



**UNIVERSITY OF CAPE TOWN**

**Bridging the Digital Divide in African Post-Conflict Countries :**

A case study of the DRC cities of Kinshasa and Kananga

**A dissertation submitted to the Department of Computer Science, Faculty of Science at the University Of Cape Town in partial fulfillment of the requirements for the degree of Master of Science (in Information Technology)**

**By Maketa Lutete Thomas**  
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Supervised by Dr Audrey Mbogho

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## **Abstract**

The digital divide is largely seen as the main problem that developing economies and societies must overcome to gain economic productivity and social welfare. In this document we state that modern western perception of the digital divide lured advancement of ICT into developing countries especially in Africa. ICT must not be seen as a goal in itself but as a means to service human needs.

This study attempts to analyze the willingness of people to adopt existing ICT infrastructures and the factors impeding its use in the DRC's cities of Kinshasa and Kananga.

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## List of Acronyms

AMPS	Advanced mobile phone system.
ARPTC	Autorité de régulation des postes telephones et communication: DRC Independent authority for regulation of post, phones and communication.
ATM	Automatic teller machine.
DRC	Democratic Republic of Congo.
GSM	Global system for mobile communication
ICI	Information and Communication Infrastructures.
ICT	Information and Communication Technologies.
ITU	International Telecom organization.
LAN	Local area network.
NGO	Non-governmental organization.
SNEL	Société Nationale d'Electricité: Government owned national electricity distribution agency.
UWB	Ultra-Wide Bandwidth.
WAN	Wide area network.
WiMAX	

Worldwide Interoperability for Microwave Access, Inc. (group promoting IEEE 802.16 wireless broadband standard)

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## **Chapter 1. Introduction**

### **1.1. Research overview**

The aim of this work is to approach the digital divide concept from an African perspective and analysis; and find ways to integrate it efficiently into the African environment.

In studying DRC we think that we will be looking at one of the worst possible scenarios: a broken country emerging from 5 years of civil war. We also think that the outcome of this study could be applicable, even if slightly modified, to other African (developing) countries.

### **1.2. Purpose**

Everywhere in the press, Internet, and forums, bridging the digital divide is seen as a major requirement for bringing developing countries to economical and social welfare.

Decades of aid plans aimed at bridging the digital divide in Africa, based on western assumptions and approaches, have been spent by NGO's, international organizations and governments without bringing tangible results on the ground. An alternative approach was necessary, and an alternative based on African realities and perceptions would be the best.

For an African approach to bridging the digital divide in African countries, Information and Communication Technologies (ICT) must be placed into their social and economic context. Ordinary citizens are not exposed to or don't interact with a wired society where ATMs, emails, blackberries, search for information, or newspapers are the common daily landscape. Most potential African users have very low levels of computer literacy, with the cellular telephone or television often being the most high-tech appliance to which they have been exposed and little within their vicinity to expose them to a wider range of ICT usage.

In DRC, the subsistence, semi-rural and low mechanized economy in conjunction with lack of easy access to banks makes e-commerce and its associated concepts very exotic and far from common people's realities.

Just as the automobile facilitated transport but did not create it, so will ICT not create an economy, but rather facilitate an already existing economy and create new business opportunities. This requires that a good strategy is used to implement it and that the people participating in the economy have the knowledge, the means and the will to use it.

### **1.3. Contribution**

This study hopes to contribute to an African "in context" assessment of the digital divide problem and ICT sector in the cities of Kinshasa and Kananga as well as to propose an original approach to bridging the digital divide.

### **1.4. Methodology**

The original questions the research intended to answer were:

1. Can bridging digital divide in DRC really sustain its development?
2. What real effects does the digital divide have on the economy and sustainable development of a society?
3. What slows bridging of the digital divide in DRC?

To respond to these questions, 3 tasks have been identified:

1. To define the digital divide, to assess the technologies used to bridge it and to review experiences of bridging such digital divide in other countries;
2. On the ground assessment of ICT sector of cities of Kinshasa and Kananga, and discussion with key players and population;
3. Based on the research findings to point out the main problems to overcome for bridging the digital divide in DRC and to answer research questions.

For each part a different methodology has been used:

- The first part used primarily technical notes, newspapers, official reports and interview of experts.
- For part two, an internet café survey has been carried out and interviews with ordinary people, key players, personalities and officials of different sectors have been undertaken.
- The last part includes synthesis of all the above-mentioned tasks into a report putting the DRC's ICT sector in perspective.

### **1.5. Scope and limitation**

The cities where physical surveys have been conducted are the cities of Kinshasa and Kananga, presenting opposing scenarios and two faces of the same country: the capital Kinshasa, the political, economical and cultural lighthouse of the country which is relatively open to the world versus the more reserved Kananga, landlocked in the center with limited contacts with the outside world. To gain insight from the rest of DRC we telephonically interviewed people and reviewed reports.

All prices stated in this document are given as indication and may change in accordance with the market. They have been collected during the period running from the 27<sup>th</sup> Of February to the 12<sup>th</sup> of June 2007.

Because of lack of available statistics the findings of this work could not be corroborated as desired. We used statistics from our own survey, and we lived as close as possible with the local population to understand their lives and realities from which we have eventually based our convictions.

### **1.6. Dissertation outline**

The dissertation has 4 chapters:

The Introduction sets up the background of the research in defining its scope, limitation and purpose. The Research Survey gives some commented results of the Kinshasa and Kananga survey undertaken to assess ICT sector

Analysis of DRC's Digital Divide tries to understand the figures of the survey in performing an in depth analysis of DRC's digital divide. This part drills into the theory of digital divide, bringing out the definitions and understanding. It also reviews available technologies and factors influencing the digital divide when putting them in the perspective of the DRC situation.

The Conclusion and Recommendation chapter brings out the conclusions of the precedent chapters and propose some recommendations.

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## Chapter 2. Research survey

### 2.1. Research survey protocol

100 ICs in the city of Kinshasa and all the 3 ICs of the city of Kananga have been surveyed, using questionnaire of the appendix A.

ICs have been chosen because the home computers' penetration is very low, and ICs are the places where population access internet and look for ICT guidance. In Kinshasa the ICs to survey have been chosen on geographical basis with an attempt to have at least 4 ICs for each of the 24 communes of Kinshasa.

The questionnaire has been addressed to the ICs' responsible, by IT responsible we means the person within IC who is in charge of receipting clients and assisting them when they have problems.

The aim of the survey was to understand how ICT is used, how its benefit is understood by populations and what type of problems ICs face.

Questionnaire was written in French and included open answer question like "what are the main factors limiting your business?" and yes or not question like: "do you have microphones and speakers?", An English translated version is available on (Appendix A).

