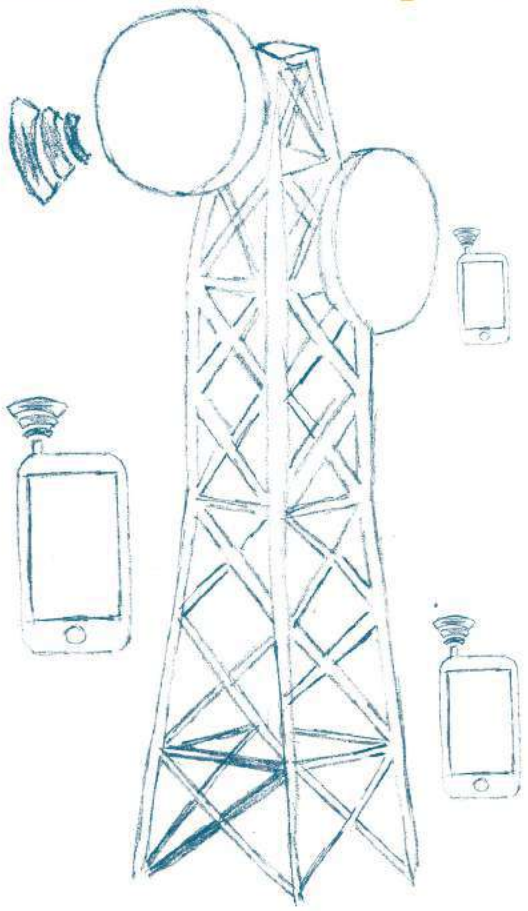
Dr. Pantelis Koutroumpis
Research Fellow
Imperial College Business School

Grégory Domond
ICT Consultant
PromoTIC

Benefit-Cost Analysis

Benefits of Government Digitization and Improved Mobile Access in Haiti



COPENHAGEN CONSENSUS CENTER

Haïti Priorise
Un plan de développement alternatif

The benefits of government digitization and improved mobile access in Haiti

Haïti Priorise

Dr. Pantelis Koutroumpis
Research Fellow
Imperial College Business School

Working draft as of February 28, 2017.

info@copenhagenconsensus.com
www.copenhagenconsensus.com

This work has been produced as a part of the Haiti Priorise project.

This project is undertaken with the financial support of the Government of Canada. The opinions and interpretations in this publication are those of the author and do not necessarily reflect those of the Government of Canada.

Canada

Academic Abstract

In this report I estimate the return on investment for a large-scale infrastructural upgrade in mobile broadband in Haiti aiming to an adoption rate of 50% of its population. I also attempt to estimate the impact of a broader digitization policy in the country focusing on specific areas for improvement like property registration, business registration and access to credit for small firms. The results are based on a mix of academic literature, evidence from the local conditions and explicit assumptions. Overall the effects of increased mobile broadband penetration return the cost by a factor of 12 while the returns from government digitization vary substantially with an average return of almost 4.7.

Policy Abstract

Overview

ICT infrastructure is a key enabler of growth across the world. Unlike other public and private investments, telecommunications networks form the basis for broader socioeconomic digitization. Haiti has a rudimentary fixed line infrastructure that covers limited parts of the dense urban areas and its mobile networks are generally voice-only covering busy transport links and the larger cities. Without investments in high quality and broader coverage mobile networks the country will continue to suffer from poor connectivity while its citizens will not be able to better organize their everyday activities and connect with the rest of the country and the world. I propose a number of initiatives that aim to increase mobile broadband penetration to 50% of the population. To support this transition I consider the installation of another undersea cable to help cover the increased international traffic. The increased connectivity combined with improved connection speeds (3G/4G) and low prices (at a fraction of the median monthly income) will help start new businesses that digitize everyday activities while individuals will be able to better monitor their business activities and interact with the government.

The second intervention deals with the government digitization process and particularly the transition from a predominantly paper-based organization that is hard to manage, costly to operate and slow in processing simple tasks. This transition is extrapolated by some case studies that particularly tackle existing bottlenecks. For example it takes 312 days to start a business in Haiti while this process can be reduced by a factor of 100. Similarly it takes 97 days to register a property and this can also by cut be a factor of 10. Last, there is no broad micro-financing facility in Haiti for Small and Medium Enterprises (SMEs) and the current records cover only 1.6% of all population according to the Doing Business report (2016). In this second intervention I address the costs and benefits that the computerization of these activities can provide and then map these effects as an overall government digitization initiative.

Implementation Considerations

Increase mobile broadband penetration to 50%

The intervention to increase mobile broadband penetration to 50% will cost $34mn - $56mn in the first 5 years to develop infrastructure (backhaul, undersea cable) with ongoing costs of $0.5mn - $76mn including all business operations of mobile providers after 2025. The primary benefit is a 0.1% boost to annual GDP growth. While this seems small, it cannot be overstated how significant this small boost to growth becomes when compounded over several decades. In 2020 this means GDP is 2.2bn gourdes higher, but by 2050 it means that GDP is 191bn gourdes larger - with Haitians 16% more wealthy than they otherwise would have been per capita. The cost of the infrastructure can be financed by infrastructure loans, say from IDB, and can be repaid over 30-40 years by charging a modest user fee of 2% of monthly income. This modest fee ensures a greater proportion of Haitians – higher than the 50% envisaged – can access broadband and ensures equity as well as efficiency.

The returns are insensitive to the rate of annual income Haitians need to contribute in a range of 0.5% - 2% or the decision and timing of international connectivity upgrade (with or without the undersea cable, in a 5-20 year horizon). The technological risks are minimal given the choice of internationally established best practices and the usage caps are also aligned with the increasing trends in data consumption. The transition of the entire customer base is planned to be fully operational by 2021. Any catch up effects are not factored in this analysis suggesting that the returns may be underestimated.

This intervention is an enabler for a number of other activities that can be achieved, ranging from applications in health, education, transport, manufacturing, energy and others.

Digitize Government

The intervention to digitize the Haitian government activities will cost $148mn for the initial setup (hardware, software, training) with operational costs of $85.6mn per year. The digitization process will take 5-10 years and require an additional $664 mn to become fully operational. The different elements of the government activities that will be digitized will generate various benefits ranging from possibly negative returns to highly positive ones. In order to analyze this

variation further we look into three separate types of intreventions. In most cases the revenues and benefits accrue from increased efficiency and transparency

Property registration

The intervention to digitize the property registration will cost $1.2mn for the initial setup (hardware, software, training) with operational costs of $2.9mn per year. The transcription process will take 5-10 years and require an additional $26.6 mn to become fully operational. Given the lack of titles in many cases and the lengthy or uncertain dispute resolution the intervenetion should also include a legal underpinning with specified deadlines for this process to materialize. After the implementation the whole process will be much quicker and from 312 days it will drop to 14. For every 10,000 transactions or registrations the country will benefit $19 mn due to increased efficiency, lower costs and higher transparency throughout the process.

Access to finance

The intervention to increase access to financ will cost $1.6mn for the initial setup (hardware, software, training) with operational costs of $0.6mn per year. The data collection effort from existing resources (banks, suppliers, etc) will take 3-5 years and require an additional $4.4 mn to become fully operational. After the implementation there will be 20% of Haitians and businesses covered with updated credit data compared to 1.6% today. Access to finance will increase to 7.4% for medium, small and micro businesses and boost their potential by an average 10% annually. The overall benefit from this change will reach $9.1 mn annually when fully operation and can increase further to cover a higher proportion of the economy.

New business creation

The intervention to reduce business will cost $1.3mn for the initial setup (hardware, software, training) with operational costs of $1.3mn per year. The transcription process will take 1-3 years and require an additional $12 mn to become fully operational. After the implementation the whole process will be much quicker and from 97 days it will drop to 11. For every 9,000 business registrations the country will benefit $4.9 mn due to increased efficiency, lower costs and higher transparency throughout the process.

Digitization benefits

There are various spillover effects that are hard to factor in this analysis thus increasing the overall effects of these interventions. These benefits include the increased participation in business activities, the increased number of property exchanges, the improved rates and personalization of financing products with more information, the ease-of-doing business in Haiti and others.

