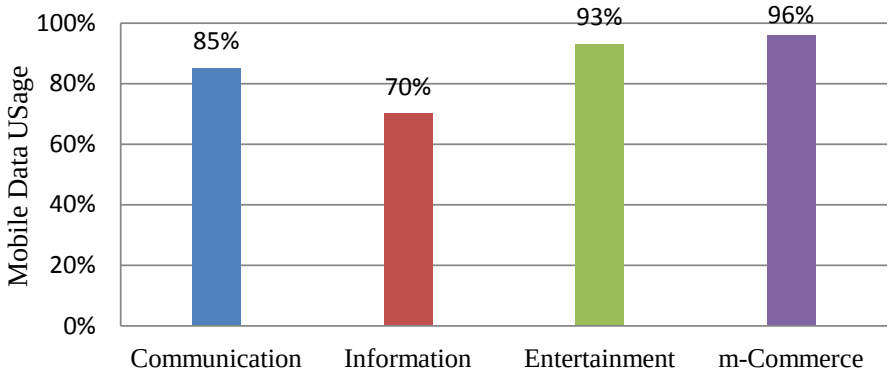


Source: Online Internet survey and Ipsos-Google study 2012

FIGURE 6.2: shows percentage of Switzerland mobile user in term of types of information seeking or searching

There is a multi-activity usage for the Smartphones in Switzerland more than just a voice and SMS services. Switzerland users are fond of Apps and are biggest users of

Apps only second in the world after Japan. Apps allows various activities to done on Smartphones are shown in figure 6.3 which are included in all types of mobile data services as explained at the beginning of this chapter.



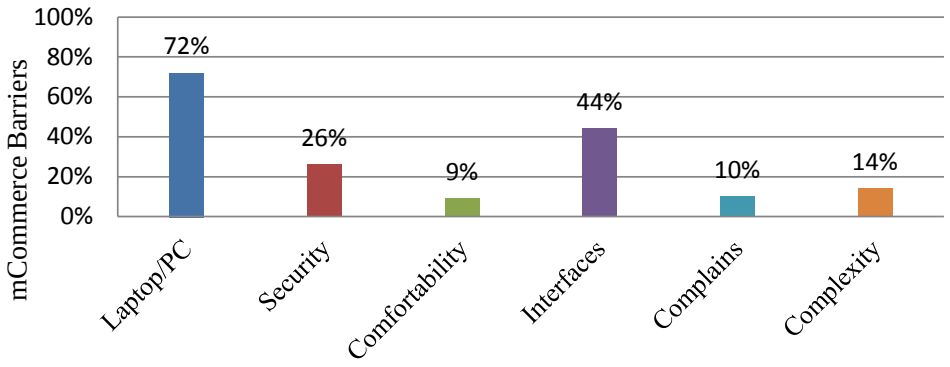
Source: Online Internet survey and Ipsos-Google study 2012

FIGURE 6.3: shows percentage of Switzerland mobile user in term of types of mobile data services

The analysis of collected data shows that Smartphone users are multi-tasking their devices such media content management such as streaming online songs while doing other activities like information seeking. Interestingly, most of users who look for local information on their phone do take action of the result such as going into a place according to search results.

Mobile commerce has an interesting growth in Switzerland. Smartphones are critical shopping tools with many users have experienced already with m-commerce at least research a product or service. However very few have made purchase by using their phones compared to the research number. However this is normal for m-commerce. Smartphone users in Switzerland expect to make more purchases in the future via their phones. This could rise the rate of purchase but still some barriers to mobile commerce still exists in Switzerland. Of the few to be mentioned: 1. Most of mobile users would still prefer to use laptops/desktops to make the purchase. 2. Some do not feel secure to use mobile for purchase, 3. Others finds it complicated, 4. Unavailability of all payment features and other facilities and 5. Uncomfortablility of using mobile phones. Also, brands and websites need to improve the user experience. This finding is indicated on figure figure:mCommerceBarriers.

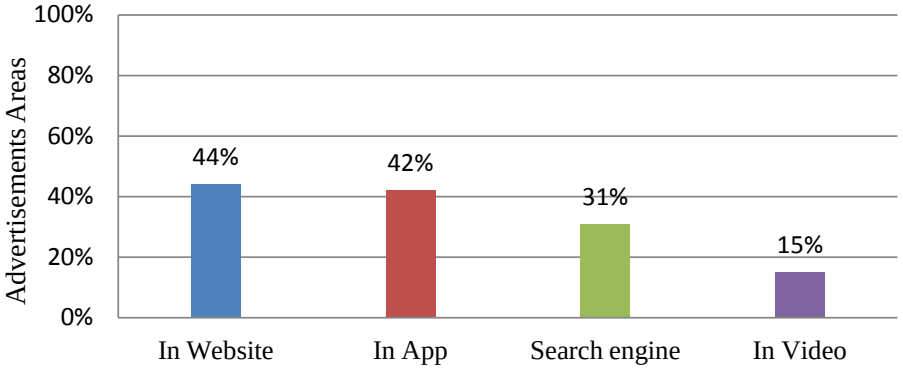
Furthermore, mobile advertisements are noticed by 86% of Smartphone users. Smartphones are also a critical component of traditional advertising as 69% have performed a search on their Smartphone after seeing an offline advertisement. Advertisements in Switzerland are found in wide area of IT domain from website, Smartphone Apps,



Source: Online Internet survey and Ipsos-Google study 2012

FIGURE 6.4: shows various barriers of Switzerland mobile user when comes to mobile commerce purchase

search engines to online video. Figure 6.5 shows the impact of advertisements to mobile phone users in Switzerland [39].

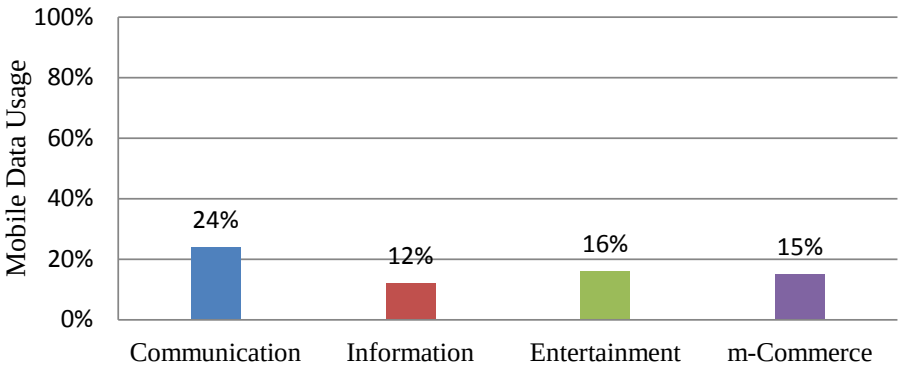


Source: Online Internet survey and Ipsos-Google study 2012

FIGURE 6.5: shows various areas in which users find advertisements from their action on mobile phones in Switzerland.

