

Connecting the unconnected: The case of Mexico's Shared Wholesale Network

Catalina Ovando^{1*}, Zoraida Frias², Juan Carlos Bocarando¹

¹ Universidad Popular Autónoma del Estado de Puebla, Mexico

² Information Processing and Telecommunications Center, Universidad Politécnica de Madrid, Spain

*Corresponding author: mariacatalina.ovando@upaep.mx

Abstract

The Shared Wholesale Network (SWN) is the Mexican project intended to provide broadband access to 92.2% of the population. While most of the territory (95%) is already covered by the incumbent's voice coverage, the Mexican Government has recently launched a call for tenders to rollout a nationwide mobile wireless wholesale network using the digital dividend frequencies (700 MHz). The successful bidder will not be able to provide retail services directly, nor offer services to the incumbent.

Since the Telecommunications Reform was initiated in 2013, telecommunication policies have been engaged in promoting competition and affordability, which is overwhelmingly reported as the main barrier to the adoption of mobile broadband services. In this paper, we explore the potential of the SWN to connect the unconnected in Mexico, discussing how the shared network may affect both the supply and demand of mobile wireless broadband services.

Keywords – Share wholesale network, digital divide, zero-rating, Internet adoption

1. INTRODUCTION

It is well known that Information and Communications Technologies (ICTs) are key drivers for economic growth and structural changes. In 2012, the OECD reported several inefficiencies in the telecommunications sector (OECD 2012, p. 14), including the Mexican case. Then, Mexico was ranked 34, 33 and 32 in fixed, mobile and broadband telephony, respectively, out of the 34 OECD countries. The document raised serious concerns and stated that “*the sector is characterized by high prices, among the highest within the OECD countries, and a lack of competition¹, which results in poor market penetration rates and low infrastructure development.*”

The digital divide is a complex problem that must be addressed from both the supply and the demand side. Despite the poor coverage and limited consumer choices in Mexico, as recognized by the Mexican Government (SEGOB, 2014), the lack of Internet access service is reported as the third reason for not adopting broadband services (INEGI, 2016).

¹ América Móvil's Telmex held 80% of the market share in the fixed line segment and América Móvil's Telcel 70% in the mobile segment.

According to INEGI, the National Statistical Agency, 55.2% of the respondents pointed to the lack of economic resources as the main reason for not adopting internet access services. The second most frequent response was "other" (none of the reasons listed in the questionnaire) with 16.3%, followed by the aforementioned lack of Internet access service (15.7%) and the lack of digital literacy skills (10.8%). Finally, not having an Internet-capable device was reported with only 2%. Although broadband adoption factors may vary at the different market stages, as suggested by (Lin & Wu, 2013), in Mexico the survey carried out by INEGI confirmed that affordability is one of the main barrier to Internet adoption, in line with much of the academic literature (see e.g.(Hoffman, Novak, & Venkatesh, 1997)).

The role of governments and policy-makers in the promotion of broadband has been deeply studied (Galperin, Mariscal, & Viacens, 2013; LaRose, Gregg, Strover, Straubhaar, & Carpenter, 2007; Li, 2012; Lin & Wu, 2013; S. E. Stern, Gregor, Martin, Goode, & Rolfe, n.d.; WEF, 2016). The rationale behind such interventions can easily be identified under one of the three following reasons: being either a matter of equity, supporting an industrial policy or having spillover effects on the rest of the economy (Cave & Martin, 2010) .

Inter-platform competition has been reported as crucial for adoption (Aron & Burnstein, 2006), while adoption, in turn, largely influence the viability of network rollout (Ovando, Pérez, & Moral, 2015). Policy-makers face the non-trivial decision of how to balance supply- and demand-side policies to maximize overall social benefits (Stern, 2006), which includes the preservation of a competitive market.

In such an attempt, most countries have designed national broadband plans, and Mexico is no exception (BID, 2016). However, in Mexico, a market broadly dominated by one single provider and with no regulatory body, broadband policies have also been included in a regulatory reform (IFT, 2014b; SEGOB, 2013) with a strong focus on the supply-side.

The Reform of the Telecommunications Sector included the proposal of building a Shared Wholesale Network (SWN). The SWN is the Mexican project intended to provide broadband access at least 85% of the population. The Government launched a call for tenders to roll out a nationwide mobile wireless wholesale network using the 90 MHz digital dividend frequencies (700 MHz).

The SWN aims to complement the regulatory remedies described above facilitating the entry of new players in the Mexican mobile wireless market at the time that network coverage is expanded for an infrastructure other than the incumbent's.