Cost Benefit Table

Interventions	Benefit	Cost	BCR	Quality of Evidence
Increase mobile **broadband penetration** to 50% in 5 years and install an undersea cable to support the increased traffic	685,742,245,838	56,108,821,955	12.22	Strong
Significant digitization of government processes	558,982,749,750	120,080,048,968	4.66	Medium
Case Studies				
Digitize the government to reduce property registration from 312 days to 11 days	14,577,198,923	4,061,245,114	3.59	Medium
Create a credit bureau to increase access to finance from 1.6% to 20% of MSMEs	7,014,182,109	841,170,276	8.34	Medium
Digitize the government to reduce the days to start a business from 97 days to 12 days	3,786,158,378	1,858,409,638	2.04	Medium

Note: All figures assume a 5% discount rate

1. Introduction

There is ample evidence about the importance of broadband infrastructures on local and national economic growth. The effects are both direct and indirect in this process. The early direct effects originate from the investments and maintenance of new or improved networks and these returns increase gradually as adoption of fixed and mobile infrastructures diffuses to broader parts of the local population. The indirect effects stem from the general-purpose services that these infrastructures offer. The seamless exchange of data for citizens and businesses through fixed or mobile channels is both fundamental and transformative – with the current level of technological capabilities –enabling phenomenal changes in everyday life across various socioeconomic contexts. The ability to participate in business and social networks, buy and sell goods and services online, collect and share information in a standardized context, telework, interact with the government, receive educational and health services are all indirect services that can be provided to individuals through mobile broadband networks.

The returns from broadband adoption range substantially with scale, income, culture and region. Other parameters like management practices and skills have also been found to crucially impact the impact of ICT use. In spite of this heterogeneity the recent literature confirms the positive effect on broadband adoption on economic output. Using a panel of 66-countries for the period 1980-2002 from the World Bank, Qiang and Rossotto (2009) found that an increase of 10 lines in 100 inhabitants in high-income economies can increase Gross Domestic Product (GDP) per capita by 1.21%. These results along with other early studies have been found to suffer from relatively low subscription rates at the time of analysis (there were hardly any countries in 2002 with more than 10% adoption levels), methodological issues (endogeneity and reverse causality) and technological limitations (very limited broadband infrastructure in place). In terms of the methodological constraints it is worth emphasizing that broadband adoption can be endogenous to economic performance. Since the level of development affects the level of adoption the research design has to account for these reverse effects. Using a more recent panel of 22 OECD from 2002-2007 and a structural model to disentangle the reverse effects Koutroumpis (2009) found a 0.24% average annual effect from broadband adoption, representing almost a tenth of

all growth in these countries. Instrumenting broadband coverage with fixed line access reach, Czerinch et al (2011) analyzed an OECD panel from 1996-2007 and found an equivalent effect of 0.9-1.5% for the addition of 10 more broadband lines in 100 people. More importantly the former study identified that a critical mass of users needs to be in place before the larger effects begin to emerge. This level of adoption was estimated at 30% of fixed broadband penetration (lines per 100 people), which practically translates into half of the population being connected to the Internet.

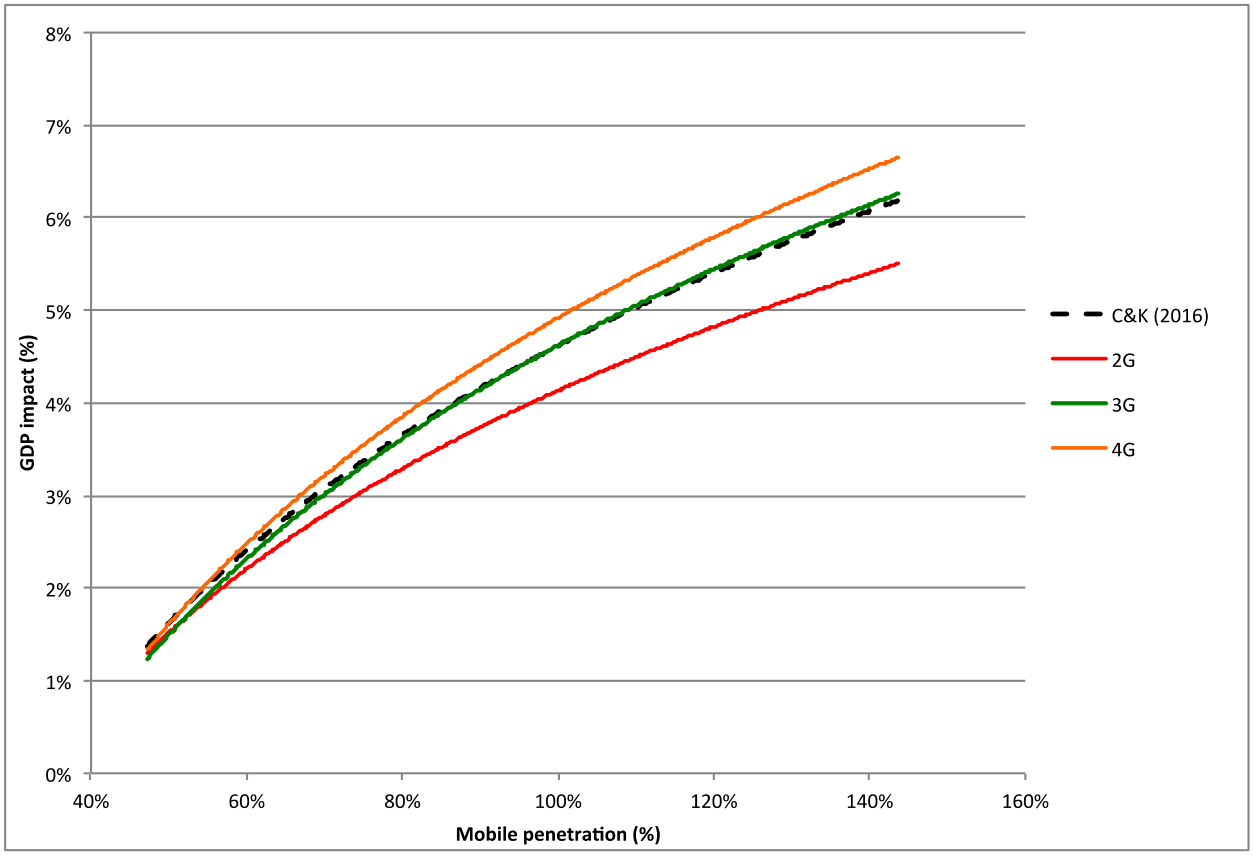
More recent evidence has moved away from simple adoption metrics to quality-adjusted estimates and from macroeconomic analysis to consumer surplus assessments and estimates for willingness to pay for broadband. These approaches are more informative about the level of speeds that are necessary for various types of users and help operators and policy-makers decide on their investment strategies for the future. Ahlfeldt et al (2016) linked willingness to pay for broadband speeds with property prices in the UK and found a strong effect that increases with speed at a decreasing rate. They analyzed a large micro-dataset of millions of properties for the period 1995-2010 and reported a 2.8% increase in property price for the connection with a first generation ADSL connection (up to 8MBps) whereas this effect grows to 3.8% in case a house is connected to a second-generation ADSL2+ connection (up to 24MBps). Rosston et al. (2010) estimate the demand from an online US survey for various levels of broadband speed and report that the representative household is willing to pay 48$ a month for an improving from slow to very fast connection speeds; this result is very close to the – implied monthly – effect estimated from property prices in Ahlfeld et al (2016).

Focusing on mobile access instead of fixed is a common characteristic of the developing countries. The lack of legacy copper based networks has prevented these regions to install some cost-effective upgrades and hence achieve more advanced speeds as was the case in most of the OECD countries. This effect combined with the relatively quick deployment of mobile infrastructures and the much higher (compared to ADSLx) speeds achieved today has shifted their interest to mobile infrastructure upgrades first. There is no reason to expect a lesser effect based on the channel of use (fixed or mobile) as modern technologies can seamlessly connect to

either medium in a transparent way. Still there is evidence in the recent literature that the impact of mobile infrastructure on economic growth is strong and significant too. Looking at a panel of 192 countries for the period 1990-2007 Gruber and Koutroumpis (2011) estimated a 0.2% annual GDP effect from mobile communications and a direct increase in productivity. More recently Koutroumpis and Cave (2016)[1] looked at 49 countries for the period 2000-2015 and estimated the mobile broadband effect for various generations of mobile access. This annual GDP effect (not simply a growth effect but the total impact on an annual basis) is a function of the speed of connection – again increasing with generations at a decreasing rate – and overall adoption levels (see Figure 1). Put simply, the transition from 2G to 4G for a country with 100% penetration increases the annual GDP effect by 1%. A similar effect is achieved if the same country grows from 75% adoption to 100% in the case of 2G networks.

