The Digital Divide in Trinidad and Tobago 2007

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ABSTRACT

The primary task of this study is the collection of data to allow for the calculation and analysis, at the level of 585 identifiable geographical areas or communities in Trinidad and Tobago, and for the country as a whole, of the Digital Opportunity Index (DOI) and the Digital Access Index (DAI). Three indices are calculated for the communities and for the country as a whole: the Digital Opportunity Index (DOI), an Alternate Digital Opportunity Index (DOI_ALT) and the Digital Access Index (DAI). The various indicators and category indices of the DOI, DOI_ALT and the DAI are also calculated and analyzed. Recommendations are made for improving indicators and indices for the country as a whole but especially for the less favoured communities.

1. INTRODUCTION

The primary task of this study is the collection of data to allow for the calculation, at the level of identifiable geographical areas or communities in Trinidad and Tobago, and for the country as a whole, of the Digital Access Index (DAI) and the Digital Opportunity Index (DOI). The different quality of service available across the various communities implied by the differing values is analysed and explained, with particular emphasis on those communities within Trinidad & Tobago that are under-served in terms of access to information and communication technologies (ICT). Reasons are advanced to explain why these areas are under-served, as a first step toward identifying and administering projects that may enable the reduction of the digital divide.

The rest of the paper is presented as follows: in section 2, the DOI and DAI measures are described and compared. The data and sources of the data used are discussed in section 3 and in section 4 the methodology by which the measures are obtained using the data is outlined. The resulting measures for the various communities are then summarized and analysed, following which recommendations are made and conclusions drawn.

2. THE DOI AND DAI: INTERPRETATION AND COMPARISON

More and more the DOI is being considered the preferred index and is in fact "the newer kid on the block," refined to take into account some of the shortcomings of the DAI. It groups 11 indicators into three category indices: Opportunity, Infrastructure and Utilization. An alternate DOI is constructed, the DOI_ALT, which groups 10 of the 11 indicators into three category indices. The indicators and their relationship to the category and overall indices are shown in Appendix, Table A1.

The DAI follows the same methodology as the DOI and HDI. Table A2 in the Appendix shows that the DAI groups 8 indicators into five categories: Infrastructure, Affordability, Knowledge, Quality and Usage.

There are identifiable drawbacks with the DOI and DAI methodology. The determination of the goalposts is difficult for an ever evolving sector like ICT where technologies decline and grow in importance. Although the goalposts are often determined by best

practice or logical limits, they can be exceeded. For instance, Trinidad and Tobago and other jurisdictions now appear to have more mobile phones than inhabitants. National and regional definitions of the indicators may result in exaggerated values; if these are used as best practice, they can establish goalposts that will be impossible for other countries to reach. Best practice, as reflected in an indicator value, is not always possible with ICTs since the indicators can vary for social reasons. The categorization of indicators into sub indices and the weights assigned involve a degree of subjectivity and may impact the index values. The impact may be minimized through statistical techniques that determine appropriate weights and classifications while retaining the analytical power of categories.

The DOI indicators lend themselves to a logical classification:

- The first is Opportunity. In order to participate in the information society, consumers must have accessibility to ICT service and must be able to afford it. The percentage of the population covered by mobile cellular telephony represents coverage (basic accessibility) while the two tariff indicators, Internet access tariffs as a percentage of per capita income and Mobile cellular tariffs as a percentage of per capita income reflect affordability;
- The next category is Infrastructure, which includes network indicators such as the proportion of households with a fixed line telephone, mobile cellular subscribers per 100 inhabitants, proportion of households with Internet access at home and mobile Internet subscribers per 100 inhabitants. It also includes the devices that provide the interface between the user and the network; here it is represented by proportion of households with a computer;
- Utilization shows the extent of ICT usage and includes proportion of individuals that used the Internet. Quality reflects a level of access that enables higher degrees of functionality. This provides support for services such as video streaming that can enhance desirable information society applications such as telemedicine, e-government and e-learning. The indicator selected for this category is the ratio of broadband subscribers among Internet subscribers (separated by both fixed and mobile).

The classification is sequential, in that each category is dependent on the previous. The classification also reflects higher levels of access, from basic voice communications to broadband connectivity. In order to have access to infrastructure, users must have the opportunity to be covered by the service and able to afford it. Utilization depends on having infrastructure and a device. Finally, given all the prerequisites for connectivity, users will then want to aspire to higher levels of quality through broadband access.

The popularity of mobile communications and introduction of high-speed 2.5 and 3G (third generation) services make wireless technology a key component of the information society. Almost all of the indicators selected for the DOI have a mobile component. Some are explicit, such as mobile coverage or mobile subscribers, while others are embedded in indicators such as computers (e.g., smart phones, PDAs) or Internet subscription (which may include mobile Internet subscriptions). This lends the DOI to an alternate classification of fixed versus mobile. This allows analysis of the relative importance of each in a country's progression to the information society. The trend toward ubiquity suggests that countries should not sacrifice one path at the expense of the other but that both should be pursued simultaneously. Similar observations may be made about the DAI.

