

# **ASSESSING THE GLOBAL ACCESSIBILITY OF THE INTERNET**

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## **ABSTRACT**

Although the Internet is recognised as having significant and beneficial impacts upon many aspects of life for both organisations and individuals, previous studies have identified significant disparity in the levels of Internet access availability in different countries, particularly in developing nations. This paper presents the findings of an investigation into Internet connectivity and usage in different countries, in an attempt to determine the extent of Internet access, and whether the availability of such technology is considered to be beneficial.

This research considers indicators such as available technology infrastructure and access costs, in order to identify the varying limitations that may be faced in different countries across continents. In addition, the opinions of individuals were sought regarding their typical access methods and level of Internet access, typical services utilized, and the general impact Internet has had upon their activities. A web-based questionnaire was used to elicit comments from 152 respondents from 19 countries, yielding preliminary statistical data to enable the assessment of Internet usage in different countries. Although the results illustrate aspects of the 'digital divide' (whereby some countries have better developed access and connectivity infrastructures than others, as well as a more sophisticated range of Internet uses), they also show a uniform acceptance of the benefits of the Internet, irrespective of technological differences.

## **KEYWORDS**

Internet Access, Digital Divide, User survey.

## **INTRODUCTION**

During the last decade, the increasing adoption of the Internet by organisations and individuals has contributed to our ability to view the world as a global village, reducing the spatio-temporal separation between different regions and enabling various forms of information to be freely and quickly exchanged. This globalisation has had major impacts on virtually all sectors of modern society, including business, education, healthcare, entertainment, and social interactions. As a result, the Internet has come to be viewed as an indispensable resource for economic growth, prompting the attention of individuals, groups and governments all over the world.

Unfortunately, the potential benefits are not uniformly available, and previous studies have indicated that an overwhelming majority of Internet use is concentrated within developed nations – thus adding another degree of separation to that already existing between these countries and other parts of the world. For example, although the global population of Internet users grew from 74 million in 1997 to 513.41 million by August 2001 (Nua 2001), closer inspection reveals that this population is spread very disproportionately. This is illustrated in Table 1, clearly highlighting a problem that is commonly referred to as the ‘digital divide’ (Miller 2001).

<b>Region</b>	<b>Internet users (million)</b>	<b>% of total</b>
Africa	4.15	0.81
Asia/Pacific	143.99	28.05
Europe	154.63	30.12
Middle east	4.65	0.91
Canada & USA	180.68	35.19
Latin America	25.33	4.93
World total	513.41	100