6.5.2 India

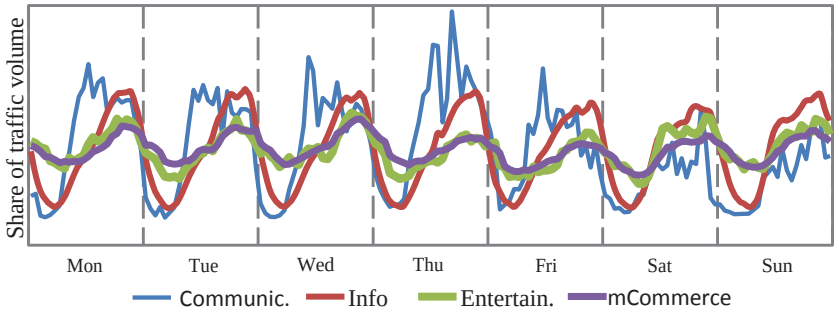
In India, more than 57% of population use the mobile internet to communicate with other parties, a figure slightly lower than the 61% which is network average. This means many users are quite matching with network coverage in term of mobile Internet. Apart for regular communication activitity, there is also a multi-activity usage for both featured phones and Smartphones in India as shown in figure 6.6 in which all four types of mobile data services are included. Indian users are keen to use their mobiles for a variety of activities including online gaming, m-commerce servces such as airtime transfers, bill payment and caf/ restaurant payments. Movies, and transport also constitute the activities.



Source: Online Internet survey 2012

FIGURE 6.6: shows four areas in which users performs various activities from their mobile phones in India.

Figure shows more than 90% of users do access mobile Internet everyday and more than half go online atleast five times a day. Once being online, again more than half of users spend long sessions of time with slightly less than 50% consumer at least one hour while more than half spend more than 30 minutes doing various activities as shown in figure 6.7 in term of traffic volume of activities per each day, with most of users being accessing their devices from home rather than in offices and schools.



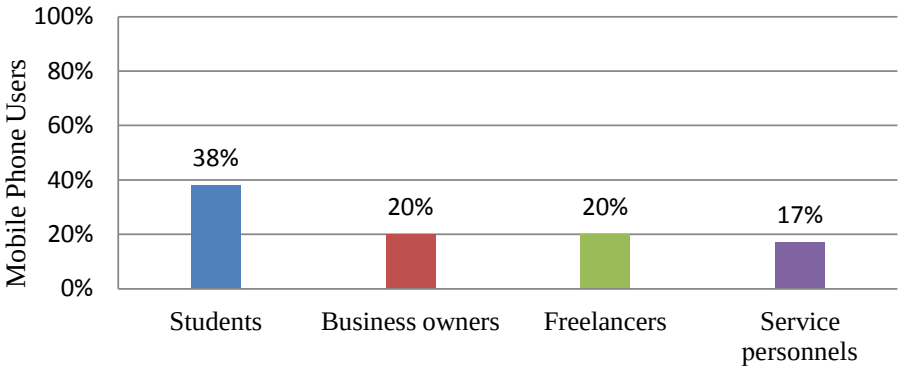
Source: Online Internet survey 2012

FIGURE 6.7: shows four application in usage according to traffic volume per day in India through mobile phones connected with mobile Internet.

In aspects of m-commerce, India's pace is very slow compared to Switzerland. Many barriers exist prior to commit mobile commerce purchase and the major one being that most of Indian mobile users do not have yet an access to either credit card or any online wallet hence rendering difficulties into performing mobile purchase. The other barriers are the same as those in figure 6.4 but with elevated percentages.

However the consumer items high on Indian wish lists with more mobile users willing to purchase new digital lifestyle devices in contrast to Switzerland. In India, most of users of mobile devices are aged between 24-30 years and holder of university/college

degree. With 38% percent of users being students forming the largest group of mobile services users. Business owners and freelancers makes 20% each followed by service personnel with 17% as indicated in figure 6.8. However, in term of gender, majority of users are male counting as thrice as much as women, possibly this is due to unequal income and other gender unbalance elements.



Source: Online Internet survey 2012

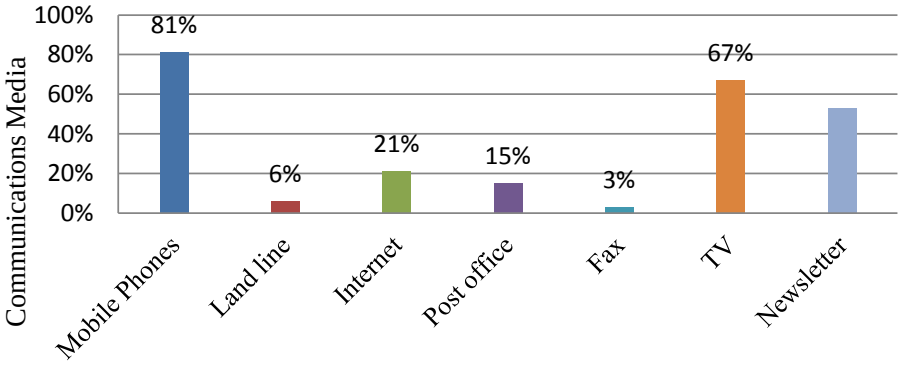
FIGURE 6.8: shows three major different groups of mobile device users in India. Users under 30 years old is the largest group made up of students mainly.

In India, Nokia is still leading as the major mobile phone distributor having reached more than 60% of the total mobile devices, but most of users express desires to purchase modern Smarphones with higher computing capabilities like iPhone and Samsung, possibly this is triggered with the information and research market through use of their mobile phones via mobile Internet.

6.5.3 Tanzania

In Tanzania, fixed communications infrastructures are stagnated and currently seems like fixed wired communication is no longer needed. The country has allowed a door open for wireless communications and mobile devices are increasing everyday with thousands of new subscribers join or shift network operators every day. Mobile Internet is also in the same status of being improving day after day. Figure 6.9 shows communication media in Tanzania.

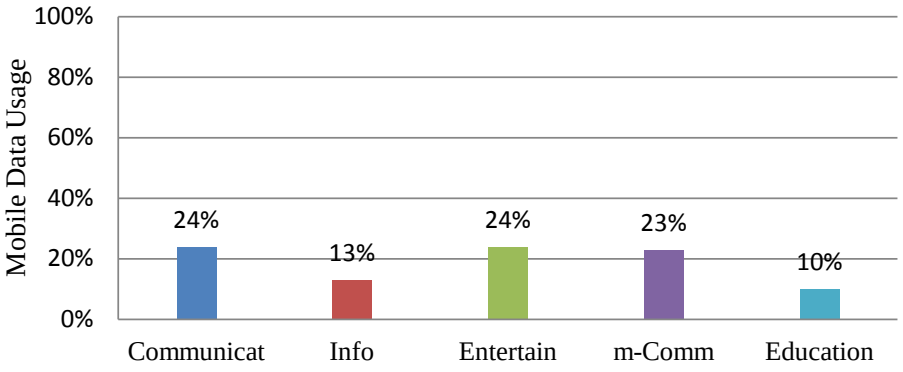
Now, all mobile providers in Tanzania provide mobile Internet access and even more wireless network operators with mobile Internet but no voice/SMS services. However, many Tanzanian do not own digital lifestyle devices like featured phones and smartphones. But survey study shows that many among population have wish lists to purchase smartphones in next two years. The penetration rate of mobile Internet is slightly below 45% which is much below the world network average.



Source: Online Internet Survery

FIGURE 6.9: shows various communications media in Tanzania, clearly mobile phone is at the top of all other media, massively used as information center.