### 2.2. Main results:

#### ➤ Internet cafés usage

ICs WHERE USERS PERFORM RESEARCH ON INTERNET	ICs WHERE USERS USE EMAIL	ICs WHERE USERS USE CHAT	ICs PROVIDING INTERNET TRAINING TO USERS	ICs WHERE USERS ACCESS ADULT SITES
85%	94%	70%	74%	48%
ICs HAVING PRINTERS	ICs HAVING MIC and SPEAKERS	ICs WHERE USERS USE VOIP	ICs WITH STAFF HAVING RECEIVED ICT TRAINING	ICs OFFERING OFFICE SERVICE
97%	50%	24%	88%	96%

Table 1: Internet usage  
[source: Internet cafés survey]

Within ICs, Internet is used mainly for communicating: email (94% of users), chat (74% of users) and 85 % of ICs report that their users come to perform some kind of research.

All other possibilities of Internet use, such as voice over IP and e-commerce, are largely unknown.

ICs' owners also complain that most of the youngsters are more interested in consulting adult web sites and downloading music and video than education.

➤ **Limiting factors affecting IC expansion**

Limiting factor	
Electricity	47
Electricity – tax	29
Electricity - Quality of connection	3
Electricity - Low number of clients	3
Tax	3
Low number of clients	3
Quality of connection	2
Electricity - clients escaping without paying	1
Electricity - Clients wrongly manipulating pc	1
Electricity - Office renting	1
Old Machine	1
Electricity - tax - clients escaping without paying	1
Clients wrongly manipulating pc	1
Not answered	4
	100

Table 2: Internet cafés problems limiting their expansion  
[Source: Internet cafés survey]

The main limiting factors as seen at ICs are related to electricity (84%) and taxes (33%) followed by low numbers of users (6%). In addition, 90 % of Internet cafés admit they don't have access to a stable electricity supply.

➤ **Cost of Internet:**

	NUM. OF PC/ICs	ICs LIFETIME (MONTHS)	ICs INTERNET TARIFF (FC/MINUTES)	ICs DAILY NUM. OF USERS	TIME USERS SPEND ON INTERNET (MINUTES)	ICs INTERNET CONECTIVITY COST (USD/ MONTH)
MAX observed	30	108	25	150	60	650
MIN observed	2	0.4	7	15	8	100
AVERAGE	8.448979592	30.32371134	9.602040816	56.31521739	25.47423	210.5714286

Table 3: Internet cafés statistics  
[Source: Internet cafés Survey]

ISPs charge ICs by numbers of connected PCs. The usual charge for a single PC is 100 USD and can go up to 650 USD for 30 Pcs.

The average number of users per day is 56. Interesting Information, that we have not been able to precisely verify, is the percentage of the overall population accessing the Internet, via ICs, at home or office.

According to ITU statistics Internet penetration rate is 0.08% [17] which is quite similar to the figure we get from taking the percentage of the number of ISP clients (personal, offices and internet cafés combined) approximated to be 7 500 [ARPTC] out of the overall DRC population of 65 Million [7]. This gives less than 0.01%. This last figure, though very rough and not totally accurate, gives, in our sense, a good idea of the internet penetration rate in Congolese society. That idea is reinforced when discussing with people: the masses are very unaware of what internet is and what is it for.

The overall survey figures give a rough idea of the DRC's ICT sector: they show that electricity is a serious problem, that communication is the main usage of Internet and that less than 0.5% of the population accesses it. Understanding and addressing the reality from which these figures arise is important for devising lasting solutions.

The next chapter gives the analysis of the research undertaken in order to understand the reality behind the DRC's ICT sector.

## **Chapter 3. Analysis of DRC's digital divide**

### **3.1. Introduction to the concept of digital divide**

The digital divide has many similar definitions as per different authors. All of them revolve around the difference in access and use of information and communication technologies (ICT) from different populations based on whether the lack is in information communication infrastructures (ICI) or in the skills of users of ICT.

In some literature ICT encompasses cellular phone technology like GSM, AMPS and 3G. For this research we only considered ICT as being technologies, services and functionalities depending directly on Local/Wide Area Network (LAN/WAN) or the Internet. We exclude from that definition services depending on privately owned networks such as cellular companies.

The digital divide evolves from the difference between people having access and not having access to ICT (horizontal divide) to difference in quality of use of existing ICI and available ICT by users (vertical divide) [17].

Horizontal divide is apparent within a group of people (country or regional level) with some having access to ICT and others not, while vertical divide exists within a community where ICTs are available to all but due to differences of income, education or social habits there is a difference in the quality of use by members of this community.

The term Digital Divide itself was born in the mid nineties and depicts a reality which emerged in the mid 1970s, when western countries massively deployed their low cost land line telephone infrastructures for phone and fax communication, which changed the social lifestyle and economy of that time.

In the beginning of the 1990s, using modem and dial up technology, the deployed land line telephone infrastructure became the backbone used to access the Internet, and email, its flagship service, which became popular to the public and gained rapid adoption.

Internet and email profoundly changed the way population, companies and governments circulated their information and managed their communication. Research undertaken in USA [19] attributed the rapid productivity growth observed in the mid- to late 1990s to the use of information and the Internet. In the meanwhile, development analysts feared that developing economies and those in transition, having a less developed and poor quality land line infrastructure would be left behind and de facto lose access to the Internet accelerated growth and productivity, and stagnate.

For them, the world became separated by a divide in access to ICT and its associated opportunities, and that is how the term "digital divide" appeared in our vocabulary [14].

Eventually, appearance of cheap wireless technology and satellite connectivity in the beginning of 2000 made it possible to create wireless local area network and to connect them to the Internet without using land line infrastructure and brought perspectives on new possibilities of bridging the digital divide.

In this document bridging the digital divide means building Information technology network infrastructure, raising awareness of the population and building human capacity that would make it possible to appropriate ICT by the masses.

### **3.2. DRC overview**

This overview introduces the geographical and political context where this research is taking place. It is important for the reader to have a feeling of what the country has been through and what it is facing in order to understand the complexity of building ICT infrastructure in a post conflict country like DRC.

The DRC has 12 regions, each having a regional parliament with members of the regional parliament (MRP) directly elected by the population. Governors of regions are indirectly elected by the MRPs.

The DRC follows a semi-presidential regime with 3 institutions:

- the executive : presidency and government led by a prime minister;
- the legislative body: comprising the national parliament and the senate;
- the justice body: all the judiciary system composed of judges and magistrates working in the different courts and tribunals.

The president is directly elected by the population; the prime-minister is designated from the leading coalition of the national parliament, and the senators are indirectly elected by the MRPs. In the case of presidential impeachment, the president of the senate assumes interim leadership.

