Chapter 7
The Supply Side of ICT

7.1 Introduction

The data from the university survey presented in Chap. 4 above provides us with the required information that is particularly useful for presenting interesting public-private comparative analysis to examine the supply side of ICT in Sudanese universities from public-private perspectives. This chapter discusses the main results from all the universities' academic teaching staff, support staff and students' perspectives. It provides the empirical analysis and examines from public-private perspective, the research hypotheses on the public-private differential in the supply side of ICT in Sudanese universities as a case of African universities.

This chapter examines the supply of ICT in Sudan. Section 7.1 presents introduction. Section 7.2 explains ICT regulatory framework and ICT market structure in Sudan. Before we go into the empirical analysis, it is appropriate to define the main characteristics of the supply side of ICT at the macro and micro levels in Sudan and to show an indepth analysis from the demand and consumer perspective concerning the supply side of ICT, methods and places of connection to ICT in Sect. 7.3. Next, we explain the difficulties on the supply and demand sides in Sect. 7.4. We explain the suggestions for relevant solutions on the supply and demand sides in Sect. 7.5 and Sect. 7.6 provides the conclusions.

S. Mohamed Nour, *Information and Communication Technology in Sudan*,
Contributions to Economics, DOI 10.1007/978-3-319-13999-9_7

7.2 Overview of ICT Regulatory Framework and ICT Market Structure in Sudan[1]

This section first explains ICT regulatory framework and regulation and then provides overview of ICT market and market structure, mainly the level of competition and the market shares in ICT market in Sudan.

7.2.1 ICT Regulatory Framework and Regulation in Sudan

As for regulatory framework and regulation, the Ministry of Information and Communication manages the National Telecom Corporation (NTC) and Sudan Academy for Communications Sciences. NTC is responsible for regulating the telecommunications market, and the IT market. NTC was formed in September 1996 to provide an effective regulatory framework and adequate safeguards to ensure fair competition and protection of consumers' interests.[2]

Concerning regional initiatives, NTC is the responsible entity for broadband access networks, open-source software, Arabic digital content and cybersecurity. Regarding, broadband access networks, currently, there are three commercial broadband technologies in Sudan; one fixed (wired)-broadband technology (DSL), and two wireless-broadband technologies (UMTS/HSPA and CDMA 1xEVDO). DSL has been deployed by Sudatel and Canar, while MTN and Zain have deployed 3G networks. MTN Sudan launched its 3G/3.5G services in 2007, followed by Zain Sudan and Sudatel in 2009.[3]

Regarding Arabic digital content, NTC is promoting the creation of e-government websites and donated 800 computers to the different governorates of Sudan. The objective is to establish data centers in order to ensure the governorates are connected to the National Information Center.[4] As for the support of Arabic domain names, this has not been officially addressed by Sudan's IT regulator or local online service providers in the private sector. Information on the top 20 most visited online web portals by Internet users in Sudan, implies that the adoption of Arabic online

[1] Data and information in this section and this chapter refer to the situation in Sudan before the independence of South Sudan in July 2011. This section is obtained from International Telecommunication Union (ITU) (2012) "ICT Adoption and Prospects in the Arab Region," International Telecommunication Union, 2012, Geneva, Switzerland. Section II—Country level analysis of ICT regulations, adoption and project—Sudan: pp. 107–111.

[2] See www.ntc.gov.sd

[3] See Arab Advisors Group (2011c): Arab Advisors Group (2011c), 'LTE & 3G/3.5G Cellular Services in the Arab World', December 2011.

[4] See http://ntc.gov.sd/index.php?n=b3B0aW9uPWNvbV9jb250ZW50JnZpZXc9YXJ0aWNsZSZpZD0yMyZJdGVtaWQ9MzAmbG FuZz11aw%3D%3D

content remains behind the adoption of content offered by global websites, such as Google, Youtube and Facebook.

7.2.2 ICT Market Structure: Level of Competition and Market Shares in ICT Market in Sudan

This section provides overview of ICT market structure, mainly the level of competition and the market shares in ICT market in Sudan.

7.2.2.1 ICT Market Structure: Level of Competition in ICT Market in Sudan

The main characteristics of ICT market structure defined by the level of competition of ICT in Sudan and the Arab States implies that the market structure in Sudan is characterized by partial competition that is dominant for local services, domestic fixed long distance, international fixed long distance, DSL, VSAT, Leased lines, Fixed Wireless Broadband, Mobile Fixed sat, Mobile sat, IMT 2000 and International gateways, whereas, market structure is characterized by full competition only for Internet services (see Table 7.1).

7.2.2.2 ICT Market Structure: The Market Shares in ICT Market in Sudan

Concerning the market shares in ICT market in Sudan, we find that the structure of ICT market implies that for fixed-telephone market, by December 2011, Sudatel and Canar were the only fixed-telephone operators. Sudatel, established in 1993, Sudatel's monopoly of fixed services ended as Canar began its operations in April 2005. Both operators provide fixed voice through PSTN technology.[5] By end 2010, there were about 375,000 fixed-telephone subscriptions in Sudan, translating into a penetration rate of 0.9 %. As for mobile-cellular market, strong competition exists between the three mobile-cellular operators: Zain, Sudatel (Sudani) and MTN (Areeba). By end of 2010, total mobile-cellular subscriptions were about 17.6 million, translating into a penetration rate of 40.5 %. During the first 6 months of 2011, mobile-cellular subscriptions increased by 0.54 %, as 4,428 subscriptions were added. By end of June 2011, Sudan's total mobile-cellular subscriptions stood at just over 22 million, translating into a penetration rate of 50.1 %. As for broadband Internet market, by end of 2010, there were about 165,000 fixed

[5] See www.canar.sd/canar-profile.html

Table 7.1 Structure of ICT market defined by level of competition in Sudan and the Arab States

Country	Local services	Domestic fixed long dist	International fixed long dist	Wireless local loop	Data	DSL	Cable modem	VSAT	Leased lines	Fixed wireless broadband	Mobile	Cable TV	Fixed sat	Mobile sat	GMPCS	IMT 2000	Internet services	International gateways
Algeria[a]	P	P	P	P	C	C	…	P	C	P	P	…	…	…	P	…	C	P
Bahrain[b]	C	C	C	…	…	C	…	…	C	C	P	…	C	…	…	…	C	C
	2004	2004	2004			2004			2004	2007	2003		2004				2004	2004
Comoros[a]	M	M	M	M	M	M	M	M	M	…	M	…	…	…	…	…	M	M
Djibouti[a]	M	M	M	M	M	M	M	M	M	M	M	M	M	M	…	M	M	M
Egypt[b]	P	P	P	…	…	C	…	C	…	C	C	…	…	…	…	C	C	P
Iraq[a]	M	M	…	P	…	M	M	P	M	P	P	…	…	…	…	…	P	M
Jordan[a]	C	C	C	C	C	C	C	C	C	C	P	C	C	C	C	…	C	C
	2005	2005	2005	2005			2005	2005		2005	1999		2005					2005
Kuwait[a]	M	…	M	…	P	…	…	M	M	M	M	P	M	M	M	…	P	M
	M	…	M	M	…	P	…	…	M	P	M	P	…	…	…	…	C	M
Lebanon[b]						2007				1998							1995	
Libya[a]	M	M	M	…	…	…	…	…	M	…	M	…	M	M	…	…	…	…
	C	C	C	C	C	C	C	C	C	…	C	…	C	C	C	C	C	C
Mauritania[a]	2006	2004	2004	2000	2004	2004	2004	2000	2000		2000		2004	2002	2002	2006	2006	2000
	C	C	C	C	…	C	…	C	C	…	C	…	C	C	…	C	C	C
Morocco[b]	2005	2005	2005			2003		2001	2001		1999		2000	2000		2006		
	C	C	C	C	…	C	…	C	C	C	P	…	C	C	…	P	C	C
Oman[b]	2009	2009	2009	2009		2009		2003	2009	2003	2005		2003	2003		2005	2009	2009
	P	P	P	P	…	P	…	P	P	P	P	M	…	…	…	P	P	P
Qatar[b]	2010	2010	2010	2010		2010		2010	2010	2010	2008					2008	2010	
	C	C	C	C	…	C	…	C	C	C	C	…	C	C	…	C	C	C
Saudi Arabia[b]	2009					2009		2006		2009	2004			2006		2009	2004	

Somalia[a]	C	C	C	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Sudan[b]	P	P	P	P	…	P	…	P	P	P	P	…	P	P	…	P	C	P
	M	M	M	M	…	P	…	M	M	P	P	…	M	…	…	P	P	M
Syria[b]						2003					2000					2009		
	M	M	C	M	…	M	…	C	C	C	C	…	…	C	…	M	C	P
Tunisia								2004	2002	2009	2010			2002			2009	
United Arab Emirates[b]	P	P	P	…	…	P	P	P	P	P	P	P	P	C	…	P	P	P
	2007	2007	2007			2007	2007	2007	2007	2007	2007		2007			2007	2007	
Yemen[a]	M	M	M	…	M	M	…	M	M	…	C	…	M	…	C	…	C	M

Source ITU World Telecommunication Regulatory Database

Note This table reflects what is legally permissible; therefore it may not reflect the actual number of operators in the market

Date: year when partial or full competition was introduced

M Monopoly, *P* Partial competition, *C* Full competition, . . . Not available

[a]2013 data

[b]Pre-2013 data

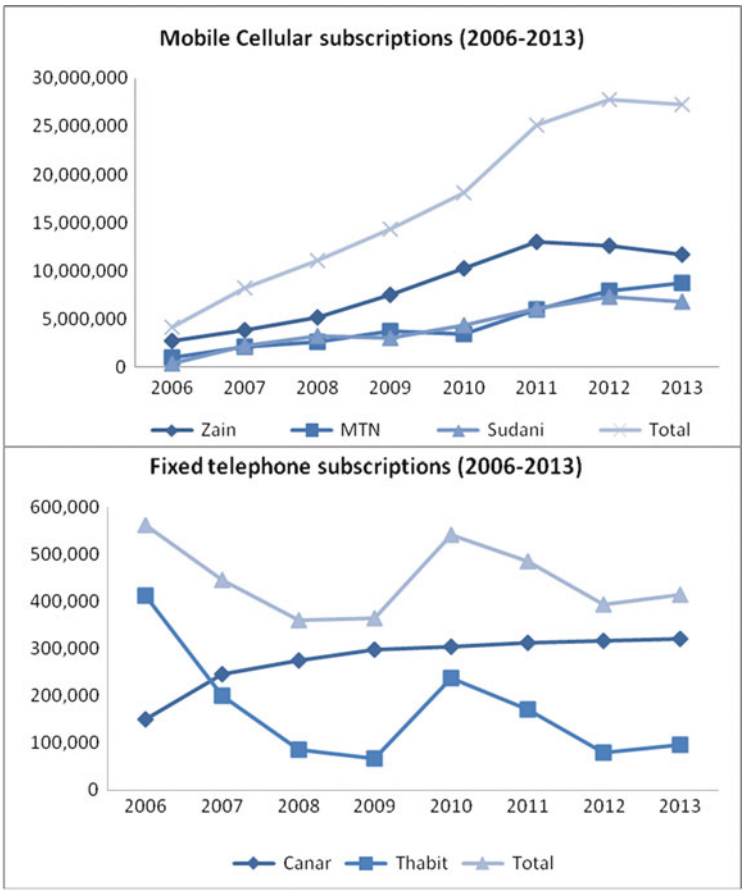

Fig. 7.1 (continued)

(wired)-broadband Internet subscriptions, translating into a penetration rate of 0.40 %.[6]

Core ICT indicators, mainly fixed telephone and mobile cellular subscriptions over the period (2006–2013) implies remarkable dynamic evolution as can be seen from the significant growth in mobile cellular subscriptions compared to significant reduction in fixed telephone subscriptions (see Fig. 7.1). There is similar remarkable dynamic evolution in market structure as can be seen from the significant structural change in terms of the share of the ICT services supplier companies (see Fig. 7.1). For instance, the share of fixed telephone supplier companies implies significant reduction in the share of Thabit Company from 73 % in 2006 to 44 % in 2010 and to 23 % in 2013, compared to significant growth in the share of Canar

[6] See ITU estimates and Arab Advisors Group.