Among the mobile users, slightly less than 95% do communicate with other parties such as chatting and is the most popular use of the mobile internet for Tanzanian subscribers. The study shows 24% of Tanzania mobile surfers use entertainment which is the highest compare to other three activities as shown in figure 6.10



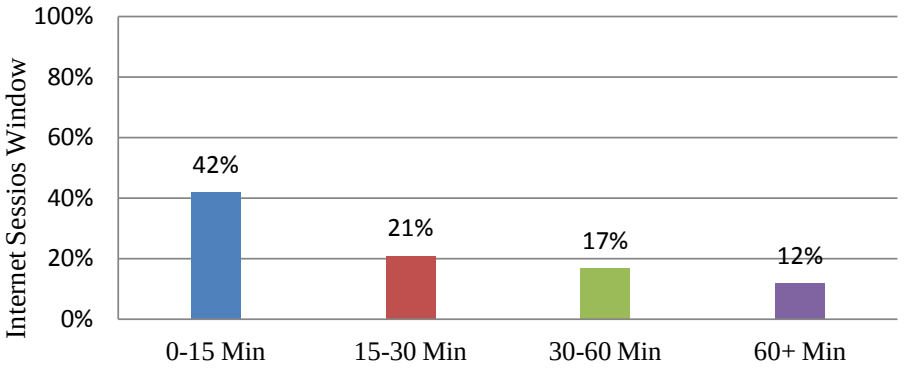
Source: Online Internet Survery

FIGURE 6.10: shows various activities in percentage among mobile Internet users in Tanzania.

Tanzania has shown a 10% response rate to education as one of mobile Internet usage activity, this more than in Switzerland and India possibly due to scarce availability of learning materials compared to other two. Furthermore, more than 85% of Tanzania mobile users go online at least once per day and more than half repeatedly acess the Internet for not less than five times a day however there is a large group of more than 10% that does not engage on mobile Internet activities and can stay for one month without accessing the mobile Internet.

The Internet session are very short among most Tanzanian mobile users compared to other users in Switzerland and India. More than one-third of mobile surfers in

Tanzania do spend less than 15 minutes on one session. And only 21% in the window of 15-30 minutes. Figure 6.11 shows the indication of individual Internet session and correspoding percentage of users. Tanzania has the lowest rate in aspect of session window online time.

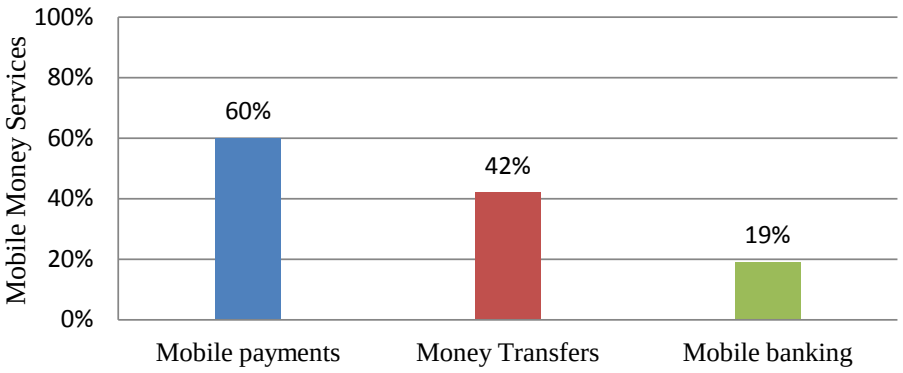


Source: Online Internet Survery

FIGURE 6.11: shows the window time of one Internet session as a response to participants in use of mobile Internet in Tanzania.

Tanzanian users surf mainly from home with a rate above 65%, while only 12% use mobile Internet out-doors and on the way. There is indication that small percentage of 6-8% use their mobile Internet at work and in school. Mobile Internet gets huge usage at evenings and drop off at late nights. In most cases, study found that users are keen to keep airtime rather than mobile Internet data volume. Around 43% percent of Tanzanian users are students in secondary schools. Business owners and freelancers makes 25% form the second largest group of users, followed by service personnel (22%).

In Tanzania, mobile banking is more pronounced that normal traditional banking now. Almost every mobile user has at least once transact using mobile phones. All major network operators provide m-banking facilities and this enabled a quick way to store, transfer and withdraw cash around the country at anytime at any local shop. It is one of major revolution of mobile phones in Tanzania, and services flocked into rural areas and villages and enables mobile users to transfer money to third party in a minute. Among mobile user, Tanzania has registered 67% of users as permanent mobile money users. Mobile money in Tanzania can be divided into three categories: 1. Mobile payments which includes airtime top-ups, merchange , bill and salary payments. 2. Mobile money transfers which includes peer to peer transfers and domestic transfer to thirdy parties. 3. Mobile Banking which incoudes balance enquiry, withdrawals, and deposits. The three categories are indicated in figure 6.12



Source: Online Internet Survery

FIGURE 6.12: shows mobile money services in which some other them involved mobile Internet. In future apps can be developed to deal with all mobile money services which use simple input codes for now.

6.6 Comparisons in Mobile Internet

Mobile devices are important gadgets to browse the mobile Internet. The impact of mobile Internet and its intent diminish quickly if the user is not using a mobile device that not only support Internet access but must be capable to provide platform for multi activities from information access to entertainment. Table 6.2 shows the penetration rates of Smartphones amongst the four countries. Smartphones are perfect devices in this era that utilize the full intent of mobile Internet and have capacity to install and launch several applications with optimize the way we work with out mobile devices.

TABLE 6.2: shows Smartphone penetration rate and daily access to mobile Internet.

Smartphones Penetration/Internet		
Country	Penetration Rate	Internet Access
USA	44%	67%
Switzerland	43%	56%
India	17%	12%
Tanzania	13%	10%

Source: Online Internet survey

The table shows USA is still at top in the world with highest level of both penetration and Internet access for the users who own a Smartphone. Switzerland is doing very well and is just below USA. However India and Tanzania shows a lagging, with India coming second and Tanzania third. The study shows that India is rapidly increasing its number of Smartphones penetration but Tanzania has a little improved Internet

access to mobile phones users. The next important thing after Smartphone is of course the software. As Smartphone is only a hardware with pre-installed apps, users do need to install additional apps to fit their needs. The study has been conducted to understand the number of installed apps in four countries and how do users manage them on monthly basis. Again, Switzerland is going well and users are very active in installing and using apps. This shows a positive indication for software development firms to target Swiss apps market. India is showing a higher pace for using installed apps more often compare to Switzerland. Indian users are keep to use softwares they have installed for a continuous long time while the use of apps is still not much pronounced in Tanzania. This is possibly due to fewer number of Smartphones and lack of interest of apps. One reason is that many of the apps are not customized to fit the needs of regular Tanzanian mobile users. The study has understand that most of users would prefer apps that enable and facilitate mobile commerce activities such as sending money to friend with just a single or two click on app rather than feeding MNO provided codes and phone numbers of the intended recipient. The difference and comparison of apps is indicated in table 6.3

TABLE 6.3: shows the number of Smartphone's apps installed by users and also the number of apps that on averaget he user activate them in a month time.