DRC has a population estimated at 65,751,512 Million inhabitants in 2007 [7], and it is about the size of Western Europe. It is rich in mineral resources and has 47% of Africa's forestry [21].

The city of Kinshasa is the economic and political capital of the country and has 6 million inhabitants. The city of Kananga is the capital of the Kasai Occidental region, and during the colonial era, was planned to be the new capital because of its central geographical position. Kananga has a population estimated to 1.5 Million inhabitants [34].

DRC has been through a civil war in the years: 1996 – 1997 and 1998 – 2002.

According to some NGOs [2,8,14], this has left 4 million people dead (approximately 10 times those killed in Rwanda's genocide), destroyed the economy and thrown the country into chaos by looting, massacres and massive violation of human rights.

Presidential and parliamentary elections held in October 2006, after a 4 year transitional period, united all former belligerents and marked the end of the instability in bringing back hope to people wanting to rebuild their country.

Currently the DRC is in a state of need of all forms of resources. Rating among the lowest amidst African countries for economic development, education has been neglected (1% of the 2005 financial budget); transport infrastructure (roads, railways, airports, ports) are in a poor state; approximately 5% of the population have access to phones, 0.08 % to the Internet [ITU], and only 6.48 % of Congolese peoples have access to electricity [21].

### **3.3. Digital divide technical review**

This chapter aims at describing the principal technical challenges the DRC has to overcome to bridge its digital divide.

#### **3.3.1. Network capacity**

Popular ICT applications like VOIP, video-conferencing or web radio, generate high amounts of data which must be reliably transmitted by the network. A network not having this capacity will only suffice to receive email or browse simple web pages whereas more advanced services will experience high latency and great difficulty.

The amount of data a network can carry is called its data rate, or commonly its bandwidth. It is measured in bit/second or Byte/second and their multiples (1 Byte= 8 bits). Each network's underlying technology has a maximum data transmission capacity; dial up is at the bottom of the bandwidth capacity scale while optic fiber is at the top.

High bandwidth networks are commonly called broadband networks, but the clear definition of broadband is not universally accepted, establishing from which bandwidth a network starts to become broadband is still subject to debate. For the European Organization for Commerce and Development of Europe (OCDE), a network starts to become broadband with a bandwidth of 256 Kbps, for the American Federal Communications Commission (FCC), broadband starts at 250 Kbps and for some commercial adverts at 512Kbps.

In this document we adopt the following definition drawn from ITU's definition within its document The Internet of Things [ITU Internet Reports, The Internet of Things, November 2005]:

“A broadband network is a network providing sufficient bandwidth to permit combined provision of voice, data and video, with no lower limit.” This implies that a broadband network should be able to sustain at least applications such as telephony or video streaming over the Internet.

To really benefit from Internet, DRC must deploy a stable broadband network infrastructure that will guarantee operation of all the Internet services at a satisfying QOS.

### **3.3.2. Industrial scientific and medical band (ISM band)**

ITU requested its member countries to keep unlicensed and set aside some of their commercially used radio frequency spectrum to be freely usable by equipments generating radio-waves for industrial, scientific or medical reasons. Some European countries, USA, Canada followed that recommendation while most African countries did not.

In recent years these radio frequency bands have started to be shared with license-free error-tolerant equipments like cordless phones and Wireless Local Area Network (WLAN). Historically these frequencies were chosen to be free because of their unsuitability to carry communication over long distances using the technology available at that time. But the declassification of spread spectrum technology by militaries, which is a technology designed to transmit information over highly jammed or poor quality medium, gave the ISM band new breath. In the mid 1990s, the Institute of Electrical and Electronics Engineers (IEEE) drafted the IEEE 802.11 open standard using spread spectrum for establishing wireless network connections over 2.4-2.5Ghz ISM band. This standard has since been branded WIFI (Wireless Fidelity).

WIFI has been rapidly adopted across the world and has fueled the “citizen's networks” phenomenon. These networks created by interconnection of citizens' WIFI LANs enable users to share internet access (not always) and freely available services such as telephony or video conferencing. In some countries (France, USA, Germany, etc) the popularity of WIFI LANs has been so great that it obliged governments to modify their regulations to accord them more space for an ordered growth.

The citizen's network model poses itself as an alternative to the commercial telecom carrier model in providing users bandwidth at no cost. The only user's cost would be the purchase of a Wireless network card (approximately 30 USD) and an external antenna (50 USD). A non negligible advantage of these networks is that they are broadband from inception without additional charge because they are based on a broadband wireless standard.

Unfortunately countries like the DRC did not adopt the ITU ISM recommendations, which could have set a framework where Congolese citizens'

networks could have germinated. In the DRC spectrum allocation plan there is no mention of ISM bands, and a great part of them has been licensed to commercial ISPs. This has created a paradox: equipment supposed to be used for creating free networks is used by commercial companies billing at prices unaffordable by the majority of the population to the extent that this majority of the population is unable to benefit from ICT.

To make the majority of the population able to access affordable broadband network DRC should adopt ITU ISM recommendation and make available for free a part of its radio frequency spectrum.

### **3.3.3. Technologies used to bridge digital divide**

This section succinctly reviews the technologies available to deploy ICT infrastructures.

Based on the transmission medium, there are 3 families of technologies used to create networks, each technology having its maximum range and bandwidth.

- Wired technology: Ethernet, GIGABIT Ethernet, fiber;
- Wireless technology: WIFI, WIMAX, Bluetooth, UWB;
- Electricity grid technology.

#### **3.3.3.1. Wired technology**

- Dial up technology;
- IEEE 802.3 Ethernet technology, based on copper cable, able to sustain bandwidth from 10Mbps up to 1Gbps on its Gigabit Ethernet version.
- Optic fiber able to provide bandwidth capacity of 1Gbps up to 10Gbps.

#### **3.3.3.2. Wireless technology**

- WIFI: range 500m max, max output 54Mbps, running in ISM band
- WIMAX : range 50 Km max with a max output 70Mbps for the norm 802.16-2004, running in licensed band
- BlueTooth: range 2m, max output depending on version, running in ISM band
- Ultra Wide Band: running in ISM band

#### **3.3.3.3. Power line over Internet**

Power line over Internet is a technology enabling to create LAN within houses using the electrical network as medium. In this type of LAN, a power line over the Internet adapter has on one edge a power outlet plugged into the power line and on the other edge an Ethernet cable to be plugged into the computer. The LAN connects all computers within the

house and cannot go beyond because it uses multiplexed signals unable to go through the house's electricity meter. Improved versions of power line products should be able to use the public grid as a medium and are under test in different parts of the world. If these tests are successful it would provide opportunity to connect a far greater number of households to the internet at low cost.