3. DATA AND DATA SOURCES

The data to construct the indicators and indices were to be obtained from four distinct sources. ICT service providers; Material published on ICT services (in the form of articles, reports, data or other format) and socio-economic indicators in Trinidad and Tobago (the 2000 Census of the Population of Trinidad and Tobago in particular); a Survey of Households (consumers of ICT services) inhabiting the communities and four specialized public agencies: the National Library Information Service (NALIS), the Ministry of Education, the Ministry of Community Development and the Telecommunications Authority of Trinidad and Tobago.

Data from the major *ICT service providers* were to be made up largely of the data on

some of the indicators making up the DAI and the DOI[1] through the administration of three very simple questionnaires, one each for the providers of each of the following four ICT services (questionnaires available on request):

- Fixed telephone line services;
- Mobile telephone line services;
- Internet services;
- Cable TV Services.

In addition to being asked to provide data for the calculation of the two indices, the ICT service providers were asked to assist in locating minor providers of ICT services, such as Internet Cafes and International Calling Centres. Questions were also asked about the marketing of the services and if, in particular, some communities are targeted more than others. All the major providers were asked to take part in this exercise including TSTT, Digicel, and Internet Service Providers.

Overall, the service providers were not very forthcoming with data and, in the end, it was not a very successful exercise. Very little data of interest to the exercise was provided and all efforts to get more failed miserably. There was a lot of concern about the confidentiality of some of the key data items, which were never resolved and the project simply had to proceed without the data sets. This also caused some delay in the execution of the project for two reasons: first, the survey of households was planned to take place after the completion of the survey of service providers, so the lack of cooperation stalled the start of the household survey. The analysis therefore had to rely more heavily on the survey of households which resulted in further delay.

*Published material*s of at least three types were consulted:

1. Documents published by state and private sector agencies, such as the Central Statistical Office (the 2000 Census of the Population in particular), Ministry of Planning and Development, and the Telecommunications Authority of Trinidad & Tobago, which will provide information about the importance and prevalence of ICT infrastructure nationwide and may even provide data at the community or household level. These were used to complement, and as a check on, data gathered from the surveys.
2. Previous studies done on the Digital Divide and related areas in Trinidad & Tobago;

[1] There are 17 distinct indicators in all.

3. Previous studies done on the Digital Divide and related areas in countries other than Trinidad & Tobago, especially (but not limited to) those done on countries at a comparable stage of development.

The documents and other papers consulted are listed under 'References and Further Readings'. None dealt directly with the measurement of the Digital Divide in Trinidad & Tobago although reference was made to it in Henry (2004), in MPATT (2003) and in some of the ITU publications cited. The MPATT document lays out a strategic plan for the development of ICT services but we were unable to determine the status of this plan.

Data obtained from *households* were of two kinds:

- Data on the indicators making up the DAI and the DOI;
- Socio-economic, demographic and other relevant data.

The data were obtained through administering a questionnaire to a sample of 6,000 households (in the hope of getting 5,000 responses) drawn from communities across Trinidad & Tobago. A multi-stage sampling design was used to obtain this sample. Trinidad and Tobago was divided into 585 communities, which were categorized into 13 relatively homogenous groups using mainly one criterion: the median income of inhabitants. Computer simulations were run using the digital spatial data based on the 2000 Census to determine appropriate income bands. However, other criteria were employed and similar computer simulations carried out to determine appropriate groupings. Such criteria included area of residence (rural/urban) and dominant ethnic group (African/Indian/Mixed/Other). A sample of 20 communities, representing the 13 groups identified was drawn at random and the samples of households from each of the 13 groups were proportionate to the size of the group in the population. One person from each household was interviewed.

In addition to data required for the construction of the DAI and DOI, data collected in the household survey covered a broad range of user attributes including age, sex, ethnicity, and income levels. One questionnaire per household was administered to the person held out to be the head of the household or someone designated by such a person or any adult willing to respond if there was no identifiable head present. The questionnaires sought information on the use of ICT services at home, at school, at work and at other locations including hot spots, mobile and other libraries, International Calling Centres and Internet

Cafés.

Enumerators were assigned to one or more selected communities in Trinidad & Tobago and were instructed on the number of households to be surveyed in each of these areas. They were provided with GIS generated maps of the areas containing the households that would form part of the survey. The first task was to determine randomly the address at which to begin the survey (the 'point of entry'), then choose every third address, until the street was exhausted (the 'skip rule'). They then proceeded to a neighbouring street and continued in the same manner. In the case of non response at a given address, the enumerator proceeded next door and applied the same skip rule thereafter.