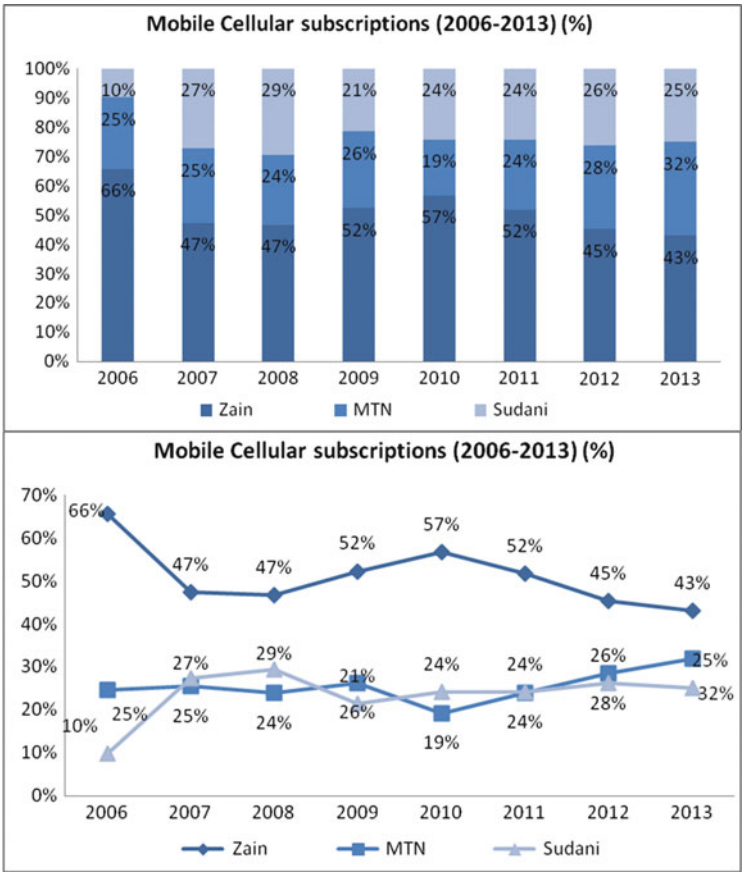

Fig. 7.1 (continued)

Company from 27 % in 2006 to 56 % in 2010 and to 77 % in 2013. Over the period 2006–2013, the dominance in fixed telephone market shifted from Thabit Company to Canar Company (see Fig. 6.1). Moreover, the share of mobile cellular supplier companies implies significant reduction in the share of Zain Company from 66 % in 2006 to 57 % in 2010 to 43 % in 2013, compared to significant growth in the share of Sudani Company from 10 % in 2006 to 24 % in 2010 and to 25 % in 2013, while the share of MTN company declined from 25 % in 2006 to 19 % in 2010, then increased to 32 % in 2013. Over the period 2006–2013, despite reduction in the share Zain Company and growth in the share of the competing companies MTN and Sudani, mobile cellular market, continued to be dominated by Zain Company (see Fig. 7.1).

In addition the dynamic evolution can be seen also from the slight improvement in terms of telecommunication networks coverage of the land area that increased from 34 to 36.2 % and the corresponding slight improvement in terms of the

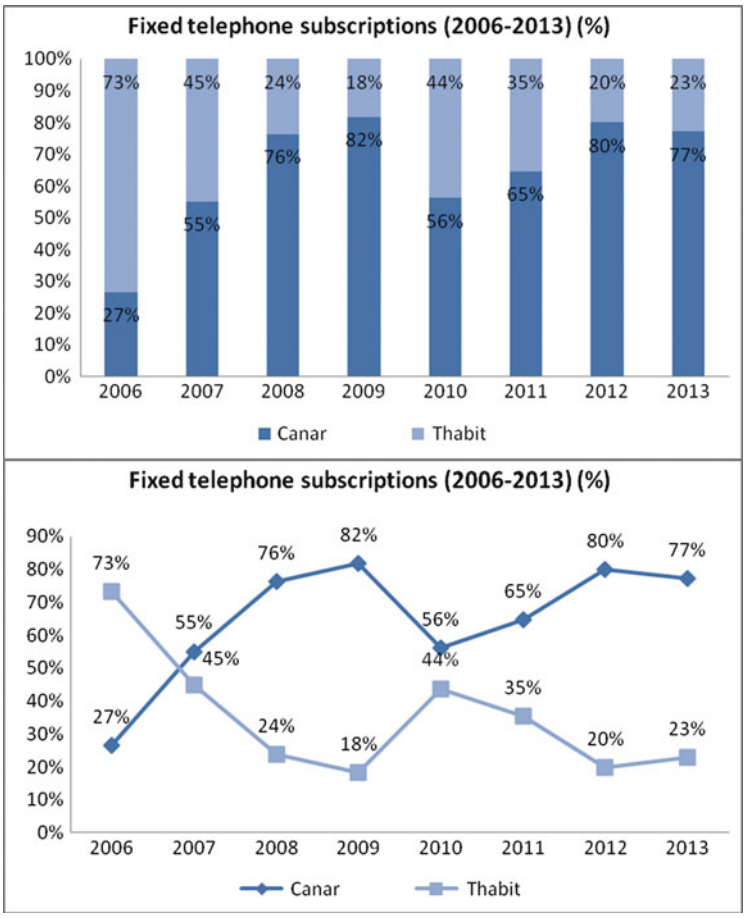

Fig. 7.1 Core ICT indicators- fixed telephone and mobile cellular subscriptions 2006–2013 (*Source* Adapted from National Telecommunication Corporation (NTC) (2012–2013) See National Telecommunication Corporation (NTC): http://www.ntc.gov.sd. Accessed on August 09, 2014)

percentage of the population covered that increased from 88 to 88.4 % over the period 2012–2013 (see Fig. 7.2).

Furthermore, the dynamic evolution can be seen also from the slight improvement in Short Messages Service (SMS), which implies the minor growth in the share of local SMS from 96 % in 2012 to 97 % in 2013 and the slight reduction in the share of international outgoing SMS from 4 % in 2012 to 3 % in 2013 (see Fig. 7.3). Over the period 2012–2013, traffic implies minor growth in the share of local traffic (off net) from 67 % in 2012 to 71 % in 2013, minor growth in the share of international outgoing traffic from 7 % in 2012 to 8 % in 2013 and the slight reduction in the share of international incoming traffic from 25 % in 2012 to 20 % in 2013 (see Fig. 7.3). Over the period 2012–2013, the highest growth rate was

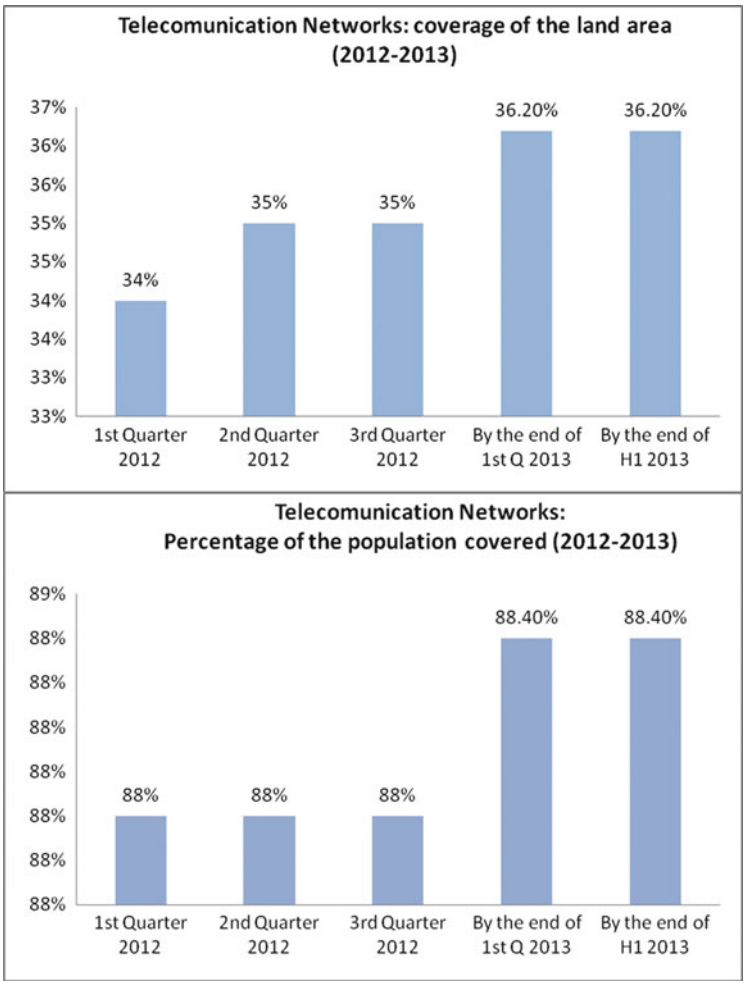

Fig. 7.2 Telecommunication networks: coverage of the land and percentage of the population covered 2012–2013 (*Source* Adapted from National Telecommunication Corporation (NTC) (2012–2013) See National Telecommunication Corporation (NTC): http://www.ntc.gov.sd. Accessed on August 09, 2014)

reported for international outgoing traffic (0.287), followed by local traffic (off net) (0.259) and international incoming traffic (0.038) respectively. In 2012 the short messages service (local SMS) was offered mainly by Zain (56.30 %), followed by MTN (17.40 %) and Sudani (26.30 %) respectively, but in 2013 was mainly offered by Sudani (47 %), followed by Zain (33 %) and MTN (19 %) (see Fig. 7.3). In 2012–2013 the short messages service (international outgoing SMS) was offered mainly by Zain (83 %; 64.40 %), followed by Sudani (15 %; 21.30 %)) and MTN (2 %; 14.30 %) in 2012 and 2013 respectively (see Fig. 6.3). In 2012–2013 the short messages service implies major share of local SMS compared to minor share of

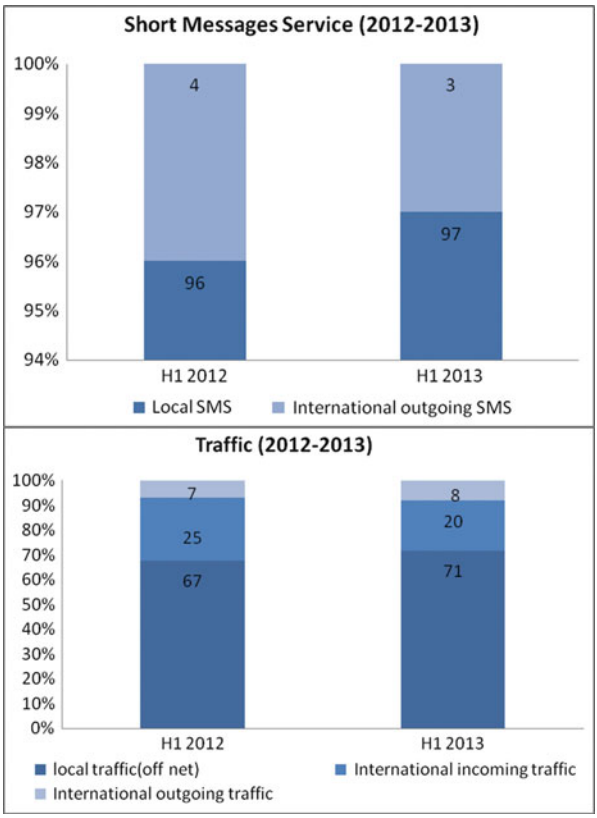

Fig. 7.3 (continued)

international outgoing SMS for all companies (96 %, 97 %) and (4 %, 3 %), particularly, for Sudani (97 %, 99 %) and (1 %, 4 %), followed by MTN (100 %, 98 %) and (0 %, 2 %), and Zain (95 %, 95 %) and (5 %, 5 %), in 2012 and 2013 respectively (see Fig. 7.3).