DRC's network deployments should favor low cost high bandwidth solution like wireless WIMAX and WIFI because the investments necessary for wired technologies would oblige higher selling cost that will exclude a great part of the population.

### 3.3.4. Bringing the Internet to the End User

This section details how internet is brought to the end user from its international backbone.

INTERNET SPEED EXPERIENCED BY ICs	
Medium	66
Slow	22
Fast	10
Don't know	2
	100

ICs WITH STABLE INTERNET CONNECTIVITY
83%

Table 4: Internet speed and stability experienced by ICs. [source: Internet cafes survey]

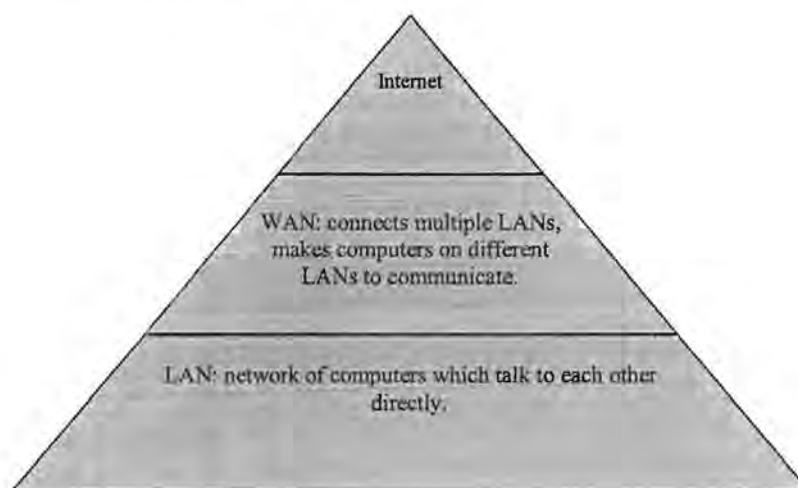


Figure 1: Simplified Internet hierarchy schema

The Internet is an interconnection of small networks made via the Internet backbone. Structurally the Internet is like a pyramid having:

- at the bottom the user connected to his home or office LAN;
- above, the home/office LAN connected to its Internet Service Provider (ISP) network;
- in the middle, the ISPs connected to its Network Service Provider (NSP). Among such NSPs are UUnet, TelKom, IBM, France Telecom, British Telecom, AT&T, and others
- At the top, NSP' networks are interconnected to each other via Network access Points (NAP). Big NSPs have Metropolitan Area Exchanges (MAEs) which are similar to NAPs but are privately owned.

Each NSP must connect to at least 3 NAPs. It is at the NAP level that packets can travel from one NSP's network to another. Originally, Internet Exchange Points (IXs) were only NAPs. Currently we have both NAPs and MAEs referred to as Internet Exchange Points or IXs.

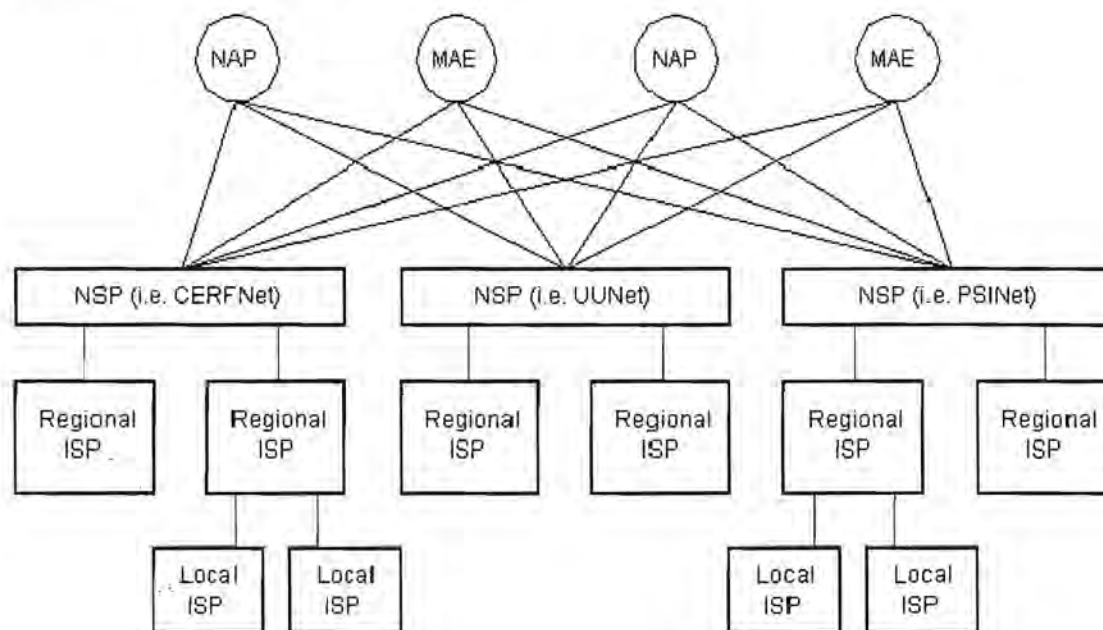


Figure 2: Detailed Internet hierarchy schema

[reproduced with the accord of Rus Shuler, How does Internet work [http://www.theshulers.com/whitepapers/internet\\_whitepaper/index.html](http://www.theshulers.com/whitepapers/internet_whitepaper/index.html), accessed on July 29, 2007]

In a country like the DRC the scheme is simpler and ICT infrastructures are basically composed of:

- Infrastructure for connecting to an Internet exchange point (IX),
- last mile equipment to connect ISPs to users' homes or offices

- LAN Infrastructure for distributing the connections within offices and homes.

In the DRC the only way ISPs connect to IX is via VSAT satellite connection which approximately in its entirety costs 15 000 USD to install for 1-8m dish and 2 000 USD for 1.2m dish. The monthly fees range from 200 USD to 1 500 USD or more depending on the type of the subscribed contract.

Last mile equipment used by ISPs to distribute connections to homes or offices is mainly WIFI and WIMAX except for one company which has started to use fiber to home in the capital Kinshasa. ISPs charge on average 500 USD for installation and setting up of the equipment and a monthly charge from 100 USD up according to the number of PCs connected and the subscribed contract type. LANs use inexpensive equipment with switches available from 50 USD and Ethernet cables from 1 USD per meter.

From the above information it is clear that only big companies can afford a VSAT terminal and ordinary citizens must look to ISPs, but these also offer prices far beyond the capacity of the majority of the population.