[1] Using an adaptation of the original structural model of Gruber and Koutroumpis (2011)

Figure 1: The GDP impact of mobile access with different levels of adoption and generations (Source: "The mobile broadband premium", Koutroumpis & Cave, 2016)



The development and use of fixed and mobile networks helps boost the broader digitization of a country. Firms with a high-speed connection can quickly adapt to variations in demand and scale their operations accordingly by using cloud infrastructures and outsourcing opportunities. Small or large corporations can search for customers and advertise in various channels. Individuals can boost their skills and communicate with employers directly and self-employed individuals can trade through online platforms and manage their assets in real time. These changes do not appear immediately with the deployment of the networks but the significant lag in adoption that is observed in many cases – including Haiti – can be caught up by existing solutions in these areas.

The academic literature is also supportive of the productivity that stems from the gradual "computerization" of business processes. Looking at a sample of 527 large US firms between 1987 and 1994 Brynjolfsson and Hitt (2003) found that the productivity impact of ICT

investments appear after a period of time and not immediately. In realizing those benefits much appears to depend on culture and skills along with management practices that enable the full realization of these returns. One striking example of these business processes and their impact has bee highlighted by Bloom et al (2012) who performed an analysis of multinational firms operating in Europe for the period 1999-2006. The US-owned firms made much better use of the IT systems and this was reflected in their overall productivity compared to their non-US counterparts. These results help identify that the infrastructures and networks are a necessary but insufficient condition for growth in output or productivity for a firm or – more widely – for an economy. More recently a gradual adaptation of international management practices – partly through the broadband networks themselves – and the increase in international competition has reduced those initial differences. Cardona et al (2013) indicate that firm level differences can be vast but growth accounting across entire sectors tends to find these differences across the US and other countries as overestimated. This finding is also supported by the view that the exploitation of ICT is reflected in the skills necessary in different phases of digitization in a country. O'Mahony et al (2008) point to the fact that in the US the impact of ICT intensity was larger for non-IT workers with a degree than on IT workers compared to the same period (2000s) in Europe. They argue that this is a result of the different phases of adoption; the earlier stages require more technical skills while the later ones take advantage of the diffusion of technologies that requires more people with general skills to undertake the workload created by these channels.

Apart from the necessary technologies, adaptation of management practices, investment in skills and an understanding of local cultures, the digitization process requires a sound institutional and regulatory environment to materialize. A sound regulatory framework guarantees competition across operators, helps provide lower access prices to subscribers, protects personal data from firms and individuals that seek to use them in unforeseen ways and oversees the business practices in the ICT sector. The digitization process as with every other systemic change in a country needs to be supported in full by the local government and institutions to make any significant change. Alike management processes, governance and institutions underline the necessity for a holistic approach in this impending revolution. A number of countries around the

world have embarked on national broadband plans or digital agendas to differentiate this process from other activities and support the parallel actions that are necessary for the growth opportunities to emerge.

2. The telecommunications infrastructure in Haiti

Before getting into the details of each proposed intervention in the ICT sector it is important to give an indication of the current economic and political situation in Haiti. The country has been hit by a number of natural disasters including an earthquake in January 12th 2010 that killed more than 200,000 people, displacing 1.5 millions and causing extensive damages to critical infrastructures with long-lasting effects that have not yet been addressed. More recently in October 2016, hurricane Matthew struck the southwestern part of Haiti killing more than 500, destroying 200,000 houses and leaving 1.4 million people – approximately one tenth of the population – in need for humanitarian aid[2].

Haiti has one of the lowest incomes per capita in the world with 828.8 current USD reported by the World Bank in 2015, ranking the country as the poorest in the Americas. The economy has decelerated in recent years from 2.8% in 2014, to 1.2% in 2015 and 0.8% in 2016 (expected) and foreign aid has fallen sharply from 16.5% to 5.3% in 2015 due to political instability and mediocre performance of the agricultural sector. The vast depreciation of the gourde (local currency) and the drought have led to increases in prices and a high (but decreasing) inflation at 12.9%. Six out of ten Haitians (59%) live under the poverty line earning less than 2.42$ per day and almost half of them (24%) live under extreme poverty earning less than 1.23$ per day[3].

2.A. Telecommunications networks

The situation in the telecommunications infrastructure in the country is also rudimentary. Fixed phone connections are reported to be thin on the ground (0%) while less than one tenth of the households have a computer at home (9.4%). Less than half of the computer-equipped households have Internet access at home (4.4%). Only 12.3% of Haitians use the Internet in

[2] BBC, Wikipedia and World Bank (2016)
[3] Data from World Bank (Dec 2016)
http://www.worldbank.org/en/country/haiti/overview

some way, either at work, home or other communal place. In terms of mobile connections these have faired much better in the country. There are currently 68.8 connections per 100 people in the country providing a broad basis for the deployment of more advanced network access. From these subscribers only 0.2% use mobile broadband (ITU, 2016).

The costs for any digital access are informative of the underlying situation. For example a fixed broadband connection (FTTx) from Digicel costs from 55$/month translating in 80% of the average annual income just for Internet access. Higher speeds cost even more reaching up to 220$/month a cost more than three times the average income and almost 100 times higher than the income of the majority of Haitians. Similarly the cost of a basic computer ranges from 500-600 which is prohibitive for most people in the country. Based on this situation it is clear that the deployment and use of fixed line networks outside the major urban areas of the country is not a feasible alternative to boost Haiti's digital economy as there is reportedly limited existing infrastructure in place hence preventing the quick and cost-effective upgrades. Table 1 summarizes the current situation in Haiti in terms of telecommunications infrastructure.

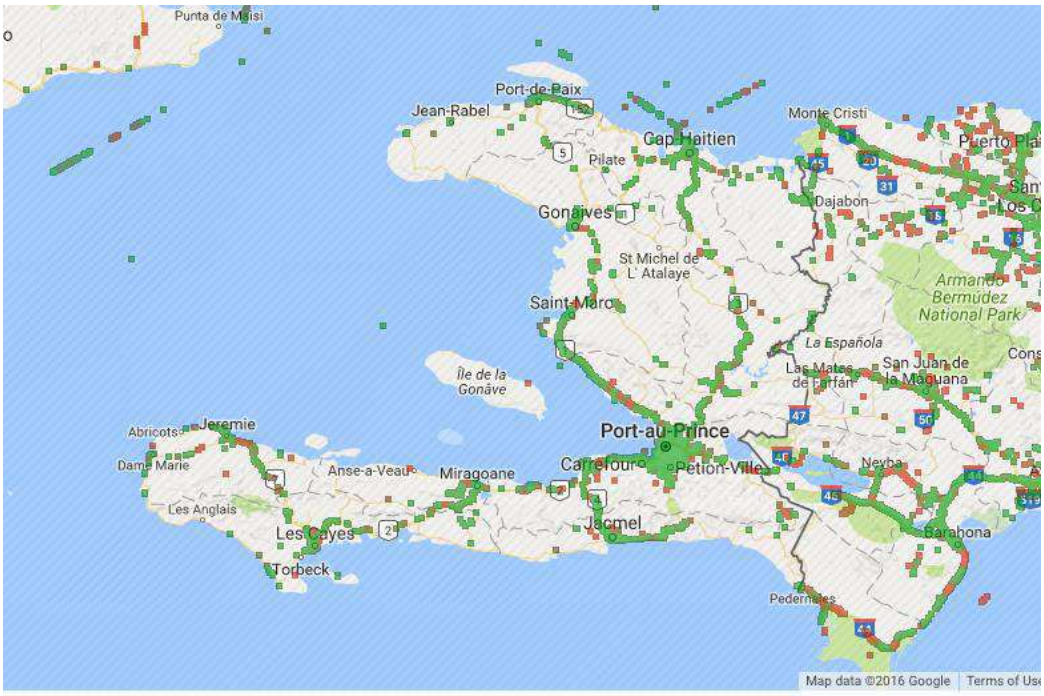
Table 1: The telecommunication adoption and networks in Haiti (Source: ITU, 2015)

	Haiti
Fixed-telephone subscriptions per 100 inhabitants	0
Mobile-cellular subscriptions per 100 inhabitants	68.8
Fixed (wired)-broadband subscriptions per 100 inhabitants	0
Mobile-broadband subscriptions per 100 inhabitants	0.2
Households with a computer (%)	9.4
Households with Internet access at home (%)	4.4
Individuals using the Internet (%)	12.2

While mobile adoption is relatively strong – still one of the lowest in the region – mobile coverage is not as expected. Using crowdsourced data from OpenSignal I observe that mainly Port-au-Prince and a handful of other large cities are well covered. Moreover some of the connection transport routes are also well lit but the vast majority of the rural country is a "not-spot". Increasing the impact of mobile infrastructure will require an increase in coverage and quality of connections. This also has to take into account the local economic conditions so that

the investments can break even and also produce significant returns to the economy. Currently the most popular plans in the country include 50MB or 100MB of data use from mobile phones and these are predominantly prepaid[4].