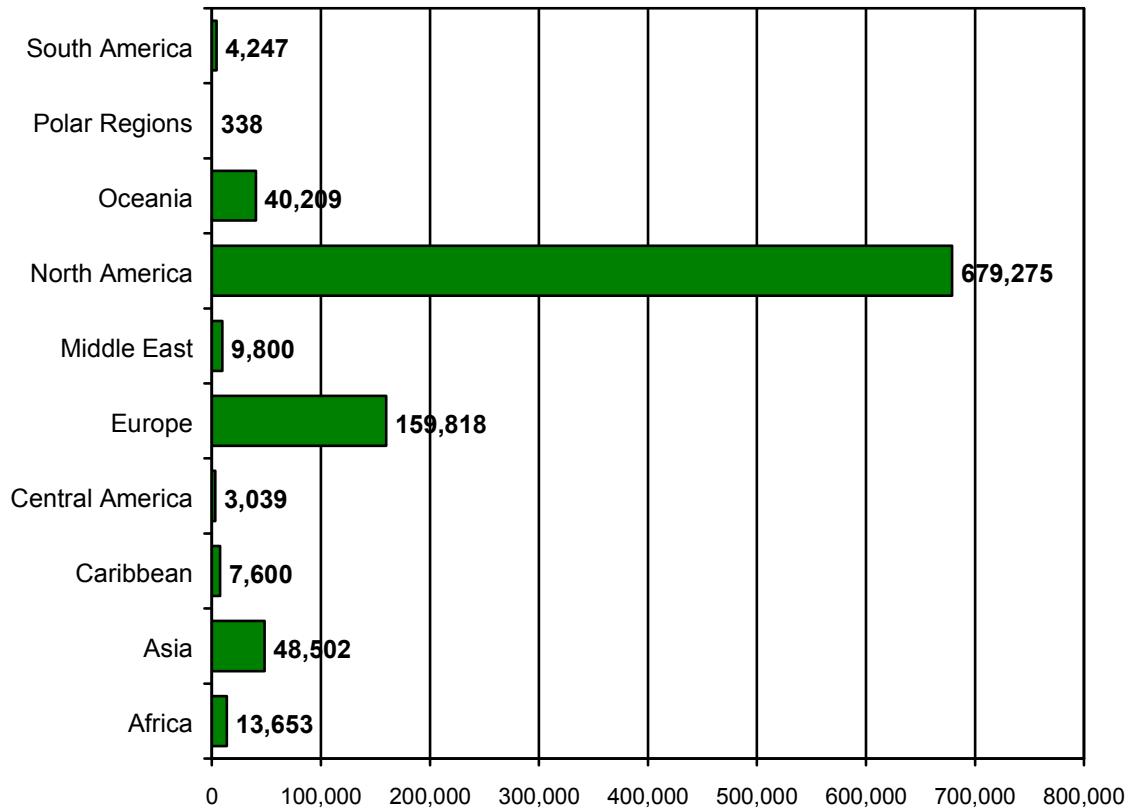
**Table 1 : Online Population by region (source: Nua Internet Surveys)**

Although it may be assumed that Internet is a global phenomenon, the reality of the situation for some countries is that access may either be unavailable or not considered a priority. For those that have access, the availability may not be as balanced or equal as assumed. While 78% of youths aged between 12-24 in Sweden can access the Web from school, and 74% in Canada (Ipsos-Reid 2000), many Universities in Africa do not have Internet access (Jensen 2000), and even when they do, students are sometimes denied access because of high costs of providing computer facilities and bandwidth.

A 1999 United Nations Development Programme (UNDP) report on Human Development describes the Internet as a resource for global development, and notes that the global reach is progressively increasing but in an uneven pattern. To quote the report: “In mid 1998 industrial countries- home to less than 15 % of people – had 88% of Internet users. North America alone – with less than 5% of all people had 50% of Internet users. By contrast, South Asia is home to over 20% of all people but had less than 1% of the world’s Internet users” (UNDP, 1999). Literacy and computer skills are mentioned as contributory indicators, as well as ethnicity and language. English is the major language used on the Internet, whereas only one in ten people worldwide are English speaking. The UNDP report draws two conclusions:

- The complex imbalance of Internet access is such that “the typical Internet user worldwide is male, under 35 years, with a college education and high income, urban based and English speaking –a member of a very elite minority of worldwide”
- The general pattern of development influences Internet connectivity.

Another interesting metric is provided by the online web directory, Google, which presents statistics of the number of web site resources hosted in different geographical regions (Google, 2001). The chart in Figure 1 presents the results as of 5 November 2001, and shows very clearly that web content provisioning is largely dominated by a small number of regions.



**Figure 1 : Web URLs by geographic region (Source: Google)**

The results above do not present a particularly encouraging picture, especially when set against the idealistic view of the Internet as a global enabler. However, to consider only the disparity inherent within the current situation overlooks some significant issues, such as what people in the different regions are actually doing with the access that they *have* got, and whether they find the situation satisfactory from a personal perspective. To this end, the paper will now present an investigation of Internet usage in a number of geographic regions, set against the background of the available technologies in each case.

## A SUMMARY OF INFRASTRUCTURES AND SERVICE COSTS

Before presenting details of peoples' experience with the Internet, it is appropriate to consider in more detail the technological conditions that prevail in different regions, and thereby shape the ability to gain access. As such, issues relating to network connectivity infrastructure and service costs will now be examined. The information presented here was obtained via data collection from appropriate Internet sites in the

target regions. It should be noted that this discussion does not encompass the full range of possible regions previously listed in Figure 1. Specific focus has instead been given to those regions from which responses were received to the authors' web-based questionnaire (described in the next section), namely Africa, Asia, Europe, the Middle East, and North America.