### **3.3.5. Africa and DRC's Interconnection with Internet**

Africa has one physical connection to the internet backbone via the South Atlantic 3/West Africa Submarine Cable(SAT3/WASC) which is itself a part of the SAT-3/WASC/ South Africa to East Asia (SAT3/WASC/SAFE) submarine cable system, where the SAFE submarine cable connects South Africa to East Asia.

The Europe-Africa part of SAT3/WASC/SAFE has 15 landing points: Portugal(Sesimbra), Spain (Chipiona), Spain (Alavista), Senegal (Dakar), Côte d'Ivoire (Abidjan), Ghana (Accra), Benin (Cotonou), Nigeria (Lagos), Cameroon (Douala), Gabon (Libreville), Angola (Cacuaco), South Africa (Melkbosstrand), South Africa (Mtunzini), La Reunion (St. Paul), Mauritius, (Baie Jacotet).

Another submarine cable is under negotiation: the East Africa Submarine cable System (EASCS) planned to connect 7 east Africans coastal countries to South Africa. DRC, which has only Very Small Aperture Terminal (VSAT) satellite system for connecting to the Internet backbone, is planning to enter the consortium driving the project.

While negotiating with EASCS consortium, DRC should connect to SAT3/WASC/SAFE submarine cable via one of its neighbors having a landing point. It will decrease the Internet cost which is very high using VSAT.

### 3.4. Discussion on application of ICT

This section discusses the African use of ICT and what affects it from an African perspective.

We start this discussion with a few simple statements:

- ICT stands for Information Communication Technologies. It is a branch of computer science and engineering which specializes in electronic ways to facilitate communication;
- ICT did not create communication: people have always communicated and so will continue;
- People can communicate without ICT, for instance traveling to see a person, sending a letter, calling;
- ICT needs electricity;
- ICT needs a computer;
- ICT is not essential for the life of a person as there are more basic needs.

These statements balance the importance of ICT, and may be stating the obvious for a western citizen, but may be more subtle to citizens of a developing country. ICT needs fundamentally 3 things: electricity, computers and network connectivity. In the DRC only 6.48 % of the population has access to electricity, which shows that the potential market of ICT is negligible. Moreover, out of this 6.48% very few have ever seen a computer and most of them live under the poverty threshold. We can easily understand from the above why ICT is not the most pressing of the issues government attempts to address, and why populations don't see it as an issue that matters.

ICT could potentially ease and diminish communication costs, but it is dependent on infrastructures and devices which must be paid for, either by government, individuals or the private sector. All these actors must first perceive a social or economic benefit (we will call them economic factors) for investing in it. But these potential investors are in a relatively reserved position: The government is struggling with multi-faceted population-based problems while the private sector remains skeptical of the eventual return on its investment. Furthermore, the rapid roll-out of the GSM and GPRS network over the main cities of the DRC substantially filled a communication need and made individuals wonder about the measurable added value that big ICT infrastructure could bring.

Another aspect important to ICT in developing countries like DRC is the willingness of the population having access to ICT to actually use it. Reviewing the literature, it seemed that implications of the economy, education and regulation of the use of ICT are more often emphasized and discussed than aspects such as access to electricity, human rights, democracy, good governance, social realities (we will call them willingness factors), which are largely left out.

Most of the studies looking at the digital divide focus on building infrastructure, satellite connectivity, regulations, creation of cyber centers, funding initiatives, economic model and productivity. Very few assess the use of existing infrastructure and its impact in their societies. Questions such as : "Why did so many initially funded cyber centers and ICT projects disappear as soon as their funding ceased?" are seldom answered in the literature. One answer could be that in areas where installed, these cyber centers or ICT projects did not constitute either a social or economic benefit for their population and so did not encourage them to continue to pay for their use. These projects were doomed since their inception as they did not account for willingness factors and stressed only financial and technical factors.

According to financial and technical factors, the ICT problem assumes that once the legal framework is grounded, and the infrastructure set and people are taught to use it, people will rush and widely use freshly installed cyber centre. Infrastructure, legislation, technology are important but the persons who must use them and the persons for whom these three items were created are even more important.

Willingness factors define the environment and the population's mindset where the ICT sector evolves, and are key factors for adoption and wide use of ICT. Ignoring these factors increases the risk of planning solutions not fitted for the intended audience. To really have an impact, an ICT solution must account for all aspects (social, economic, and technical) and address them together; otherwise it could result in a waste of precious time, money and hope.

A successful ICT policy should first understand why people don't use existing infrastructure; not only because of cost and availability of the service but also in terms of social willingness, stereotypes and urban legends.

### **3.5. Economical and Social Parameters influencing digital divide**

Complementary to the pure technical approach for bridging the digital divide, economical and social aspects are important influencers to be considered. There is a string of technical prerequisites and human competencies needed for a good appropriation and use of ICT: income, power availability, Internet standards appropriation (domain name, ICANN, management of IP addresses,...), regulatory mechanisms (ISP licenses, VOIP licenses, ISM usage regulation...), education (ICT awareness, PC usage ...).

Examination of these topics is the aim of this section.

### 3.5.1. Income

Money is required whether to buy a computer and all equipment necessary to get connected or at least for access at the cyber centre. If your income barely enables you to fulfill your primary needs ICT would be a neglected budget post. This situation makes it clear that since his economic situation is not improved it would be difficult for the average Congolese to spend money on ICT related activities.

### 3.5.2. Human rights condition

In the 2006 list of failed states, the DRC is ranked as number 2. A failed state is by definition a state incapable of maintaining a monopoly on the legitimate use of physical force within its borders (e.g., through the dominant presence of warlords, militias, or terrorism); this makes the very existence of the state dubious [11].

The DRC, now out of 5 years of civil war, continues to face attacks by rebel militia within its eastern provinces. According to MPs [Roger Lumbala commission's report on Kahemba incident] a part of the DRC in the district of Kahemba rich in diamonds has been invaded by Angola since January 2007. Political opposition now keeps a low profile after repression on its militants and exile of the main opponent after his guards clashed with presidential guards on the streets of the capital.

The judicial system is deemed largely corrupted by the MPs [Matenda's commission's report on management of electoral bone of contention by the supreme court] and the "conseil superieur de la magistrature" [high council of magistracy] acknowledged this fact in putting the blame on MPs for not diligently passing judicial reform laws, and allowing the judge to work unpaid for years [Conseil superieur de la magistrature letter to president of parliament].

In this situation the Congolese citizen is in a position where one's own physical integrity is not clearly guaranteed and one's future uncertain, which negatively affects his receptive response to everything that does not fall within the category of primary needs.