7.3 Characteristics of the Supply Side of ICT at Macro–Micro Levels in Sudan

This section is explains the main characteristics of the supply side of ICT at the macro and micro levels in Sudan. We begin by the characteristics at the macro and then micro levels.

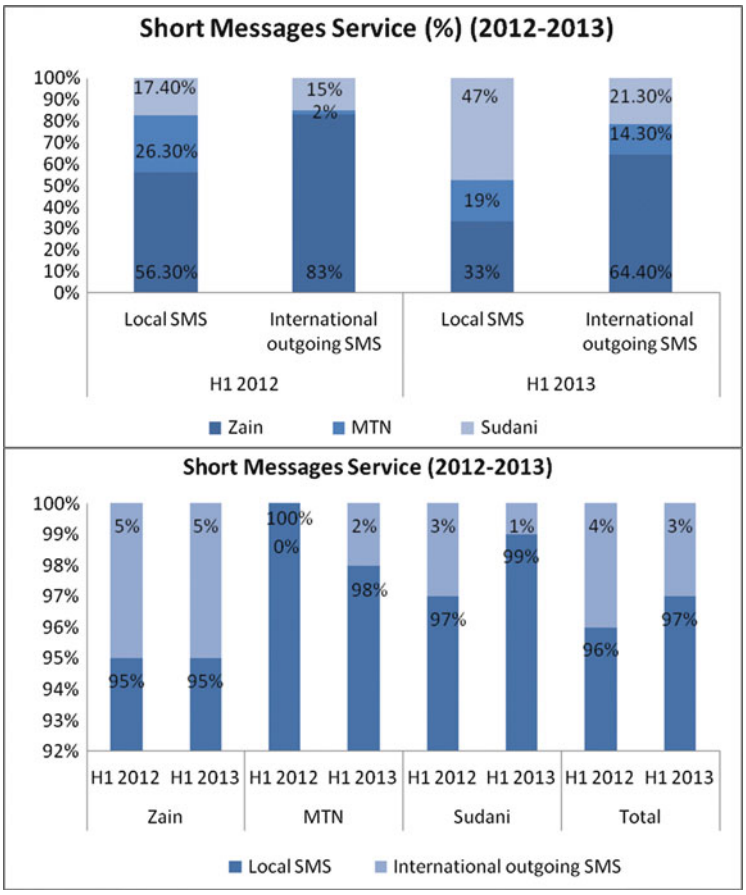

Fig. 7.3 Short messages service (SMS) and traffic 2012–2013 (*Source* Adapted from National Telecommunication Corporation (NTC) (2012–2013) See National Telecommunication Corporation (NTC): http://www.ntc.gov.sd. Accessed on August 09, 2014)

7.3.1 Characteristics of the Supply Side of ICT at the Macro Level in Sudan

This section is based on the paper presented for the National Telecom Corporation (2007) NTC Workshop on Internet Issues 19 July, 2007.

In Sudan, ICT services are mainly supported and provided through the three channels of National Telecommunication Corporation (NTC), Network Operators and Internet Service Providers (ISP). The National Telecommunication Corporation (NTC) is the regulatory authority of Information and Communication Technology in Sudan; it assumes the responsibility of promoting Internet services and regulates the relationships between the operators, service providers and stakeholders. The ISP together with the network operators are the essential providers

of the infrastructure upon which the service provision is effected; they assume the genuine role of sector promotion and provision of connectivity to global backbone.[7,8] In particular, the NTC attempts to enhance the promotion of ICT supply and to support IT as can be seen from its policies including: offering a computer for each family; distributing 50,000 computers as a first stage; supporting E-government projects; focusing on ICT in universities and schools (providing 1,480 computers for universities and 750 computers for Sudanese States. In addition it: provides 7 student housing complexes with 232 computers; is launching Universal Service centres at a rate of 5 centres for each state beside special centres for women and religious schools (khalwas), totalling 100 centres with devices distributed to 47; set up 500 labs in secondary schools, with 300 devices ready to be distributed; increased the capacity of the Council of Ministers' network to 4 mb/s and work is progressing to upgrade universities' networks from 512 kb/s to 1 mb/s (6 universities are ready). [9] According to Zain (2007), the Sudanese state created the National Center for Information, the E-government project and customs duty exemption for computers and related material in order to comply with the international attention manifest in the United Nations and other international organisations focused on bridging the digital divide and spreading the culture of informatics.[10]

The Sudanese Telecommunication Company Limited (Sudatel) is a public shareholding company and one of the major telecommunications companies in Africa and the Arab world. Sudatel, a network operator and service provider, is offering and developing telecommunication services and information transfer in Sudan. The company was founded in 1993, following the state's decision to privatise the telecommunications sector in Sudan. Sudatel's developed infrastructure in different fields of communications technology is currently considered the backbone of other communications companies. Sudatel's objectives include: spreading information and communication services to all parts of Sudan with the latest technologies and cost-based prices; supporting Sudan's development programme requirements; utilising advanced techniques to increase coverage, upgrade networks operational efficiency and building capable human resources capacities and uphold the company's continual success; fulfil shareholders' objectives and sustain the company's ability to compete globally and to become a regional carrier for Africa and the Arab world. Sudatel offers different types of Internet service including via the fixed network, via the wireless network, Internet Data network, leased lines and Internet broadband services. The technologies used

[7] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

[8] In addition to the NTC, the operators companies and the ISP, other main partners of Internet governance in Sudan are the National Information Center, the Sudanese Internet Society, the Internet clubs, the educational institutions, the public, the Intellectual Property Authority and civil society organisations. See Abu-Al-Fedl Mokhtar (2007) 'Internet Management in Sudan', Ministry of the Cabinet Affairs, National Information Center, NTC Workshop on Internet Issues, 19 July 2007.

[9] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

[10] See Zain (2007) 'Zain Presentation for NTC Workshop ISP/ASP/SMS/IVR', NTC Workshop on Internet Issues, 19 July 2007.

to provide Internet services enable the subscriber to choose from the available options of technologies according to the required speed and future need. The main characteristics of the Internet service are linking individuals and corporate entities to information centres and performing e-commerce applications though virtual networks (VPN), providing databases of all fields and linking individuals in-home and abroad. The basic infrastructure for information interchange includes major world entertainment sources such as data cloud services that connects local computer networks (LANs) inside Sudan (networks of ministries, government entities, banks, private enterprises, educational institutions and individuals) in order to attain a Wide Area Network (WAN). The service includes nearly all customers with different operating systems. Leased Lines is a dedicated connection between two separated points with high speed ranging between 64 kb/s and 2 Mb/s; customer premises' equipment is normally a router that directs traffic to and from the network and it is normally programmed by the company's engineers to be able to interconnect with the other destinations. Asymmetrical Digital Subscriber Line (ADSL) is a broadband access service that reaches about 60-fold the dial-up modem speed; it is a safe service and compatible with data, voice and video traffic.[11] In 2004, Sudatel introduced broadband service via DSL technology over telephone lines. According to the UNDP/NIC e-readiness report in 2005, the Internet broadband users in Sudan were 2,500, which is considered a meagre proportion. Broadband Internet service is normally provided via landlines due to its expandability, reliability and high quality. Nevertheless, telecommunication service in Sudan started lately to forgo landlines and introduce wireless networks.[12]

In addition to Sudatel, during 1997 the Sudanese Company for Internet service (SUDNET) began its work as the first ISP in Sudan via telephone system (Dial-Up Access).[13] As a result of the rising number of subscribers to the service, who numbered 2,283 subscribers in 2000, the company gradually increased the capacities of the Internet available for use. Then the Integrated Services Digital Network (ISDN) for subscriber access was introduced in 2001 to enhance the efficiency of Copper network and thus the common use and speed up of the telephone lines such as telephone (voice, fax, data). In line with the advancing development in communications and information technology, broadband technology was utilised to optimise the use of networks and the frequency spectrum. Enhanced Voice-Data Optimized or Enhanced Voice-Data Only (EVDO) and Digital Subscriber Line (DSL) service were then introduced. Then the infrastructure of communications was developed in Sudan to include the Fiber Optic National Backbone Network that

[11] See Almuneer Taha Elkabashi (2007) 'Introduction and Enhancement of Internet Services in Sudan The Role of Sudatel', NTC Workshop on Internet Issues, 19 July 2007.

[12] See Mohammed Al Bashier Ahmed (2007) 'Development of Internet services in Sudan Challenges and Prospects', Sudanese Internet Society, NTC Workshop on Internet Issues, 19 July 2007.

[13] All ISP in Sudan provide the dial-up service which started in 1997 by Sudanet. The service started in Khartoum then extended piecemeal to other cities. See Mohammed Al Bashier Ahmed (2007) 'Development of Internet services in Sudan Challenges and Prospects', Sudanese Internet Society, NTC Workshop on Internet Issues, 19 July 2007.

covers most of the country's area. In addition to digital exchange networks, there are subscriber access networks via copper cables, wireless and fibre-optic with multi-techniques. Sudan is linked to two global optical cable networks through the international gateways fibre-optic land system to Egypt and via a submarine fibre-optic gateway to Saudi Arabia (SAS) and hence to the international networks via the Red Sea through the Port Sudan—Jeddah (SAS) system; the submarine fibre-optic gateway from Port Sudan then links to the international FLAG cable system. Sudan is also linked to Intelsat satellite via Um Haraz for international communications. As a result of building this infrastructure, the Internet service speed for users in Sudan has developed and is now available via the following technologies: dial-up; frame relay; EVDO; DSL; and Wi-Max (World Interoperability for Microwave Access). After liberation of international gateways there is now more than one source of Internet (Sudatel and Canar) via submarine cables to feed ISP.

The increase in the demand for ICT motivated the recent movement towards privatisation and competition since 2000.[14] For instance, 2005 was marked by the entry of new companies into the telecommunications market in Sudan, such as Areeba and Canar, in addition to the existing companies Mobitel and Sudatel. Sudatel is considered the pioneer in the modernisation and development of telecommunications in Sudan. The cooperation between other ISP with Sudatel has contributed effectively in spreading the technical and scientific awareness and culture of information. Large sums of money had been invested at the beginning, where big investment and strenuous efforts were secured to perform their mission. That investment was not just for easy return but to educate the citizens and develop the country to gain national advantage and avail opportunities for Sudanese graduates. Zain (2007) started with the objective of providing developed Internet services and integrated solutions for the corporate market. The current services provided by Zinanet beside the Internet include: registration and hosting of websites; website design; short messages service; interactive voice service; network solutions; and security and software solutions. [15]

Since 2000, the NTC encouraged competition in the domain of Internet services by preparing a guidebook for license applications and offering licenses to the public, for instance, in 2007, the number of licensed parties reached 22 ISP, including 18dial-up and 4 wireless. Monitoring Internet services usage shows that the overall monthly traffic ranges from 30 million minutes to 35 million minutes per month divided among dial-up service providers according to market share of each in the competitive market. To provide Internet service to the subscribers at affordable prices with freedom of choice of ISP, the NTC has reduced the tariff of ISP to 3 Dinars per minute—lower than telephone calls. The NTC secured DSL connectivity to the ISP's through Sudatel network via leased lines.[16]

[14] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

[15] See Zain (2007) 'Zain Presentation for NTC Workshop ISP/ASP/SMS/IVR', NTC Workshop on Internet Issues, 19 July 2007.

