Devices to access Internet in Developing Countries

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ABSTRACT

In this paper, we present the multiple options of devices to choice to access Internet in Developing Countries. We select four basic features to classify them: Price, Usability, Power supply and Operating conditions and we consider the relative suitability of those devices in respect of these features.

We also present the different data communication links that might be used with some or all the mentioned devices to complete the Internet service. To conclude we propose some future paths of research.

Categories and Subject Descriptors

A.1 [**General**]: Introductory and Survey.

H.4.3 [**Information Systems Applications**]: Communications Applications – electronic *mail, information browsers.*

K.4.m [**Computers and society**]: Miscellaneous.

K.8.1 [**Personal computing**]: Application Packages – *data communications, freeware/shareware.*

K.8.2 [**Personal computing**]: Hardware.

General Terms

Design, Economics, Human Factors.

Keywords

Devices, Terminal, Ultra low cost handsets, One laptop per child, Internet access.

1. INTRODUCTION

Last 3GSM World Congress in Barcelona, Spain, has left plenty of impressions on communication services in Developing Countries. One of the most interesting comes from Mr. Simon Beresford-Wylie, CEO designate of Nokia Siemens Networks: "(he) said that of the next two and a half billion new users expected to be added within the next decade, 90 per cent to 95 per cent will be in the developing world - and they won't necessarily be on GSM or CDMA and its successors. (…) We think here in Europe the predominant mobile carriage will be the HSDPA/ LTE path. In countries like India, that's not necessarily the case - where operators are spectrum constrained, there probably will be demand for WiMax."[1]

This means that this new market is open to competition. This it is partially due to the quoted spectrum issue - related with cost of the service - and partially due to the need for widespread browsing and e-mail. This last need has been repeatedly reported by institutions as important as the GSM Association Development Fund [2].

A key battle between service providers will be fought on customer's hands to put the right terminal there to obtain a loyal market share. We will focus in this paper in the apt devices to access Internet, which ranges from a computer with broadband connectivity to a modern cellular handset. For instance, if you want to use e-mail you will be tempted by last generation handsets, PDAs with Wi-Fi or GPRS/3G, Nintendo DS and SONY PSP with Wi-Fi, laptops with Wi-Fi or GPRS/3G/HDSPA (integrated or in a PCMCIA) and the usual home PC with xDSL. Ironically, this diversity of devices and links is being named "Convergence".

Not all of them are equally suitable for Developing Countries and especially for those on their low incomes. We will study this aspect of the user equipment starting form this introductory paper.

We will firstly select the basic characteristics to consider in a device, after that we will describe generic devices grouped in a few categories and generic communication solutions. We will conclude with the key questions to answer or developments to make in order to foster the widespread access to Internet terminals.

2. KEY FEATURES
2.1 Price

The adoption of new features of Mobile Telephony in Developed Countries has been always driven by the decrease in the cost of terminals including such feature. In Developing Countries, this is likely to be the same but aggravated by the slower replacement rate of terminals due to the low income levels.
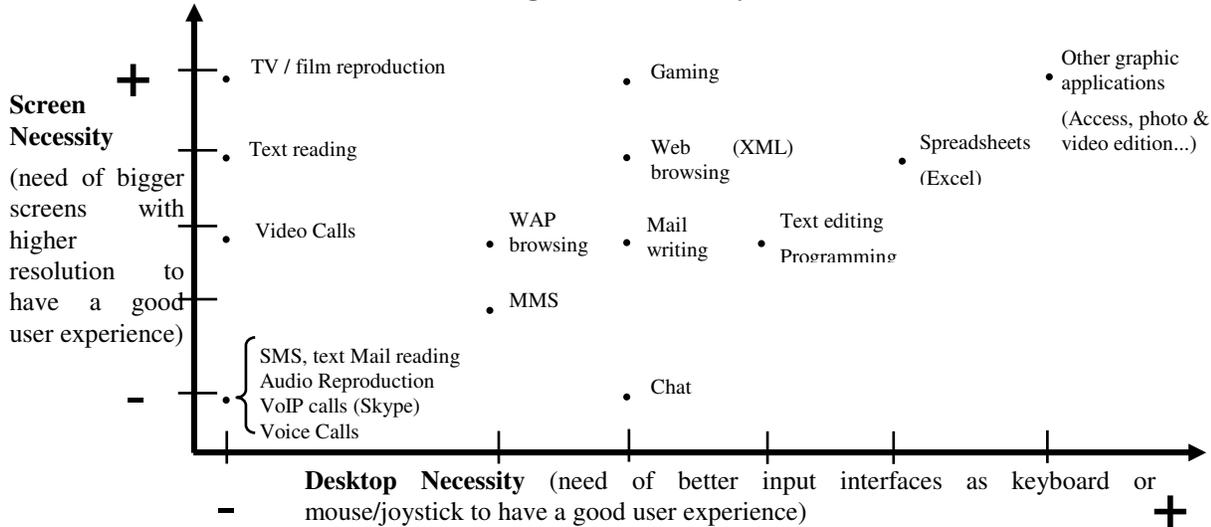
As with the other features, we will consider the relative price between devices instead the actual price because we consider that this ratio will be more stable in time.

