Vive Digital: Colombia's own approach to transforming its broadband ecosystem

Abstract

Many countries have embarked on expansion of their broadband infrastructure following international trends and claims that positively correlate growth in gross national product with growth in the number of broadband accesses. Colombia has adopted an idiosyncratic approach to reduce disparity in broadband access to avoid repeating the existing inequalities in the fixed-line market between large urban centers and small, remote areas. This paper analyses the rationale for Colombia's "Vive Digital", the government plan for broadband expansion and other ICT-related initiatives. In particular, it examines the development of the public–private partnership that currently expands the country's broadband capacity through the build-up of a fiber-based backbone, the proposed modifications to spectrum designation, the future 4G auction process, and the goals of the plan to improve the provision of electronically mediated services. Finally, we question the potential of the mechanisms employed to solidify the so-called "broadband ecosystem". Conclusions put in perspective the dual role of the government in incentivizing the supply side of the broadband market and in subsidizing its demand side.

Keywords

Colombia, Vive Digital plan, Broadband, Fiber-optics network, 4G, spectrum.

Article classification

Research paper

1. Introduction

In 2010 the Colombian government started to seriously address the need to improve the broadband connectivity of the country, to provide better and more efficient services through its many agencies and institutions and diminish the gap between those who enjoy Internet broadband access and those who do not. Projects and plans involved in reaching those goals were wrapped with the Vive Digital plan label, the government program designed to lead the country into widespread use of ICT in general and to broadband access in particular.

The Colombian approach relies on the injection of public funds to find a partner in charge of building a fiber-based backbone that must reach a large number of small towns which are not yet served with high capacity, fiber-based links. Two other Vive Digital projects are the allocation of more radio spectrum to respond to the growing demand for mobile services, especially for broadband wireless access, and the government plan to improve government provision of services, also known as On-line Government (or GEL, the Spanish language acronym for *Gobierno en Línea*).

The present paper analyses the current state of the abovementioned three initiatives of the Vive Digital plan. The unifying framework is the extent to which the projects contribute to the evolution of the Colombian broadband ecosystem. The aim is to provide a middle-of-the-road critical view that identifies and analyses the outstanding elements of Vive Digital. Each element is a particular initiative for which relevant literature provides an analytical framework and a particular analytical approach is used as means to provide a preliminary assessment. The fiber-based broadband backbone initiative is examined using the OECD approach to analysing the effectiveness of a public–private partnership (PPP), a vehicle that has been recently used in several countries, to improve the government's delivery of services. Furthermore, the plan to allocate new spectrum bands to mobile services and especially to wireless mobile broadband is described and the proposed allocation method is analysed. Finally, the government program for improving electronically mediated government services is described alongside a critical discussion of its goals, and current achievements and drawbacks.

The present paper is organised as follows. Section 2 discusses international trends in the adoption of government-backed programs for broadband expansion. Section 3 summarises the current state of the Colombian telecommunications industry as it displays some of most important figures in terms of revenues and coverage per service. Section 4 describes the three main initiatives of the Vive Digital plan, among a number of initiatives proposed by the government. Section 5 presents an analysis of the three initiatives as a means to provide a preliminary assessment of their ability to strengthen the Colombian broadband ecosystem. Section 6 concludes.

2. Trends in government initiatives for broadband expansion

Since it is already a widely accepted fact that any modern economy needs to be utterly concerned with the deployment of broadband access for consumers and businesses (Crandall and Singer, 2010; Falch and Henten, 2010; FCC, 2010; Greenstein and McDevitt, 2011), the question arises about the most efficient pathway towards accelerated broadband deployment. In countries where markets have not shown a strong move towards broadband growth the inquiry turns on why and how a government initiative can effectively substitute or complement private investment initiatives in broadband access. Under such schemes public funds investment in broadband networks can be to some extent seen as a lack of trust in the market's ability

to deliver on the build-up of critical infrastructure (Falch and Henten, 2010); nevertheless, several countries have made the use of public funds on broadband access expansion a strategic component of their economic growth policy.

In recent empirical research, Belloc *et al*., (2012) conclude that governments' efforts throughout the world "appear to be well-grounded" with public policies exerting a positive impact on broadband growth either on a supply-side or a demand-side basis. Gulati and Yates (2012) go a step further as they show that factors that determine broadband growth have relatively different impacts in developed and developing countries. The main finding in their approach is that technologically developed countries' broadband growth is positively correlated with higher levels of investment in information and communication technologies (ICT), among other factors. In less developed countries, investment in ICT has a larger impact on broadband expansion than in developed countries. Another interesting finding by Gulati and Yates is that the presence of a national telecommunications regulatory authority has a negative impact on broadband diffusion.

A recent OECD report (OECD, 2008a) advocates for supply and offer policies that stimulate the construction of broadband infrastructure capable of creating a virtuous circle by which deployment encourages use and use encourages further deployment. It also highlights the role of the private sector in network upgrade and development with caveats for government intervention especially when remote areas and low-income users are targeted. The OECD (OECD, 2009) advises on the way forward for government participation when it states that "policy makers may want to consider investing in partnership with private companies. These public private sector partnerships have been successful in a number of cases and allow government investment to be coupled with technological and market experience".