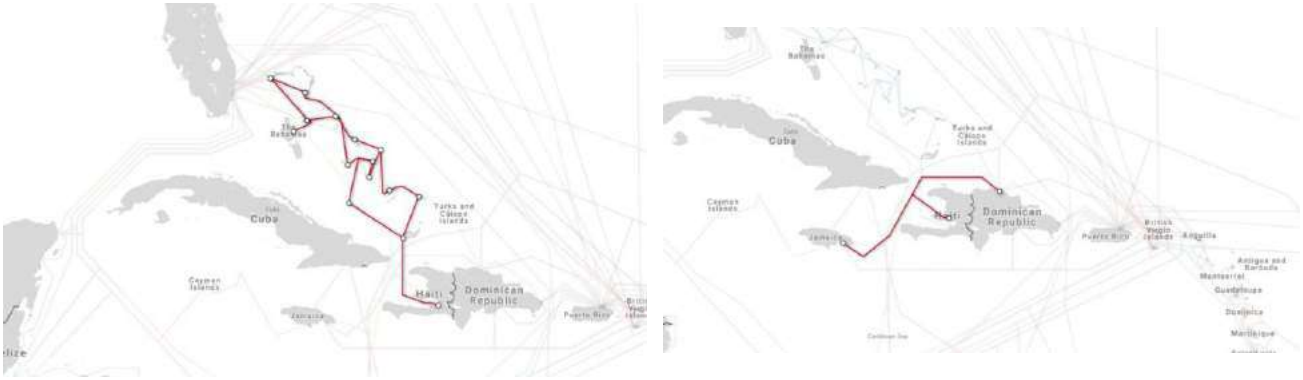
Figure 2: The mobile coverage in Haiti – green squares indicate good coverage, red squares indicate mediocre coverage and no squares no coverage (Source: OpenSignal, 2016)



The backbone infrastructure is also necessary to deploy high quality telecommunications services. Operators need to exchange their data with other providers around the world and this is achieved with international undersea cables. At present, Haiti is connected with the global Internet across 2 links: One submarine cable in Port-au-Prince that connects to Jamaica and another one that hops in the Caribbean Islands to reach the Bahamas. In addition to this capital expenditure, international connectivity providers are required to pay for IP transit to global telecom players. (Telegeography 2015)

[4] Information provided by Gregory Domond (Haiti Prioritise)

Figure 3: The two undersea cables connecting Haiti (Source: Telegeography , 2016)



2.B. Government Digitization

Government digitization necessitates a holistic approach that blends a thorough understanding of local laws, culture and institutions, an identification of the various bottlenecks in everyday processes, experience in managing projects in the public sector and above all political will to drive this change. In this section I present some key areas that Haiti performs poorly compared to other countries in the Americas and can be addressed to have a lasting impact in the country's economy. In particular these changes aim to address the limited international investment being attracted to Haiti and also improve the efficiency of the government and the country's ranking in the "Doing Business" report.

From this report I have isolated three key areas that the country trails other neighbors in the Latin America and the Caribbean. In particular it takes 97 days to start a business in Haiti whereas the Americas average is less than a third at 29.4. The reason for this delay is that the Commercial Registry at the Ministry of Commerce and Industry take almost 80% of that time to authorize operations for new firms.

Why should someone care for the process to start a business? First it is a matter of bureaucratic requirements that can be reduced to streamline this process. By itself this change has been found to significantly reduce the burden for the authorities[5]. Second, by reducing the barriers to

5 From Doing Business 2016: "In the 107 economies covered by both *Doing Business* and the World Bank's Entrepreneurship Database, an estimated 3.1 million limited liability companies were newly registered in 2012 alone. Data show that if these economies had followed best practice, their local entrepreneurs would have saved 45.4 million days spent in satisfying

entry more firms will gradually become formal. This is particularly relevant for resource-constrained entrepreneurs in developing markets. Third the increased business registration increases the chances of entrepreneurial activities creating significant spillover effects to the economy. In practice this change can increase job creation and limit government spending to other more productive areas. In a recent paper looking at a similar change in Mexico the authors found that the simplification of business registration increased formally registered businesses by 5%. The majority of the change was due to previously wage earners that decided to start a business or become formal[6].

Similarly property registration is a tantalizing process in Haiti. It takes more than 10 months to register the sale of a property, which is almost 5 times the time it takes in other countries in the region. The majority of the time is spent to transcribe and record the sale agreement at the Tax Authority (DGI). Property registration is also an important process with increased economic implications for a country as land and buildings account between 50% and 75% of the wealth in most economics around the world. Moreover the transparency and updated information in land registries has been found to be associated with increased investment, increased land values and higher chances of financing. Additionally an updated property registry allows for better city planning and governments to map their needs and deploy their services accordingly.

Last – even after starting a business in Haiti – it is possible that access to financing will be limited. In fact there is no credit bureau in the country or any kind of distribution of credit data (either positive or negative) and no information from other sources about the credit worthiness of individuals and firms (including utilities, etc.). The current registry covers 1.6% of the adults whereas in other countries in the Americas this spans to 12.3%, still a very low figure. Also the "depth" of credit information index is non-existent while in other countries it is at 4.7 out of 8.

---

bureaucratic requirements. This valuable time could have been better employed focusing on firm growth, productive activities and innovative endeavours.

6 Bruhn, M. (2011). License to sell: the effect of business registration reform on entrepreneurial activity in Mexico. The Review of Economics and Statistics,93(1), 382-386.

Credit registries are a precondition for almost any investment activity in many economies around the world. This type of Information can help reduce asymmetries among lenders and borrowers thus improving access to credit, providing lower interest rates and helping maintain a coherent basis for further analysis. The credit history, often referred as a reputational collateral is a good predictor of future behavior and helps minimize risk perceptions. Information sharing allows more competition among borrowers too while credit information systems are often the basis of regulatory supervision. This information sharing can also be used as a disciplinary measure for future snowball effects of credit disruptions. Overall the effects from increased access to credit data are often underestimated and in the context of this report these effects have been proxied by the increased borrowing for small firms in Haiti (see section 3.b).

All the data from "Doing Business (2016)" are presented in Table 2.

Table 2: The state of Doing Business in Haiti, (Source: Doing Business, 2015)

	Haiti	Latin America and Caribbean
Starting a Business		
Time (days)	97	29.4
Reason for performance deviation:	Registration with the Commercial Registry at the Ministry of Commerce and Industry and obtain the authorization of operations (Droit de fonctionnement)	
Registering Property		
Time (days)	312	63
Reason for performance deviation:	The sale agreement is recorded and transcribed at the Tax Authority (DGI) 6-9 months	
Getting Credit		
Depth of credit information index (0-8)	0	4.7
Credit registry coverage (% of adults)	1.6	12.3
Reason for performance deviation:	○ No credit bureau (no scores or records) ○ No distribution of credit data positive or negative for firms of individuals ○ No data redistribution from utilities	

3. Calculation of Costs and Benefits

In this paper I undertake the cost and benefits assessment for improved mobile broadband coverage and use and increased digitization in government activities. Based on the established benefits from the increase in digitization I look into the following interventions:

Intervention 1:

- Install an additional undersea cable to increase international connectivity (to allow for higher speeds in fixed and mobile connections)
- Build or upgrade infrastructure to increase mobile broadband coverage and capacity to 50% population for specific usage baskets (from 100Mb to 1Gb per subscriber per month) prioritise the major cities like Port au Prince to reduce initial adoption risks)

Intervention 2:

- Digitizing government to enhance workflows, streamline internal procedures. This involves the necessary equipment, software and training required to upgrade the government services.
- In this process I undertake three separate case studies that help tackle particular issues in the Haitian public sector. This are the following:
    - Digitizing government to enhance workflows, streamline internal procedures. This involves the necessary equipment, software and training required to upgrade the government services.
    - Create a credit bureau to increase access to finance from 1.6% to 20% of MSMEs
    - Digitize the government to reduce the days to start a business from 97 days to 12 days

3.A. Mobile broadband Costs and Benefits

Mobile broadband in Haiti will be the basis for increased benefits from broadband infrastructure. Other fixed line alternatives are not considered based due to much higher costs and a much longer deployment period. The adoption scenario assumes that 4G coverage will be in place by

2017 for 50% of the population with a focus on the largest and busiest parts of the cities[7]. Conditional on the success of this intervention additional coverage can be provided to more rural parts of the country. The areas that will be prioritized are presented in Table 2.