Smartphones Apps Usage		
Country	Installed	Used per month
USA	41	32
Switzerland	34	13
India	16	11
Tanzania	12	5

Source: Online Internet survery

Last, table 6.4 shows various useful information on Smartphones, mobile Users, and mobile Internet usage in Switzerland, India and Tanzania. Switzerland is once again demonstrating its higher availability of mobile devices and better infrastructures to offer mobile broadband services. However majority of population are not yet driven into higher wish lists to purchase more Smartphones or demand for improved mobile data plans, the research work shows that Switzerland population is currently satisfied with the pace of their mobile communications including Smartphones and mobile usage while India and Tanzania population is striving to both raise the penetration rate of Smartphones and also presses mobile operators to tailor data plans with improved mobile broadband. This call is even heard by authorities and government

bodies. Out of respect of their costs, India and Tanzania mobile consumers are in great deal to purchase Smartphones and other mobile devices in future.

TABLE 6.4: shows Smartphone penetration rate and daily access to mobile Internet.

	Switzerland	India	Tanzania
Smartphones & Users			
Penetration	High	Medium	Low
In daily life	Medium	Very High	Very High
Always with you	Medium	Very High	Very High
Places in use	High	High	High
Full Connected	Medium	Medium	Low
Expected increase	Low	Very High	High
Internet Usage			
Access search point	High	Medium	Low
Information of daily life	Medium	Medium	Low
Multi-activity portal	Medium	Very High	Very High
App usage	High	Medium	Low
Social Networking	High	High	Low
As Media device	Less	High	High

In scale of 0%-100%. Low denotes 0-44%, Medium 45-75%, High 76-90% and Very High 91-100%

Source: Online Internet survey

Chapter 7

Discussion and Conclusion

This is last chapter of this report. It finalizes the main findings of the research work. Furthermore, provides author's personal suggestions for further research and recommendations. In addition, a touch on future outlook of mobile Internet is outlined.

7.1 Introduction

PCs and laptops are important devices in nowadays society as they enable and enhance communications, information seek, entertainment and commerce via Internet. It is obvious that without Internet, computer becomes less useful in aspect of above activities. Now that digital lifestyle devices, tablets, wireless phones, and other Internet appliances are beginning to come of age at higher penetration power and spread over every part of the world. It is right time to provide a deep insight of current status of key players in this wireless telecommunications domain. This report covered wireless technology evolution, network carriers, mobile consumers, mobile Internet services, and software developers as key players in Switzerland, India and Tanzania; three country case study.

7.2 Summary of Findings

This section provides descriptive details of the main findings of this research work.

Active key players in Telecommunications domain paradigm

We have outlined and successful discussed individual key players in Telecommunications area which enables mobile Internet and co-related services. The players; MNO, Wireless technologies, Electronic industries, Mobile devices and consumers, and Software developers are all linked together and strongly develop a bond that influence each player to take a significant role in Telecommunications domain. The paradigm

showed adequately understanding of consumer needs by which MNOs use the most recent wireless technologies to provide Internet while Software developers takes advantage of available computing power of mobile devices to tailor APIs that enables mobile Internet services.

Significantly improved mobile Internet

Switzerland, India and Tanzania are countries on distinct continents with different ICT development curve. These countries have dissimilarities in almost every sector in discussion. However wireless network communications and mobile Internet proved to be much similar to the point that intensive mobile users will experience almost the same quality of mobile Internet at nearly the same cost across all cosmopolitan cities in Switzerland, India and Tanzania. This international improvement in mobile Internet is strongly related to the above first mentioned finding about Telecommunications paradigm.

Wireless substitution

With increased number of active mobile subscriber that surpass fixed-telephone lines, with evolution of wireless technologies 2G, 3G, 4G and N-next G that enable mobile broadband, with readiness of mobile consumers to own handheld digital devices, we have established the fact that wireless networks are rapidly overtaking other conventional means of communications. While MNO are striving to improve their services due to stiff competition among carriers, numbers of mobile consumers are raising steadily globally and mobile phones industries respond by providing cutting edge digital devices.

Mobile services evolution

Most of network carriers offers value added services to their existing mobile subscribers. While in the last decade, MNO were purely infrastructure based, this current era proves to be service based instead. Among findings I documented, mobile operators are shifting from 2G and 3G to most recent generations, voice to data services, pay-per-use to long term subscription. Others; Operator's portals to Application stores, support services for smart devices and most important from one-size-fits-all marketing strategy to market segmentation that fits individual customers.

Similarity in mobile data schemes

Apart from existing abbonement data plans in Switzerland, all three countries seems to follow the similar-like style of tailoring data plans for both marketing purposed and traffic congestion control. Typically, broadband pricing strategy divides subscription

into prepaid and postpaid schemes which further segmented into occupation, age, location based group community.

Mobile data plans and traffic control

We have seen various mechanism employed to monitor traffic congestion and ensure fairly use of mobile Internet resources to subscribers. Again, all three countries deploy same tactics such as: 1. Setting data volume limits on monthly basis, 2. Setting predefined downlink/uplink data transfer speeds and 3. Penalties for resource over usage, these are either by throttling to lower data speeds or levying higher charges per single extra consumed data. However, Switzerland users enjoys much huge data limits and higher speeds compared to India and Tanzania where most of MNOs encourage Internet usage at late night hours to control congestion. This always come at low cost.

Offline browsing systems

It has been shown that Internet availability and mobile broadband is vital for mobile devices. Their capability is extremely hindered in case of poor Internet connectivity. This research work established the importance of enabled offline browsing systems through Google Gears, HTML 5 and embedded chips. These means enable mobile consumers to continue experiencing uninterrupted browsing in case of environment constrains of handheld devices that limit connectivity.

Mobile Internet usage

In all three country case study, Smartphones and other featured phones are on high demand, consumers are determined to get the latest available mobile digital gadget from the store. Of course, this elevates mobile Internet usage with main activities being information seeking, communications, mobile commerce and entertainment. Through statistics, we showed that tasks that have been commissioned on PCs/laptops are now taking place at high pace on Smartphones.

Africa embracement on mobile commerce

In the wake of mobile commerce, four payment models including SMS, Direct payment, WAP and NFC have been discussed as means to accomplish m-commerce, m-payment, m-banking, m-money transfer. It is noted that India and Tanzania, intensively use SMS and WAP services to make payment that surpass other stagnated means of goods and services payments. On other side, Switzerland users make mobile commerce only on web with mobile payment options. The much developed fixed infrastructures and conventional payment systems such as PostFinance are hindering mobile payment advancements in Switzerland.

Mobile consumer awareness and readiness

Results from three country survey indicates the consumer's alertness on mobile devices. Majority of citizens posses featured phones and Smartphones over which added services are more pronounced rather than voice and SMS text messaging. Statistics shows that mobile Internet activities such as social networking, communications, Apps distribution and entertainment is far overtaking typical voice and SMS activities among phones. More interestingly, voice and SMS services are even shifting to mobile Internet dependency with Apps such as Skype, Viber, and Whatsapp.

7.3 Author's Suggestions and Recommendation

1. This study is applicable for providing up to date status of mobile Internet and mobile data schemes for the distinct stakeholders. In summary, the findings are useful in aspect of mobile market, mobile communications, software and Apps developments, and any other relevant domain in touch with mobile devices.