In all, valid responses were obtained from 5,912 households. The data was processed using CSPro and SPSS. Of the 20 communities, it is believed that the data obtained from the community of Navet was considered unreliable. This data was therefore omitted from consideration. All remaining communities were classified into 19 income groups or cohorts and ranked from lowest to highest on the basis of per capita income as determined by the 2000 Census of the population. The income levels so obtained were used to define 19 income bands, each centred on the per capita income of the sampled community. A non sampled community was declared as belonging to the income cohort of the sampled community if its per capita income in the 2000 Census fell into the band centred on that community's per capita income.

There was inevitably some overlap between the questions asked to the households and the providers, especially those relating to the indicators making up the DAI and the DOI. This turned out to be useful since the providers were not forthcoming with information and data obtained from the households had to be extended to the rest of the population. The methodology used to achieve this is detailed in section 4.

In addition to the overview data supplied by the Service Providers, data was obtained from *specialized public agencies*. The NALIS provided overview information on the number of libraries that provide Internet access to the general public. The Ministry of Education provided information on the location of all schools in Trinidad and Tobago, the number of students enrolled in each of these schools, and whether or not these schools had Internet service. Finally, information on Internet Cafés was obtained from an

information gathering exercise conducted by the Telecommunications Authority of Trinidad and Tobago.

4. METHODOLOGY

The DOI and DAI indicators represent the basic data requirements. While some of these indicators are common to both the DOI and the DAI and others are similar, they may carry different weights (see Section 3 above). The procedures followed for obtaining values of the indicators are presented below.

4.1 DOI and DAI Indicators

A description of how each of the indicators was determined is presented here together with an example of the results obtained for each of the indicators.

Mobile cellular coverage (percentage of population)

This relates to the DOI only. This was taken as 100% for the entire country. This figure enters with a weight of 1/3 in the calculation of the DOI Opportunity Index.

Mobile cellular tariffs (percentage of per capita income)

This relates to the DOI only. The estimated cost for the entire country for 100 minutes per month (the international benchmark) is just less than TT$100.00 per month, which is the basic cost used, giving an annual total of TT$1,200.00. Because there is no breakdown of GDP by geographical community, this was approximated, for each community, by the per capita income of the corresponding community based on the 2000 Census of the population. The corresponding value, using the community of Barackpore as an example, is TT$10,540.66 and the corresponding indicator is 1200 divided by this figure: 0.114. To be consistent with the overall index, this 'negative' indicator must be converted to a positive one (1-0.114) and then adjusted (divided) by the 'goalpost (1-0.0016) to give (1-0.114)/(1-0.0016)= 0.887. This figure enters with a weight of 1/3 in the calculation of the DOI Opportunity Index.

Internet access tariffs (percentage of per capita income)

This indicator relates to both the DOI and the DAI and is in fact the DAI Affordability Index. The estimated cost for about 20 hours a month (the international benchmark) is TT$80.00, or TT$ 960.00 per annum which, relative to per capita GDP, is 960/10,540.66 or 0.091, for Barackpore. The same procedure is followed as for 'mobile cellular tariffs' to convert this 'negative' indicator/index into a positive one. In the case of the DOI, this requires the adjustment for the benchmark (1-0.002), to arrive at an indicator value of 0.911 for Barackpore. This figure enters with a weight of 1/3 in the calculation of the DOI Opportunity Index. The DAI Affordability Index is (1-0.091), or 0.909 (goalpost is 100%).

Proportion of households with a fixed-line telephone

This indicator relates to the DOI only. The sole fixed-line provider was unwilling or unable to provide the breakdown of fixed lines by the communities that were identified. The ratio was therefore estimated from the sample using, for each community in the sample, the ratio of the total number of fixed lines to the total number of households sampled. In the case of Barackpore, for instance, the number of fixed-line telephones was 404 and the total number of households sampled was 595. The corresponding DOI Indicator (goalpost 1000%) is therefore estimated as 404/595=0.679. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort. For instance, Acono Village, which is in the same income cohort as Barackpore, was assigned a DOI Indicator of 0.679. The DOI Indicator accounts for 20% of the DOI Infrastructure Index.

Mobile cellular subscribers per 100 inhabitants

This indicator relates to both the DOI and the DAI. Both mobile service providers were unwilling or unable to provide the breakdown of mobile telephones by the geographical communities that we had identified. The ratio was therefore estimated from the sample: for each community in the sample, we determined the total number of mobile phones and the total of all members of households sampled. In the case of Barackpore, the number of mobile telephones was 1956 and, for a total household membership sampled of 2344, the corresponding value of the DOI and DAI indicators (goal post 100%) is therefore 0.885.

A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort. The DOI Indicator accounts for 20% of the DOI Infrastructure Index and the DAI Indicator for 50% of the DAI Infrastructure Index.