Table 2: The cities that will be first coverage by 4G based on population densities (Source: World Bank, 2015)

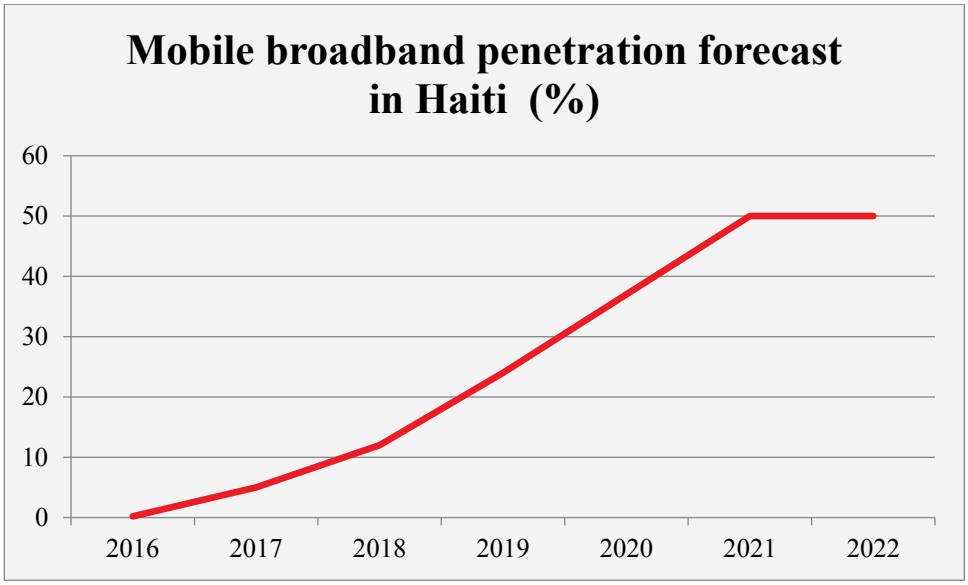
Communes	Department	Arrondissement
Port-au-Prince	Ouest	Port-au-Prince
Carrefour	Ouest	Port-au-Prince
Delmas	Ouest	Port-au-Prince
Pétionville	Ouest	Port-au-Prince
Gonaïves	Artibonite	Gonaïves
Cap-Haïtien	Nord	Cap-Haïtien
Saint-Marc	Artibonite	Saint-Marc
Cité Soleil	Ouest	Port-au-Prince
Croix-des-Bouquets	Ouest	Croix-des-Bouquets
Port-de-Paix	Nord-Ouest	Port-de-Paix
Léogâne	Ouest	Léogâne
Jacmel	Sud-Est	Jacmel
Dessalines	Artibonite	Dessalines
Petit-Goâve	Ouest	Léogâne
Petite Rivière de l'Artibonite	Artibonite	Dessalines
Gros-Morne	Artibonite	Gros-Morne
Les Cayes	Sud	Les Cayes
Saint-Michel-de-l'Atalaye	Artibonite	Dessalines
Jean-Rabel	Nord-Ouest	Môle-Saint-Nicolas
Verrettes	Artibonite	Saint-Marc
Grand-Goâve	Ouest	Léogâne
Jérémie	Grand'Anse	Jérémie

The benefits from the use of the services will stem from the adoption process. For this purpose I envisage a gradual transition of existing subscribers to 4G and a 50% penetration rate for mobile broadband by 2021. The adoption path is presented in Figure 4 and is relatively insensitive to the

[7] Major operators in the country suggest that they already cover the entire population NATCOM with 3G (http://www.natcom.com.ht/4g-network-4119510228.html) and DIGICEL with 4G (http://4g.digicelhaiti.com/en/coverage). Using third party data (OpenSignal) this is not confirmed for either. In any case the increased demand for data will require upgrades and a more dense network to support the intervention. Based on this increased adoption and used I make all calculations.

actual growth rate until 2021 as long as the adoption target is reached within the specified timeframe.

Figure 4: The mobile broadband adoption in Haiti after the first intervention (Source: Author's calculations)



The backbone connectivity is necessary to address the increased capacity required for the network traffic. By 2021 the country will require international transit in excess of 60GBps and the current infrastructure that is vastly underutilized can cover up to 23GBps (Digicel, Natcom and Access Haiti). This investment can be postponed for a period of 5-10 years as the estimations are based on doubling speeds every 5-6 years and a similar increase in mobile data consumption[8]. The alternatives for a new undersea cable can be found in Table 3. There are two main options: either build a new cable to connect with an existing hub or join an existing cable. In terms of a cost benefit approach the connection with Barranquilla (see Table 3) is the closest to Port-au-Prince (884 km). Joining one of the existing ARCOS or America Movil Submarine Cable System-1 that both go through Miami seems to be the most cost-effective solution. Cost calculations per kilometer of undersea cable are based on a rough estimate of 90,000 USD per km of cable.

[8] Given the relatively low priority investment of the undersea cable at the moment I calculate the BCR without this cost. For the 5% case the returns increase only marginally from 10.11 to 10.37. Similar changes are observed for the 3% and 12% discount rates BCRs.

(Telegeography, 2016). Clearly this estimate depends on a number of other parameters but in the absence of specific technical criteria for this link this generic estimate has been used instead.

Table 3: The options for laying a new undersea cable or connecting with an existing one (Source: Telegeography, 2015)

Build new cable	Distance in km	USD (mil)
Miami	1144	102.96
Caracas	1076	96.84
Barranquilla	884	79.56
Join existing	Distance in km	USD (mil)
America Movil Submarine Cable System-1 (Goes through Miami)	250	22.5
ARCOS (goes through Miami)	350	31.5

On top of the backbone link that is necessary to support the increased demand for mobile data, operators need to pay for exchanging international traffic and the transit prices vary substantially depending on the type of medium and other parameters in these agreements. As an indication of the transit prices for two relatively close hubs to Port-au-Prince in Table 4[9]. These costs are also accounted in the estimations of the total cost of the intervention.

Table 4: The options for laying a new undersea cable or connecting with an existing one (Source: Telegeography, 2015)

	$/Mbps/month for 10GigE IP prices
Miami	0.15
Sao Paolo	16

Moving away from the international interconnections the cost estimations have been based on the average cost of delivery of 1GBps in the local networks. This is a relatively broad estimate of the telecommunications industry that takes an overall average cost of delivering the service of 1GBps for subscribers and has been shown to fall substantially over the years. Based on the

[9] https://www.telegeography.com/press/press-releases/2015/09/09/ip-transit-prices-continue-falling-major-discrepancies-remain/index.html

speeds per subscriber and the minimum possible concurrent needs for these speeds (contention ratios) I am able to estimate the average cost of local mobile broadband delivery for the entire intervention. As an indication the cost per 1GBps in the local networks was 1$ in emerging markers according to a specialist report[10].

In order to address some of the financing challenges of this intervention I also include a user fee in the process. This is equal to 2% of the minimum wage of the country and equals 7$/month for a 4G connection with 1Gb of data on a monthly basis[11]. Currently the cheapest price for a 3G offering (prepaid) is 900 gourdes (~14$/month) with speeds that are not guaranteed and almost one tenth of the ones envisaged in the first intervention. It is worth mentioning that current offerings can drop to 256kbps and still be considered a 3G data package[12]. The overall cost calculations are largely dependent on the subscribers in the local networks where 4G are provided. The cost of the undersea interconnection and the timing of this intervention do not affect the Benefit-Cost Ratios estimated.