Intervention in the deployment of telecommunications infrastructure is justified in the neo-classical approach by the existence of market failures. Regardless of the specific path followed by a country's telecommunications markets, governments are reappearing as main players in the field by either promoting or developing broadband expansion plans. Applying Stiglitz's classification of causes for intervention (as cited by Gomez-Barroso and Feijoo, 2010) and its application to telecommunications, Gomez-Barroso and Feijoo (2010) suggest that acceptable justifications for government intervention in the information society age include market conditions that reveal markets are not fully competitive, economies that have embarked on plans to push forward the knowledge economy, and national commitments to close the digital divide.

The complexities inherent to such a set of justifications (lack of competition, construction of a knowledge economy and commitment to inequality reduction) led to the realization that the split between private and public is in fact a dead end, especially when supply-side has proven ineffective or too slow in providing society with the means to fair broadband access. One vehicle for the implementation of a supply-side policy, as in the expansion of broadband connectivity facilities, is the PPP scheme (OECD, 2008b), which is expected to balance out four factors: connectivity; competition; innovation/growth; and social benefit (OECD, 2009).

The OECD (OECD, 2008b) defines a PPP as "an agreement between the government and one or more private partners" that has the private partners delivering the service "in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners" with the condition that sufficient risk be transferred to the private partners.

The variety of arrangements that shape PPPs is broad. PPPs are as diverse and creative as they can be designed: from the creation of a new agency, wholly or partially owned by the government, which fully manages network build-out, to the private partner's undertaking of network deployment with risk-sharing, to the complete assumption of risk with management control by the private partner. All of which can be understood as a reinterpretation of the pragmatic logic approach (Mintzberg, 1996) that envisions government and the market as the extreme points of a continuum, the difference being that bipolar antagonism is replaced by cooperation and the location of the interaction on the continuum is given by the level of risk being transferred. However as important as it may be in terms of settling the conditions of the partnership, risk is only one dimension that characterizes the public-private relation. Because of this Barroso and Feijoo (2010) refer to "interplay" instead of "partnership", broadening the scope for interaction especially in the context of deployment of Next Generation Networks (NGN). A well-nourished stream of recent literature exemplifies the richness of the interplay between government and the private sector. Several country-cases include (Nuciarelli et al, 2010) who describe how the public-private interplay can facilitate local broadband initiatives in Italy and The Netherlands; (Beltran and Gomez-Torres, 2011) on a comparative analysis of New Zealand, Korea and the Netherlands to support their description of the Colombian plan; (Ragoobar et al., 2011) on several cases of public intervention in the UK, Sweden and the Netherlands; and local experiences such as (Troulos and Maglaris, 2011) on EU municipal broadband plans and, (Ganuza and Viecens, 2011) on the Catalonian case in Spain. In spite of these and other cases that exemplify the public-private interplay in the expansion of NGNs (core and access) both Barroso-Gomez and Feijoo (2010) and Falch and Hente (2010) coincide on their opinions that it is early to evaluate the effects of intervention policy. It is also early to assess which mode of interplay turns out to be the most effective.

One aspect not to be disregarded is the regulatory implications of adopting one particular path towards broadband expansion. Paramount to this end is the consideration of how public intervention may distort competition. Falch and Henton (2010) distinguish between direct and indirect effects. Direct effects relate to short-term impact of broadband expansion whereas indirect effects. More difficult to measure, indirect effects refer to its impact on, among others, private investment and the strength of facility--based competition, which includes investment in wireless infrastructure. Although several models of regulatory policy may be identified, three main regulatory paths are proposed in (Kirsch and Hirschhausen, 2008) as seen in Figure 1: (i) infrastructure-based competition, (ii) vertical separation with open access, and (iii) integrated incumbent and regulated access. Countries with no market intervention exemplify path (i). Where countries have chosen (ii), wholly new markets are expected to flourish and regulatory concerns

have focused on compensating the incumbent (usually vertically split), regulating wholesale prices (as a means to reduce investment uncertainty), and providing enough incentives to attract upper layer players. (iii) is considered by Kirsch and Hirschhausen as the most flexible and effective.

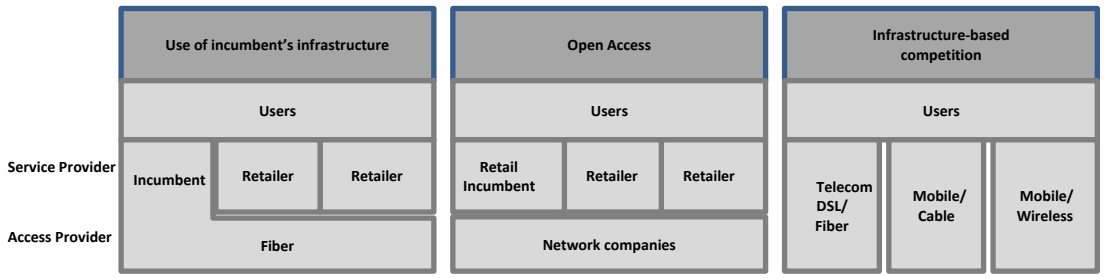

Fig. 1. Regulatory trajectories in the transition towards NGNs. Adapted from Kirsch and Hirschhausen (2008)

3. Telecommunications in Colombia

Following world trends, Colombian telecommunications went through radical changes during the mid-1990s as a result of the liberalization and privatization that occurred in the sector. Early twenty-first century, individual and corporate consumers found new portfolios of services, a growing market and seemingly strong investment in network infrastructure. Today´s market is shared by one large, vertically integrated player, several fixed telephone service operators which also operate long distance businesses, three major mobile phone providers and a variety of Internet service providers, which includes cable TV operators. Major local phone companies in Colombia are wholly owned by their municipalities.