Proportion of households with Internet access at home

This relates to the DOI only. In each geographical community sampled, the number of households with Internet access (whatever the medium used for this access) may be inferred from the sample. In the case of Barackpore, this number was 76 and the number of households sampled in that area was 595, giving an index of 76/595, or 0.128. For a goalpost of 100%, this is the value of the indicator used, which enters with a weight of 20% in the DOI Infrastructure Index. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

Mobile Internet subscribers per 100 inhabitants

This relates to the DOI only. For each community in the sample, the number of households with Internet access using a mobile device may be inferred from the sample. In the case of Barackpore, this number was 27 and the number of households sampled in that area was 595, giving an index of 27/595, or 0.045. For a goalpost of 100%, this is the value of the indicator used, which enters with a weight of 20% in the DOI Infrastructure Index. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

Proportion of households with a computer

This relates to the DOI only. In each community sampled, the number of households with at least one computer (desktop or laptop) may be inferred from the sample. In the case of Barackpore, this number was 179 and the number of households sampled in that area was 595, giving an index of 179/595, or 0.30. For a goalpost of 100%, this is the value of the indicator used, which enters with a weight of 20% in the DOI Infrastructure Index. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

Internet users per 100 inhabitants

This indicator relates to both the DOI and the DAI and is in fact the DAI Usage Index. In each community sampled, the number of persons using the Internet (at home or elsewhere) may be inferred from the sample. In the case of Barackpore, this number was 420 and the total of all members of households sampled in that area was 2344, giving a value of 420/2344, or 0.179. For a goalpost of 100%, this is the value of the DOI indicator used, which enters with a weight of 33% in the DOI Utilization Index. For a goalpost of 85%, the value of the DAI Usage Index was calculated as (0.179/0.85)=0.211. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

Ratio of Fixed Broadband Internet subscribers to total Internet subscribers

This relates to the DOI only. The information is inferred from the sample where it is possible to determine the number of fixed broadband Internet users and the total number of Internet subscribers. Once again, the service providers did not or could not provide us with either pieces of information by community. In the case of Barackpore, the number of broadband subscribers was 13 and the total number of Internet subscribers was 420, giving a value of 13/420, or 0.031. For a goalpost of 100%, this is the value of the DOI indicator used, which enters with a weight of 33% in the DOI Utilization Index. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

Ratio of Mobile Broadband Internet subscribers to mobile Internet subscribers

This relates to the DOI only. This ratio was inferred from the sample. Of the two mobile providers, only one provides broadband Internet services. Moreover, access to it is cheaper than access to the non broadband services of the other network. It was assumed that a household with mobile Internet access had broadband Internet access if there was at least one mobile phone from the broadband provider in the household. For Barackpore, the number of broadband Internet subscribers so determined was 24 and the total number of Mobile Internet household subscribers was 27. The ratio was therefore calculated as 24/27, or 0.889. For a goalpost of 100%, this is the value of the DOI indicator used, which enters with a weight of 33% in the DOI Utilization Index. A community that did

not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

It is our opinion that the DOI should be calculated without the use of this indicator. The reason for the proposed omission is that there are very few mobile Internet subscribers in Trinidad and Tobago and most of them are broadband subscribers. This ratio is therefore like to carry a disproportionately heavy weight in the Utilization Indicator and consequently in the overall DOI index. For example, in some communities, there are no more than two mobile Internet subscribers and both are broadband subscribers, giving a ratio of 100%. In the case where it is omitted from consideration, we recommend that the Utilization Index be made up of the remaining two indicators in this category ('Internet users per 100 inhabitants' and 'Ratio of Fixed Broadband Internet subscribers to total Internet subscribers'), each equally weighted. We shall call the resulting Utilization Indicator and DOI Index the 'Alternate Utilization' Indicator and 'Alternate DOI' Index (DOI_ALT) respectively.

Fixed-line telephone subscribers per 100 inhabitants

This indicator relates to the DAI only. The sole fixed-line provider was unwilling or unable to provide the breakdown of fixed lines by the communities that we had identified. The ratio was therefore estimated from the sample: for each community in the sample, we determined the total number of fixed lines and the total of all members of households sampled (the sum of all persons in all households sampled). In the case of Barackpore, the number of fixed-line telephones was 404 and the total of all members of households sampled was 2344. The corresponding DAI Indicator (goalpost 60%) is therefore 0.287. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort. For instance, Acono Village, which is in the same income cohort as Barackpore, was assigned a DAI indicator of 0.287. The DAI Indicator accounts for 50% of the DAI Infrastructure Index.

Adult Literacy

This relates to the DAI only. The figure for each geographical region was estimated directly from the 2000 Census as (1-Adult Illiteracy Rate), where Adult Illiteracy Rate =

(Persons 15 years old and over with no formal education/All persons 15 years old and over). For a goalpost of 100%, this is the value of the DAI indicator used, which enters with a weight of 67% in the DAI Knowledge Index.