In terms of the benefits assessment I follow a relatively conservative approach and apply the findings from the Gruber and Koutroumpis (2011) study for developing countries with a discount rate of 10% (i.e. a 0.1 coefficient instead of 0.11). This value represents a conservative estimate for two reasons: first the mobile broadband impacts are equalized with the simple voice offerings and second the adoption levels in mobiles have shifted the returns substantially. If the benefit cost ratio is adapted to the most recent evidence (Cave and Koutroumpis) we find more than double the effect of mobile broadband across all discounting variations[13]. Still I find the former estimates more appealing as they indicate significant returns on investment, a basic usage fee and a forward-looking strategy for higher quality in telecommunications service delivery. The results are presented in Table 5.

[10] Jeroschewski 2013, 0.1 cent per MB: Ensuring future data profitability in emerging market, http://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/telecoms/pdfs/recall_no17_cost_per_mb.ashx.
[11] The estimated BCRs are insensitive to user fees. I repeated the calculations with a 1% and a 0.5% of the minimum wage and the BCR for the 5% discount rate dropped marginally from 10.11 to 10.01 and 9.97 respectively.
[12] http://www.natcom.com.ht/mobile-internet-4933055156.html
[13] For 3% discount we get a BCR of 23, for 5% of 21 and for 12% a 14.

Table 5: Benefits-cost ratios for 50% mobile broadband penetration in Haiti (Source: Author's calculations)

Intervention	Discount	Benefit	Cost	BCR
Increase mobile broadband penetration **to 50% in 5 years & install an** undersea cable **to support the increased traffic**	3%	1,097,697,384,874	80,119,502,151	13.70
	5%	685,742,245,838	56,108,821,955	12.22
	12%	166,864,176,471	20,301,146,639	8.22

3.B. Government digitization Costs and Benefits

In this section I explain the cost and benefit calculations for each of the various digitization projects (starting a business, property registration & getting credit). To begin with I use a 20-year horizon for these process unlike the infrastructural ones that span up to 2050. The main reason is that computing equipment and software have much shorter amortization periods compared to large-scale infrastructures. Also the trend towards cloud-based solutions may necessitate substantial investments for these facilities in the future.

Starting a business in Haiti requires a first stage registration with Commercial Registry and a second stage to obtain authorization of operations. The first leg requires 20 days and the second 77. A simple registration should not take more than 1 day to complete while the authorization should be feasible to be completed in less than 11 days (two-weeks) in a fully digitized environment[14]. This process has substantial setup costs though. According to recent evidence there are 900,000 businesses[15] in Haiti – although only a third of them are formally registered. The registration of all firms in a new distributed access system will require on average 5 hours of

[14] Previous attempts on this front have been published in 2012 (a business registry by the local ministry : www.mci.gouv.ht.) and in 2014 (http://lenouvelliste.com/lenouvelliste/article/130728/Le-ministere-du-Commerce-devoile-son-programme-dappui-aux-PME). Other attempts include the Investment Facilitation Center, CFI (see http://www.cfihaiti.com/) that provides services to foreign and domestic investors.

[15] Private Sector Assessment in Haiti (2016) – Inter-American development Bank.
The Enterprise Finance Gap Database compiled by the International Finance Corporation (IFC, the World Bank's private-sector financing arm) estimates the total number of micro, very small, small and medium-sized formal and informal enterprises at around 900,000, of which slightly fewer than 60,000 are small and medium-sized enterprises, or SMEs (small enterprises employing between 10 and 49 people and medium-sized firms with 50 250 employees). The great majority (around 95%) of companies in Haiti are informal.

a data-entry employee to update and correct any missing information. All employees should undergo at least 100 hours of training in case they have not used similar environments in the past. This process will require 500 employees with new computer facilities and software to be developed as well. The time required to register a business is not assumed to have been fully devoted to operational activities (i.e. I do not expect that employees worked on a single application for 97 days) but only a fraction of this time (at 20%) will be considered for the increased productivity. Other management and processing bottlenecks that will be addressed in a digital context are responsible for these vast delays. Table 6 summarizes the benefits and costs of revamping the process to start a business.

Table 6: Benefits-cost ratios for starting a business in 11 days in Haiti (Source: Author's calculations)

Case Studies	Discount	Benefit	Cost	BCR
Reduce the days to start a business **from 97 days to 12 days**	3%	4,574,576,423	2,086,513,592	2.19
	5%	3,786,158,378	1,858,409,638	2.04
	12%	2,163,368,123	1,369,945,306	1.58

Increasing the access to credit from 1.6% to 20% in Haiti will require the digitization of all formal entities and an initiative to formalize the informal ones. Collecting this information will require the training of the government employees for an average of 10 hours (for data-entry) and this will include the purchase of equipment and software for 1,000 employees. After the reform more that 165,000 firms in the country will be able to have their credit records available for use by lenders and this will allow them to gain access to credit. I estimate the benefits from this change at the lowest level of business entities, i.e. the micro-enterprises with expected annual revenues on average at 0.5 million gourdes. For every 1% increase in credit coverage the total credit in the economy increased by 0.4%[16]. Table 7 summarizes the benefits and costs of revamping the process to start a business.

[16] Martinez Peria, M. S., & Singh, S. (2014). The impact of credit information sharing reforms on firm financing?. World Bank Policy Research Working Paper, (7013).

Table 7: Benefits-cost ratios for increasing access to finance in Haiti (Source: Author's calculations)

Case Studies	Discount	Benefit	Cost	BCR
Create a credit bureau **& increase** access to financing **from 1.6% to 20% of MSMEs**	3%	8,474,793,947	944,416,763	8.97
	5%	7,014,182,109	841,170,276	8.34
	12%	4,007,824,414	620,077,107	6.46

Improving property registration is also an important digitization task. In my calculations I estimate approximately 10 million property titles (or rights) that need to be digitized.[17] The time to transcribe a record is expected to take up to two hours for ministerial employees and the training required for this should not exceed 30 hours per person (to account for the possible GIS training too). The three main stages in property registration, i.e. the processing of a transaction, the transcription of the transaction and the sale confirmation is expected to take 11 in total – in fact the first two steps will be completed in less than one day. The time required to register a property follows the business registration practice and does not assume full commitment from the employees but only a fraction of this time (at 20%) will be considered for the increased productivity. Table 8 summarizes the benefits and costs of digitizing property registries.

Table 8: Benefits-cost ratios for reducing property registration delays in Hait (Source: Author's calculations)

Case Studies	Discount	Benefit	Cost	BCR
Reduce property registration **from 312 days to 11 days**	3%	17,612,710,260	4,559,728,360	3.86
	5%	14,577,198,923	4,061,245,114	3.59
	12%	8,329,246,779	2,993,787,573	2.78

Last, the overall government digitization will include all 73,954 employees that will go through some generic training to use and interact with the new software and hardware. This training will take up to 100 hours for people without any previous experience in using computers. Similarly the computing equipment and software that will be purchased will count in the cost of this process. The expected returns from this investment are based on the average benefit-cost ratios found in the previous case studies. This is an oversimplification of the process but it has been

[17] This is a ballpark estimate based on the country's population and comparing with more than 50 other property registries versus local population

suggested by the local officials and Copenhagen Consensus to help create a measurable target. The results of this exercise are found in Table 9.

Table 9: Benefits-cost ratios for overall digitization in Haiti (Source: Author's calculations)

Intervention	Discount	Benefit	Cost	BCR	Quality of Evidence
Digitization of government processes	3%	675,383,608,613	134,818,852,205	5.01	Medium
	5%	558,982,749,750	120,080,048,968	4.66	
	12%	319,396,428,111	88,518,212,598	3.61	

4. Conclusion

The proposed interventions have been selected as fundamental to help upgrade the existing telecommunications infrastructure and increase its resilience from natural disasters with the addition of another international link. Moreover they aim to improve the current institutional and governance practices by enabling a quicker turnaround of basic business processes, instilling transparency and accountability to the government officials and curbing corruption that will put the country back on its feet.

From the summary table (Table 10) we observe that albeit the high costs of the infrastructural investments these seem to have a healthy payback for the economy at 12.22 when a 5% discount rate is used. The digitization process costs almost twice as much and retains a benefit cost ratio of 4.66 at the baseline scenario. More importantly the creation of a credit bureau and the increase in credit coverage seems to be the most crucial intervention from the cases discussed, bringing back 8.34 of its costs. Property registration is strong too returning its cost at 3.59 times and reducing the days for business registration will make slightly more than twice the cost of its implementation. All these estimations are based on a number of assumptions but more often these are largely conservative thus partly accounting for the particularities of the country and its deviation from the other cases analyzed in the literature. It is also preferable from a prioritization standpoint to have relatively more realistic expectations of the impending returns on investment when addressing so fundamental changes.