2.2 Usability

Lack of comfort is one of the causes to the slow rate of adoption of mobile data services in Europe. Only those with the most advances devices (laptops with data cards, Blackberrys and the likes) are consistently using e-mail and browsing in mobility.

We have described in Figure 1 the relationship between the necessity of having a better screen, in size and resolution, and a better keyboard and mouse in respect of the use given to the

Figure 1: Usability and uses

Screen Necessity (need of bigger screens with higher resolution to have a good user experience)

TV / film reproduction · Gaming · Other graphic applications (Access, photo & video edition...)

Text reading · Web (XML) browsing · Spreadsheets (Excel)

Video Calls · WAP browsing · Mail writing · Text editing · Programming

MMS

SMS, text Mail reading
Audio Reproduction
VoIP calls (Skype)
Voice Calls

Chat

Desktop Necessity (need of better input interfaces as keyboard or mouse/joystick to have a good user experience)

device. Natural Interaction interfaces are not specifically considered in this diagram and they are included as a feature that will change the current paradigm of desktop.

Illiteracy in the dominant languages in user interfaces and Internet contents is another aspect affecting the usability. Again, Natural Interaction seems to change the landscape but simpler solutions as icon-based applications are accepted workarounds.

Considering only the needs of browsing and e-mail, we understand rapidly why there is so much discussion about the proper device to provide them: they are in the middle, exceeding the capabilities of an average mobile phone and wasting the ones of a desktop computer.

2.3 Power supply

It is usual to consider that the device will have to work without a stable power supply. This implies that we should consider the presence of batteries, the consumption, the protection of the circuitry against power outages and the robustness of the operative system and applications against unexpected crashes.

2.4 Operating conditions

The temperature and humidity in Developing Countries, and especially in the homes of the people with lowest incomes, are far beyond current specifications for most of the devices considered. Dust and corrosion are other challenging elements to keep in mind when selecting devices to distribute in such countries.

3. DEVICES
3.1 Laptops

The goal of the non-governmental organization (NGO) One Laptop Per Child is to offer a laptop in Developing Countries for 100$ [3]. This NGO has recently release the 2B1 model with colour LCD screen, WiFi capabilities and an autonomous power supply alternative. They are currently debugging the software, which is included in the price, and they plan to deliver up to 6 million units to several governments of Developing Countries.

Some alternatives to the 2B1 are the Eduwise model from Intel ranged in the 300-400, the Personal Internet Communicator form AMD, not commercialized yet, and the plans of the

Taiwanese microchip manufacturer Via and the Korean Telecom company KT to offer similar products with probably lower prices.

Usability of these devices will be fair good, nearly as good as with a desktop computer, with an increase in flexibility for power and environment conditions.

3.2 PDAs, Smartphones, Ultra Mobile PCs and the like

All of them are considered techie gadgets for the early adopter except the unsuccessful experience of Simputer as a "low cost portable alternative to PCs" [4]. They will probably remain in the future in the highest price range of all the devices considered, being quite delicate to work in harmful operating conditions.

As good points, they count with battery and low consumption components. Their usability is greater than the basic mobile phones but worst than devices with bigger screens and keyboards.

3.3 Modems and desktop computers

The original fixed modems are an idea that has been renewed in several projects to provide shared access to Internet through wireless data links to a small network of computers.

In addition, the original device to access Internet is becoming cheaper and cheaper, for instance, the Indian company HLC Infosystems and the Chinese company IHT have crossed the barrier of commercialising desktop computers by less than 200$, screen not included.

Other method to reduce costs is to connect several workstations (screen, keyboard and mouse) to a single computer running linux, as the Nivo developed by Ndiyo or the Desktop Multiplier by Novell.

All these devices are logically the most adequate for accessing Internet content and services - Internet is designed for them. On the other hand, their requirements of power and operating conditions are among the most restrictive ones of the devices considered.