[16] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

As a result of the development of the telecommunications market in Sudan and the multi-operator environment, plus the introduction of the mobile telephone service, the number of subscribers in the fixed telephone service has dropped and consequently so has the usage of the system. That reduced further Internet access via the dial-up through ISP. In addition, the advanced technology of wireless Internet such as General packet radio service (GPRS) and Code division multiple access (CDMA), in addition to high speed land line technologies ADSL and High-bit-rate Digital Subscriber Line (HDSL), provided multiple options for customers. That led to the reduction of dial-up service uptake due to its inherent demerit. Moreover, the technical problems of underground copper networks, problems such as underground and overhead faults, cable cuts and the weather-induced problems due to storms, heavy rains and very high temperatures, are some of the main reasons that led to the reduction of dial-up usage and the rise of the other advanced alternatives.[17]

Furthermore, the changing circumstances had influenced the performance of these ICT companies due to high prices of capacities and other basic services with low returns. That was an inevitable result of clients shifting towards 'broadband DSL and Wireless Technologies' at lower prices and constituted heavy burden on these companies. As a result, the working ISP companies are decreasing from 17 companies day after day. For those who managed to survive the crunch, they still suffer high expenditure for continuation (cost of survival). Despite their undisputed pioneering role, due to operators' monopoly of Internet access service and the inadequacy of the wired underground network, customers resorted to wireless access that led to decrease in dial-up use and a decline in financial returns to beyond 56 %.[18]

Therefore, the above results imply that in recent years, there is visible structural change in the supply and in preference of means of connection to the Internet as can be seen from the growth in ADSL and decline of dial-up and drop of fixed telephone service subscribers. This structural change can be attributed to the above-mentioned four reasons.

7.3.2 Characteristics of the Supply Side of ICT at the Micro Level in Sudan

Regarding the supplier companies, our results from the University Survey (2009) at the micro level are consistent with the macro level. For instance, our results at the micro level indicate that from the demand perspective, the respondents reported

[17] See Almuneer Taha Elkabashi (2007) 'Introduction and Enhancement of Internet Services in Sudan The Role of Sudatel', NTC Workshop on Internet Issues, 19 July 2007.

[18] See Zain (2007) 'Zain Presentation for NTC Workshop ISP/ASP/SMS/IVR', NTC Workshop on Internet Issues, 19 July 2007.

different preferences for depending on many sources of ICT supplier companies offering ICT services; this includes for example, Areeba MTN, Canar, Sudani, Sudate and Zain. For instance, from all the respondents' perspective, for all staff the main suppliers companies offering fixed telephone are Sudatel (42 %), followed by Canar (23 %), Sudani (10 %) and Zain (6 %). The main supplier companies offering mobile telephone are Zain (68 %), followed by Sudani (23 %) and Areeba MTN (15 %). The main supplier companies offering Internet services are Sudatel (28 %), followed by Sudani (25 %), Zain (19 %), Canar (16 %) and other (4 %).

From the public staff's perspective, the main supplier companies offering the services fixed telephone are Sudatel (34 %), followed by Canar (25 %), Sudani (9 %) and Zain (8 %). The main supplier companies offering mobile telephone are Zain (67 %), followed by Sudani (23 %), Areeba MTN (16 %), Canar (13 %) and Sudatel (2 %). The main supplier companies offering Internet services are Sudatel (25 %), followed by Sudani (25 %), Zain (22 %), Canar (13 %) and other (5 %).

From the private staff's perspective, the main supplier companies offering fixed telephone are Sudatel (71 %), followed by Zain (24 %), Canar (18 %) and Sudani (12 %). The main supplier companies offering mobile telephone are Zain (71 %), followed by Sudani (24 %), and Areeba MTN (12 %) and Sudatel (12 %). The main supplier companies offering the Internet services are Sudatel (41 %), followed by Canar (29 %), Sudani (24 %) and Zain (6 %).

From the students' perspective the main supplier companies offering fixed telephone are Sudatel (38 %), followed by Canar (38 %) and Sudani (19 %). The main supplier companies offering mobile telephone are Zain (62 %), followed by Canar (23 %), Sudani (15 %), Sudatel (12 %) and Areeba MTN (8 %). The main supplier companies offering Internet services are Sudani (38 %), followed by Sudatel (19 %), Zain (15 %), Canar (23 %) and other (4 %).

From the support staff's perspective the main supplier companies offering fixed telephone are Sudatel (60 %), followed by Canar (40 %) and Sudani (20 %). The main suppliers companies offering mobile telephone are Zain (60 %), followed by Sudani (20 %) and Areeba MTN (20 %). The main supplier companies offering Internet services are Canar (60 %), followed by Sudatel (20 %), Sudani (20 %) and other (4 %) (see Table 7.2).

From the demand perspective the selection and preferences of the supplying companies is related to preferences of some specific characteristics characterising the different supplying companies offering ICT services; these include fashion, style, good design, efficiency and high quality, ease of use, cheap price and price discrimination. For instance, from all the respondents' perspective in terms of the characteristics of fashion, style and good design, the supplier companies are ranked as follows: Zain (28 %), followed by Sudani (11 %), Sudatel (5 %), Canar (4 %) and Areeba MTN (1 %). In terms of the characteristic of cheap price, Sudani (31 %) is followed by Zain (25 %), Canar (15 %), Sudatel (14 %) and Areeba MTN (11 %). In terms of the characteristic of ease of use, Zain (30 %) is followed by Sudani (21 %), Canar (12 %), Sudatel (12 %) and Areeba MTN (5 %). In terms of the characteristics of efficiency and high quality, Zain (57 %) is followed by Sudani (21 %), Sudatel (16 %), Canar (11 %) and Areeba MTN (10 %). In terms of the

Table 7.2 Assessment of preferences of specific characteristics related to ICT supplier companies offering ICT services

	Sudatel (%)	Sudani (%)	Areeba MTN (%)	Zain (%)	Canar (%)	Others (%)
a. Preferences of the company offering ICT services: fixed telephone, mobile telephone and Internet						
All staff						
Fixed telephone	42	10		6	23	
Mobile telephone	0	23	15	68		
Internet	28	25		19	16	90
Public staff						
Fixed telephone	34	9		8	25	
Mobile telephone	2	23	16	67	13	88
Internet	25	25		22		
Private staff						
Fixed telephone	71	12		24	18	
Mobile telephone	12	24	12	71		
Internet	41	24		6	29	100
Students						
Fixed telephone	38	19			38	
Mobile telephone	12	15	8	62	23	
Internet	19	38		15		100
Support staff						
Fixed telephone	60	20			40	
Mobile telephone		40	20	60		
Internet	20	20		38	60	100
b. Assessment of the importance of characteristics related to ICT for satisfaction of personal need/utility						
Distinguished characteristics	Sudatel	Sudani	Areeba MTN	Zain	Canar	Others
All staff						
Fashion, style, good design	5	11	1	28	4	
Cheap price	14	31	11	25	15	1
Easy for use	12	21	5	30	12	1
Efficiency and high quality	16	21	10	57	11	1
Price discrimination	10	28	19	37	12	
Public staff						
Fashion, style, good design	5	9	2	30	3	
Cheap price	13	31	13	25	16	2
Easy for use	14	20	5	30	11	2
Efficiency and high quality	17	23	13	58	13	2
Price discrimination	9	30	22	34	14	

(continued)

Table 7.2 (continued)

	Sudatel (%)	Sudani (%)	Areeba MTN (%)	Zain (%)	Canar (%)	Others (%)
Private staff						
Fashion, style, good design	6	18	0	24	6	
Cheap price	18	29	6	24	12	0
Easy for use	6	24	6	29	18	0
Efficiency and high quality	12	12	0	53	6	0
Price discrimination	12	24	6	47	6	
Students						
Fashion, style, good design	0	15	4	50	12	
Cheap price	8	23	8	27	23	0
Easy for use	12	8	8	42	12	0
Efficiency and high quality	0	23	8	65	23	0
Price discrimination	4	31	15	42	15	
Support staff						
Fashion, style, good design	0	0	0	0	20	0
Cheap price	0	40	0	20	20	0
Easy for use	0	0	0	20	0	0
Efficiency and high quality	20	60	20	40	20	0
Price discrimination	20	40	20	60	40	0

characteristic of price discrimination, Zain (37 %) is followed by Sudani (28 %), Areeba MTN (19 %), Canar (12 %) and Sudatel (10 %).

From the public staff's perspective, in terms of the characteristics of fashion, style, good design, the suppliers companies are ranked as follows: Zain (30 %), followed by Sudani (9 %), Sudatel (5 %), Canar (3 %) and Areeba MTN (2 %). In terms of the characteristic of cheap price, Sudani (31 %) is followed by Zain (25 %), Canar (16 %), Sudatel (13 %) and Areeba MTN (13 %). In terms of the characteristic of ease of use, Zain (30 %) is followed by Sudani (20 %), Sudatel (14 %), Canar (11 %) and Areeba MTN (5 %). In terms of the characteristics of efficiency and high quality, Zain (58 %) is followed by Sudani (23 %), Sudatel (17 %), Canar (13 %) and Areeba MTN (13 %). In terms of the characteristic of price discrimination, Zain (34 %) is followed by Sudani (30 %), Areeba MTN (22 %), Canar (14 %) and Sudatel (9 %).

From the private staff's perspective, in terms of the characteristics of fashion, style, good design, the companies are ranked as follows: Zain (24 %) followed by Sudani (18 %), Sudatel (6 %) and Canar (6 %). In terms of the characteristic of cheap price, Sudani (29 %) is followed by Zain (24 %), Sudatel (18 %), Canar

(12 %) and Areeba MTN (0 %). In terms of the characteristic of ease of use, Zain (29 %) is followed by Sudani (24 %), Canar (18 %), Sudatel (6 %) and Areeba MTN (6 %). In terms of the characteristics of efficiency and high quality, Zain (53 %) is followed by Sudani (12 %), Sudatel (12 %) and Canar (6 %). In terms of the characteristic of price discrimination, Zain (47 %) is followed by Sudani (24 %), Sudatel (12 %), Canar (6 %) and Areeba MTN (6 %).

From the students' perspective, in terms of the characteristics of fashion, style, good design, the companies are ranked as follows: Zain (50 %) followed by Sudani (15 %), Canar (12 %) and Areeba MTN (4 %). In terms of the characteristic of cheap price, Zain (27 %) is followed by Sudani (23 %), Canar (23 %), Sudatel (8 %) and Areeba MTN (8 %). In terms of the characteristic of ease of use, Zain (42 %) is followed by Canar (12 %), Sudatel (12 %), Sudani (8 %) and Areeba MTN (8 %). In terms of the characteristics of efficiency and high quality, Zain (65 %) is followed by Sudani (23 %), Canar (23 %) and Areeba MTN (8 %). In terms of the characteristic of price discrimination, Zain (42 %) is followed by Sudani (31 %), Areeba MTN (15 %), Canar (15 %) and Sudatel (4 %).