Since 2005, revenues in the telecommunications sector have been driven by the revenues generated by mobile market, the most important telecommunications market in terms of coverage, number of subscribers and revenue growth (see Table 1). On the other hand, fixed telephony, in spite of being the second highest earner, is also the only one since 2001 with a continuing decline in revenue generation. Pay TV market share continues to grow thanks to the increasing number of subscribers, and the diversity of pricing plans and services such as pay-per-view, premium channels and triple play.

	2006	2007	2008	2009	2010	2011	2012 - 3Q
Telephony	7,7	8	8,1	7,5	7,2	7,1	6,2
Mobile	29,8	33,9	41,4	41,2	44,5	46,2	48,7
Internet	0,9	1,4	2,2	3,2	4,4	6,1	7,0
Pay TV	1,6	2,2	3,2	3,2	3,5	3,9	3,8

Table 1. Historical number of subscribers (millions) by telecommunications service Source: MinTIC 2012

In 2012-3Q there were more than 7 million Internet subscribers in Colombia of which 5.9 million accessed the Internet through broadband connections [1] (see Table 2); 53% of those connections are fixed access whereas the remaining 47% are mobile.

Total	7.037,2
Broadband Vive Digital	5.917,3
Other connections	1.119,8
Subscriptions by access	
Fixed Internet	3.747,0
DSL	3.554,9
Dial-up	192,0
Mobile Internet	3.290,3
Mobile Internet 2G	994,8
Mobile Internet 3G + 4G	2.295,5

Table 2. Main Internet indicators (subscribers) – 2012 3Q (thousands) Source: MinTIC 2012

While for almost ten years three mobile operators have shared the market (Claro – formerly Comcel, Movistar and Tigo), in 2012 two new operators, Uff Móvil and UNE EPM, entered the market with a combined market share not yet exceeding 1%. In mid-2012 the five mobile operators served 48.7 million subscribers (See Table 3), which translates into a 103% penetration rate.

Provider	**Subscribers** (000)	**Market share**	**Spectrum owned**(MHz)
CLARO	29,961	61.5%	55
TIGO	12,005	24.7%	55
MOVISTAR	6,355	13.0%	55
Uff MOVIL	306	0.6%	
UNE EPM	71	0.1%	50
TOTAL	48,699	100%	

Table 3. Mobile market distribution by subscribers (thousands) – 2012 3Q. Source: MinTIC 2012

4. Promoting the development of broadband access: the Vive Digital plan

In October 2010, Colombia's ICT Ministry launched its national broadband plan for the next four years. The plan, called Vive Digital, seeks to increase the number of broadband access connections in the country. By 2014 Vive Digital expects to:

1. Reach 50% of households and MSME (Medium-Small-Micro enterprises) connected to the Internet;

2. Multiply by 4 the number of Internet connections; and
3. Triple the number of municipalities connected to the information highway via an optical fiber backbone.

To achieve this, the Colombian government aligns with the World Bank (Kim *et al.*, 2010) in conceiving broadband deployment as an ecosystem that consists mainly of four elements: infrastructure; services; applications; and users. Figure 2 displays a schematic representation of the digital ecosystem following Kim *et al*. (2010).

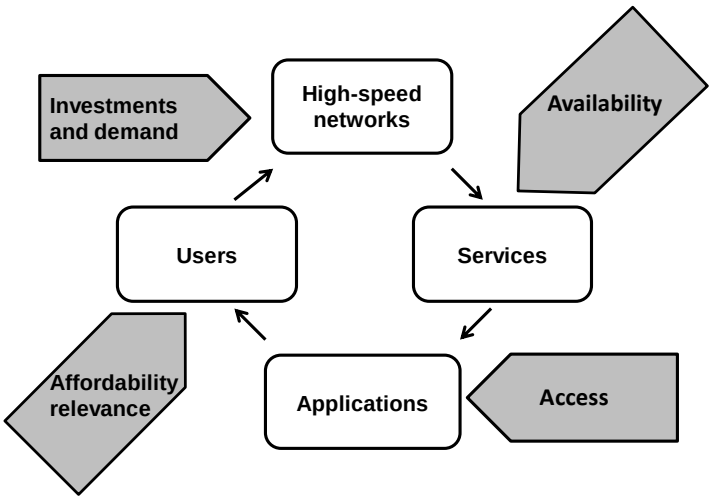

Fig. 2. The broadband ecosystem. Source: Kim *et al*. (2010)

As an ecosystem, a high-speed broadband must include both the supply and demand sides of the market; the very idea of integrating several domains into a single, yet complex concept also "leads to a rethinking of approaches to spur broadband access and use" (Kim *et al*., 2010).