2. In order to realize a complete chain of network in the world in which people are connected together and transforming the world into electronic village, at least one has to bring those mentioned key players together. The most obvious realization is through wireless networking especially by improving the existing mobile Internet services.

3. In search for new revenue sources, many software firms are interested in determining the changes of mobile Internet data plans including availability, size and cost, over which could help understand the development of new revenue sources, softwares and applications for mobile Internet and phone users in general. This research work is good as a reference point.

4. As Internet is a valuable resource right now, still there are questions to ask. Is it possible to maintain data services such as information seek and entertainment without the continuous access of the Internet? Can novel idea provide other means to enable uninterrupted connectivity of mobile devices? This thesis strongly suggest to pursue implementation of offline browsing systems with intention to enable optimization of computing capabilities of mobile devices with less Internet dependency.

7.3.1 Further Research

- First, to precisely measure the mobile Internet traffic associated with mobile devices and draw conclusion line on competition between mobile devices and

traditional laptops/PCs. This is to provide a deep insight of network data traffic and mobile Internet.

- Second, to gain an insight on offline website contents browsing system, the system should be intended to enable uninterrupted web browsing experience even with no Internet connectivity on mobile devices. This research might involve both software and hardware systems.

- Third, a newly research is required to study mobile commerce that would come out with commended results to convince developed countries like Switzerland to adopt mobile commerce and mobile payment systems as in developing countries.

7.4 Future Outlook

A closely connected world as an electronic village is very possible in future with use of wireless mobile communications. Of course, with the convergence of key players in telecommunications domain, with enabled offline browsing systems, and with the rightful mobile digital device.

Appendix A

MNO Data Plans

Table A.1

Country	Pricing Scheme	Mobile Operator	Data Plan Features	Data Volume	Transfer Speed	Validity in days	Fees
Switzerland	Prepaid	Lebara	Volume Based	120MB	3 G	30	4,9 CHF
		Lebara	Volume Based	1000MB	3 G	30	14,9 CHF
		Lebara	Volume-Speed Based	1000MB	32 kbps	30	14,9 CHF
		Orangeclick	Volume Based	Unlimited	128 kbps	1	5 CHF
		Orangeclick	Volume Based	1000MB	128 kbps	30	19 CHF
		Orangeclick	Volume Based	5000MB	128 kbps	30	49 CHF
	Abbonment	Swisscom	Speed Based	Unlimited	0.2 mbps	30	59 CHF
		Swisscom	Speed Based	Unlimited	1 mbps	30	75 CHF
		Swisscom	Speed Based	Unlimited	7.2 mbps	30	99 CHF
		Swisscom	Speed Based	Unlimited	21 mbps	30	129 CHF
		Swisscom	Speed Based	Unlimited	100 mbps	30	169 CHF
		Swisscom	Speed Based	Unlimited	1 mbps	30	9 CHF
		Swisscom	Speed Based	Unlimited	7.2 mbps	30	29 CHF
		Swisscom	Speed Based	Unlimited	21 mbps	30	49 CHF
		Swisscom	Speed Based	Unlimited	100 mbps	30	69 CHF
		Orange	Volume Based	1GB	3G and pre-4G	30	35 CHF
		Orange	Volume Based	3GB	3G and pre-4G	30	55 CHF
		Orange	Volume Based	5GB	3G and pre-4G	30	70 CHF
		Orange	Unlimited Voice:Volume Based	1GB	3G and pre-4G	30	95 CHF
		Orange	Unlimited Voice:Volume Based	3GB	3G and pre-4G	30	115 CHF
		Orange	Unlimited Voice:Volume Based	5GB	3G and pre-4G	30	130 CHF
		Orange	Under 27 years: Volume Based	1GB	3G and pre-4G	30	25 CHF
		Orange	Under 27 years: Volume Based	3GB	3G and pre-4G	30	45 CHF
		Orange	Under 27 years: Volume Based	5GB	3G and pre-4G	30	60 CHF
		Orange	Under 27 years:Unlimited Voice	1GB	3G and pre-4G	30	85 CHF
		Orange	Under 27 years:Unlimited Voice	3GB	3G and pre-4G	30	105 CHF
		Orange	Under 27 years:Unlimited Voice	5GB	3G and pre-4G	30	120 CHF
		Sunrise	Unlimited Volume, Voice andSMS	Unlimited	1 mbps	30	59 CHF
		Sunrise	Unlimited Volume, Voice andSMS	Unlimited	7.2 mbps	30	79 CHF
		Sunrise	Unlimited Volume, Voice andSMS	Unlimited	21 mbps	30	115 CHF
		Sunrise	Without a new mobile phone	500 MB	256 kbps	30	30 CHF
		Sunrise	Without a new mobile phone	500 MB	256 kbps	30	45 CHF
		Sunrise	Without a new mobile phone	Unlimited	256 kbps	30	75 CHF
		Sunrise	Without a new mobile phone	Unlimited	256 kbps	30	110 CHF
		Sunrise	Without a new mobile phone	Unlimited	256 kbps	30	190 CHF
		Sunrise	With a new mobile phone	500 MB	256 kbps	30	45 CHF
		Sunrise	With a new mobile phone	500 MB	256 kbps	30	65 CHF
		Sunrise	With a new mobile phone	Unlimited	256 kbps	30	90 CHF
		Sunrise	With a new mobile phone	Unlimited	256 kbps	30	120 CHF
		Sunrise	With a new mobile phone	Unlimited	256 kbps	30	200 CHF