From the support staff's perspective in terms of the characteristics of fashion, style, good design, the only preferred company is Canar (20 %). In terms of the characteristic of cheap price, Sudani (40 %) is followed by Zain (20 %), Canar (20 %) and Sudatel (40 %). In terms of the characteristic of ease of use, Zain (20 %) is followed by Canar (20 %). In terms of the characteristics of efficiency and high quality, Sudani (60 %) is followed by Zain (40 %), Sudatel (20 %), Canar (20 %) and Areeba MTN (20 %). In terms of the characteristic of price discrimination, Zain (60 %) is followed by Sudani (40 %), Canar (40 %), Areeba MTN (20 %) and Sudatel (20 %) (see Table 7.2).

From all the respondents' perspective, Sudatel is preferred because of the specific characteristics of efficiency and high quality (16 %), cheap price (14 %), ease of use (12 %), price discrimination (10 %) and fashion, style, good design (5 %). Sudani is preferred because of the specific characteristics of cheap price (31 %), price discrimination (28 %), ease of use (21 %), efficiency and high quality (21 %), and fashion, style, good design (11 %). Areeba MTN is preferred because of the specific characteristics of price discrimination (19 %), cheap price (11 %), efficiency and high quality (10 %), ease of use (5 %), and fashion, style, good design (1 %). Zain is preferred because of the specific characteristics of efficiency and high quality (57 %), price discrimination (37 %), ease of use (30 %), fashion, style, good design (28 %), and cheap price (25 %). Canar is preferred because of the specific characteristics of cheap price (15 %), price discrimination (12 %), ease of use (12 %), efficiency and high quality (11 %), and fashion, style, good design (4 %).

The above findings indicate preference for depending on many sources of ICT supplier companies offering ICT services. From all the respondents' perspective, fixed telephone is mainly supplied by Sudatel and Canar, mobile telephone is mainly supplied by Zain and Sudani, Internet services are mainly offered by Sudatel and Sudani, Zain and Canar. The above results also imply that from all the respondents' perspective, preference amongst ICT suppliers companies indicate

that Zain is the most preferred company and ranks first compared to other companies because of its distinguished characteristics in terms of fashion, style, good design, efficiency and high quality, ease of use and price discrimination. Zain is also ranked second next to Sudani in terms of cheap price.

As for the methods and places of connection to ICT and Internet, our results at the micro level are consistent with the macro level. For instance, our results at the micro level indicate that based on the above findings concerning the importance of the Internet, there are now more than one method for connection to the Internet, and the common ways for connection with the Internet differ according to different means used by different respondents. For instance, from all the staff's perspective, for the majority, the most often widely used and common way for connection with the Internet is through ADSL (78 %), followed by connection by wireless (46 %), fixed telephone (41 %) and others (50 %). From the public staff's perspective, for the majority, the most often widely used and common way for connection with the Internet is through ADSL (74 %) this is followed by connection by fixed telephone (48 %), wireless (41 %), and others (50 %). From the private staff's perspective, for the majority, the most often widely used and common way for connection with the Internet is through ADSL (91 %), this is followed by connection by wireless (62 %), and by fixed telephone (13 %). From the students' perspective, for the majority, the most often widely used and common way for connection with the Internet is through ADSL (62 %) this is followed by connection by fixed telephone (35 %), wireless (28 %), and others (17 %). From the support staff's perspective, for the majority, the most often widely used and common way for connection with the Internet is through ADSL (40 %) followed by connection by wireless (40 %) and fixed telephone (40 %) (see Table 7.3).

The above findings indicate that there are now more than one method for connection to Internet; from all the staff's perspective, for the majority, the most often widely used and common way for connection with the Internet is through ADSL, which is used by more than three quarters of all respondents, this is followed by connection by wireless, which is used by near to half of all respondents and by fixed telephone which is used by more than one third of all respondents and others.

For the majority of all staff, ADSL is often (78 %) or sometimes (12 %) used for connection, fixed telephone is sometimes (41 %) or often (41 %) used for connection, Wireless is often (46 %) or sometimes (42 %) used for connection and finally others means is often (50 %) or sometimes (6 %) used for connection. For the majority of public staff, ADSL is often (74 %) or sometimes (13 %) used for connection, fixed telephone often (48 %) or sometimes (33 %) used for connection, wireless is often (41 %) or sometimes (46 %) used for connection and finally others means is often (50 %) or sometimes (6 %) used for connection. For the majority of private staff, ADSL is often (91 %) or sometimes (9 %) used for connection, fixed telephone is sometimes (75 %) or often (13 %) used for connection, wireless is often (62 %) or sometimes (31 %) used for connection and finally for the majority of private staff, the connection through others means is not reported at all (0 %). For the majority of students, ADSL is often (62 %) or sometimes (19 %) used for connection, fixed telephone is sometimes (45 %) or often (35 %) used for

Table 7.3 Common ways and methods for connection to the Internet

Connection through using	Often	Sometimes	Not at all
All			
of ADSL	78	12	10
of Fixed telephone	41	41	17
of Wireless	46	42	12
Others (specify)	50	6	44
Public			
of ADSL	74	13	13
of Fixed telephone	48	33	18
of Wireless	41	46	14
Others (specify)	50	6	44
Private			
of ADSL	91	9	0
of Fixed telephone	13	75	13
of Wireless	62	31	8
Others (specify)			
Students			
of ADSL	62	19	19
of Fixed telephone	35	45	20
of Wireless	28	50	22
Others (specify)	17	50	33
Support staff			
of ADSL	40	20	20
of Fixed telephone	40	0	0
of Wireless	40	20	0
Others (specify)	0	20	20

connection, wireless is sometimes (50 %) or often (28 %) used for connection, and finally, others means is often (17 %) or sometimes (50 %) used for connection. For the majority of support staff, ADSL is often (40 %) or sometimes (20 %) used for connection, fixed telephone is often (40 %) used for connection, wireless is often (40 %) or sometimes (20 %) used for connection, others means is sometimes (20 %) used for connection (see Table 7.3).

For all staff, there is now more than one place for using ICT; common locations for the use of ICT include home, office and Internet café and telecommunication office. In the home fixed telephone is often (47 %) or sometimes (22 %) used, mobile telephone is often (86 %) or sometimes (8 %) used, computer is often (74 %) or sometimes (24 %) used, Internet is often (61 %) or sometimes (51 %) used. In the office fixed telephone is often (48 %) or sometimes (18 %) used, mobile telephone is often (86 %) or sometimes (14 %) used, computer is often (85 %) or sometimes (14 %) used, Internet is often (80 %) or sometimes (20 %) used. In Internet café and telecommunication offices fixed telephone is sometimes (26 %) or often (3 %) used, mobile telephone is often (21 %) or sometimes (3 %) used, computer is sometimes (24 %) or often (22 %) used, Internet is sometimes (33 %) or often (30 %) used.

As for public staff common locations for the use of ICT include home, office and Internet café and telecommunication offices. In the home fixed telephone is often (45 %) or sometimes (26 %) used, mobile telephone is often (86 %) or sometimes (9 %) used, computer is often (69 %) or sometimes (29 %) used, Internet is often (51 %) or sometimes (30 %) used. In the office fixed telephone is often (39 %) or sometimes (14 %) used, mobile telephone is often (90 %) or sometimes (10 %) used, computer is often (84 %) or sometimes (14 %) used, Internet is often (79 %) or sometimes (21 %) used. In Internet café and telecommunication offices fixed telephone is sometimes (24 %) or often (4 %) used, mobile telephone is often (25 %) or sometimes (4 %) used, computer is often (22 %) or sometimes (22 %) used, Internet is sometimes (37 %) or often (26 %) used.

For private staff common locations for the use of ICT include home, office and Internet café and telecommunication offices. In the home fixed telephone is often (55 %) or sometimes (9 %) used, mobile telephone is often (88 %) used, computer is often (92 %) or sometimes (8 %) used, Internet is often (86 %) or sometimes (14 %) used. In the office fixed telephone is often (67 %) or sometimes (25 %) used, mobile telephone is often (63 %) or sometimes (38 %) used, computer is often (90 %) or sometimes (10 %) used, Internet is often (85 %) or sometimes (15 %) used. In Internet café and telecommunication offices fixed telephone is sometimes (33 %) used, mobile telephone is not at all (100 %) used, computer is sometimes (40 %) or often (20 %) used, Internet is often (50 %) or sometimes (13 %) used.

As for students common locations for the use of ICT includes home, office and Internet café and telecommunication offices. In the home fixed telephone is often (63 %) or sometimes (16 %) used, mobile telephone is often (75 %) or sometimes (19 %) used, computer is often (61 %) or sometimes (39 %) used, Internet is often (67 %) or sometimes (27 %) used. In the office fixed telephone is often (55 %) or sometimes (45 %) used, mobile telephone is often (53 %) or sometimes (33 %) used, computer is often (79 %) or sometimes (14 %) used, Internet is often (67 %) or sometimes (33 %) used. In Internet café and telecommunication offices fixed telephone is often (47 %) or sometimes (7 %) used, mobile telephone is often (42 %) or sometimes (17 %) used, computer is often (50 %) or sometimes (17 %) used, Internet is often (47 %) or sometimes (21 %) used.

For support staff common places for the use of ICT include home, office and Internet café and telecommunication offices. In the home fixed telephone is often (20 %) or sometimes (20 %) used, mobile telephone is often (80 %) or sometimes (20 %) used, computer is often (60 %) or sometimes (40 %) used, Internet is often (60 %) or sometimes (40 %) used. In the office fixed telephone is often (40 %) or sometimes (20 %) used, mobile telephone is often (60 %) or sometimes (20 %) used, computer and Internet are often (100 %) used. In Internet café and telecommunication offices fixed telephone is sometimes (40 %) used, mobile telephone is often (40 %) used, computer and Internet are often (20 %) used (see Table 7.4).

The above results indicate that there are now more than one location for using ICT; from all the respondents' perspective common locations for the use of ICT include home, office and Internet café and telecommunication offices. From all the respondents' perspective in the home and office mobile telephone, computer and

Table 7.4 Common locations for the use of ICT

		Fixed (%)	Mobile (%)	Computer (%)	Internet (%)
All					
Home	Often	47	86	74	61
	Sometimes	22	8	24	25
	Not at all	31	6	2	14
Office	Often	48	86	85	80
	Sometimes	18	14	14	20
	Not at all	35	0	2	0
Internet café/telecommunication office	Often	3	21	22	30
	Sometimes	26	3	24	33
	Not at all	71	76	54	37
Public					
Home	Often	45	86	69	51
	Sometimes	26	9	29	30
	Not at all	29	5	2	19
Office	Often	39	90	84	79
	Sometimes	14	10	14	21
	Not at all	46	0	2	0
Internet café/telecommunication office	Often	4	25	22	26
	Sometimes	24	4	22	37
	Not at all	72	71	56	37
Private					
Home	Often	55	88	92	86
	Sometimes	9	0	8	14
	Not at all	36	13	0	0
Office	Often	67	63	90	85
	Sometimes	25	38	10	15
	Not at all	8	0	0	0
Internet café/telecommunication office	Often	0	0	20	50
	Sometimes	33	0	40	13
	Not at all	67	100	40	38
Students					
Home	Often	63	75	61	67
	Sometimes	16	19	39	27
	Not at all	21	6	0	7
Office	Often	55	53	79	67
	Sometimes	45	33	14	33
	Not at all	0	13	7	0
Internet café/telecommunication office	Often	47	42	50	47
	Sometimes	7	17	17	21
	Not at all	47	42	33	32

(continued)

Table 7.4 (continued)

		Fixed (%)	Mobile (%)	Computer (%)	Internet (%)
Support staff					
Home	Often	20	80	60	60
	Sometimes	20	20	40	20
	Not at all	0	0	0	0
Office	Often	40	60	100	100
	Sometimes	20	20	0	0
	Not at all	20	0	0	0
Internet café/telecommunication office	Often	0	40	20	20
	Sometimes	40	0	0	0
	Not at all	0	0	20	20

Internet are often widely used, while fixed telephone is less often used. In particular, both computer and Internet are very often used in offices; this is probably because they are offered free of charge in the work place or offices for the respondents in the universities. The Internet café and telecommunication offices are less often widely used compared to both home and offices as common places for the use of ICT.