Combined primary, secondary and tertiary school enrolment level

This relates to the DAI only. Ideally, this should be estimated as the proportion of all persons between the ages of 4-24 (the age cohort) enrolled in primary, secondary and tertiary level. We were in fact able determine the size of the age cohort from the 2000 Census as well as the numbers enrolled at each level, but were unable to determine the ages of those enrolled. We therefore used the ratio of total enrolment at all levels/Total persons in age cohort. For a goalpost of 100%, this is the value of the DAI indicator used, which enters with a weight of 33% in the DAI Knowledge Index. This clearly is an overestimation of the desired figure especially since many enrolled at the tertiary level are likely to be older than 24.

International Internet bandwidth (bits) per capita

This relates to the DAI only. It was difficult to get exact information on the International Internet Bandwidth and the most reliable that we could obtain from an expert was that "TSTT is using an Internet Protocol speed on their Next Generation Backbone Network (NGN) of OC12, OC24 depending on the traffic (a mixture of voice, data and video)." The bandwidth associated with OC12 is 622 Mbps and with OC 24 is 1.244 Gbps. We therefore estimated that, on average, Trinidad & Tobago's International Internet bandwidth was roughly 900 Mbps. This total was divided by the population total (about 1.3 million) to obtain an estimate of 692.31 bps, which was applied to the entire country. For a goal post of 10, 000, we calculated the value of this indicator using the formula [LOG(692.31)-LOG(0.01))/(LOG(10000)-LOG(0.01)], which is recommended by the ITU. The resulting value of 0.807 is the value of the DAI indicator used, and it enters with a weight of 50% in the DAI Quality Index.

Broadband subscribers per 100 inhabitants

This relates to the DAI only. This was estimated from the sample of households. The total amount of broadband users was taken as the total members of households where

broadband was available. This was in turn divided by the total of all members of households sampled. In the case of Barackpore, the number of broadband subscribers was estimated as 13 and the total of all members of households sampled was 2344. The ratio is therefore 13/2344= 0.0055. For a goalpost of 30%, the value of the DAI indicator was calculated as 0.0055/0.30 = 0.018, which enters with a weight of 50% in the DAI Quality Index. A community that did not form part of the sample was assigned an indicator value identical to that of the sampled community in its income cohort.

4.2 Calculation of DOI and DAI indices for Barackpore

Barckpore is used to illustrate how the DOI and DAI sub-indices and overall indices are calculated. The DOI and DAI Index and Indicators for the community of Barackpore are shown in Tables 1 and 2 respectively.

Table 1: The DOI Index and its Component Indicators for the Community of Barackpore

Category / Indicators	Score %	Goalpost %	Indicator	Weight within category (%)	Category Index
Opportunity					
Percentage of population covered by mobile cellular telephony	100	100	1	33	0.9322
Mobile cellular tariffs as a percentage of per capita income	11.38	0.16	0.8860	33	
Internet access tariffs as a percentage of per capita income	9.11	0.2	0.9107	33	
Infrastructure					
Proportion of households with a fixed line telephone	67.90	100	0.6790	20	0.3975
Mobile cellular subscribers per 100 inhabitants	83.45	100	0.8345	20	
Proportion of households with Internet access at home	12.77	100	0.1277	20	
Mobile Internet subscribers per 100 inhabitants	4.54	100	0.0454	20	
Proportion of households with a computer	30.08	100	0.3008	20	
Utilization (figures in parentheses refer to DOI_ALT)					
Internet users per 100 inhabitants	17.92	100	0.1792	33 (50)	0.3664 (0.1051)
Ratio of Fixed Broadband Internet subscribers to total Internet subscribers	3.1	100	0.031	33 (50)	
Ratio of Mobile Broadband Internet subscribers to mobile Internet subscribers	88.89	100	0.8889	33 (0)	
		DOI_ALT			**0.4784**
		DOI			**0.5655**

Table 2: The DAI Index and its Component Indicators for the Community of Barackpore

Category	Indicator	Score	Goal Post %	Indicator	Weight in Category %	Category Index
Infrastructure						
	Fixed telephone subscribers per 100 inhabitants	17.24	60	0.2873	50	0.5609
	Mobile cellular subscribers per 100 inhabitants	83.45	100	0.8345	50	
Affordability						
	Internet access price as percentage of Gross National Income per capita	9.11	100	0.9089	100	0.9089
Knowledge						
	Adult Literacy	96.13	100	0.9613	67	0.8457
	Combined primary, secondary and tertiary school enrolment level	61.09	100	0.6109	33	
Quality						
	International Internet bandwidth (bits) per capita	692.31	10000	0.8067	50	0.4126
	Broadband subscribers per 100 inhabitants	0.555	30	0.0185	50	
Usage						
	Internet users per 100 inhabitants	17.92	85	0.2108	100	0.2108
DAI						**0.5878**

5. ANALYSIS OF RESULTS

Modern practice places greater reliance on the DOI index and in fact the DAI Index is being phased out. It is therefore recommend that international practice be followed in this regard. Furthermore, it is also recommended that we place greater reliability on the DOI_ALT index than on the standard DOI for reasons outlined in Section 2.