## **Connectivity Infrastructure**

One of the fundamental factors that influences the availability of Internet access within a country is the telecommunications infrastructure upon which it must operate. While developed regions may enjoy a full range of access technologies (e.g. fixed line, cellular and satellite), developing countries may experience a more restricted range of options, which in many cases will be far more sparsely deployed. A metric that is often used to indicate the extent of a country's connectivity infrastructure is teledensity, which refers to the number of telephone lines (wired residential and business lines) per 100 people. It is a rough estimation of Public Switched Telephone Network (PSTN) availability to the inhabitants of a country. The International Telecommunication Union (ITU) recommends that countries wishing to attain rapid telecommunication development should not have teledensity less than ten.

### **Africa**

A major contributory factor to the low level of Internet access in Africa is the poor telecommunication infrastructure, with very low bandwidths in most of the countries. Owing to the high international tariffs and lack of bandwidth capacity, it is an up-hill task to obtain sufficient international bandwidth for delivering web pages over the Internet in most countries. Until recently, only a few countries, aside from South Africa, had international Internet links greater than 64kb/s. Today about 23 countries have links with 2Mb/s or more, and about 10 countries have outgoing links up to 5Mb/s and more. The total international Internet bandwidth reached the 1Gb/s mark only in 2000 (Jensen 2001). There is no regional network backbone in Africa (as compared to Europe, Asia and America). Apart from South Africa, Egypt and Kenya, no country in Africa has an Internet exchange. This means that connectivity and peering between the African local ISPs are provided overseas via the expensive international Internet bandwidths. Most local Internet traffic in African countries are therefore first routed to either USA or Europe, and then back to their destinations.

Availability of a telephone line is a precursor to individuals having a basic Internet access. For a continent of about 765,642,000 people, there are only about 16,671,250 telephone lines and 3,642,392 mobile phones. With a very low teledensity of 2.48 (ITU 2001), and total Internet users of between 1.5 and 2 million, the overall Internet penetration and access level in Africa is extremely low (NICI 2000).

Ongoing projects are supporting the efforts of individual African countries to improve their access levels. One such project is the Leland initiative - a five year \$15 million US government aid to extend full Internet connectivity to 20 or more African countries (USAID 2001). It builds on the existing capacity with the purpose of facilitating Internet access throughout each country. Another indication that the problem of international Internet bandwidth in Africa may be reduced in due course is the availability of some ongoing broadband projects like submarine optic-fibre cable

networks such as SAFE/SAT-3/WASC, the growing awareness and booming of VSAT installations and wireless technology. The 28,000km SAT-3 cable project will give Africa high capacity link to lucrative European and Asian markets. The SAT-3 system has two segments – one is a 15,000km connection between South Africa and Europe (with landings at ten West and Southern African countries), whereas the second is a 13,800km link from South Africa to Malaysia (with landings at Reunion, Mauritius and India. The initial capacity of 20Gb/s can be progressively upgraded to 40Gb/s and 120Gb/s (SAFE 2000).

## **Asia**

The status of telecommunication connectivity infrastructure in Asia is markedly different to Africa. All of the countries analysed (China, Indonesia, Singapore and Philippines) have high-capacity domestic and international network backbone infrastructures, which is representative of the trend in Asia. At least fifteen Asian countries have Internet exchanges for routing local traffic and providing peering between the ISPs. Asia has a high-capacity regional Internet backbone connecting most Asian countries together, as well as to European and North American backbone. There is an appreciable presence of 'last mile' broadband access methods in Asia. While China and Singapore have the full range of the broadband access methods, Indonesia has not got cable modem but has cable TV which gives potential for cable modem service. Philippines has ISDN and Cable TV, with ADSL in development. The presence of international connectivity providers in these countries facilitates the infrastructure development and illustrates the commitment of their governments towards development of information and communication technology. Above all, there is a better level of telephone line penetration in Asia than in Africa, with an average teledensity of 9.55 (ITU 2001).