7.4 Difficulties on the Supply and Demand Sides

At the macro level, several studies show many problems of the Internet. For instance, the above results indicate that access to Internet services in Sudan is made possible through narrow band: broadband, Leased Line, ADSL, Wi-Max and Pre-Wimax, VSAT, Web hosting, Email hosting and Co-location. Although Internet is essential for many businesses and it leads to several gained benefits, Sudan's Internet market is growing rapidly but the Sudanese Internet content is not matching the Sudanese Internet community volume.[19] In Sudan main access to Internet is still via dial-up; study of the use of dial-up service and Internet status in Sudan compared to selected countries indicates the low penetration of Internet service in Sudan, while world status show a gradual increase of Internet users. The statistical figure of 2005 in Sudan is improbable, as market facts indicate that users in 2005 were subjected to a slump not an increase. Study of the use of the DSL service indicates that DSL service started in Sudan in 2003; the study indicates that penetration of the DSL service in Sudan is very low, due to many reasons such as poor copper outside plants, the investment barrier imposed by Sudatel and the lack of incentive policies. In Sudan, even access to Internet via dial-up service was confronted with some difficulties such as bad copper outside the plant network of Sudatel, the only supplier of this access. Sudatel normally overlooks the Internet

[19] See Mohamed Abdelaziz Tangasawi (2007) 'Internet Services In Sudan', V 1.0. NTC Workshop on Internet Issues, 19 July 2007.

service as its profitability is far less than other main services and lack of incentive policies from the regulator (NTC), but Sudatel—the significant market power—normally forestalls smaller ISP from gaining market share. This is manifested in the fact that out of 17 licensed companies, 15 were shut down. In addition to ousting of ISP's co-located equipment in Sudatel premises under the pretence of security measures, there is often a lack of response from Sudatel to ISP's request for connectivity and capacity increase. ISP often suffer from service disconnection due to Sudatel's claim of bill non-payment, though Sudatel suffers seriously from collection problems. In addition there are high costs imposed on capacity price (before the application of revenue-sharing principle) and the revenue-sharing agreement, submitted by Sudatel and approved by the NTC, is disadvantageous and unfair to ISP for the following reasons: unjust revenue-sharing ratio, 60 % for Sudatel and 35 % for ISP; capacity rent bill is paid to Sudatel from ISP share; ISP pay for substitute locations after Sudatel's revocation of co-location agreement; ISP pay for power consumption and sundry services; and ISP pays dual impost, one within Sudatel's invoice and the other directly to the Taxation Authority. In addition: ISP pays the regular business tax noting that the Taxation Authority does not normally consider the losses inflicted; and ISP do not enjoy any tax exemptions for equipment and facilities as big operators (Sudatel) and the high cost of Sudatel's connection lease for the states.

Broadband service began toward the end of 2004 by Sudatel. By mid-2005 the number of subscribers totalled less than 600 and are now less than 2,000. The meagre number of subscribers is mainly due to Sudatel's monopoly and refusal to the ISP to market the service. For instance, Ashrafcom, after procuring the needed equipment, applied to Sudatel to share provision of the broadband service; after 1 year, Sudatel compelled Ashrafcom to sell it the equipment. Furthermore, Sudatel mandated that Ashrafcom should not attempt to offer this service in the future. That was tacitly accepted by the NTC. Ashrafcom communicated the matter to NTC to sanction its attained relevant licence but to no avail. Zain, another ISP, suffered from the defectiveness and unreliability of Sudatel's copper cable network where availability is one good line in 100, in addition to the unavailability of the optic fibre network outside a 5 km diameter area cantered in the midtown area (Dar el Hatif). Therefore, Sudan is considered a country with no broadband services, as indicated in the ITU year book.[20]

The current situation of the ISP indicates that rent of Internet capacities fell by 88.5 % in 2005 after the operation of submarine cable (SAS); the number of ISP decreased from 22 companies to 9 companies offering dial-up access and 2 companies wireless access. The reasons for the shrinking number of service providers are due to losses resulting from weak revenues, the inability of providers to innovate, high administrative and general expenses (often more than 100 % of the total revenue and provision of the service by main operators). The Internet services

[20] See Ashraf Communication Company (2007) 'The Importance of Internet Services', NTC Workshop on Internet Issues, 19 July 2007.

in Sudan suffered from many disadvantageous factors that rendered it a poor service, not up to the expected standard and unable to develop the Internet applications. The factors of poor service performance are due to low speed to customers, limitation of the associated services and poor quality, poor roll-out of the service to cover other regions in Sudan and weak competitive attitudes due to failure to provide multiple choices for customers (note: a licensed company has applied creative and innovative method of marketing the Internet service and was rewarded substantial profits).[21] Technical issues affect Internet business, including availability, bandwidth, access coverage, bandwidth per subscriber, add-on services, quality staff and operation. The presence of many obstacles are mainly related to factors such as Internet access (majority over dial-up), landline, use of telephone declining, new technologies (3G services, WLL, etc.), high cost of hosting services in Sudan, reliability and service availability and business relationship with the operators[22] (see Table 7.5).

According to Mobitel the problems that restrain Internet use in Sudan include the common prevailing culture and knowledge faculty (as the ordinary citizen is not yet qualified), academic qualifications, material qualifications as the fact that Internet services are unaffordable to the public and high access cost (including PCs and laptops, net cafés), scant proliferation, unaffordable prices, low standards (which do not encourage users) and high operational cost forcing ISP to raise prices. In addition both private and public institutions do not admit the Internet as a mean to handle transactions, which has led to it being regarded by some as of no importance and by others as means of communication only. Moreover, the titular bodies have not used enough promotion to invite users for their websites [23] (see Table 7.6). The problems of Internet service in Sudan include capacity, as the estimated Internet capacity in Sudan ranges between 300 and 450 Mb. Though it is more than those of some neighbouring countries (Ethiopia, Eritrea and Chad) it is still well below other regional countries (Egypt, 2.1 gb, UAE 5.1 gb). There is no definite assessment of capacity need, neither of the market nor those required to meet the ISP's demand to meet the requirements of additional services, local contents and other applications. The second problem is related to quality of service and technical support; despite the paucity of Internet users, there is inefficiency in the technical support, installation and follow-up and the technical faults demand a relatively long time to recover. The third problem is related to website hosting as some websites are hosted locally in Sudan but at high prices compared with hosting abroad. As a result optional values (such as e-mail) are still fewer than abroad. Dedicated Internet Bandwidth 'CIR' prices offered by Telco's are higher than abroad and considered a barrier to local hosting. That will add to the restriction of the Internet market in Sudan. Website owners have genuine desire to host their

[21] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

[22] See Mohamed Abdelaziz Tangasawi (2007) 'Internet Services in Sudan', V 1.0. NTC Workshop on Internet Issues, 19 July 2007.

[23] See Mobitel (2007) 'Internet Issues', NTC Workshop on Internet Issues, 19 July 2007.

Table 7.5 The Internet users, personal computer (PC) owners, the use of DSL services and International Internet band width in Sudan and selected countries 2001–2005

(a) Internet user/100 inhabit & Pc owner/100												
	2002		2001		2002		2003		2004		2005	
	Pc 100	Internet 100	Pc 100	Internet 100	Pc 100	Internet 100	Pc 100	Internet 100	Pc 100	Internet 100	Pc 100	Internet 100
Sudan	0.097	0.321	0.47	0.36	0.91	0.60	2.82	1.10	33.30	1.76	7.98	9.3
Algeria	0.49	0.66	0.65	0.71	1.69	0.77	2.20	0.83	4.63	0.9	5.83	10.06
Egypt	0.71	1.26	0.93	1.55	2.82	1.66	4.37	2.91	5.57	3.29	6.75	3.65
Lebanon	9.12	5.32	7.76	7.46	11.72	8.78	14.29	10.00	16.90	11.27	19.57	11.45
K.S.A	2.14	6.05	4.6	8.09	6.25	13.22	6.43	21.62	6.62	35.39	–	–
Kenya	0.33	0.49	0.64	0.56	1.27	0.65	3.15	0.95	3.22	–	3.24	–
South Africa	5.26	6.39	6.27	6.72	6.66	7.09	7.09	7.94	7.55	7.29	10.75	8.36
Argentina	7.06	6.96	9.82	7.80	10.93	8.00	11.96	8.19	16.10	8.37	17.79	9.07
Canada	41.13	41.90	44.96	45.61	48.30	48.62	55.39	–	62.33	–	67.89	–
Germany	30.15	33.60	31.54	38.00	33.92	43.13	39.99	48.47	42.67	54.55	43.17	60.47
	(b) DSL services				(c) International internet band width (Mbp)[c]							
	2002 DSL	2003 DSL	2004 DSL	2005 DSL	2001	2002	2003	2004	2005			
Sudan	00.00	00.00	1,400	1,900	12	24	90	202	202			
Algeria	00.00	00.00	36,000	195,000	86.30	156.0	156.3	156.3	156.3			
Egypt	937	4,850	29,307	91,111	274.60	735	559	1,412	3.784			
Lebanon	00.00	00.00	00.00	00.00	40.0	60.0	60.0	200	290			
K.S.A	2,287	8,400	19,700	52,000	–	340	390	750	1.200			
Kenya	00.00	00.00	00.00	00.00	26.0	26.0	26.0	34.0	1.134			
South Africa	2,669	20,313	60,000	95,290	4.750	5.645	6.255	8.815	–			
Argentina	85,904	140,620	352,130	592,090	4.172	5.476	7.358	12.248	12.248			
Canada	1,471,000	1,958,000	2,400,000	2,839,000	55.623	89.273	172.530	217.520	–			
Germany	3,160,000	4,400,000	6,770,000	10,380,000	207.670	260.670	384.850	566.060	566.060			

Source Ashraf Communication Company (2007) "The Importance of Internet Services," NTC Workshop on Internet Issues, 2007

Table 7.6 The tariff for Internet capacity rent in Sudatel and Canar companies (SDG/month), 2007

Sudatel tariff for Internet capacity rent (SDG/month)					Canar tariff for Internet capacity rent (SDG/month)		
2000	2005	2006	2007	Capacities	2006	2007	Capacities
2,891	500	500	500	64 k/bit	380	380	64 k/bit
5,782	850	850	850	128 k/bit	710	710	128 k/bit
11,564	1,450	1,450	1,450	256 k/bit	1,310	1,310	256 k/bit
17,340	2,170	2,170	2,170	348 k/bit	1,850	1,850	348 k/bit
23,128	3,250	3,250	3,250	512 k/bit	2,460	2,460	512 k/bit
43,365	5,000	5,000	5,000	1 Mbit	4,460	4,460	1 Mbit
86,730	10,000	10,000	10,000	2 Mbit	8,240	8,240	2 Mbit

Source National Telecom Corporation (2007) NTC Workshop on Internet Issues 19 July 2007

web pages locally due to the trouble of fund transfers abroad and the impossibility of direct technical support. Moreover, the language barrier is an added complication. The United States' embargo is another standing threat; any web service is subjected to shut down hereupon. However, due to the strategic importance of the matter, the ISP's problems should be considered and resolved. The state's e-government project necessitates local hosting and collocation services and the establishment of data centres, which must be hosted locally for security and confidentiality. Presently, the high cost of engineering works and setting up of data centres may deter the investment in the field. Unfortunately, Telco's have not managed to create their own data centres up to international standards that could offer hosting of websites for the local market, (moreover, enriching the local content is hindered by the high bandwidth prices for ISP's). Such prices will reflect negatively on customer use. The fourth problem is related to IP addresses and software licensing; the present policy of IP address assignment restrains users from developing Internet applications. To have an IP address, Telco's stipulate paying for a dedicated leased circuit. In addition, IP addresses are not offered for broadband applicants against nominal prices. University students, for example, cannot post their graduation projects on the Internet due to the unavailability of IP addresses and the difficulty of securing bandwidth. ICANN and African Network Information Center (AfriNIC) (the body responsible for IP-address assignment in Africa) recommend free-of-charge assignment or a nominal charge. ISP and other corporate entities must be encouraged to join AfriNIC to increase the numbers of Local Internet Registry agents in order to mitigate the rigmarole of obtaining Internet addresses for users. The dependence of programmers and developers on banned foreign software imposes difficulties on applications based thereon, which inflict high costs. So, it is advisable to encourage the use of open source to develop Internet applications.[24]

[24] See Mohammed Al Bashier Ahmed (2007) 'Development of Internet services in Sudan Challenges and Prospects Sudanese Internet Society,' NTC Workshop on Issues, 19 July 2007.