The detailed results for the 585 communities and for Trinidad & Tobago as a whole, showing values for indicators, category indices as well as the DOI_ALT, DOI and DAI indices, are given in a EXCEL file accompanying this report. For Trinidad & Tobago as a whole, the overall indices were calculated as:

DOI_ALT = 0.5595

DOI = 0.6315

DAI = 0.6668

These figures are high by International standards but are not unrealistic. In a 2004/5 study (ITU 2006), Trinidad & Tobago as a whole had a DOI score of 0.45 and in another in 2002 (ITU 2003) it obtained a DAI score of 0.53. These studies employed macro data only, not sample (micro) data as is the case here. At any rate, there must have been some improvement since that date, especially given the pace of liberalization in the sector. Nevertheless, international comparisons done on the basis of these figures should be carried out with extreme caution.

This study is less concerned with the national values than with the value of the three indices for the 585communities. The different indices are highly correlated (over 97% in all cases), indicating that each one conveys more or less the same *relative* information about the digital divide in the individual communities. In particular, high scores in one index are associated with high scores in the other two and vice-versa. On a community by community basis, however, the indices are markedly different. A summary descriptive statistics of the three indices are shown in Table 3.

Table 3: Summary Descriptive Statistics for the DOI and DAI Indices

		DOI_ALT	DOI	DAI
No. of Observations		585	585	585
Mean		0.5452	0.6321	0.6582
Std. Error of Mean		0.00349	0.00288	0.00309
Mode		0.48	0.58	0.59
Std. Deviation		0.08430	0.06970	0.07480
Skewness		1.182	1.093	1.130
Kurtosis		4.099	3.682	3.444
Jarque-Bera		164.938	127.227	126.539
Range		0.46	0.39	0.33
Minimum		0.38	0.48	0.57
Maximum		0.85	0.87	0.90
Ratio of Max to Min		2.210	1.806	1.577
Percentiles	25	0.4777	0.5771	0.5959
	50	0.4989	0.5930	0.6271
	75	0.5829	0.6660	0.6951

Jarque-Bera statistics are all significant at values close to 0

The mean values are all over 50% and the ratio of the highest to lowest values range from 1.58 for the DAI to 2.21 for the DOI_ALT. The distributions are all skewed and leptokurtotic and deviate therefore substantially from the normal distribution as is evidenced by the very significant values of the Jarque-Bera statistics. In the case of the DOI, only two communities are below 50% (barely) and in the case of the DAI none is. Though all relatively high in value, the index values are significantly different from each other: the value is relatively high for relatively richer communities and relatively low for relatively poorer communities. Furthermore, the story is not as rosy when we consider the more reliable DOI_ALT Index: 264 communities are below the 50% mark and two are in the 30s. The scores are highly correlated with income levels: 190 of the 264 sub 50% DOI_ALT scores are from the lowest income cohort in the country and close to 99% of the rest are from the next three lowest cohorts. Furthermore, the top 10 communities are the same, no matter what index is used, and they are in the highest income cohort. Maps of the islands of Trinidad and Tobago showing the distribution of the values for the three indices are available on request.

The individual indicators making up the three indices have quite different stories to tell, as Table 4 shows.

Table 4: Summary Descriptive Statistics for the DOI and DAI Indicators

	DOI				**DAI**				
	OPP	INF	UTI_ALT	UTI	INF	AFF	KNO	QUA	USA
No. of Observations	585	585	585	585	585	585	585	585	585
Mean	0.9405	0.4845	0.2123	0.4707	0.6236	0.9204	0.8872	0.4667	0.3899
Std. Error of Mean	0.00106	0.00439	0.00538	0.00370	0.00298	0.00110	0.00125	0.00366	0.00815
Mode	0.94	0.40	0.11	0.40	0.56	0.92	0.89	0.41	0.21
Std. Deviation	0.02565	0.10606	0.13001	0.08956	0.07197	0.02668	0.03018	0.08861	0.19719
Skewness	-4.384	0.894	1.749	1.526	0.937	-0.359	0.490	2.417	0.962
Kurtosis	47.865	2.467	7.231	6.515	2.744	3.941	4.957	10.918	2.693
Jarque-Bera	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202
Range	0.34	0.38	0.68	0.67	0.25	0.16	0.21	0.50	0.66
Minimum	0.65	0.39	0.10	0.18	0.55	0.82	0.78	0.40	0.21
Maximum	0.99	0.77	0.78	0.85	0.80	0.98	0.99	0.90	0.87
Ratio of Max to	1.5231	1.9744	7.8000	4.7222	1.4545	1.1951	1.2692	2.2500	4.1429
Percentiles 25	0.9300	0.4000	0.1100	0.4000	0.5600	0.9100	0.8700	0.4100	0.2100
50	0.9400	0.4100	0.1500	0.4300	0.6000	0.9200	0.8900	0.4200	0.3400
75	0.9500	0.5500	0.2800	0.5200	0.6700	0.9400	0.9000	0.5100	0.4800