Country	Pricing Scheme	Mobile Operator	Data Plan Features	Data Volume	Transfer Speed	Validity in days	Fees
Switzerland	Postpaid	Swisscom	Speed based	Limited	1 mbps	30	39 CHF
		Swisscom	Speed based	Limited	7.2 mbps	30	49 CHF
		Swisscom	Speed based	Limited	21 mbps	30	69 CHF
		Swisscom	Speed based	Limited	100 mbps	30	89 CHF
		Orange	Volume Based	300 MB	3G	30	10 CHF
		Orange	Volume Based	1000 MB	3G	30	20 CHF
		Orange	Volume Based	Unlimited	3G	30	49 CHF
		Yallo	Prepaid Volume Based	150 MB	3G	30	6 CHF
		Yallo	Prepaid Volume Based	500 MB	3G	30	12 CHF
		Orange	Volume Based	5 MB		1	7 CHF
		Orange	Speed Based	Unlimited	1 mbps	30	39 CHF
		Orange	Speed Based	Unlimited	7.2 mbps	30	49 CHF
		Orange	Speed Based	Unlimited	21 mbps	30	69 CHF
		Orange	Speed Based	Unlimited	100 mbps	30	89 CHF
		Orange	Prepaid Volume Time Based	500 MB	3G	1	2 CHF
		Orange	Prepaid Volume Time Based	500 MB	3G	7	10 CHF
		Orange	Prepaid Volume Time Based	500 MB	3G	14	20 CHF
		Orange	Prepaid Volume Time Based	500 MB	3G	30	30 CHF
		Sunrise	Prepaid Volume Based	250 MB	256 kbps	30	7,5 CHF
		Sunrise	Prepaid Volume Based	1 GB	256 kbps	30	19 CHF
		Sunrise	Prepaid Speed Data	Unlimited	256 kbps	1	1 CHF
India	**Prepaid**	Airtel	Volume Based	140 MB	2G, 3G	7	53 INR
		Airtel	Volume Based	300 MB	2G, 3G	30	101 INR
		Airtel	Volume Based	1 GB	2G, 3G	30	252 INR
		Airtel	Volume Based	2 GB	2G, 3G	30	451 INR
		Airtel	Volume Based	4 GB	2G, 3G	30	749 INR
		Airtel	Volume Based	10 GB	2G, 3G	30	1495 INR
		Airtel	Volume Based	30 GB	2G, 3G	30	3000 INR
		Airtel	Volume-Speed Based	6 GB	4G, 2G after 6GB	30	999 INR
		Airtel	Volume-Speed Based	9 GB	4G, 2G after 9GB	30	1399 INR
		Airtel	Volume-Speed Based	18 GB	4G, 2G after 18GB	30	1999 INR
		Airtel	Volume-Speed Based	30 GB	4G, 2G after 30GB	30	2999 INR
		Reliance	Volume -Time Based	1 GB	3G, 2G after 1GB	2	98 INR
		Reliance	Volume -Time Based	750 MB	3G, 2G after 1GB	7	153 INR
		Reliance	Volume -Time Based	1 GB	3G, 2G after 1GB	7	173 INR
		Reliance	Volume -Time Based	2 GB	3G, 2G after 2GB	7	449 INR
		Reliance	Volume -Time Based	3 GB	3G, 2G after 3GB	7	650 INR
		Reliance	Volume -Time Based	5 GB	3G, 2G after 5GB	7	800 INR
		Reliance	Volume -Time Based	10 GB	3G, 2G after 10GB	15	1099 INR
		Reliance	Volume -Time Based	12 GB	3G, 2G after 12GB	30	1500 INR
		Reliance	Volume -Time Based	30 GB	3G, 2G after 30GB	30	3000 INR
		Reliance	Volume-Speed Based	1 GB	64 kbps	2	98 INR
		Reliance	Volume-Speed Based	5 GB	64 kbps	30	800 INR
		Reliance	Volume-Speed Based	10 GB	64 kbps	30	1099 INR
		Reliance	Volume-Speed Based	15 GB	64 kbps	30	1300 INR
		Reliance	Volume Based	5 GB	64 kbps	30	750 INR
		Reliance	Volume Based	10 GB	64 kbps	30	950 INR
		Reliance	Volume Based	15 GB	64 kbps	30	1200 INR
		Reliance	Volume Based	200 MB	3G	30	293 INR
		Reliance	Volume Based	500 MB	3G	30	699 INR
		Reliance	Volume Based	200 MB	3G	30	302 INR
		Vodafone	Volume-Time Based	250 MB	3G	1	26 INR
		Vodafone	Volume-Time Based	150 MB	3G	7	44 INR
		Vodafone	Volume-Time Based	300 MB	3G	30	102 INR
		Vodafone	Volume-Time Based	1 GB	3G	30	251 INR
		Vodafone	Volume-Time Based	3 GB	3G	30	850 INR
		Vodafone	Volume-Time Based	5 GB	3G	30	898 INR
		Vodafone	Volume-Time Based	5 GB	3G	30	1250 INR
		Vodafone	Volume-Time Based	10 GB	3G	30	1501 INR
		Vodafone	Volume Based	5 GB	3G	30	1252 INR
		Vodafone	Volume Based	10 GB	3G	30	1502 INR

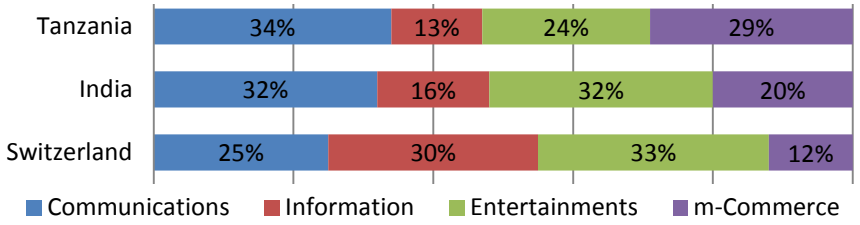
Country	Pricing Scheme	Mobile Operator	Data Plan Features	Data Volume	Transfer Speed	Validity in days	Fees
India	Prepaid	Vodafone	Voice, SMS and Volume-Based	500 MB	3G	30	502 INR
		Vodafone	Voice, SMS and Volume-Based	1 GB	3G	30	1002 INR
		MTS	Volume-Time Based	2 GB	2G, 3G	1	96 INR
		MTS	Volume-Time Based	2 GB	2G, 3G	7	348 INR
		MTS	Volume-Time Based	4 GB	2G, 3G	30	490 INR
		MTS	Volume-Time Based	4 GB	2G, 3G	60	698 INR
		MTS	Volume-Time Based	6 GB	2G, 3G	90	998 INR
		MTS	Volume-Time Based	9 GB	2G, 3G	180	1798 INR
		Idea	Volume Based	300 MB	2 G or 2.75 G	30	103 INR
		Idea	Volume Based	600 MB	2 G or 2.75 G	30	199 INR
		Idea	Volume Based	1 GB	2 G or 2.75 G	7	169 INR
		Idea	Volume Based	1 GB	2 G or 2.75 G	30	249 INR
		Idea	Volume Based	1.5 GB	2 G or 2.75 G	30	349 INR
		Idea	Volume Based	2 GB	2 G or 2.75 G	30	449 INR
		Idea	Volume Based	3 GB	2 G or 2.75 G	30	599 INR
	Postpaid	Idea	Volume Based	300 MB	2 G or 2.75 G	30	100 INR
		Idea	Volume Based	600 MB	2 G or 2.75 G	30	200 INR
		Idea	Volume Based	1GB	2 G or 2.75 G	30	250 INR
		Idea	Volume Based	1.5 GB	2 G or 2.75 G	30	350 INR
		Idea	Volume Based	2 GB	2 G or 2.75 G	30	450 INR
		Idea	Volume Based	3 GB	2 G or 2.75 G	30	599 INR
		Idea	Volume Based	5 GB	2 G or 2.75 G	30	750 INR
		Idea	Volume Based	6 GB	2 G or 2.75 G	30	850 INR
		Idea	Volume Based	10 GB	2 G or 2.75 G	30	1250 INR
		Idea	Speed Based	Limited	256 kbps	30	950 INR
		Idea	Speed Based	Limited	256 kbps	30	1500 INR
		Idea	Unlimited	3 GB	256 kbps	30	751 INR
		Idea	Unlimited	6 GB	256 kbps	30	951 INR
		Idea	Unlimited	8 GB	256 kbps	30	1501 INR
		Reliance	Volume-Based	300 MB	3G	30	100 INR
		Reliance	Volume-Based	750 MB	3G	30	199 INR
		Reliance	Volume-Based	1 GB	3G	30	250 INR
		Reliance	Volume-Based	2 GB	3G	30	450 INR
		Airtel	Volume Based	300 MB	3G	30	100 INR
		Airtel	Volume Based	1 GB	3G	30	250 INR
		Airtel	Volume Based	2 GB	3G	30	450 INR
		Airtel	Volume Based	3 GB	3G	30	675 INR
		Airtel	Volume Based	10 GB	3G	30	1500 INR
		Airtel	Volume Based	25 MB	2G	1	5 INR
		Airtel	Volume Based	75 MB	2G	3	14 INR
		Airtel	Volume Based	0.200 MB	2G	7	25 INR
		Airtel	Volume Based	300 MB	2G	15	46 INR
		Airtel	Volume Based	500 MB	2G	15	52 INR
		Vodafone	Volume Based	300 MB	3G and 4G	30	100 INR
		Vodafone	Volume Based	500 MB	3G and 4G	30	200 INR
		Vodafone	Volume Based	1 GB	3G and 4G	30	250 INR
		Vodafone	Volume Based	2 GB	3G and 4G	30	450 INR
		Vodafone	Volume Based	3 GB	3G and 4G	30	650 INR
		Vodafone	Volume Based	5 GB	3G and 4G	30	850 INR
		Vodafone	Volume Based	8 GB	3G and 4G	30	1250 INR
		Vodafone	Volume Based	12 GB	3G and 4G	30	2500 INR
		MTS	Volume Based	3 GB	3G	30	444 INR
		MTS	Volume Based	3 GB	2G and 3G	30	499 INR
		MTS	Volume Based	8 Gb	3G	30	749 INR
	Prepaid & Postpaid	MTS	Volume Based	2 GB	3G and pre-4 G	30	348 INR
		MTS	Volume Based	2.5 GB	3G and pre-4 G	30	375 INR
		MTS	Volume Based	4 GB	3G and pre-4 G	30	490 INR
		MTS	Volume Based	4 GB	3G and pre-4 G	30	498 INR
		MTS	Volume Based	6 GB	3G and pre-4 G	30	647 INR
		MTS	Volume Based	6 GB	3G and pre-4 G	30	798 INR