Failed States 2006 (2005 ranking in brackets):

1. Sudan (3)
2. Democratic Republic of the Congo (2)
3. Côte d'Ivoire (1)
4. Iraq (4)
5. Zimbabwe (15)
6. Chad (7)

7. Somalia (5)
8. Haiti (10)
9. Pakistan (34)
10. Afghanistan (11)

Table 5: Failed States ranking  
[source: Fund for Peace [11]]

### 3.5.3. Electricity

ICs WITH UNSTABLE ELECTRICITY SUPPLY	ICs USING GENERATOR IN CASE OF ELECTRICITY FAILURE
90%	74%

Table 6: Internet cafes having access to stable electricity  
[source: survey ]

DRC has the highest hydro-electric potential in Africa. The falls of Inga, on the Congo River, have the potential to produce electricity for all of southern-Africa, part of Europe and the Middle East [10]. Despite this potential, only 6.48% of the population of DRC, have access to electricity [10]. These 6.48 % live in the major cities of Kinshasa, Kisangani, Lubumbashi, Matadi, Bukavu and Goma. Over the whole DRC only 1% of all rural areas have access to electricity [21]. Inside served cities the electricity coverage is unevenly distributed; downtown and residential areas remain privileged while the suburbs are less fortunate. Furthermore people living in these areas face power failure constantly. It is not rare to have areas experiencing power cuts for 2 weeks continuously.

For the city of Kinshasa out of 6 million inhabitants 40.67 % of them [21] have access to the erratic electricity supply of the governmentally owned Société National d'Electricité (SNEL). This situation is not caused by the quantity of electricity in demand by the city, which does not exceed supply, but by the lack of transformers to redistribute the electricity to end users. The few still in operation are overloaded.

The obsolete power supply service inherited from colonial times, the incorrectly maintained power grid built by SNEL, and the lack of investment on infrastructure to extend capacity to cope with the growth of the population and the economy make the power supply in the city of Kinshasa a serious problem.

The city of Kananga is not interconnected to the national grid. It had in the past its own hydro-electric plant that is now broken for years. Currently the SNEL and national railways company have each a fuel plant that, when the fuel is available, supply power to a small part of the downtown area (600 houses connected to SNEL network by end of October 2007) and the train station at Kananga

complex, which is one of the biggest in the country. These two agencies randomly, some days, provide electricity in some areas for one hour or two.

Some private electricity providers tap into the power market and sell electricity from their generators to their neighbors for 30 USD deposit and 50 USD monthly fees. Usually the service is provided during the intervals of 6-8AM and 6-10PM. Big Companies have managed to have their own fuel or hydro-electric power plant.

The ICT usage corresponds to the electricity coverage and it depends on its extension to grow.

Electricity is one of the main causes of the horizontal divide within DRC.

#### **3.5.4. Education**

In this section we will look at how ICT training is provided in DRC's educational system which is in a poor state because of the civil war which closed schools and made it difficult for the government to decently pay teachers and university professors.

##### Primary and High school

The primary and high school sectors are particularly affected by the overall bad health of DRC. Some public high school teachers receive a monthly pay of 25 USD and all good schools have fees far beyond the capacity of the normal civil servant to pay. For instance one of the most prestigious private school of Kinshasa, "Le loupot", demands for 900 USD per year in school fees whereas the highest paid civil servant the "secretaire generale" of administration is paid 300 USD per month.

At primary and high school, IT awareness courses are available only at private schools or schools having support of NGOs.

##### University

We have visited the Universities of Kinshasa and Kasai respectively the biggest university in the DRC and the only university in Kananga.

Professors at university are paid approximately 500 USD by government plus a variable amount from their respective institution, based on grade, ranging from 250 USD to 500 USD, which is drawn from the student fees. This low pay does not motivate professors and pushes some of them to seek extra money from their students.

In the city of Kananga it is believed that this situation is widespread, known and accepted by the population and authorities. Ladies are said to be more affected, as it has reportedly become common for them to be in positions where the lecturer threatens that if they do not give them money or sexual favors, they will fail their course. Married women are said to send their husbands to see the academics to explain to them their marital status and to beg them to take money and leave their wives in peace.

At the University of Kinshasa, IT education is good despite the lack of computers and sufficiently qualified staff. The staffing issue came from the fact that the majority of the staff sent abroad by the university for Msc and Phd studies, never came back fearing the disastrous economic situation and instead accepted appointments all over the world.

The University of Kinshasa (UNIKIN) cooperates with the University of Leuven in Belgium under the "University Backbone project" that aims at increasing university IT infrastructure and staff training. The project financed two VSATs, Pcs, network equipment and IT training. UNIKIN houses a CISCO networking academy where students can be trained in networking, using CISCO equipment, at the cost of 500 USD for the 4 modules leading to certification. This cost keeps a class of students aside.

The Agence Universitaire de la Francophonie ([www.auf.org](http://www.auf.org)) at Kinshasa "Campus numerique" (<http://cd.refer.org>), is doing remarkable work in IT awareness and training, favoring the open source approach. In return for the training, participants must engage to be trainers themselves if the "campus numerique" needs them.

At university of Kasai In Kananga, the level of IT education is very low, all the courses given merely focus on Microsoft Windows and Microsoft Office suite. Within the city of Kananga there are small centers giving the same courses with fee costs ranging from 10 USD to 50 USD.

In general ICT Training fees vary from 5 000 USD for Microsoft Certification, to 500 USD for Cisco certification, to between 40 USD and 10 USD for an Internet initiation session.

Education guarantees that a society has the required knowledge to master and enhance ICT; it also guarantees its independence for finding solutions to its own problems. It should be a major part of a national ICT policy.

### **3.5.5. Internet standards appropriation**

The DRC is not represented in the international bodies governing the Internet; it took 5 years for the government to take ownership and management of the top level domain ".CD". There is no central body managing the delivery of public IP

addresses. To get a public IP address, one must request it from the body in charge of delivering public IP addresses for African countries: AFNIC based in Mauritius. And AFNIC has no correspondent in the DRC. Most of the ISPs using public IP addressees in fact lease them from their satellite providers.

There is a Congolese chapter of the Internet Society (ISOC) but it is little known. The DRC official body in charge of all these matters is the ARPTC, which has been created to look after all regulation of telecommunication and information technology.

### **3.5.6. Content**

To have popularity and success, information provided by ICT must be relevant to the targeted population and must be in a language which that population will be able to easily comprehend.

Average web content production and publication cost in the DRC:

- Web site hosting: 100 USD deposit fees for professional web hosting plus a monthly 10 to 30 USD;
- Web design: from 100 USD going up.

For the majority of the population and entrepreneurs, these prices appear excessive compared to the benefit they can return.

DRC should promote production of local content and give incentive to entrepreneurs to mark their presence in the cyber world.