Jarque-Bera statistics are all significant at values close to 0

In the DOI category, the Opportunity Index (OPP) is by far the highest: if we ignore the two lowest values (0.65 and 0.68), the lowest value is 0.87. Opportunity is clearly not an issue: all communities in Trinidad & Tobago seem well poised to launch themselves into the ICT era. The population as a whole has wide access to ICT services: this includes 100% mobile coverage and relatively low mobile cellular and Internet access tariffs.

Infrastructure, on the other hand, is quite a problem: 354 of the 585 (61%) communities are below the 50% mark and 474 (81%) below 60%. The average is less than 40%, with values ranging from a low of 0.39 to a high of only 0.77, and this is despite the existence of a relatively high proportion of mobile subscribers. Most of the poorer households do not have computers and Internet access at home. Many as well do not have fixed lines at home and, though very many own mobile cellular phones, access to the Internet by this means is not widespread.

Utilization in the DOI category is also a serious problem, especially if we consider only the Alternate index (UTI_ALT): mean utilization is just over 20% and half of the communities are below 15%.

Similar conclusions are drawn when the DAI category indices are analyzed: opportunity is good but infrastructure and utilization relatively quite poor, especially in the lower income communities. In fact, scores obtained within the category indices (DOI and DAI) are once again highly correlated with income: the poorest communities consistently score the lowest and the richest communities the highest. Maps of the islands of Trinidad and Tobago showing the distribution of the values for the various DOI and DAI indicators are available on request.

The results of the above computation, especially Internet access, must be tempered with the data collected for the schools and tertiary level institutions (TLI), public libraries, Internet cafes and businesses. While there is overlap in access, since some persons have access both at home and outside of the home, many persons only have access at their workplaces, institutions, from public places or through Internet cafes.

Many of the TLIs offer Internet access to both staff and students of their institution. The estimated number of students registered to TLIs is approximately 30,000. While not all of

them may actually use the Internet, the opportunity exists for most of these students. Some institutions such as UTT, UWI and COSTTATT provide either wired or wireless Internet access to most of their students.

The details provided by the Ministry of Education about Internet access in schools is summarized in table 5. It may be noted that a majority of schools have dial-up Internet access rather than DSL. In addition, while the number of students registered in the schools is provided, there is no indication as to the extent of usage amongst students. Potentially though, all of these students have available to them access to computers and the Internet.

Table 5: Internet access at schools in Trinidad & Tobago

District	Type of Schools	Number of Schools	Have Internet Dial Up	DSL	Total Number of Potential Users
St Patrick	Secondary	14	11	0	2142
St Patrick	Primary	61	37		21824
Caroni	Secondary	17	9	2	5060
Caroni	Primary	70	46		28438
Nariva/Mayaro	Secondary	5	3	0	3349
Nariva/Mayaro	Primary	52	21		7439
St. Andrew/St David	Secondary	10	6	0	6291
St. Andrew/St David	Primary	45	29		11825
St George East	Secondary	18	6	4	6990
St George East	Primary	107	50		31060
St George West	Secondary	32	14	10	30980
St George West	Primary	94	17		49236
Tobago	Secondary	9	3	0	4261
Tobago	Primary	40	31		5597
Victoria	Secondary	31	15	4	29976
Victoria	Primary	79	42		35852

Source: Ministry of Education of Trinidad & Tobago

A summary of Internet access available from Internet cafes is provided in Table 6.

Table 6: Internet access through Internet Cafés

Internet Café	Numbers
Number of Cafes responded	17
Locations	Tobago (3) Port of Spain and Environs (4) East West Corridor (3) San Fernando and Environs (3) North East Trinidad (2) South East Trinidad (2)
Type of Services Provided by most	Internet/Gaming Café, Typing Services, Document Preparation, Photocopying, Printing, Sale of Office/Multimedia Accessories, Scanning, faxing, laminating, local and international calls
Connection speeds	DSL – 1 Dial Up – 16, (128-512 kbps) High Speed – 0
Average number of Users/week/Internet Cafe	127 persons per Café.
Average number using all cafes per week	2040
Total number of Computers available in Cafes	120

Source: Telecommunications Authority of Trinidad and Tobago

It may be noted that this is not an exhaustive list but represents those that responded to the call for registration with the Telecommunications Authority of Trinidad and Tobago.