Country	Pricing Scheme	Mobile Operator	Data Plan Features	Data Volume	Transfer Speed	Validity in days	Fees
Tanzania	Prepaid	Airtel	Volume-Speed Based	20 MB	64 kbps	1	500 TZS
		Airtel	Volume-Speed Based	500 MB	64 kbps	15	10000 TZS
		Airtel	Volume-Speed Based	2048 MB	64 kbps	30	30000 TZS
		Vodacom	Speed-Time Based	unlimited	256 kbps	1	500 TZS
		Vodacom	Speed-Time Based	unlimited	256 kbps	7	1000 TZS
		Vodacom	Speed-Time Based	unlimited	256 kbps	30	30000 TZS
		Tigo	Volume-Time Based	25 MB	2 G	1	450 TZS
		Tigo	Volume-Time Based	35 MB	2 G	1	700 TZS
		Tigo	Volume-Time Based	125 MB	2 G	7	2500 TZS
		Tigo	Volume-Time Based	250 MB	2 G	7	4500 TZS
		Tigo	Volume-Time Based	450 MB	2 G	30	9000 TZS
		Tigo	Volume-Time Based	1280 MB	2 G	30	15000 TZS
		Tigo	Volume-Time Based	200 MB	3G and 3,5 G	1	3000 TZS
		Tigo	Volume-Time Based	500 MB	3G and 3,5 G	7	7500 TZS
		Tigo	Volume-Time Based	4 GB	3G and 3,5 G	7	30000 TZS
		Tigo	Volume-Time Based	1 GB	3G and 3,5 G	30	10000 TZS
		Tigo	Volume-Time Based	2 GB	3G and 3,5 G	30	28000 TZS
		Tigo	Volume-Time Based	4 GB	3G and 3,5 G	30	35000 TZS
		Tigo	Volume-Time Based	7 GB	3G and 3,5 G	60	75000 TZS
		Tigo	Volume-Time Based	15 GB	3G and 3,5 G	60	100000 TZS
		Tigo	Volume-Time Based	30 GB	3G and 3,5 G	60	150000 TZS
		Zantel	Volume-Time Based	40 MB	3G	1	1000 TZS
		Zantel	Volume-Time Based	150 MB	3G	1	3000 TZS
		Zantel	Volume-Time Based	300 MB	3G	7	7000 TZS
		Zantel	Volume-Time Based	750 MB	3G	30	15000 TZS
		Zantel	Volume-Time Based	2 GB	3G	30	40000 TZS
		Zantel	Volume-Time Based	5 GB	3G	30	90000 TZS
		Zantel	Volume-Time Based	8 GB	3G	60	140000 TZS
	Postpaid	Vodacom	Volume Based	50 MB	3G and pre-4G	7	2000 TZS
		Vodacom	Volume Based	500 MB	3G and pre-4G	30	8000 TZS
		Vodacom	Volume Based	1 GB	3G and pre-4G	30	15000 TZS
		Vodacom	Volume Based	5 GB	3G and pre-4G	30	20000 TZS
	Prepaid & Postpaid	Airtel	Volume-Time Based	200 MB	2 G,3 G	1	3000 TZS
		Airtel	Volume-Time Based	500 MB	2 G,3 G	7	7500 TZS
		Airtel	Volume-Time Based	1 GB	2 G,3 G	30	10000 TZS
		Airtel	Volume-Time Based	2 GB	2 G,3 G	30	28000 TZS
		Airtel	Volume-Time Based	4 GB	2 G,3 G	7	30000 TZS
		Airtel	Volume-Time Based	4 GB	2 G,3 G	30	35000 TZS
		Airtel	Volume-Time Based	7 GB	2 G,3 G	60	75000 TZS
		Airtel	Volume-Time Based	15 GB	2 G,3 G	60	100000 TZS
		Airtel	Volume-Time Based	30 GB	2 G, 3 G	60	150000 TZS
		Airtel	Volume Based	25 MB	3 G	30	1500 TZS
		Airtel	Volume Based	150 MB	3 G	30	6000 TZS
		Airtel	Volume Based	250 MB	3 G	30	10000 TZS
		Airtel	Volume Based	500 MB	3 G	30	12000 TZS
		Airtel	Volume Based	1 GB	3 G	30	15000 TZS
		Airtel	Volume Based	2 GB	3 G	30	25000 TZS
		Airtel	Volume Based	3 GB	3 G	30	30000 TZS
		Airtel	Volume Based	5 GB	3 G	30	45000 TZS
		Airtel	Volume Based	8 GB	3 G	30	70000 TZS
		Airtel	Volume Based	15 GB	3 G	30	140000 TZS
		Airtel	Time-Speed Based	unlimited	256 kbps	0.04	200 TZS
		Airtel	Time-Speed Based	unlimited	256 kbps	1	500 TZS
		Airtel	Time-Speed Based	unlimited	256 kbps	7	10000 TZS
		Airtel	Time-Speed Based	unlimited	256 kbps	30	30000 TZS

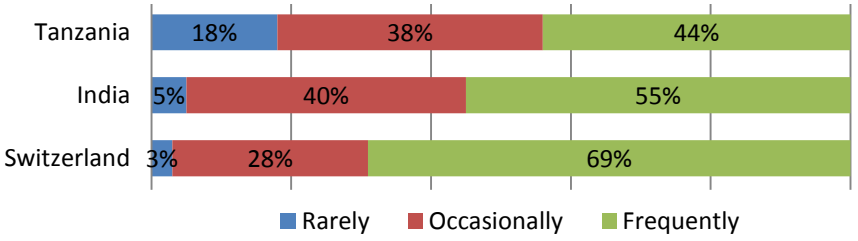
Appendix B

Survey Questions

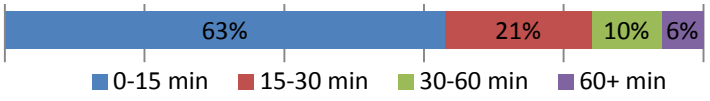
1. In which activities do you use mobile Internet for? Rate the following mobile data services from 1 to 5 according to your usage priority.