The main conclusion of this report is that improving connectivity in Haiti is beneficial for the country and its citizens and it also acts as an indication of strong political will to improve the governance and business environment in the country.

Table 10: Benefits-cost ratios for all interventions in Haiti (Source: Author's calculations)

Intervention	Dis-count	Benefit	Cost	BCR	Quality of Evidence
Increase mobile broadband penetration to 50% in 5 years & install an undersea cable to support the increased traffic	3%	1,097,697,384,874	80,119,502,151	13.70	Strong
	5%	685,742,245,838	56,108,821,955	12.22	
	12%	166,864,176,471	20,301,146,639	8.22	
Digitization of government processes	3%	675,383,608,613	134,818,852,205	5.01	Medium
	5%	558,982,749,750	120,080,048,968	4.66	
	12%	319,396,428,111	88,518,212,598	3.61	
Case Studies	**Discount**	**Benefit**	**Cost**	**BCR**	**Quality of Evidence**
Reduce property registration from 312 days to 11 days	3%	17,612,710,260	4,559,728,360	3.86	Medium
	5%	14,577,198,923	4,061,245,114	3.59	
	12%	8,329,246,779	2,993,787,573	2.78	
Create a credit bureau & increase access to financing from 1.6% to 20% of MSMEs	3%	8,474,793,947	944,416,763	8.97	Medium
	5%	7,014,182,109	841,170,276	8.34	
	12%	4,007,824,414	620,077,107	6.46	
Reduce the days to start a business from 97 days to 12 days	3%	4,574,576,423	2,086,513,592	2.19	Medium
	5%	3,786,158,378	1,858,409,638	2.04	
	12%	2,163,368,123	1,369,945,306	1.58	

5. References

Ahlfeldt, G. M., Koutroumpis, P., & Valletti, T. M. (2016). Speed 2.0-Evaluating access to universal digital highways. JEEA, (forthcoming)

Bloom, N., Sadun, R., & Van Reenen, J. (2012). Americans do IT better: US multinationals and the productivity miracle. *The American Economic Review*,*102*(1), 167-201.

Bruhn, M. (2011). License to sell: the effect of business registration reform on entrepreneurial activity in Mexico. *The Review of Economics and Statistics*,*93*(1), 382-386.

Cardona, M., Kretschmer, T., & Strobel, T. (2013). ICT and productivity: conclusions from the empirical literature. *Information Economics and Policy*,*25*(3), 109-125

Cave M. and P. Koutroumpis (2016), "The mobile broadband premium in developing countries"

Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband infrastructure and economic growth. *The Economic Journal*, *121*(552), 505-532.

Gruber, H., & Koutroumpis, P. (2011). Mobile telecommunications and the impact on economic development. *Economic Policy*, *26*(67), 387-426.

Jeroschewski 2013, 0.1 cent per MB: Ensuring future data profitability in emerging market, (McKinsey)

Koutroumpis, P. (2009). The economic impact of broadband on growth: A simultaneous approach. *Telecommunications policy*, *33*(9), 471-485.

Martinez Peria, M. S., & Singh, S. (2014). The impact of credit information sharing reforms on firm financing?. *World Bank Policy Research Working Paper*, (7013).

O'Mahony, M., Robinson, C., & Vecchi, M. (2008). The impact of ICT on the demand for skilled labour: a cross-country comparison. *Labour economics*,*15*(6), 1435-1450.

Qiang, C. Z. W., Rossotto, C. M., & Kimura, K. (2009). Economic impacts of broadband. *Information and communications for development 2009: Extending reach and increasing impact*, *3*, 35-50.

Mobile Broadband Challenges in Haiti

Haiti Priorise

Grégory Domond
ICT Consultant

Mobile Broadband Challenges in Haiti

The telecommunications market which was once focused on voice (telephone services) is now becoming strongly influenced by data traffic. In fact, this is the global trend in the telecommunications sector. This change is taking place thanks to the digitization of the information to be transmitted. Today, all information can be digitized, which means it can take the binary values 0 and 1. Thus, the information is expressed as a kilobit, kilobyte, megabyte and gigabyte. The transmission of all these bits and bytes requires a speed, hence the bit rate. The higher the bit rate, the faster the data transmission. This explains the need for broadband in this information society.

High data transmission rate or broadband service is defined as a high speed of connection to the Internet. Broadband is better suited for use than low-bandwidth services (telephone line, modem) since it allows you to send and download more information faster. It's a question of, in fact, the speed of the connection established between the subscriber and the network. It should be emphasized that this connection consists of two links: an uplink (from the user to the network) and a downlink (from the network to the user).

There is no overall consensus on the minimum flow of broadband. The definition of broadband varies from country to country. It is defined on the basis of the transmission and the technology used.

Thus, yesterday's broadband network is becoming low-bandwidth today thanks to the fact that speeds increase with the development of transmission technologies. However, many players claim that 512 kilobits per second is the minimum for a broadband service. A speed of 512 kbps allows for participation in video-conferencing in real time. In reality, broadband is measured in megabits per second (Mbps) and gigabits per second (Gbps).

Broadband access is available in a number of ways: ADSL connections, fiber optic, fixed wireless connection, satellite connection, cable modem and wireless networks (3G, 4G networks).

The ability to transmit large volumes of information at any time is an important feature in today's telecommunications landscape. Some services and applications cannot function without broadband because the exchanges are made in real time.

Haitian Telecommunications Market

The Haitian telecommunications market was dominated by fixed-line, wired telephony for a long time. Today, the landscape is markedly different thanks to a variety of electronic means of communication available. However, it must be recognized that many ICT services remain unavailable or underutilized due to several factors. Moving from a monopoly to a liberalized

market status, progress today is enormous and palpable. Twenty years ago, the telephone penetration rate was less than 1 phone per 100 inhabitants. Today, more than 65% of Haitians have a cell phone. All this market evolution is a direct consequence of the decision to liberalize this market.

The first mobile operators to penetrate the Haitian market used the CDMA and TDMA standards. The TDMA was to be quickly abandoned in favor of the GSM standard. Shortly thereafter, all the operators on the market were utilizing the GSM standard (2G). The challenge of cellular telephony was taken up in 2000. Shortly afterwards, users were able to use short message service (SMS) thanks to the migration of 2G networks to GPRS (General Packet Radio Service, 2.5G).

The data market went through a profound revolution in Haiti. This migration also made it possible to access the Internet via cellular phone at low data transmission rate, that is to say with speeds in the order of a few kilobits per second. This rate would be improved by the migration to EDGE (Enhanced Data Rate for GSM Evolution, 2.75 G). Cellular subscribers could access the Internet at speeds over 100 kb/s.

3G is the step that is revolutionizing the data market in Haiti. Now, a considerable percentage of the Haitian population has access to 3G services.

Why broadband?

Broadband meets a demand for quality telecommunications services. Large files (in megabytes, gigabytes) require high speed or a large bandwidth for their fast download. The download of a message consisting of a billion bits would take about three hours with a data transmission rate of 100 kbps. This same message would need 9 minutes to be downloaded with a data transmission rate of 2Mbps, and one second for a data transmission rate of 1Gbps. In the age of the information society, ICT professionals and users want to swiftly exchange all kinds of information all day long. What is most demanding is real-time exchanges. Telephony, videoconferencing, video games and multimedia applications cannot be delayed. These communications that involve interaction must reach the recipients as quickly as possible so that they can respond in a timely manner.

Data traffic increases daily thanks to social networks. The demand for capacity remains constant, given young people’s enthusiasm for using social networking applications (Facebook, YouTube, WhatsApp, etc.).

In view of the increasing demand for MB, operators are regularly required to make significant investments in order to be able to support the traffic thus generated. Paradoxically, these regular and intensive uses do not return the investment made in network infrastructures and

operations, because the data market in Haiti faces pressing obstacles, such as the low purchasing power of consumers, high illiteracy rates, etc.

The data market, which absorbs a large part of the voice market, struggles to guarantee a return on investment in the medium term.

The highest data transmission rate or most bandwidth-intensive services include videos, attachments to e-mail, videoconferencing, etc.

Broadband Mobility

Nowadays, multimedia, broadband and mobility are the areas of interest for consumers of telecommunications services.