## **Europe**

The European economy is well developed, which is reflected in the high level of connectivity infrastructure development. All the researched countries (Belgium, Czech Republic, Germany, Greece, Switzerland and UK) have high-capacity domestic and international connectivity infrastructures, including exchange points for peering between ISPs. Many international connectivity providers operate in Europe, where they own and operate regional networks that link major European cities. One such network is the 10Gb/s Ebone network, which was recently extended to the US and linked directly to London, Amsterdam, Paris and Frankfurt (FibreSystems 2001). European network infrastructures provide routing facilities and peering for many ISPs in Africa and other developing nations. The European countries have appreciably high teledensity, with an average of 39.43 (ITU 2001), and a high proportion of 'last mile' broadband access technologies. While Belgium and UK have all broadband access methods, the Czech Republic, Germany and Switzerland have all except cable modem. Greece does not have ADSL and cable modem.

## **Middle East**

In the Middle East, there appears to be a conflict of policy interest. Although the governments of Saudi Arabia and Oman show commitment towards development of connectivity infrastructures, their restrictive policies tend to counterbalance their

efforts. In Saudi Arabia, for example, establishing an independent link to the Internet is prohibited, and all links must go through the King Abdulaziz Centre for Science and Technology. State monopolization of telecom service provision severely limits the adequacy of the infrastructure and leads to high prices (University of Nebraska 1999). While Oman has not got broadband access methods, ISDN and ADSL are being developed in Saudi Arabia, which also has an Internet Exchange.

### **North America**

North America, like Europe, has a well-developed economy in which the telecommunication industry is fully deregulated. There is an overwhelming presence of high-capacity domestic and international connectivity infrastructures, broadband access methods and exchange points in North America. This has propagated and sustained the erroneous impression that the North America is the sole Internet backbone. The North American backbone infrastructure provides routing for much of the inter-continental Internet traffic.

### **Service cost**

Having an infrastructure in place is, of course, only part of the solution to enabling online activities. Access to the technology must also be made affordable to the would-be user population. Again, it is possible to identify significant disparity between the regions in this respect. In many cases this can, of course, be linked back to the connectivity infrastructure issue – if the resource is scarce, then the price for accessing it is set accordingly, to control and regulate demand.

### **Africa**

High access costs remain a problem to Internet access in Africa. Presently, the average total cost of a local loop dial-up Internet account for 20 hours monthly is about \$68. This includes usage fees and local call telephone time, but excludes phone line rental. The ISP subscription charges vary according to the different environments, including different levels of market maturity, different regulation and licensing regimes, and upon access to the expensive international telecommunication bandwidth. The absence of Internet exchanges (peering points) in most African countries contribute to the high cost of bandwidths available to the ISPs and ultimately, the users are disadvantaged through the payment of high access fees.

### **Asia**

The Internet access costs are comparatively cheaper in developed Asian countries. Whereas unlimited monthly dial-up access cost is \$15.95 in China, it is as high as \$176 in Indonesia for intensive users. Nevertheless, Indonesian light users pay cheap access fees like \$3.96 for 6 hours monthly access and \$0.3 for each extra hour. As exemplified in Singapore for a well developed Asian economy, access costs have been driven down to an all time low of \$3.98 per month with 12 hours free time.

### **Europe**

The Internet access costs across Europe vary between \$12 to \$13 for unlimited dial-up monthly access for individual users, and as low as \$9.94 for students. In some countries, per minute access charges are still used. These rates are very cheap when compared to what one obtains in the Middle East and Africa, where costs for unlimited monthly access are in the region of \$40 and \$50 respectively. In general terms however, it could be argued that the access costs in Europe are affordable notwithstanding that these costs are still perceived as high in some European countries. This contention is viewed against the fact that the access cost represents a much smaller percentage of the GDP (Gross Domestic Product) per capita compared to what obtains elsewhere. For example, unlimited dial-up monthly access cost of \$60 in Ghana represents 3% of the GDP per capita, whereas in the UK the same service would be given at about \$12 representing 0.05% of the GDP per capita.