At the micro level our findings from the University Survey (2009) indicate the importance of the difficulties in the supply and demand sides in hindering the personal usage of ICT. For instance, from all the respondents' perspective, the difficulties in the supply side include high costs of offering the services, lack of networks, interruption/disconnection of services, lack of R&D, low quality/efficiency of services, lack of government spending on ICT, inadequate capacity of the services, lack of/inadequate investment, slow speed of services, lack of infrastructure, interruption of electricity supply, uncertainty related to investment in ICT, lack of technical skills and others respectively.[25] In addition, from all the respondents' perspective, difficulties on the demand side include: high spread of electronic illiteracy, high cost for offering the services, lack of awareness of the importance of ICT in the new economy, high spread of poverty and others respectively[26] (see Table 7.7). Moreover, our results show that assessment indicates the importance of the lack of fluency in English language in hindering the personal usage of ICT. For instance, from all the respondents' perspective, the majority of all staff indicated that for mobile telephone it is unimportant (63 %), followed by those who indicated it as slightly (25 %), extremely (7 %) and moderately (6 %) important. For computer it is unimportant (43 %), followed by those who indicated it as slightly (21 %), moderately (20 %), and extremely (16 %) important. For Internet it is unimportant (38 %), followed by those who indicated it as extremely (22 %), moderately (22 %), and slightly (17 %) important.

From the public staff's perspective, the majority indicated that for mobile telephone it is unimportant (60 %), followed by those who indicated it as slightly (29 %), extremely (7 %), and moderately (4 %) important. For computer it is unimportant (40 %), followed by those who indicated it as slightly (19 %), moderately (21 %) and extremely (19 %) important. For Internet it is unimportant (34 %), followed by those who indicated it as extremely (25 %), moderately (22 %), and slightly (19 %) important.

From the private staff's perspective, the majority indicated that for mobile telephone it is unimportant (71 %), followed by those who indicated it as moderately (12 %), slightly (12 %), and extremely (6 %) important. For computer it is unimportant (53 %), followed by those who indicated it as slightly (24 %),

[25] As indicated by 93 %, 93 %, 93 %, 93 %, 92 %, 92 %, 90 %, 89 %, 89 %, 88 %, 86 %, 84 %, 79 % and 92 % of all respondents respectively. As indicated by 93 %, 93 %, 93 %, 94 %, 93 %, 91 %, 89 %, 89 %, 89 %, 86 %, 86 %, 82 %, 80 % and 90 % of public respondents respectively. As indicated by 94 %, 94 %, 93 %, 88 %, 88 %, 94 %, 94 %, 88 %, 88 %, 94 %, 82 %, 88 %, 76 % and 100 % of private respondents respectively. As indicated by 90 %, 90 %, 71 %, 95 %, 90 %, 100 %, 81 %, 95 %, 86 %, 81 %, 52 %, 67 %, 76 % and 67 % of student respondents respectively. As indicated by 60 %, 40 %, 40 %, 60 %, 40 %, 40 %, 60 %, 60 %, 60 %, 40 %, 60 %, 40 %, 40 % and 0 % of support staff respondents respectively.

[26] As indicated by 92 %, 92 %, 90 %, 88 % and 88 % of all respondents respectively. As indicated by 91 %, 91 %, 91 %, 88 % and 100 % of public respondents respectively. As indicated by 94 %, 94 %, 88 %, 88 % and 75 % of private respondents respectively. As indicated by 95 %, 100 %, 90 %, 95 % and 100 % of student respondents respectively. As indicated by 60 %, 60 %, 60 %, 60 % and 0 % of support staff respondents respectively.

Table 7.7 Assessment of the importance of the effect of the difficulties in the supply and demand sides in hindering personal use of ICT

Supply sides	All (%)	Public (%)	Private (%)	Students (%)	Support staff (%)
High costs of offering services	93	93	94	90	60
Lack of networks	93	93	94	90	40
Interrupt/disconnection services	93	93	93	71	40
Lack of R&D	93	94	88	95	60
Low quality/efficiency of the services	92	93	88	90	40
Lack of govt. spending on ICT	92	91	94	100	40
Inadequate capacity of services	90	89	94	81	60
Lack of/inadequate investment	89	89	88	95	60
Slow speed of the services	89	89	88	86	60
Lack of infrastructure	88	86	94	81	40
Interrupt of electricity supply	86	86	82	52	60
Uncertainty related to investment in ICT	84	82	88	67	40
Lack of technical skills	79	80	76	76	40
Others	92	90	100	67	0
Demand side:					
High spread of electronic illiteracy	92	91	94	95	60
High cost for offering the services	92	91	94	100	60
Lack of awareness of the importance of ICT in the new economy	90	91	88	90	60
High spread of poverty	88	88	88	95	60
Others	88	100	75	100	0

moderately (18 %), and extremely (6 %) important. For Internet it is unimportant (53 %), followed by those who indicated it as moderately (24 %), slightly (12 %), and extremely (12 %) important.

From the students' perspective, the majority indicated that for mobile telephone it is slightly (33 %) important, this is followed by those who indicated it as moderately (29 %), unimportant (25 %) and extremely (13 %). For computer it is moderately (44 %) important, followed by those who indicated it as extremely (39 %), slightly (13 %), and unimportant (4 %). For Internet it is extremely (61 %) important, followed by those who indicated it as moderately (34 %), slightly (4 %), and unimportant (0 %).

From the support staff's perspective, the majority indicated that for mobile telephone it is unimportant (40 %), followed by those who indicated it as moderately (40 %), slightly (20 %), and extremely (0 %) important. For computer it is moderately (40 %) important, followed by those who indicated it as extremely (20 %), slightly (20 %), and unimportant (20 %). For Internet it is moderately (40 %) important, followed by those who indicated it as extremely (20 %), slightly (20 %), and unimportant (20 %) (see Table 7.8).

Table 7.8 Assessment of the importance of the effect of the lack of fluency in English language in hindering the personal usage of ICT

All	Extremely (%)	Moderately (%)	Slightly (%)	Unimportant (%)	N
Mobile telephone	7	6	25	63	76
Computer	16	20	21	43	
Internet	22	22	17	38	
Public					59
Mobile telephone	7	4	29	60	
Computer	19	21	21	40	
Internet	25	22	19	34	
Private					17
Mobile telephone	6	12	12	71	
Computer	6	18	24	53	
Internet	12	24	12	53	
Students					24
Mobile telephone	13	29	33	25	
Computer	39	44	13	4	
Internet	61	35	4	0	
Support staff					5
Mobile telephone	0	40	20	40	
Computer	20	40	20	20	
Internet	20	40	20	20	

7.5 Suggestion for Solutions on the Supply and Demand Sides

At the macro level, several studies provide many suggestions for solutions of the above-mentioned problems. For instance, it is mandatory to strengthen the ISP trade environment and modify their business approach through: increased investment capital and consideration of mergers with each other to establish a solid investment base; diversifying and enriching the offered services to enhance competitiveness; commitment to quality of service; providing optional access methods to improve affordability; consideration of geographical expansion outside the capital; consideration of inter-connectivity to improve storage and hosting capacity of frequent sites (peer-to-peer operation) and encourage investment in e-applications. To contribute to the proliferation of Internet services and substantiate the role of service providers, the operators should consider secure Internet capacities to the providers all over Sudan and separating uplink and downlink capacities according to providers' requirements, provide direct connection circuits with preferential prices to make use of the infrastructure and provide Reference Interconnection Offer for data service. In addition, they should enable the ISP to undertake retail

selling; operators should sell Internet capacities and connection lines at wholesale prices, diversify the parties with direct links to the Internet network to ensure the continuity and stability of the service; gradually withdraw from the service provision competitive market to enable ISPs' role and meet Next Generation Networks and services convergence (an agreement between the NTC and the SIS upon the management of the Internet Top-Level Domain of Sudan and doling out the subsequent domains). In order to accomplish the information society and optimise the Internet service, the NTC should contribute to: achieving a clear policy for the Internet; implementing a realistic pricing policy to differentiate between the wholesale and retail prices; encouraging fair competition between service providers and the elimination of the unified tariff system; realising the roll-out of service to other regions in Sudan through promotional advantage; obliging operators and service providers to adhere to the adopted quality standards; advising operators to remain as network and capacity providers and abandon the Internet service provision and supervising the service performance and drafting market statistical data.[27]

In conclusion, refreshing Internet related business requires application service provisioning, enhancement of the existing services (availability, quality, coverage, etc.), getting engaged in the content market (Farouq Telecom), co-operation with the operators to generate new business opportunities, monitoring the technology directions towards the Internet and Internet services, prolonging the business cycle and setting quality standards.[28] Mobitel Road Map includes that Mobitel provides multi-technology Internet access through MobiNet, which started in 1999 to cover all subscribed customers via fixed or mobile networks with speeds 56 kb/s for fixed service and 9.6 kb/s for mobile service, and through GPRS which started in 2005 for Mobitel customers with telephone sets supporting this service. In addition to provision of an advanced GSM data transmission technology in 2007 and provision of maximum speed services that was planned to be introduced in 2007 to meet the aspiration of business and corporate sector. Moreover, as an Internet Service Promoter Mobitel utilises all media resources to acquaint the public and raise their level of awareness of its services, supports all educational institutions to uphold academic qualification, and offers incentives to customers to urge them to use the Internet (free credit and session hours and others). Furthermore, Mobitel offers various gifts to customers as PCs, laptops and mobile phone sets as motivation to elevate their "technological value". This has helped to develop the overall stance.[29] The main recommendations include developing the ISP services offered by introducing new packages like web, e-mail and hosting and designing websites, offering the value-added services of the fixed telephone network such as games, multi-choice television, videophone and video-on-demand. This comes in addition to offering the value-added services of the mobile telephone network such as SMS

[27] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

[28] See Mohamed Abdelaziz Tangasawi (2007) 'Internet Services in Sudan', V 1.0. NTC Workshop on Internet Issues, 19 July 2007.

[29] See Mobitel (2007) 'Internet Issues', NTC Workshop on Internet Issues, 19 July 2007.