Haitian consumers want access to broadband services anywhere and everywhere. The utilization of broadband mobility meets professional needs and the need to be able to exchange information anywhere with contacts. The provision of broadband in mobile mode is far more demanding than in fixed mode. Broadband mobility means that the same speed is available throughout the user's trajectory. This is not always guaranteed due to various technical constraints in providing the same radio coverage in all geographical areas of a given country. To ensure mobile broadband, a great deal of infrastructure needs to be deployed in the targeted area. Mobile broadband should not only be available in major cities such as Port au Prince, Jacmel and Cap Haitien, but in all municipalities of the country, and especially along roads, to allow users to wholly access a quality service.

Technology Options for Mobile Broadband in Haiti

The principal options for mobile broadband in Haiti are broadband wireless technologies such as 3G, HSDPA (High Speed Downlink Packet Access, 3.5G), Wimax, 4G and telecommunications satellites. Both cellular operators have been providing 3G services for some time. However, third generation services are only available in certain areas of the country.

The HSPDA, a variant of 3G, that is to say 3.5G, is part of the offer in some parts of the metropolitan area of Port-au-Prince. Internet service providers allow subscribers to access speeds in excess of 3G in certain areas of the Ouest Department.

Given the current reality, very few users have access to mobile broadband in Haiti. What options should be considered to provide this service?

The deployment of mobile broadband by satellite is a viable technological solution for high radio coverage and broadband service. However, this option is not adapted to the consumption capacity of the Haitian market.

The option that makes the most sense and is most adapted to the Haitian environment is the migration of mobile operators to 4G. This is true both for consumers and existing operators. This solution is not without challenges.

Challenges for Deploying Mobile Broadband in Haiti

Several challenges must be met by the players (regulators, telephony and television operators) in order to guarantee mobile broadband in Haiti. The principal challenges to be met are the following: deployment of a national backbone, availability of spectrum resources, access to services in remote areas, ability to operate Internet services, consumer purchasing power and capacity of international connections.

1. Deployment of a National Backbone

The provision of broadband depends on the existence of a national backbone. In effect, this national transmission network, thus this big conduit, has the function of supplying all areas with high-speed signal. With respect to expectations and available resources, this national backbone should be deployed in fiber optics.

A national fiber optic backbone is the best option for Haiti. It will power 4G base stations installed across the country. The 4G base stations will subsequently radiate radio signals in all areas to allow users to access mobile broadband.

Operators have already begun deploying fiber optics across the country to connect all broadband base stations.

2. Availability of Spectrum Resources

The radio frequency spectrum is a scarce resource and indispensable for the deployment of telecommunications networks. Thus, each telecommunications service is allocated a specific frequency range because of the desired radio performance.

The portion of the frequency spectrum used globally for the deployment of 4G networks is currently occupied in Haiti by analogue television stations. In order to have these frequencies available for 4G networks, analogue television channels must necessarily be moved. The transition from analogue television to digital television therefore enables the freeing of this frequency range. Thus, digital television will occupy other frequency ranges. The frequency range thus liberated will be used for 4G networks.

In Haiti, the transition process from television to digital has already begun. Currently, the regulator for the telecommunications sector, CONATEL and the public television channel, Télévision Nationale d'Haïti (TNH), are in the process of testing digital television. At the end of the pilot project in the metropolitan area of Port-au-Prince, digital terrestrial television (DTT) will

be launched nationwide. After switching from analogue to digital television channels, operators will be able to utilize the 700 MHz band to deploy 4G networks.

3. Access to Telecommunication Services in Remote Areas

Access and use of services are what justify the *raison d'être* for these technologies. In Haiti, the availability of services in all inhabited areas is the weak point for all providers. In the areas served by operators, users complain about the poor quality of the services provided. Some services are not deployed in certain areas. The basic principles of universal access and service are not yet a reality in Haiti. Some parts of the territory are subject to discriminatory treatment because of their weak purchasing power or the low consumption capacity of certain services considered to be advanced relative to others.

Telecommunications operators must commit to deploying their infrastructures throughout the national territory in order to ensure equitable access to all.

A high rate of mobile broadband penetration in remote areas can help bridge the digital gap between Port-au-Prince users and those in other geographic departments.

4. Ability to Operate Internet Services

The optimal utilization of ICT services and applications requires a certain level of knowledge and competence. Unfortunately, Haiti has a high illiteracy rate, hampering the full use of ICT by a large percentage of Haitian consumers.

Those who can read and write lack training in information and communication technologies. Many professionals struggle to use services due to a lack of introduction to information and communication technologies.

This deprives many potential users of the opportunity to profit from the benefits and opportunities of the sector.

5. Consumer Purchasing Power

Haitian consumers have low purchasing power, which does not fail to negatively impact the consumption of products and services in the telecommunications/ICT sector. The country's precarious socio-economic situation prevents potential consumers from taking advantage of the sector's progress. The socio-economic conditions are such that Haitians with low incomes give priority to what is vital, such as basic needs. Given the limited purchasing power of consumers, service providers simply provide basic ICT services.

Compared to other markets, the cost of the MB of data (Megabyte) is too high in Haiti. This situation is not without negative consequences on consumption. The daily MB allowance offered to users is clearly insufficient for the amount of transactions they make. After the allocation has been exhausted, consumers have to pay all other data consumptions by the MB.

Monthly subscription to the Internet is an option little used in Haiti because of the prohibitive rate practiced on the market.

The acquisition of mobile terminals is another sizable challenge. Access and use of broadband Internet are dependent on a smartphone. The cost of this sophisticated cellular terminal is prohibitive in Haiti because of the low purchasing power of consumers.

6. Capacity of International Connections

International connections are another link in the chain that should not be neglected. The Internet is available in Haiti through international connections put in place between foreign suppliers and local operators. The signals carrying the Internet in Haiti pass through satellites or fiber optic cables. Currently, there are two international optical cables serving Haiti. Each of the telephony operators utilizes a submarine optical cable in order to serve its customers.

Concerning the capacity of international connections, mobile operators can intervene on two fronts.

The first is to make optimal use of the tens of gigabits per second they have to serve the Haitian mobile broadband population across the country.

Second, they will need to consider increasing international bandwidth to meet future user demands.

Satellite Internet in Haiti is part of some private international organizations' connections.

Conclusion

Telecommunications traffic is increasing every day thanks to the multiplication of the electronic means of communication available to users. Data exchange between mobile devices is the inevitable trend for all markets in the world.

The Haitian telecommunications market must meet the challenge of broadband because too many opportunities depend on this high-speed access: improved service quality, new services development, electronic services, electronic government, etc. The technologies that enable broadband access are available and have already yielded results in other countries. They must be deployed in Haiti. The actual deployment of 4G networks in Haiti should help make broadband services available to Haitian users wherever they may be across the country. The 4G deployed on an experimental basis in some areas of the country will soon be a reality for all consumers.

Broadband has considerable impacts on the economy and education. All actors in the chain will benefit from the positive impact of broadband mobile services in Haiti.

Haiti faces some of the most acute social and economic development challenges in the world. Despite an influx of aid in the aftermath of the 2010 earthquake, growth and progress continue to be minimal, at best. With so many actors and the wide breadth of challenges from food security and clean water access to health, education, environmental degradation, and infrastructure, what should the top priorities be for policy makers, international donors, NGOs and businesses? With limited resources and time, it is crucial that focus is informed by what will do the most good for each gourde spent. The Haïti Priorise project will work with stakeholders across the country to find, analyze, rank and disseminate the best solutions for the country. We engage Haitans from all parts of society, through readers of newspapers, along with NGOs, decision makers, sector experts and businesses to propose the best solutions. We have commissioned some of the best economists from Haiti and the world to calculate the social, environmental and economic costs and benefits of these proposals. This research will help set priorities for the country through a nationwide conversation about what the smart - and not-so-smart - solutions are for Haiti's future.

Haïti Priorise

Un plan de **développement** alternatif

For more information visit www.HaitiPriorise.com

COPENHAGEN CONSENSUS CENTER

Copenhagen Consensus Center is a think tank that investigates and publishes the best policies and investment opportunities based on social good (measured in dollars, but also incorporating e.g. welfare, health and environmental protection) for every dollar spent. The Copenhagen Consensus was conceived to address a fundamental, but overlooked topic in international development: In a world with limited budgets and attention spans, we need to find effective ways to do the most good for the most people. The Copenhagen Consensus works with 300+ of the world's top economists including 7 Nobel Laureates to prioritize solutions to the world's biggest problems, on the basis of data and cost-benefit analysis.