### **Middle East**

As represented by Saudi Arabia and Oman, the Internet access service delivery in some Middle East countries is run by state owned monopolies. This situation, in concert with the government restrictive policies, renders the costs of bandwidth and access high. While the monthly dial-up access cost in Saudi Arabia can be as high as \$40, the cost of a 64kb/s leased line in Oman is about \$1174 monthly (OMANTEL 2001). In general, while the Internet access level in Asia is encouraging and fast growing, the same may not be said for the Middle East.

### **North America**

The access costs in North America are affordable, ranging from £4.95 per month for light user dial-up access and rising to \$23 per month for unlimited private use. In Canada, monthly dial-up access cost goes from \$9.95 to about \$24.95 for unlimited access. For a US economy with GDP per capita of \$33,900 and Canadian economy with \$23,300 GDP per capita, these unlimited access costs are cheap and respectively represent 0.06% and 0.1% of the two countries GDP per capita.

## **A SURVEY OF INTERNET USERS**

Having established the potential for access within each region, the study then attempted to collect data from end users around the world, in order to seek their opinions in relation to typical access methods, levels of Internet access, types of services utilised, and the general impact they consider the Internet to have had in their region. The investigation did not attempt to constrain the potential respondent group, and the only qualifying criterion was that participants should be users of the Internet in either domestic or business contexts. Data collection was achieved via a web-based questionnaire, targeted at individual Internet users. The amalgamation of the data collected here, along with the previous information in relation to infrastructure and costs, enables an overall picture of Internet accessibility within each region to be created.

### **Methodology**

The web questionnaire aimed to build a profile of Internet access in the target regions, and requested a variety of details from each respondent, split into factual and opinion based elements:

- Factual
  - access technology (last mile access method – i.e. PSTN, ISDN, ADSL, cable modem, or wireless);
  - means of Internet access (i.e. own facility, friend's facility, or public access);
  - weekly Internet usage;
  - Internet application usage.
- Personal opinions
  - whether the available bandwidth is adequate;
  - whether use of the Internet has improved the way things are done in terms of speed, efficiency and output;
  - whether increased application of the Internet is advocated.

A number of Internet uses were considered in the questionnaire, ranging from the accepted baseline applications, such as email communication, to more recent developments, such as e-commerce, online banking and IP telephony. It was expected that some of the latter applications would be significantly more prevalent in some regions than others.

The survey questionnaire was made available online in early 2001, and was accessible for the subsequent five months (the overall timeframe being limited by the project in which the investigation was being conducted). Links were provided to it from the authors' website, and potential respondents were specifically directed towards it via a series of targeted emails to contacts and ISPs in the different regions (candidate email addresses were obtained from websites, advertisements and personal contacts). A constraint of the survey method was that the outgoing emails, and indeed the questionnaire itself, were written and published in English only. Consequently, the potential for contact with non-English speaking countries was limited, and few responses were obtained from these areas. In view of these points, and the relatively limited timeframe in which data was collected, it was impossible to guarantee a consistent and meaningful level of response from all of the desired regions. However, it was felt that sufficient information was obtained from a subset of them to enable at least an initial assessment to be made.

In addition to those who may have found the survey directly on the web, a total of 708 email messages were sent to directly promote the site. Of these, a total of 147 were unfortunately returned undelivered, for reasons such as inactive accounts, or unrecognized (or unreachable) addresses. This left a total of 562 messages that reached their destination, and combined with those who found the site directly, this yielded 152 responses, distributed as shown in Table 2. As can be seen, the sampling attempted in each region was not uniform (which related to the availability of suitable target email addresses), but in most cases it was felt that a sufficient number of messages were sent to give the possibility of a meaningful response (it may be noted that the total of values in the 'emails sent' column in the table is 552 rather than the

562 mentioned above – this is because ten further emails were sent to South America, but no responses were received).