Public libraries are located throughout the country as summarized in table 7.

Table 7: Computer and Internet Access at Public Libraries in Trinidad and Tobago

Information Item	Numbers
Number of Libraries	Trinidad – 21 Tobago – 3
Number of Computers	Staff Use – 400 Public Use – 250, where 150 are located at the National Library in POS, 100 at other service points
Internet Access	All computers
Type of Internet Access	Dial Up and Frame relay
Number of Persons accessing Internet	National Library – 283/month Other Service Points - 17000

Source: NALIS

6. RECOMMENDATIONS AND CONCLUSIONS

The relatively high value of the DOI Opportunity Index for all communities is proof enough that accessibility to and affordability of ICT services is generally not a major issue throughout Trinidad and Tobago. However, the relatively low Infrastructure and Utilization Indices in most communities is cause for concern.

The first recommendation is that immediate steps be taken to improve the infrastructure, with particular emphasis of encouraging Internet access.

In the first instance, this may be done through facilitating (1) the provision of widespread fixed-line services, since this is by far the easiest way to access the Internet from home and (2) the acquisition of home computers, especially in the 502 (out of 585) communities where the DOI Infrastructure Index is less than 50%. It is, of course, becoming more and more possible to access the Internet from home other than by using a fixed-line telephone. In addition to the mobile phone (which is a relatively expensive option), there are services available through providers of cable/satellite services. These may be encouraged given the trend in many communities to de-emphasize the use of fixed-line telephones in favour of mobile telephone services.

It is quite possible that, if the infrastructure is developed as recommended, then as a consequence utilization will improve quite naturally. However, this must not be taken for granted.

A second recommendation, therefore, is that a serious effort be made to encourage the use of the Internet, even with the given infrastructure, at home, at school, at the workplace, Internet Cafés and other places.

This may be done through a media blitz, but it must be of benefit to use the Internet. More and more government forms, services etc may be made available on line (including the preparation and submission of completed forms). At the time of writing, for instance, travel between Trinidad and Tobago by sea or air cannot be completed 100% on line (airfare must be paid offline although the booking may be done online).

Access is one thing: quality and ease of access are another:

The third recommendation is that priority should be given to the provision of affordable broadband services through fixed-line and, especially, mobile services.

In the sphere of non mobile services, much of this is happening at the moment of the preparation of this report. The current monopoly provider of fixed-line telephone services is in the process of phasing out its DSL services and replacing them with genuine broadband services. Other Internet providers are doing likewise. The problem persists, though, that most users of fixed–line services remain attached to dial-up Internet connections. The widespread availability of affordable broadband services ought to militate against this continued state of affairs.

The fourth recommendation is that, throughout the length and breadth of Trinidad & Tobago, more and more people be encouraged to subscribe to mobile (broadband) Internet services.

There is no reason why all further mobile Internet services should be, purely and simply, broadband services: the technology allows it and it should be used.

The recommendations need not be implemented in the order shown as, for instance, it is quite possible to implement the last first. If the are implemented, the various communities of Trinidad & Tobago will go a long way to closing the gap of the digital divide, both internally and externally.

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Appendix

Table A1: The DOI and DOI_ALT Indices and their Component Indicators

Category / Indicators	Score	Goalpost	Indicator	Weight within category (%)	Category Index
Opportunity					
Percentage of population covered by mobile cellular telephony		100		33	
Mobile cellular tariffs as a percentage of per capita income		0.16		33	
Internet access tariffs as a percentage of per capita income		0.2		33	
Infrastructure					
Proportion of households with a fixed line telephone		100		20	
Mobile cellular subscribers per 100 inhabitants		100		20	
Proportion of households with Internet access at home		100		20	
Mobile Internet subscribers per 100 inhabitants		100		20	
Proportion of households with a computer		100		20	
Utilization*					
Internet users per 100 inhabitants		100		33 (50)	
Ratio of Fixed Broadband Internet subscribers to total Internet subscribers		100		33 (50)	
Ratio of Mobile Broadband Internet subscribers to mobile Internet subscribers		100		33 (0)	

* Weights for DOI_ALT shown in parentheses.

Table A2: The DAI Index and its Component Indicators

Category	Indicator	Score	Goal Post %	Indicator	Weight in Category %	Category Index
Infrastructure						
	Fixed telephone subscribers per 100 inhabitants		60		50	
	Mobile cellular subscribers per 100 inhabitants		100		50	
Affordability						
	Internet access price as percentage of Gross National Income per capita		100		100	
Knowledge						
	Adult Literacy		100		67	
	Combined primary, secondary and tertiary school enrolment level		100		33	
Quality						
	International Internet bandwidth (bits) per capita		10000		50	
	Broadband subscribers per 100 inhabitants		30		50	
Usage						
	Internet users per 100 inhabitants		85		100	