In this paper we argue that, in addition to stating a vision of broadband network infrastructure for a country, government initiatives need to strongly support themselves on the design of investment incentives and the promotion of broadband use. The latter is aligned with the manifest need to enable environments in which access to network and services is available via growth and expansion of supply as it is also key to provide sustained conditions that facilitate demand for, and adoption of, broadband. Table 4 summarizes Vive Digital's main goals.

Vive Digital components	Goals
Infrastructure	To expand international connectivity and promote hosting infrastructure in Colombia. To connect 700 towns to a fiber-optic backbone. To promote mobile internet and allocate additional spectrum.

	To develop a regulatory framework to duct sharing and in-house wiring and deploy networks for digital terrestrial television.
Services	To increase PC and terminal device penetration through import tariff reduction. To promote access to credit, mandate inclusion of computers in Internet access plans offered by operators. To reduce value-added tax on Internet access service. To redirect public funds to subsidize fixed Internet for the lowest economic strata.
Applications	To lead by example, that is, the government promotes new online government services, by strengthening the ICT industry via the development of human resources and through the creation of a regulatory framework and stimulus for public–private development applications.
Users	To create 800 new training centers (called Tecnocentros); to provide training and expertise on entertainment and ICT services. To boost cooperation with the Ministry of Education's training programs for individuals, teachers and microenterprises; and to create a system for consumer protection.

Table 4. Vive Digital's main goals by component. Source: MinTIC-Vive Digital

4.1. Fiber-optics network expansion in Colombia

The slow pace in the growth of broadband connections in Colombia (Plan Vive Digital, 2011), in spite of the increasing growth in Internet-based activities such as e-commerce (EIU, 2010) and e-government services (UN, 2010) demanded that the Colombian government take a leading role in the deployment of broadband access as an urgent solution to the deficient access infrastructure. In 2010 when Vive Digital was conceived, only 200 towns had at least one fiber access node. In November 2011, Azteca Comunicaciones, a new player in the Colombian telecommunications market, was awarded a US$225 million contract via a tender process to build a fiber-optics communication network (MinTIC, 2011). The backbone network is a PPP initiative whereby Azteca Comunicaciones must invest about two-thirds of the total expected cost, which is estimated at about US$600 million and build fiber nodes – points of connection – in 735 towns. It is expected that, by the end of 2014, new network fiber nodes will be operational in about 95% of Colombian towns. The network will be an open access infrastructure and Azteca will be allowed to provide services over it while competing with downstream operators. In addition, contractual obligations dictate that the winner must supply broadband access for 5 years to at least 2,000 government offices, which includes national, regional and local institutions, providing each with last-mile access to the network (MinTIC, 2011). Network build-up is in three stages: planning, deployment and operation. The deployment stage will take 2 years; once the network becomes operational, which marks the start of stage 3 planned for 15 years, the operator will manage, operate and maintain the network. It may also provide end-user services with a contractual obligation to provide third parties with wholesale access to the network which should encourage competition in the retail sector.

One significant aspect of the Vive Digital's fiber project is that it does not address the last-mile issue of the access problem. Building a fiber access node in 700–plus, small-sized urban centers does not equate to expanding broadband access to marginal populations, even if those live in urban areas. Tables 5 and 6 display the current situation in terms of the number of towns and the populations that reside in those towns as clustered in accordance to the level of penetration for fixed-telephony and Internet access.

Level of fixed-telephony penetration	**Number of towns**	**%**	**Population** (000)	**Population in urban areas**(000)
Less than5%	662	88.0	9,480	3,618
5% to 10%	23	3.1	349	214
10% to 15%	3	0.4	127	112
More than 15%	2	0.3	47	34
Informationnotavailable	62	8.2	707	190

Table 5. Availability of fixed-line telephony (in terms of number of towns, fraction, total population and urban population) corresponding to different penetration levels.
Source: MinTIC, DANE and authors

Level of Internet access penetration	**Number of towns**	**%**	**Population** (000)	**Population in urban areas**(000)
Less than5%	748	99.5	10,519	4,013
5% to 10%	2	0.3	154	137
10% to 15%	-	-	-	-
More than 15%	1	0.1	9	9
Informationnotavailable	1	0.1	19	9

Table 6. Availability of fixed Internet access (in terms of number of towns, fraction, total population and urban population) corresponding to different penetration levels.

Source: MinTIC, DANE and authors

Telephone lines reach only about 200,000 people in around 88% of the targeted towns, which points at the large potential in terms of people not yet connected to the network.

The information above signals that reaching users who are supposed to fill up the fiber with traffic is going to take a great deal of effort by either the current builder or by any operator that decides to build last-mile accesses in those areas. Bringing broadband to towns that do not have it is the main purpose of the fiber initiative. However, there are several obstacles that have to be overcome, including the current deployment of last-mile access in those towns' areas and the eventual adoption of services provided therein. Assuming that non-urban locations continue to be poorly attractive to commercial operators, the target population would not be more than about 40% of the total population of the 752 towns. The current mobile penetration index (at about 103% in the country) though not homogeneously distributed indicates that even in these towns cellular coverage is at least an order of magnitude higher than that of fixed access.