### **3.5.7. Regulation**

Regulation has a great impact in terms of services available to the population and in terms of business competition modeling. Wireless ICT infrastructure depends on radio telecommunication devices using radio spectrum resources which are internationally controlled by governments.

It is essential that the regulation, in terms of radio resources as well as in terms of business behavior, favors a beneficial use of ICT by the population. For instance in some countries the regulation forbids use of VOIP or strictly regulates the use of certain devices like WIFI equipment or has some anti-trust mechanisms.

In DRC ICT is regulated by two bodies: the minister of post and telecommunication which represents the government and the "Autorité de Régulation des Postes et Télécommunication" (ARPTC), which is an independent authority in charge of regulation of postal and telecommunication services.

The ARPTC was created in 2004, to remediate a conflict of interest: the government owned the Office Congolaise des Postes et Telecommunication (OCPT), competing in post and telecom areas, and was at the same time the arbitrating body of the post and telecom business market.

ARPTC's aim is to frame the role of the government in removing its arbitration role. ARPTC's role is to assure that all telecom and post related societies (both private and government owned) evolve in a fair environment guaranteeing the priority of public interest. ARPTC fixes fees, decrees telecom and post rules, monitors and enforces their application and arbitrates conflict between operators.

Some aspects that a body like the ARPTC should look at are [17]:

- Fair competition and anti-trust: new market entrants must not be denied access by long established incumbents using their market dominant position to practice unfair competition. They may do this by, for instance, keeping prices low while subsidizing their network activities by their other activities. Alternatively they might bundle ICT services with other services where they are dominant and are then able to provide ICT at low cost.
- Interconnection: all operators must allow their infrastructure to be accessible from the infrastructure of their competitors. Operators must interconnect without excessive charges that penalize the end user. Mobile operators must allow calls from internet VOIP traffic to reach their networks.
- Cross ownership: a society possessing infrastructures allowing different technologies and deploying on the market the most expensive and least efficient purely because of an economic interest.
- Universal service: all services which must be available from any operators whatever the cost for the operator to deploy them. An example is the emergency calls.

The regulating body must ensure that commercial companies guarantee that public interest gets priority and don't block any advancement in the implementation of ICT for their own commercial or strategic reasons.

ARPTC is still setting up its operational infrastructure and building up its human resources skill set. It does not look yet at all the aspects enumerated above, primarily because of its lack of sufficiently qualified staff and secondarily because of the low level of development of the DRC ICT sector. ARPTC sent a great number of its staff abroad in training in an effort to fill its human skill set gap, and it is hoped that at their return ARPTC's impact on the telecom area will be more noticeable.

Assessing its current impact on the population, one can not say that ARPTC favors the blooming of ICT in DRC. Some ARPTC decisions or lack of decision has badly impacted the sector. For instance:

- the failure to apply the ITU's ISM recommendation, which precludes creation of citizen's networks;

- the prohibitive fees to buy ISP licenses in the context of the DRC economic market (approximately 250 000 USD). This excludes all local NGOs willing to create low cost ICT distribution networks and allows ISPs to apply high pricing excluding the majority of the population because DRC's perceived volatility pushes them to recover license fees and their investment in the shortest possible time.

Nevertheless, discussions with the Vice President of the ARPTC indicated that ARPTC is conscious of the issues and that it tries to address the situation and review the contracts it has inherited from the time there was no law and no common willingness to push ICT use for the population.

### **3.6. Current Impact of ICT in DRC**

#### **3.6.1. Society**

ICT impact on the DRC's society is marginal because of its limited ability to spread due to all the causes highlighted in preceding paragraphs. The western cultural environment where the need for information is expressed by the diversity of newspapers and magazines and the continuous search and discovery for new outlets in ICT is not reproducible within the DRC; where the press sector is in deficit and the quality of news often subject to doubt. The current situation reflects the fact that the people of the DRC have few means and no reason to go into cyberspace.

#### **3.6.2. Economy**

According to different studies it has been clearly shown that ICT has a beneficial impact on the economy mainly through an increase in productivity.

In the DRC, ICT potential to boost the economy is seriously challenged. Few companies have introduced ICT in their operational strategy, except in telecom, multinational and foreign owned companies whose activities depend largely on communication with the outside world. DRC enterprises are largely still at the paper era using computers only for word processing and spreadsheet financial operations. The most advanced of them have Ethernet LAN to share a printer and an Internet connection (if available). Corporate email service or web servers are largely unknown; most organizations still use yahoo, hotmail or other free web email services

The DRC's marginal Internet penetration with few connected people makes eCommerce, VOIP and other Internet related business non-existent. Lack of reliable postal service for delivering goods to clients and a poor banking system, with credit cards having been introduced only recently and currently not widespread, only reinforce that situation.

Nonetheless, raising awareness of organizations on the importance of incorporating ICT in their strategies for increasing productivity will catalyze the growth of an embryonic ICT consulting and service industry. Existing DRC ICT companies provide services for: hardware maintenance, ICT training, Microsoft products and UNIX support for telecom and banks (only one Lebanese owned company provides UNIX support).

According to most of the ICT companies we contacted the development of software and complex IT solutions are not profitable yet. It is mainly training, support and maintenance of well known brands (eg. Microsoft Active Directory, Microsoft Exchange and ISA servers, CISCO routers and switches) that are marketable; however some companies are trying to create the need for ICT and have met with some success, for instance, the Inter-bank communication system which has been designed by a Congolese company.

### **3.6.3. eGovernment**

The public administration is poorly equipped in terms of ICT infrastructure. There is no governmental network linking all the governmental organizations, no central governmental web portal, no intra governmental email system, and the number of computers is insignificant compared to the number of civil servants.

The ICT administration must be built from scratch in terms of computers, ICT infrastructure and skilled human resources.

An interesting e-governance experiment was conducted during the 2007 presidential and parliamentary elections. The Independent electoral commission (IEC) made available for download all the forms and application material for presidential and MP candidates, and then proceeded to publish online the results of the elections. Though there were allegations of errors and manipulation of results that tarnished the experience and lowered people's confidence in the results, it proved successful to the public in decongesting IEC offices and exposing the population to the utility of ICT.

There are several projects under discussion for establishing a governmental intranet and building human competencies, but at this stage the technical details and feasibility of these projects are still unclear.

### **3.7. Open technologies and the digital divide**

The open movement, including open source software, open standards, open bios, open university, etc, is coming from different (sometimes divergent) motives:

- Commercial benefit, overall economies of scale and cost reduction from manufacturers who want to invest less in research and development and ensuring inter-operability of their material by adhering to open standards;

- Ideological and idealistic motives, namely access to knowledge must be free: open source software, open university;
- Mix of the above and indecipherable motives: open bios, open motherboard.