There are other similar initiatives to the SWN taking place in Kenya, Russia and Rwanda. The results are not promising, though. In the two former countries, the SWN initiative has not been very successful due to the lack of consensus among the government and the operators. In Rwanda, despite having started as scheduled in 2014,

the penetration of service is limited, essentially because of the high prices. Finally, there is a proposal in South Africa for a wholesale open access network that implies significant changes in public radio access and licensing policies. The strategy is not significantly different from those that have been implemented in other countries, but the South African project is larger in scale (GSMA, 2016b).

The SWN is a supply-side policy. The Mexican Government has not planned to influence the take-up of the new infrastructure, beyond seeking that it will offer high quality services with wider coverage and at least at similar costs than the alternatives. It remains unknown whether the SWN will be automatically meeting an underserved demand or, on the contrary, innovative business models will be needed to fill the network with traffic that so far does not exist.

The aim of this paper is to explore the potential of the SWN to bridge the digital divide in Mexico, analysing both supply and demand-side factors. The research question we address is: “*How may the SWN contribute to mobile Internet broadband adoption in Mexico?*” To answer the question, we look at the role of the SWN in terms of infrastructure and service competition, coverage expansion and business models enabled.

The rest of the paper is structured as follows. Section 2 describes the regulatory reform and the rationale of building the Mexican SWN. Section 3 presents the recent evolution of the Mexican telecommunications market and assess the impact of the reform. In light of this, section 4 discusses the potential of the SWN to bridge the digital divide. Finally, section 5 draws some conclusions and points out to future work.

2. THE TELECOMMUNICATIONS REFORM AND THE SHARED WHOLESALE NETWORK

The document entitled ‘Pact for Mexico’, published in 2012, is the first precedent for the telecommunications reforms initiated shortly thereafter, in 2013. The Telecommunications Reform aimed to extend the benefits of competitive markets to the Mexican telecommunications sector, which had long suffered from a quasi-monopoly market structure, as well as to ensure equitable access to telecommunication services (Pacto por Mexico, 2012).

The regulatory reform took place in 2013. This reform included: i) constitutionally recognizing several fundamental rights (right of access to ICTs, rights of audiences and users of telecommunications); ii) establishing the Federal Telecommunications Institute (IFT) as the telecommunications regulatory body; iii) deeming telecommunications and broadcasting services as public services of general interest; iv) creating specialized courts in telecommunications, broadcasting and economic competition; v) defining the figure of preponderance (market dominance); vi) making the limits of foreign investment more flexible; vii) building a shared public wholesale network; or viii) mandating establishment of a public broadcaster; among others (Álvarez, 2017).

The IFT became the responsible body for regulating the provision of broadcasting and telecommunications services, as well as promoting access to active and passive network infrastructure where deemed necessary and other essential inputs, such as radio spectrum. It is also the competition authority in both broadcasting and telecommunications sectors, aiming to ensure free competition, as well as preventing, investigating and fighting monopolies, monopolistic practices, mergers and other restrictions on the efficient functioning of markets. The entrance of Mobile Virtual Network Operators (MVNOs) and the SWN project, are the result of IFT policies.

Shortly after it was created, the IFT launched a market analysis and imposed several remedies on América Móvil (Telcel), deemed as *Preponderant Economic Agent*² (PEA) in the telecommunications sector³. The obligations imposed to the incumbent (IFT, 2014b) can be summarized as follows:

- To provide new entrants with access to all elements that may be necessary for the provision of service to the new entrant's end users.
- To allow commercialization and resale of services and capacity of their networks to Mobile Network Operators (MNO) in the technologies available in its system, and for all the telecommunication services that the PEA offers to its users. Network neutrality, not discriminating between content, applications, and traffic of different services and providers, must be guaranteed.
- To allow concessionaires of public telecommunications networks to access and use the passive infrastructure that they hold under any legal title.

The SWN aims to complement the regulatory remedies described above facilitating the entry of new players in the Mexican mobile wireless market at the time that network coverage is expanded for an infrastructure other than the incumbent's.

In January 2016, the Government launched public tender to deploy and operate a wireless mobile network using the recently released spectrum at 700 MHz, following the digital television switchover, completed by December 2015. This spectrum, known as the digital dividend, results particularly attractive for mobile services for both the amount of spectrum that would be allocated, 90 MHz (2x45 MHz), and the propagation properties of sub-1GHz spectrum, which allow for more cost-efficient rollouts and/or wider coverage footprints (SCT, 2017b).