(news, sports, banks, etc.) and new technologies (Wi-Fi, WiMax).[30] To adopt a broad vision of the Internet governance based on the five cases (technical, economic, cultural, and social aspects and developmental issues), it is mandatory to form a work group to study how to develop mechanisms and lay foundations for Internet governance in Sudan, taking into account achieving active Sudanese presence on the Internet, coordination between stakeholders in the field to ensure suitable environment to deploy the Internet to greater community sectors and coordination with the UN and relevant concerned international organisations to develop optimal vision for Internet Governance.[31] Prospects and solutions includes development of the Internet service and making optimal use of the telecommunications infrastructure at hand, which is considered the best in Africa; this implies that it is mandatory to maintain a cooperative partnership between Telco's and ISP to enable the latter to offer broadband services to the widest targeted Sudanese sectors possible. In this way, Telco's can assume their role as carriers utilising their infrastructure. As the ISPs in a position to offer other value-added services, there will be a competitive market activity that will render Internet prices more affordable. Moreover, broadband service via landlines should be resumed and not to be abandoned. There must be an opportunity offered for Telco's/ISP partnership. The Egyptian case is a good example; Telecom Egypt, the main Telco-extended revenue-sharing partnership with the ISP to disseminate the Internet service via Telecom Egypt. That enabled the ISP greater expansion in offering broadband services at token prices. That partnership instigated positive competition in the market. As for Internet capacities, the Internet bandwidth dedicated to corporate bodies should be reduced. A special rate must be worked out for universities and educational institutions so they can avail the Internet adequately to their students. That should indeed unleash progress and development of scientific research. In addition to Internet Added Services, as a contribution to the development of Internet local services including website hosting, it is advisable to sponsor value-added and additional services via Telco's and ISPs. The establishment of data centres by the state or private sector is a strategic issue to develop the Internet applications service. A government data centre is a pressing need; Sudan has now its own address on the Internet global map. That will no doubt enhance all services including the contents. Still, there is a big need to develop the DNS infrastructure to bolster Internet development.[32] Proposals for upgrading Internet services imply that most Sudanese cities are covered with state-of-the-art telecommunications infrastructure.[33]

[30] See Almuneer Taha Elkabashi (2007) 'Introduction and Enhancement of Internet Services in Sudan The Role of Sudatel', NTC Workshop on Internet Issues, 19 July 2007.

[31] See Abu-Al-Fedl Mokhtar (2007) 'Internet Management in Sudan', Ministry of the Cabinet Affairs, National Information Center, NTC Workshop on Internet Issues, 19 July 2007.

[32] See Mohammed Al Bashier Ahmed (2007) 'Development of Internet services in Sudan Challenges and Prospects', Sudanese Internet Society, NTC Workshop on Internet Issues, 19 July 2007.

[33] See National Telecom Corporation (2007) NTC Workshop on Internet Issues, 19 July 2007.

Table 7.9 Assessment of the importance of implementation of selected policies in the supply and demand sides in encouraging and supporting the use of ICT

	All (%)	Public (%)	Private (%)	Students (%)	Support staff (%)
Policies in the supply sides					
Improve and increase R&D	99	100	94	100	40
Improve and increase infrastructure	96	96	94	96	80
Encourage the use of preferential tariff or free access to electronic publications for academic purpose in developing countries	96	96	94	100	40
Improve and increase efficiency and capacity of services	95	95	94	100	40
Improve and increase speed of the services	95	95	94	96	40
Improve and increase govt. spending and investment on ICT	95	95	94	100	40
Improve and increase networks offering the services	94	96	87	100	80
Introduction of policies to increase collaboration in the field of research and publication and free access to electronic publications for academic purpose in developing countries	93	95	88	95	40
Introduction of policies to reduce digital and scientific gap between Sudan and advanced countries in the world.	93	93	94	100	40
Treatment of problem of Interrupt/disconnection services	93	91	100	92	40
Encourage and support private investment to offering services	93	91	100	96	40
Treatment of Interrupt of electricity supply	92	95	82	87	40
Others	80	75	100	100	0
Policies on the Demand side:					
Improve and increase quality of education and electronic knowledge and eradication of electronic illiteracy	97	96	100	92	80
reduce cost for offering the services	97	98	94	96	80
Improve and increase awareness of the importance of ICT in the new economy	95	95	94	100	40
Improve and increase income and eradicate poverty	91	91	88	91	40
Others	80	80	0	100	0

At the micro level, our findings from the University Survey (2009) show the importance of the implementation of the following selected policies in the supply and demand sides in encouraging and supporting the use of ICT. For instance, from all the respondents' perspective, policies in the supply sides include improving and increasing R&D, improving and increasing infrastructure, encouraging the use of preferential tariff or free access to electronic publications for academic purpose in developing countries, improving and increasing efficiency and capacity of the services, improving and increasing speed of the services, increasing government spending and investment on ICT and improving and increasing networks offering the services. In addition: introduction of policies to increase collaboration in the field of research and publication and free access to electronic publications for academic purpose in developing countries, introduction of policies to reduce the digital and scientific gap between Sudan and advanced countries in the world, encouragement and support of private investment, improving and treating the problem of interruption or disconnection in the supply of the services, treating the provision of electricity supply and others respectively. Moreover, from all the respondents' perspective, policies on the demand side include improving and increasing quality of education and electronic knowledge and eradication of electronic illiteracy, reducing the costs for offering the services, improving and increasing awareness of the importance of ICT in the new economy, improving and increasing income, eradicating poverty and others respectively[34] (see Table 7.9).

7.6 Conclusions

This chapter discusses and provides empirical analysis and examines from the public-private perspective the research hypotheses on the public-private differential in the supply side of ICT in Sudanese universities. Section 7.1 presents introduction. Section 7.2 explains ICT regulatory framework and ICT market structure in Sudan. Section 7.3 defines the main characteristics of the supply side of ICT at the macro and micro levels in Sudan and shows an indepth analysis from the demand and consumer perspective concerning the supply side of ICT and methods and places of connection to ICT. Section 7.4 explains the difficulties on the supply and

[34] As indicated by 99 %, 96 %, 96 %, 95 %, 95 %, 95 %, 94 %, 93 %, 93 %, 93 %, 93 %, 92 %, 80 %, 97 %, 97 %, 95 %, 91 % and 80 % of all respondent staff respectively. As indicated by 100 %, 96 %, 96 %, 95 %, 95 %, 95 %, 96 %, 95 %, 93 %, 91 %, 91 %, 95 %, 75 %, 96 %, 98 %, 95 %, 91 % and 80 % of respondent public staff respectively. As indicated by 94 %, 94 %, 94 %, 94 %, 94 %, 94 %, 87 %, 88 %, 94 %, 100 %, 100 %, 82 %, 100 %, 100 %, 94 %, 94 %, 88 %, and 0 % respondent private staff respectively. As indicated by 100 %, 96 %, 100 %, 100 %, 96 %, 100 %, 100 %, 95 %, 100 %, 92 %, 96 %, 87 %, 100 %, 92 %, 96 %, 100 %, 91 % and 100 % of respondent students respectively. As indicated by 40 %, 80 %, 40 %, 40 %, 40 %, 40 %, 80 %, 40 %, 40 %, 40 %, 40 %, 40 %, 0 %, 80 %, 80 %, 40 %, 40 % and 0 % of respondent support staff respectively.

demand sides. Section 7.5 provides some suggestions for relevant solutions on the supply and demand sides and finally, Section 7.6 provides the conclusions.

Our findings in this chapter provide further evidence in support of the second hypothesis in Chap. 1 above on the incidence of structural change in the demand for ICT. In particular, in this chapter we complement our discussion in Chap. 5 above and we elaborate the incidence of structural change in the demand for ICT from the supply side. For instance, next to the well-investigated structural change in the structure of the supply of ICT market from monopoly to monopolistic competition with more than one operating companies, we explain further structural change from the demand perspective. We find that the increasing number of operating companies has been in favour of consumers not only by increasing availability of ICT services but also by offering consumers wider options for selection from the different ICT supplier companies. For instance, our results indicate that from all the respondents' perspective fixed telephone is mainly supplied by Sudatel and Canar, mobile telephone is mainly supplied by Zain and Sudani and Internet services are mainly offered by Sudatel and Sudani. Our findings indicate that the above observed structural change in the supply side from monopoly by Sudatel to monopolistic competition with many operating companies has been in favour of consumers, not only by increasing availability of ICT services, but also by increasing competition between different ICT supplier companies to attract more consumers by offering ICT services with high or improved efficiency, low or cheap prices and also introduction of price discrimination mechanism. Our results indicate further evidence in support of the hypothesis on the incidence of structural change in the demand for ICT from the demand perspective in relation to the supply side; for instance our findings imply shift from Sudatel as ICT pioneer company to Zain as new recent ICT supplier company. Our results imply that the justification of this shift or structural change is related to preference of certain characteristics of the supplier company. For instance, our findings imply that from all the respondents' perspective, the preference of the company offering ICT services indicates that Zain is the most preferred company and ranks first compared to other companies because of its distinguished characteristics in terms of fashion, style, good design, efficiency and high quality, ease of use and price discrimination. Zain is also ranked second next to Sudani in terms of cheap price. This result is also consistent with the conventional stylised fact in the theoretical literature concerning the rationality of consumers.

Another piece of evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our findings on the methods of connection to the Internet, which indicates a significant shift from connection via dial-up by telephone to connection by ADSL. For instance, our results indicate that from all the staff's perspective, for the majority, the most widely used and common way for connection with the Internet is through ADSL, which is used by near to half of all respondents, this is followed by connection by wireless, which is used by near to one third of all respondents and finally by fixed telephone which is used by near to one fifth of all respondents. Further evidence in support of the hypothesis on the incidence of structural change in the demand for

ICT can be elaborated from our findings, which imply that from all the staff's perspective, for the majority, in both the home and office, mobile telephone, computer and Internet are often widely used, while fixed telephone is less often used. Our results indicate that from all the respondents' perspective ICT is often and widely accessed in both the home and office, while Internet café and telecommunication offices are less often widely used compared to both home and offices as common locations for the use of ICT. In particular, both computer and Internet are very often used in the office or work place, this is probably because they are offered free of charge for the respondents in public and private Sudanese universities. The major policy recommendation from our results in this chapter is the improvement of availability, efficiency and sustainability of ICT supply.

References

Abu-Al-Fedl Mokhtar (2007) Internet management in Sudan. Ministry of the Cabinet Affairs, National Information Center

Almuneer Taha Elkabashi (2007) Introduction and enhancement of Internet services in Sudan the role of Sudatel. NTC workshop on Internet issues, 19 Jul 2007

Ashraf Communication Company (2007) The importance of Internet services. NTC workshop on Internet issues, 2007

Mobitel (2007) Internet issues. NTC workshop on Internet issues, 19 Jul 2007

Mohamed Abdelaziz Tangasawi (2007) Internet services in Sudan. V 1.0. NTC workshop on Internet issues, 19 Jul 2007

Mohammed Al Bashier Ahmed (2007) Development of Internet services in Sudan challenges and prospects. Sudanese Internet Society, NTC workshop on Internet issues, 19 Jul 2007

National Telecom Corporation (2007) NTC workshop on Internet issues, 19 Jul 2007

University Survey (2009) The impacts of ICT in connections, transformation and production of knowledge in Sudanese Universities, Khartoum

Zain (2007) Zain Presentation for NTC workshop ISP/ASP/SMS/IVR. NTC workshop on Internet issues, 19 Jul 2007. Confidential Document Sudatel 8/5/2007