4.2. Allocating spectrum for IMT and mobile Internet

As a complement to the deployment of the fiber-based infrastructure, Vive Digital plan has proposed broadening the available spectrum to provide mobile Internet access. Such a decision is due to the increase in demand for mobile Internet access and the high penetration of mobile devices; it also seeks to encourage the penetration of IMT services to improve the provision of Internet-based services.

While in 2011 an auction for allocating 30 MHz in the 1.9 GHz band – whereby only 25 MHz were successfully allocated among the three major mobile operators – only as recently as November 2012 the Colombian Spectrum Agency (ANE) published the final conditions for the 4G spectrum auction to be held in early 2013. The auction will allocate 225 MHz as shown in Table 7.

Spectrum amount	Bands	How are they segmented?
90 MHz	AWS bands- 1700 MHz and 2100 MHz	Three paired 2 x 15-MHz segments
130 MHz	2500 MHz band	Four non-paired 10-MHz segments Nine paired 2 x 5-MHz segments
5 MHz	1900 MHz band	Onepaired 2 x 2.5-Mhz segment

Table 7. Future 4G spectrum auction features. Source: ANE

In the 2500 MHz band no bidder will be allowed to win more than 40 MHz. Likewise any successful bidder in the future 4G auction will have to:

1. Open its network to other operators who request access in order to reach final consumers;
2. Be able to provide national roaming; and,
3. Offer low-price pans that include tablets and other mobile device to school communities in the lowest socio-economic tiers.

4.3. On-line government

In Colombia a 2000 policy document [2] introduced the so-called Government Online Strategy, a government's strategy to lift the country's competitiveness through the use of information technologies, but only in 2008 was action undertaken to set the stage for implementation and compliance. Today, the Online Government strategy or GEL seeks to build more efficient and transparent services to citizens and businesses, with the expectation of positively impacting the competitiveness of industry, modernising

public administration and improving communities' participation in democratic processes (Programa Gobierno en Línea, 2011b). Implementing the strategy was assumed to be a gradual process, emanating from the largest agencies into remaining public organizations. The plan includes five phases: information, interaction, transaction, transformation and democracy online, all of which follow the ideas from a range of international models (Layne and Lee, 2001; Araya and Porrúa, 2004; Al-adawi *et al*. 2005; Affisco and Soliman, 2006; Valdes *et al.*, 2011).The five phases of the originally stated plan are evolving to embrace international trends in areas such as open data, environmental protection, electronic security, accessibility, usability and a citizen-centric approach.

Since 2007 the Ministry of Information and Communications Technologies has invested US$127 million in GEL; however, the amount invested by particular government agencies and additional investment in the provision of e-services and support for democratic participation through ICT raises the total invested funds to a higher figure. GEL heavily relies on the supply-side of e-government services; for instance, the plan engages local governments (both provincial and municipal) in the provision of e-services and supports democratic participation such as public auditing of government operations by citizens.

The United Nations agency for social and economic affairs (UNDESA) ranked Colombia first among 33 Latin American countries in the e-participation and e-services indexes in their 2012 report. It also ranks the country second in e-government in the region. The country's remarkable position in the ranking was achieved partly due to the work developed in recent years under the GEL online government initiative. The short experience accumulated thus far seems to have equipped the government to become a main actor in the use and promotion of e-services to be deployed in the next generation of networks.

Local administrations have also engaged in information and training programs that aim to transform the way citizens relate to local government. In 2012, GEL found that 50% of adults and 78% of businesses had already maintained some kind of electronic transaction with government offices, a clear increase compared with corresponding figures from 2009 when only 30% of adults and 24% of businesses answered positively to the inquiry. In spite of the expansion and relatively positive adoption of Internet-based government services, the road ahead at the local level (municipalities and departments) still lags behind the stage reached by the central government agencies. A mix of inadequate communications infrastructure, a still-low citizen awareness and knowledge of e-government service strategies, and on-going fiscal limitations stand on the way of progress in this area.

5. Vive Digital plan: a bet facing many challenges

ITU (ITU, 2012) established that most national plans include the following four aspects: government allocation of necessary assets to reach universal broadband service coverage; investment in promotion of

adoption programs; adoption of a competition policy, and removal of any potential supply obstacles. It also suggests that "the impact of broadband is neither automatic nor homogeneous across the economic system" (ITU, 2012) which highlights the importance of implementing public policies in education that support the adoption and use of such technologies and their supported services. In the Latin American region, recent work by Galperin (2012) reveals the importance of several factors that constrain the adoption and coverage of broadband services and become highly relevant. Such factors include low-technology adoption and low average incomes, besides low market-development indexes that characterize most Latin American economies, which is certainly the case of Colombia.

The broadband access situation in Colombia depicts a totally biased market with competitive coverage in the upper economic tiers of the major cities and a remarkable degree of neglect for many urban and rural poor areas. Vive Digital's main initiative, the fiber-optics backbone network, addresses the need to provide faster and better transport infrastructure to a large fraction of Colombian towns, setting up improved conditions for private operators to expand the number of broadband connections. Now that Vive Digital´s initiatives are reaching middle-of-the-road ground, a preliminary assessment of its intermediate goals may be useful in questioning whether the chosen pathway is likely to deliver on its promise of radically increasing broadband penetration and whether the institutional arrangements in place are the most adequate. In particular, given that supply-side policies have been widely advocated, it is necessary to question the effectiveness of the market disruption performed via the government decision to invest in a fiber-optics backbone. Next we analyze the current state of the three most prominent initiatives within Vive Digital.