Although responses were received from 19 countries, the total responses observed in each case were widely variable, and statistically significant responses were only received from a minority of locations (namely Canada, Nigeria, UK and USA), and some regions (such as Central and South America) were not represented at all. As such, the summary and discussion that follows is presented at a regional level, with country-specific comments provided where the sufficiency of responses allows. Given that only one response was received from Oceania, it is not possible to present any statistically useful information from that region, and hence it will be omitted from the discussion.

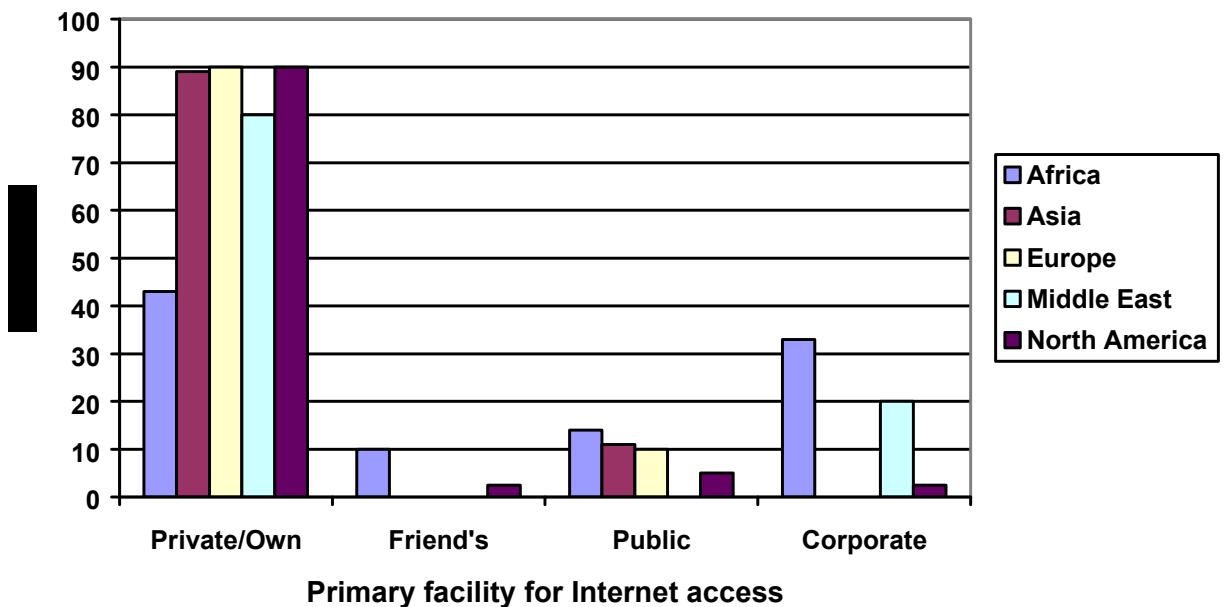
Region	Total emails sent	Responses		
		Country	Country Total	Region Total
Africa	140	Ghana	4	47
		Ivory Coast	1	
		Nigeria	39	
		South Africa	3	
Asia	98	China	4	9
		Indonesia	1	
		Philippines	2	
		Singapore	2	
Europe	158	Belgium	2	45
		Czech Republic	1	
		Germany	1	
		Greece	4	
		Switzerland	1	
		UK	36	
Middle East	47	Oman	3	6
		Saudi Arabia	3	
North America	109	Canada	11	44
		USA	33	
Oceania	0	Australia	1	1

*Table 2 : Summary of questionnaire responses*

## Findings and discussion

The respondents' means of gaining Internet access are summarised in Figure 2. The main factor that is noticeable here is that, in Africa, a significantly lower proportion of individuals gain their primary access from a personal facility. Correspondingly, a more substantial proportion consequently regards their employer's facility as being their main point of access to the Internet. It should be noted that, whilst a much larger proportion of users from other regions would also be expected to come into contact

with the Internet from their employer's facilities, the questionnaire was aimed at individual's own use of the Internet and asked them to indicate how they gained access from this perspective.