Despite their divergent original intentions, all these open initiatives, by being open, which means all their details are available for anybody and can be reproduced and improved upon without paying any royalties, are good opportunities for developing ICT sectors of countries like DRC. These initiatives enable people to build on previous knowledge without reinventing the wheel and to secure technological independence in using technologies not bound to any particular manufacturer or country. However, to benefit thoroughly from the open movement a change of mindset is necessary for shifting from a technology consumer mindset to a technology creator mindset.

The paradox of the open movement is that it could itself create a divide between populations having enough technical skill to understand raw technical information available and appropriate that knowledge and populations just using the open movement product and being dependant on others for special customization. A well thought-through education effort, at the level of the country, is necessary to create the critical mass of skilled people able to build upon the open movement.

It is worth noting that open movement does not mean free movement. The idea behind it is that the knowledge and information are free, but certain ways of using the knowledge and certain services related to the use of that knowledge are not free. For instance, the open source movement has different types of licenses circulating, each detailing how the source code of the software can be redistributed and customized. Some allow free redistribution and require free redistribution to the community of the eventual improvements made to the original source. Others do not require free redistribution of improvements made to the original source code. Some communities make available their software through an open source license but charge for its maintenance/support; others propose development by the sponsoring of certain tasks one would want the software to do. As we can see there is a lot of creativity on the different ways money and the open source movement collaborate.

Massachusetts Institute of Technology (MIT) Open University is another useful open initiative. It makes available for free all MIT faculties' educational materials, enabling students and professors from less privileged educational environments to review them and benefit from one of the most prestigious universities in the world.

## **Chapter 4. Conclusions and Recommendations**

### **4.1. Responses to the research question**

At the completion of this thesis we can get back to our original questions and with the experience gained during the research try to answer them:

1. Can bridging digital divide in DRC really sustain its development?

Response: After undertaking this research we do not think that bridging the digital divide only can sustain DRC's development. ICTs are a part of the solution but for them to be decisive they must be taken for what they are: means to ease communication between people and facilitate data flow within companies.

2. What real effects does the digital divide have on the economy and sustainable development of a society?

Response: The digital divide, which according to our definition is the lack of ICI, affects directly the capacity of companies and individuals to manage and exchange information. It can lower their productivity and makes them competitively disadvantaged compared to ICT enabled competitors. The sustainable development of a society can be reinforced by efficient channeling and exchange of the information it generates through ICT and making it available to the intended people.

3. What slows down bridging of the digital divide in DRC?

Response: The will of authority that does not handle the digital divide in its all complexity. The following section gives my summary of the causes stalling closing of the digital divide and recommendations to overcome them.

### **4.2. Recommendations**

For a country like DRC a pure technical approach of bridging the digital divide is unlikely to win because of all the economic and social factors currently influencing the use of ICT.

The following recommendations and findings derive logically from the data collected and analysis carried out:

- Human rights, good governance and economic welfare allowing citizens to feel comfortable in their land, not oppressed and with sufficient funds to use ICT must be of the utmost importance.
- Reliable electric power; which is the main technical factor limiting the use of ICT, must be made available at a reasonable cost to population.

- ICT education to have skilled ICT specialists able to propose a locally adapted ICT solution to people's needs must be one of the goals of national education policies.
- Social awareness, campaigns to explain, to show and to train people to use and benefit from ICT must be conducted all over the country;
- Government must promote open source and use it extensively for its own network.
- Government must lead by example in fixing its own ICT infrastructure to be used as a baseline for further e-governance activities;
- Regulation must be adapted to assure public interest is maintained by ICT operators and adapted to unlicensed ISM band, for favoring "citizen's networks" initiative.
- Government must directly or indirectly lead the building of a nationwide backbone infrastructure and its interconnection to international submarine fiber cable.
- Government must revive the national statistic agency because statistics are essential to assess the current situation and plan the future.

As we notice all these actions can be taken only at a government level, and it is clear that it is the duty of the government to set a viable frame where its citizens are in a position to really benefit from ICT activities.

A solution path to explore could be to create an NGO that will sign a partnership with a local community and will look globally at how to attend to all the problems described above. Specifically, these include: looking for alternative cheap power solution (pico- hydroelectricity, bio-mass, solar, etc), setting up IT awareness and education programs for schools and the general population, and helping in the creation of e-governance policies for the community's administration.

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38. Fon: <http://www.fon.com>
39. International Crisis Group: <http://www.crisisgroup.org>
40. MIT Open Course Work project :<http://ocw.mit.edu/>
41. Universal Powerline association : <http://www.upapl.org>
42. Wikipedia <http://www.wikipedia.com>
43. ZD net : <http://www.zdnet.com>

## Appendix A Questionnaire

The questionnaire was written in French as it is the languages spoken in DRC, for the reader an English translation is given between parentheses.

### Formulaire d'enquête sur l'utilisation de Internet au Congo

- 1) Nombre de Machines? (Number of PCs?):
- 2) Avez-vous une imprimante? (Do you have a printer?):
- 3) Les machines ont elles des écouteurs et micros? (Do the PCs have microphones and speakers?):
- 4) Utilisez-vous la téléphonie sur Internet? (Do you use Voice over IP?):
- 5) Avez-vous reçus une formation en Internet et ordinateurs? (Did you receive training in Internet or on PC maintenance?):
- 6) Faites vous aussi la bureautique? (Do you provide office services?):
- 7) Faites vous aussi des formations? (Do you provide training?):
- 8) Si oui quel genre de formation faites vous? (If yes which kind of training do you provide?):
- 9) Depuis combien de temps existez-vous? (How long have you been operating?):
- 10) Quels sont vos tarifs? (What are your tariffs?):
- 11) En moyenne combien d'utilisateurs recevez-vous par jour? (How many users do you receive on average per day?):
- 12) Combien de temps en moyenne vos utilisateurs passent sur Internet? (How much time on average do your users spend on the Internet?):
- 13) Que font vos utilisateurs sur Internet? (What do your users do on the Internet?):
  - a. Email :
  - b. Chat:
  - c. Recherches (research):
  - d. Divers (film, adulte):
- 14) Combien payez vous votre connexion Internet? (how much do you pay for the Internet):
- 15) Avez-vous une connexion Internet rapide ou lente? (Is your connection fast or slow?):
- 16) Votre connexion Internet est elle stable? (Do you have a stable Internet connection):
- 17) Est ce que le courant est stable? (Is the electricity supply stable?):
- 18) Que faites vous en cas de panne de courant? (What do you do in case electricity goes?):
- 19) Qu'est ce qui freine le plus votre business? (What limits your business the most?):