5.1. Expansion of an optical fiber backbone and uncertainty in broadband access growth

Construction of a fiber-based broadband backbone is being carried forward within a rather typical set of constraints: fiscal, institutional and socio-economic. Fiscal budget constraints impose a limit on the amount the government would invest on broadband growth as the expansion is for a fiber-optics backbone and 2,000 fibre-based accesses for regional and municipal government offices. Institutional constraints derive from major institutional changes brought about by the 1991 Constitution and subsequent attempts to reform it. Finally, socio-economic constraints impede the development of broadband accesses for large population groups who are not attractive to the commercial operators. The Colombian government awarded the project to a private consortium that must bear the risks associated with the abovementioned constraints. Project viability and policy and regulatory issues are discussed next.

The private partner has undertaken to build a fiber backbone reaching 753 medium and small towns, as well as 2,000 fiber-based accesses to connect regional and local government offices located in those towns. The agreement states hard deadlines and the partner's sole responsibility for interconnection agreements with other networks and right-of-way permits whenever necessary. The partner must also assess the distribution of the 2,000 connections that maximizes the government's e-presence in those locations.

In assessing the viability of a PPP a framework is provided by two criteria that can be used as benchmarks (OECD, 2008b): the affordability criterion and value for money (VFM) criterion. A third element discussed by OECD is the extent of risk shifting to the private partner.

OECD states that a project is affordable "if the expenditure it implies for the government can be accommodated within current levels of government expenditure and revenue and if it can also be assumed that such levels will be sustained into the future" (OECD, 2008b). The project stage 2 duration is two years, which does not imply long-term expenditure; clearly the public funds used for stage 2 have been secured as demonstrated by the fact that the private partner has agreed to deliver a fiber backbone in two years.

The next issue to investigate is whether the PPP is actually able to increase the VFM compared to the next-best alternative. The estimated total cost of about US$600 million indicates that the limited budget allocation of about US$225 million in public funds would not have made it possible for the government to exert complete delivery of the network. Also, since the government is in no position to operate a network traditional public procurement would not have been a feasible solution. On the other hand since existing players – private as well as local government owned – were not able to deliver substantial progress in expanding the country's transport network in recent years, central government opted for a PPP. According to the European Commission, in a work cited by the OECD (OECD, 2008b), VFM can be assessed by assessing whether life-cycle costs are reduced, a better allocation of risk is achieved, network implementation is faster, service quality is improved, and additional revenue is obtained. The one factor that seems most readily assessable is the extent to which risk has been shifted from the government to the private partner. Risk is fundamental to the success of a PPP. Furthermore, as stated in OECD (2008b) governments may be keen on entering PPPs as they can shift risk onto the private party. The amount of transferred risk determines whether the contract should be considered as a PPP or other more traditional form of contracting. Vive Digital specified the type of network that must be built but did not fully determine which towns would be reached. Instead it determined a baseline of 400 towns with an aggregate projected population for 2012 of 7,660,000 of which close to 3,390,000 live in the urban areas and left it up to the competing consortia to bid on the number of additional towns to be included. Table 8 displays the number of additional towns bidders included in their bids and the corresponding population of those additional towns. The latter clearly means the government transferred via competitive tender the risk associated with the network size.

	Number of top-up towns on bid
UT FibraÓptica Colombia	353
Telmex Colombia S.A.	342
UT ConectividadparaTodos	256

Table 8. Results of tender process for build-up of Colombian fiber-optics backbone[3]. Source: MinTIC *–Acta audiencia de adjudicación*

Regarding other factors relating to the contractual conditions that determine the fiber partnership's VFM, several observations are in order. First of all, the partnership contract does not require revenue generation to the government during stage 3, that is, the time during which the network will operate while being jointly owned. Instead, a transfer of ownership will occur at a rate of 1/15 of the total asset base in each of the 15 years of stage 3. The latter markedly contrasts with other national broadband projects –such as New Zealand's Ultra-Fast Broadband (MED, 2010) – which state that taxpayers' money be recouped as the partnership operates the network commercially. Next, while it is not possible to make any claims about service quality at this stage, there is no doubt that the PPP is to deliver a network faster than the most optimistic forecasts, had the project not been launched and had the current players continued their slow broadband expansion plans. However, the full extent of the obtained VFM will only be determined once stage 3 is fully operational; only then conditions will be met to understand the "… the optimum combination of whole-life cost and quality … to meet the user´s requirement" that a VFM assessment requires (HM Treasury, 2006).

Uncertainty about if, and when, an effective deployment of broadband access occurs is an ingredient that remains unresolved in spite of the technically conceived risk transfer achieved under the PPP. The unresolved conundrum can be stated by asking whether the government will have to also push the demand-side, in addition to stimulating demand for government services through GEL, after providing a stimulus to the supply-side.