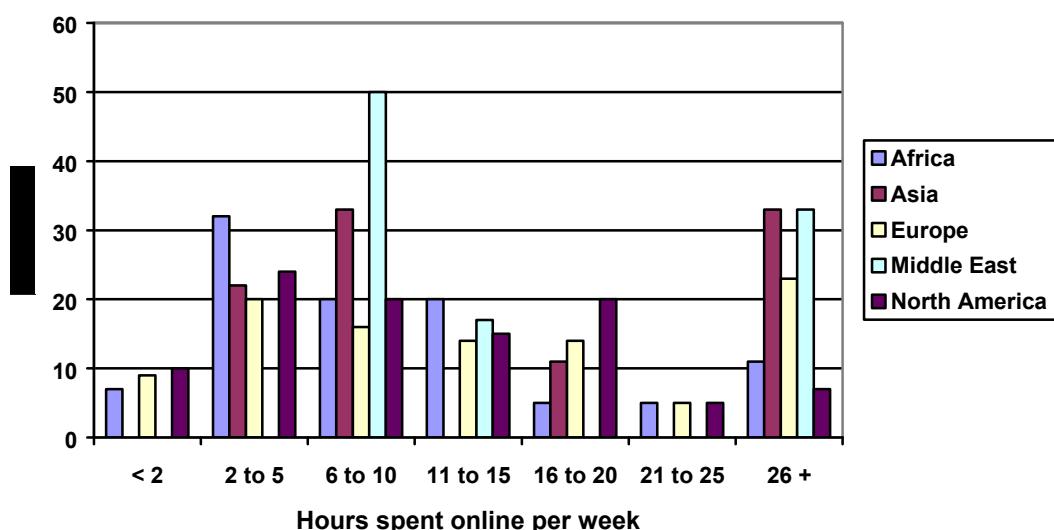
**Figure 2 : Methods of Internet access**

In addition to where they gained access, the respondents were also asked to indicate the underlying technology that was used to support it. The options presented to the respondents were the methods generally available to private subscribers and small organisations, and the results are presented in Table 3 (it should be noted that the category 'wireless' can be considered to encompass methods such as cellular and satellite-based systems, as well as radio and microwave links). The responses are illustrative of the connectivity infrastructure limitations in some regions – while all regions have dial-up access in some form, the penetration and uptake of other methods seems to be markedly different. Particularly indicative is the use of the broadband technologies, represented by ADSL and cable modem. The more significant penetration of wireless access in Africa is perhaps illustrative of the absence of fixed line telecommunications facilities in parts of the region, with wireless methods having emerged as a viable and cost-effective alternative to laying further cables over such significant distances.

Country	Dial-up (PSTN)	ISDN	ADSL	Cable modem	Wireless
Africa	73%	-	-	2%	25%
Asia	33%	22%	-	45%	-
Europe	69%	9%	7%	11%	4%
Middle East	100%	-	-	-	-
North America	69%	-	10%	19%	2%

*Table 3 : Summary of access technologies by region*

Figure 3 depicts the results in relation to the amount of time the respondents spend online. It can be observed from the results that, whilst the responses from the more developed countries are fairly liberally spread between the different categories, those coming from the developing regions are more focused towards the lower end of the scale. This finding can be clearly related to earlier observations in relation to the service costs.



*Figure 3 : Internet access per week (hours)*

Having established how the respondents gained access, and for how long, the other important issue was what they were actually doing online. Table 4 presents a number of potential end-user applications of Internet technology, along with the percentage of positive results from the respondents in each region.