3.4 Mobile phones

These devices are the cheapest among the considered in this paper and they will tend to remain in this position for two main reasons: the important second hand market of outdated but fully functional handsets from Developed Countries to Developing ones, and the Emerging Market Handset (EMH) Programme of the GSM Association to offer a handset for less than 30$.

The power necessities and working conditions are in general the less restrictive of the range of devices considered. On the contrary, they are clearly the worst in terms of usability.

Table 1. Relative ranking of key features of the devices

Device	Price	Usability	Power	Conditions
Laptops	3	2	3	2
PDAs	4	3	2	4
Modems&PC	2	Best	4	3
Mobile Phones	Best	4	Best	Best

4. COMMUNICATIONS

The discussion on price needs to be completed by the analysis of which data link will offer the best deal. In these lines we will present the possibilities and in future research we will address the business case comparison.

The predominant communications in Developed Countries used to access Internet are the xDSL fixed lines but they are generally unavailable in Emerging Countries. Older options, as the modems using the voice bandwidth at 56 Kbps, are cheaper and with wider availability.

The wireless options starts with the family of standards named WiFi, working in an unlicensed frequency band and providing generally 11 or 54 Mbps. They are very successful because of the impression of free communications once invested in hardware. In fact, standard USB WiFi plug-and-play devices can be used to link stations at up to 25 Km of separation with the aid of parabolic reflectors [5] or modifying the MAC protocol [6].

WiMax, a future version in a licensed band, will probably do not have the same feeling of freedom, but in any case it is considered a feasible option if we accept the words from Mr. David Taylor, director of strategic operations high-growth markets in the mobile devices division at Motorola Inc., in the 3GSM World Congress 2007: "We will see some operators in emerging markets upgrade their cellular networks to support lower-speed data services such as e-mail, but there is a very strong case for deploying WiMax to provide high-speed Internet services in these regions". The standard foresees connections at 75 Mbps in distances up to 50 Km.

Other group of options is the point-to-point or point-to-multipoint technologies also known as Wireless Local Loop (WLL). It is a heterogeneous group of often proprietary technologies providing nomadic wireless access at data rates from 1.5 to 72 Mbps at distances up to 16 Km.

GSM and CDMA services have the greater coverage in developing countries and can be used for data communications without upgrading to data technologies but at very low transmission rates up to 14.4 Kbps. The upgrades of these network to GPRS and EDGE multiplies this maximum speed up to 200 Kbps, but it will remain as a "low bandwidth environment", in words of Mr. Ravi Jain [8], comparing with other technologies.

UMTS networks with the upgrading possibilities to HSDPA and HDSUPA really provides a good user experience with fast refreshment of pages and acceptable transferring times; data rates achieve 1 Mbps. The Australian mobile operator Telstra recently reported a successful test at 1.9 Mbps linking places at a distance of 200 Km using special features from Ericsson. [9].

Besides all of them, there are alternative radio links as the old two-way radio, based in AM or FM transmission at low frequency bands and the ubiquitous Satellite links. In both cases the data rates are limited by the nature of the technology in use but coverage is wider than any other solution.

A deepest problem than the lack of last mile links to the data networks exists in Developing Countries: the Internet backbone. It is very limited in its coverage and in its connections to the general backbone hampering the business and social potential of pushing the access to Internet in such countries.

5. CONCLUSIONS

Our future research on devices will discard PDAs and the likes because they are the worst rated set of devices among the studied. All the other options show high potential in specific configurations that can optimize the available data communication links. The Usability of Mobile Phones is another interesting research theme because it is its only feature with a low rating.

Future work will also include the consideration on which communication network is the most suitable for providing Internet access in Developing Countries.

6. ACKNOWLEDGMENTS

7. REFERENCES

[1] Best, J. Emerging markets will split mobile. silicon.com Wireless and Mobile, 15 February 2007.

[2] GSM-A Development Fund 2006 annual report http://www.gsmworld.com/developmentfund/

[3] http://www.laptop.org/index.en_US.html

[4] http://simputer.org/

[5] Pietrosemoli, E. Geometry of Parabolic Reflectors. School on Radio Based Computer Networking for Research and Training in Developing Countries 2005, http://wireless.ictp.trieste.it/school_2005/downloads.html

[6] http://www.intel.com/research/eyecareindia.htm

[7] Jain, R. The Mobile Web in Developing Countries. W3C Workshop on the Mobile Web in Developing Countries 5/6 December 2006.

[8] Australia Gets 200km Wide 3G Cell Sites, Cellular News 13th February 2007, http://www.cellular-news.com/story/21963.php