5.2. Mobile is an alternative but it needs spectrum

The increasing use of mobile devices to access the Internet is becoming one of the drivers to promote a better use of the spectrum to respond to the growing demand (Sridhar *et al.*, 2012). At this point, the intervention of policy makers in the distribution of spectrum is linked to the characteristics of the local market. On one hand are issues like promoting competition when multiple operators attend to a massive population which favors the "maximal usage of allotted spectrum" (Sridhar *et al.*, 2012). On the other hand, when the user base is not that large, such as in advanced countries, policies favor just a limited number of operators with more spectrum blocks per operator. However, added to this, it is necessary to analyze the impact of the spectrum distribution in the infrastructure rollout because "different spectrum bands have different characteristics, which have a significant Influence on the costs and strategies of the operators" (Lunbdborg *et al.*, 2012). The latter may affect competition and the goals set by the government when allocating spectrum.

While it is true that, as the leader of the broadband ecosystem development, the Colombian government actively works on the supply-side of investment, it regards its own role in the mobile industry as mainly providing stimulus to the market. An example of the latter is the mobile market. Despite the explosive growth of the mobile market in the country, 82% of the current connection stock are prepaid subscriptions with average monthly spending of about US$8 (CRC, 2011), including voice and mobile Internet. Accordingly, promoting the development of mobile applications would encourage a market that currently is broad in coverage but poor in consumer applications.

If further usage of mobile applications needs to be stimulated, Vive Digital's goals on mobile infrastructure and service deployment must also address the spectrum scarcity problem. As with many other jurisdictions, to some extent spectrum scarcity is a consequence of conflicting policies, unclear spectrum allocation planning and pressure from incumbents. However, even when all these factors are acknowledged the reality is that, in order to efficiently respond to the growing demand for mobile services governments need to resolve the scarcity problem on a short-term basis, which may not allow them enough political grip to introduce more long-term, sustainable policies.

Vive Digital's plans for new spectrum bands allocation rely on the Colombian Spectrum Agency (ANE); amongst the most pressing problems is the expansion of mobile network coverage in remote areas (that is, far from densely populated urban areas) of the country. Vive Digital's plans for new spectrum band allocation rely on the Colombian Spectrum Agency (ANE). The Ministry of ICT and ANE submitted for public consideration a second, preliminary version of the auction process; the auction rules will allow operators to gain access, use and exploit the awarded spectrum bands for 10 years, ensuring that winners of AWS and 2.5GHz bands commit to minimum penetration goals as well as demanding that winners in the 1.9 GHz band meet conditions for minimum coverage in towns and specified regions. They also allow the dominant player to participate in the 2.5 GHz auction and will exclude it from participating in the AWS band auction.

5.3. Leading by force of example: the government's online strategy

As broadly and frequently discussed as the electronic government (e-government) concept has been, there is no commonly accepted definition (Yildiz, 2007). A commonly applied view of the concept involves the government's use of information and communications technology to efficiently provide services to citizens and business (Fang, 2002; Carter and Bélanger, 2005). The latter is complemented with changes in service delivery and interaction with citizens and businesses and between government agencies, human capital training and other aspects that, through the utilization of ICT, promote efficiency, transparency and participation (Valdez *et al.*, 2011; Yildiz, 2007). In the electronically mediated government–citizen relationship, efficiency, service delivery and transparency have been identified as key elements for the promotion of good governance (Von Haldenwang, 2004). More recently, other purposes such as citizen

empowerment, cost reduction and savings, integration, quality improvement and provision of services, have been also acknowledged (Badria and Alshareb, 2008; Valdez *et al*., 2011). For successful implementation of e-government Ayara and Porrúa (2004) state the need for attention to aspects such as basic infrastructure, technological capabilities, leadership, flagship projects, and partnerships with the private sector.

GEL is a program that speaks about the Colombian government's effort to lead by example. As much as the government seeks to promote the deployment of broadband infrastructure and the conditions for a more efficient mobile market, it is also concerned with the fact that leading a country towards the widespread use of ICT has to start within itself. GEL represents the government's efforts to promote a more efficient management of public offices as well as getting closer to citizens through an easier and massive use of ICT. GEL seeks to maintain a combination of improved efficiency, quality of services and ICT acceptance as an element to achieve its goals. To get there, it seeks to leverage the tools and applications of e-government in the transformation of government processes and the mode of interaction with the citizens (Shin and Kweon, 2011), once they become more digital.

The implementation of e-government in Colombia has shown successes but also has faced difficulties in the context of some program elements such as infrastructure, financial resources and end-user's ability to interact with government through the use of technologies, among others. While having a policy focused on the implementation of e-government has been a must on the agendas of several countries around the world (Badria and Alshareb, 2008), Colombia has taken advantage of this situation by trying to adapt to these trends, by developing a public policy that is framed in the current GEL plan.