2. How often do you access mobile Internet and visit websites/services per day?

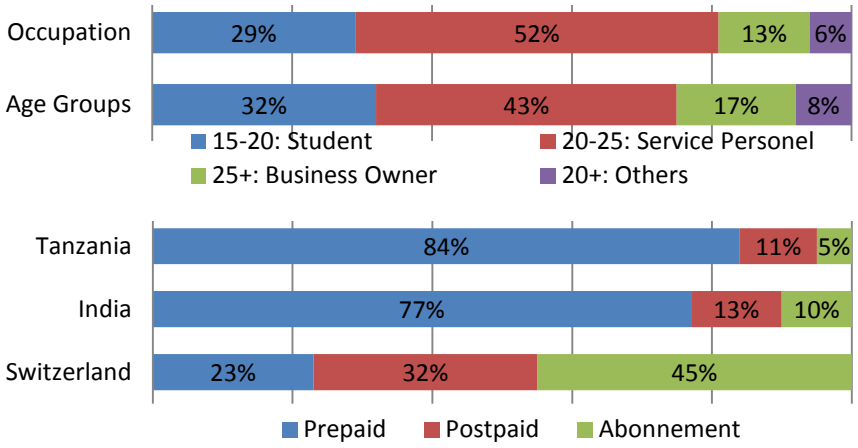


3. How long does one session lasts while using mobile Internet?



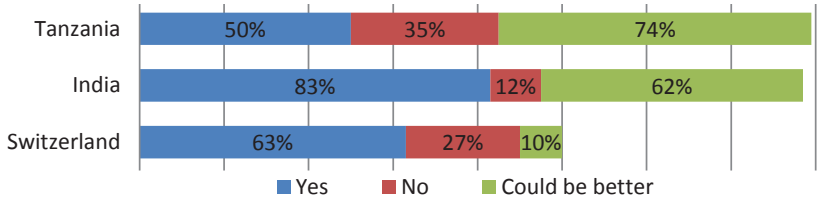
4. At what premises do you access mobile Internet?

5. What is your age and occupation?



6. What is the type of your data plan subscription?

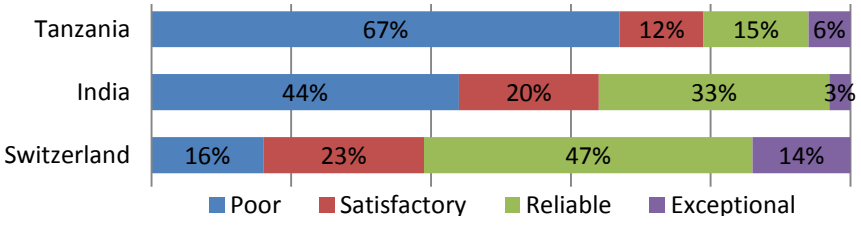
7. Did you have enough choices to make when choosing your data plan? Is your current data plan satisfactory to you?



8. What is your average cell phone bill per month for mobile Internet services?

   Answer: Switzerland - 25 CHF, India - 450 INR and Tanzania - 15000 TZS

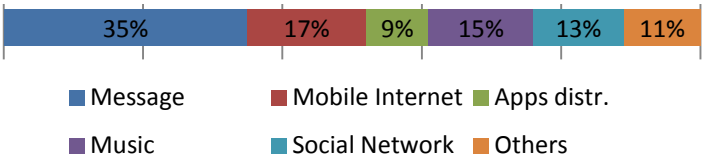
9. How will you rate the connectivity to the Internet from your mobile phone?



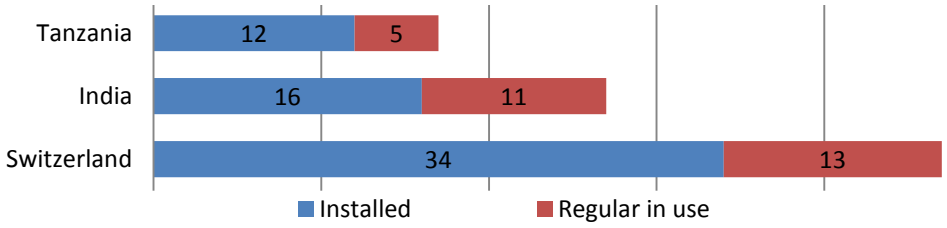
10. How much data volume and time do you spend on mobile Internet services per month from cell phone?

    Answer: Switzerland - 1 GB, India - 400 MB and Tanzania - 350 MB

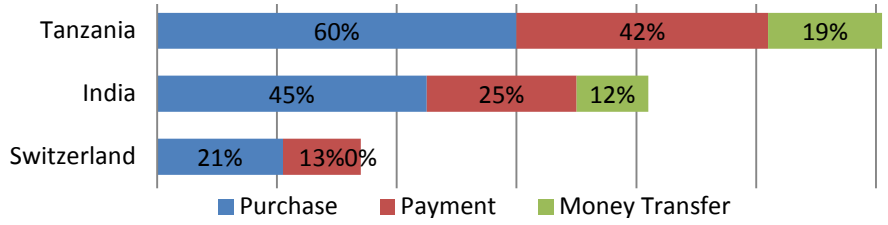
11. Which are kinds of most activities have you done in the last 3 months on your Smartphone?



12. How many Apps are installed in your Smartphone, and how many you regularly use?



13. How do you use your mobile devices for purchase, payment and money transfer?



Comment questions

14. What are the main reasons you would buy your next mobile device or a Smartphone?

15. Mobile carriers are adjusting mobile data plans by offering tiered pricing plans (price based on usage) along with unlimited data plans (which typically cost more). What is your verdict in this?

16. Over the next two years, how do you anticipate the importance of the Smartphones and mobile Internet usage?

17. Suppose that technology allows you to download movies from iTunes for watching later, but you need to make these download requests in advance. Will you use this service?

18. How would you prefer Apps that fetch and store data for an offline usage such as browsing with no Internet access? What about data sharing with other users?

Appendix C

Mobile Operator's Website Portals

1. www.swisscom.ch
2. www.sunrise.ch
3. www.orange.ch
4. www.lebara.ch
5. www.orangeclick.ch
6. www.airtel.in
7. www.vodafone.in
8. www.rcom.co.in
9. www.ideacellular.com
10. www.mtsindia.in
11. www.vodacom.co.tz
12. www.africa.airtel.com
13. www.tigo.co.tz
15. www.zantel.co.tz
16. www.smile.co.tz
17. www.sasatel.co.tz
18. www.yallo.ch

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