Uses	Africa	Asia	Europe	Middle East	North America

Emailing social contacts	64%	89%	96%	83%	93%
Emailing business contacts	53%	78%	49%	33%	41%
Online banking	17%	44%	38%	17%	25%
Voice over IP	13%	33%	13%	17%	9%
Facsimile	9%	-	7%	-	5%
E-commerce	32%	33%	38%	17%	16%
Advert & marketing	21%	33%	7%	-	2%
Publication of materials	26%	22%	22%	17%	7%
Research	53%	67%	78%	83%	80%
Interactive applications	43%	33%	20%	33%	23%
Leisure	34%	89%	58%	33%	68%

**Table 4 : Summary of Internet uses in by region**

Irrespective of region, it is clear that several uses retain the same relative levels of popularity. For example, social emails are the most popular use in all cases (in some cases by a considerable margin). Emailing business contacts and research also show a fairly high level of popularity across all regions, although the interpretation of the term ‘research’ in this context should probably be taken to include personal fact-finding activities as well as academic or business driven endeavors (which would help to account for its high frequency of occurrence). It is notable that leisure scores substantially lower in Africa and the Middle East, where infrastructure, costs and policy issues may have prevented this application from being generally perceived to date.

The final aspect of the survey questionnaire asked respondents to assess various aspects relating to the acceptability of the overall Internet experience in their country. In order to consider these more subjective opinions, a more specific view of the respondent group will be taken, by selecting one country from within each of the three regions where more significant response rates were observed. These results, relating to Nigeria, the UK and Canada, are presented in Table 5. In each case, the figure shown indicates the percentage of respondents agreeing with the assertion in the leftmost column.

Country Opinion	Nigeria	United Kingdom	Canada
Available bandwidth is adequate	70%	55%	90%
Internet has improved way things are done	95%	100%	100%
Would advocate increased application of Internet	100%	97%	73%

**Table 5 : Opinions in relation to the Internet experience**

In all cases, the vast majority of responses are positive, which enables the conclusion to be drawn that Internet access is perceived as valuable irrespective of technological limitations. Having said this, the most varied opinions were observed in relation to the issue of bandwidth adequacy (which affects both the speed of access and the range of applications that it is viable to utilise). It is particularly interesting to note that whilst the UK respondents were in receipt of more advanced access technologies and greater available bandwidth than the respondents from Nigeria, the level of satisfaction was markedly lower. While in the UK, 28% of the respondents had access to broadband facilities, all of the Nigerian respondents were using dial-up links, and thus the highest possible bandwidth for them would have been 64kb/s (and it is likely that many would not have achieved even this). In Canada, where the satisfaction was highest, 64% of the respondents were using ADSL or cable modem technologies, and thus should have had good reason to be content with their facilities.

It appears that, irrespective of the available connectivity infrastructure or associated cost, there is almost complete agreement amongst these respondents that the Internet has improved the way things are done. Somewhat strangely, however, some UK and Canadian respondents would not advocate increased application of the Internet, even though they all feel the technology is beneficial.

## CONCLUSION

This paper has presented a profile of Internet access and use from 19 countries, across five geographic regions. As one might expect, the levels of Internet access in the developed economies are generally higher. In addition, there are ongoing projects to further upgrade the existing high-capacity connectivity infrastructures of developed countries in anticipation of future Internet traffic growth. There is consequently a deepening uneven distribution of quality access infrastructures between the developed and developing economies of the world, notably, the African and Middle Eastern countries. The Asian countries appear to be winning the war on infrastructure development and low levels of Internet access. The telecommunications industry in most of the developed nations is fully deregulated, and the governments provide enabling environments for private sector participation in capacity building.

Interpretations and conclusions drawn from the questionnaire study results must be tempered by the fact that the respondents were already Internet users, and might therefore already be considered to be in a somewhat privileged position when compared to others in their region. In addition, the initial email contacts, and the subsequent responses, were unevenly distributed between the different countries and regions. With benefit of hindsight, it would have been desirable to adopt a more uniform sampling approach, as well as to have facilitated the participation of more non-English speaking countries (e.g. by making multiple language versions of the questionnaire available). Having said this, however, the results did enable an impression of the Internet access across the regions to be gained, and they show that, where access is available, people are willing and able to take advantage of the opportunities – irrespective of infrastructure and cost limitations in the area.

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