While advances have reflected on positive international measurements (UNDESA, 2012), a close inspection of some measured indexes reveal the extent of some important barriers to the overall success of GEL. The first is infrastructure; although UNDESA's index highlights the highly ranked Colombia's position among developing countries in the provision of electronic services (UNDESA 2012), the level of telecommunications infrastructure nationwide is below world and American countries' averages. Similarly, the Networked Readiness Index (World Economic Forum, 2012) shows that, although the government is offering a wide range of online services, there is a lag of ICT infrastructure and digital content and a low penetration of ICT by citizens. Furthermore, the World Governance Index that consistently showed a progressive decrease since 2006 in perceptions on government effectiveness (on issues such as corruption control) has recently shown an increase in the 2010-2011 period, proving the difficulties the government faces in using any e-government strategy to improve the perception of transparent administration and corruption control among its citizens.

Previous to the current GEL agenda the main obstacles to the e-government program sat with a set of ambitious goals that made no acknowledgements of the need to solve the connectivity and technology adoption first. The reality was that such issues would not fit within the tight budgetary constraints; in other

words, without the money to advance the government connectivity and technological transformation needs any efforts on transparency, efficiency and effectiveness of government services delivered through electronic media became almost innocuous. Many government agencies reluctantly accepted the additional burden imposed on them; the reasons were basically related to the way agency administrators regarded the mandate to deliver on more efficient and effective use of ICT. In many situations the process was regarded as an obligation and not as a strategy to be included in their core activities. Since GEL has been apportioned with economic resources for the development of its many programs there has been a shift towards embracing the utilization of ICT by national and local government institutions and a renewed acknowledgement of the citizen as being at the centre of the changes.

According Ayara and Porua (2004), the most complex processes for the implementation of e-government are not only technological difficulties but also jealousy and opposition of interests in the entities. While having technology within organizations brings a number of benefits in areas of internal operational, cost reduction and greater services for customers, such benefits are threatened because they often generate efficiency budget cuts, staff reductions, loss of resources, and internal restructuring that directly affect private interests (Trkman and Turk, 2011). The Colombian case shows resistance to change in the acceptance of electronic media and entities that lack appropriate mechanisms and incentives to ensure their implementation. In many instances the process is regarded as an obligation and not as a strategy to be included in their core activities and this has resulted in a slow adoption process in small entities, particularly at the local level. Given that the incentives within institutions are key factors to the extent that the implementation of e-government is concerned, a new value proposition should focus on renovated institutional support, without losing sight of the user-centric vision that is ultimately the reason for the entities. Regarding the previous point, it is worth noting that the development of electronic services has responded more to the needs of the institutions and not the needs of the users (Janssen et al, 2004), an observation that clearly emerges from different indicators of e-government evaluation. Since the emphasis has been placed on the supply of services and no the demand for them, the development of e-government must now achieve alignment between a user-centric view and incentives enough to achieve transformation in government.

Colombia's remarkable position in e-government rankings has been achieved through leadership from a coordinated government initiative, such as GEL, and complementing public policy that strengthens its development. However, the limitations on infrastructure and the technology appropriation gap within institutions and end-users are two barriers to full implementation. In Vive Digital, the GEL strategy becomes the direct driver to offer broadband-based services. Once content and service diversity are in place (Trkman and Turk, 2011), GEL plus complementary strategies for the development of applications and content can become the true trigger for the use of infrastructure in under-served areas of the country.

6. Conclusion

Colombia's Vive Digital main strength lies on its ability to bring together and coordinate several initiatives that go beyond the program's sole control and interlink with many other government institutions. So far the program has succeeded in its attempts to project its vision for the broadband ecosystem onto the net of agencies and other institutions. Colombia has joined an international trend for the expansion of its broadband infrastructure. Resorting to a public–private partnership the government has provided a stimulus to the supply-side as over US$225 million are invested in a two-year build-up of a fibre-based broadband backbone that will reach two-thirds of the country's towns. However, such an effort has no say in solving the last-mile problem, which may become the main factor in the realisation of macro-economic goals that rely on fuelling the dynamics of the contents and application markets.

The most important and pressing issue is the self-imposed role of the government on incentivizing both the supply-side and the demand-side. Vive Digital's initiatives contemplate the injection of funds to upgrade the supply of broadband capabilities as well as the allocation of new spectrum that stimulates the supply of new mobile broadband services. It also calls for government agencies and local government to facilitate the engagement of its citizens with government services, which exemplifies action on both sides. As crucial as those efforts may be, it is relevant to question the real capability of the government programs in achieving their goals as they demand resources that stretch in all directions. Finding an adequate balance between the two roles now that the broadband ecosystem's limitations transition from a blurred idea into an accepted, clearer vision is perhaps the most important challenge the government is facing.

Although technical aspects of the agenda's project are financially and economically justified, there remains a clear sense that Vive Digital is a political bet. This is no different from the approach some other countries have taken as they bet on a brighter future brought about by the deployment and enhancement of broadband infrastructures. The broadband ecosystem idea crystallizes, at least conceptually, the perception that an accelerated growth of the broadband access infrastructure will impregnate a country's economy with a much required dynamism. But all across the international experiences it is political will that has prevailed, having to face many challenges ahead.

7. Notes

[1] Broadband include fixed access with downstream greater than or equal to 1,024 Kbps and 3G and 4G Mobile Internet.

[2] Colombian Council for Economic and Social Policy, CONPES 3072 Agenda de Conectividad.

[3] A fourth party, Telefonica, bidded for 290 top-up towns but its bid got disqualified.

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