Proposals for the SWN should cover at least 85% of the Mexican population, 12.75% of which should include municipalities with fewer than 10,000 inhabitants and 85% of the

² The concept refers to the company or group of companies that directly or indirectly have a national share greater than 50% in the broadcasting or telecommunications services. This percentage can be measured by the number of users, subscribers, audience, and traffic in their networks or by the capacity used of them.

³ On March 6, 2014, the Plenum of the Federal Institute of Telecommunications determined as Predominant Economic Agent in the telecommunications sector: América Móvil. S.A.B. de C.V., Teléfonos de Mexico. S.A.B. de C.V. (Telmex), Teléfonos del Noroeste. S.A. de C.V. (Telnor), Radiomóvil Dipsa S.A. B. de C.V. (Telcel), Grupo Carso. S.A. B. de C.V., y Grupo Financiero Inbursa S.A.B. de C.V.

population and all Magical Villages⁴, by at last January 2022. The SWN must deliver 1Mbps upload and 4Mbps download speeds for the cell-edge user.

The tender established conditions to allow entry for foreign direct investment up to 100%, either public or private in nature. To deploy and operate the network, the successful bidder would get access to the 90 MHz at 700 MHz band as well as to two fiber cables from the Federal Electricity Commission. The successful bidder, Altan Consortium (SCT, 2017b), will not be able to provide retail services directly, nor offer services to the incumbent. As a wholesale provider of network services, it shall operate under non-discriminatory principles. The SWN will start to provide services at last by March 2018 covering 30% of the population. By 2024 Altán Consortium has committed to reach 92.2% of the population (Table 1).

Coverage	Date	Description
At least 30%	March 31, 2018	The aggregate population at a national level, which must include at least one-quarter of all Magical Villages, defined by the SECTUR up to 30 calendar days before the date of presentation of the economic offer.
At least 50%	January 24, 2020	The aggregate population at a national level for the third anniversary of the conclusion of the contract, which must include at least half of all Magical Villages, defined by the SECTUR up to 30 calendar days before the date of submission of the offer economic development.
At least 70%	January 24, 2021	The aggregate population at a national level, for the fourth anniversary of the contract, which must include at least half of the totality of the Magical Villages, defined by the SECTUR up to 30 calendar days before the date of submission of the offer economic development.
At least 85%	January 24, 2022	The aggregate population at a national level, for the fifth anniversary of the conclusion of the contract, which must include all of the Magical Villages, defined by the SECTUR up to 30 calendar days before the date of presentation of the economic offer.
At least 88.6%	January 24, 2023	The aggregate population at the national level, for the sixth anniversary of the conclusion of the contract.
At least 92.2%	January 24, 2024	The aggregate population at the national level, for the seventh anniversary of the conclusion of the contract.

Note: [1] Aggregate population based on the distribution of the population in localities according to the Census of Population and Housing 2010 published by INEGI (SCT, 2016a). [2] Altán Consortium is obliged to comply with the minimum coverage 85% on January 27, 2021, or the fifth anniversary of the conclusion of the private, public partnership contract, if held before 2016, whichever occurs first.

Table 1. Deployment schedule. Source: SCT (2017).

The SWN project contrast with the classical approach of allocating spectrum to different mobile operators that would build their own infrastructure within a facility-based competitive structure. Much like in fiber networks, this has created conflicting views on whether the SWN approach is preferable over a classical approach that would also incentivize or impose particular coverage obligation targets. Prior to the tendering procedure, the Mexican Government commissioned a study to compare the costs and benefits of two different policies for the allocation of the 700 MHz band in Mexico: allocating spectrum to concessionaires through an auction process and promoting a

⁴ The Magical Villages program is an initiative led by Mexico's Secretariat of Tourism (SECTUR), in conjunction with other federal and state agencies, to promote a series of towns around the country that offer visitors a "magical" experience – by reason of their natural beauty, cultural riches, or historical relevance.

SWN. In this regard, the Mexican Government argued that past tenders had not generated sufficient investment in infrastructure, resulting in poor coverage of 3G and 4G services. For this reason, and given the existing high market concentration, the study concluded that it was unlikely that any operator (other than incumbent) would be able to carry out a cost-efficient deployment in unserved areas (Mckinsey & Company, 2012). In addition, the Government argued that taking full advantage of the 700MHz band and adding the demand on a single network, risks and costs would be reduced (Ludlow, 2013).

MVNOs may play a fundamental role for the SWN (SCT, 2016a, 2016b, 2017b), as they might take advantage of the lower costs provided by the network to compete more aggressively with the incumbent. The Mexican Government has great expectations on the SWN, and it has been deemed as the most important telecommunications project in the Mexican history (SCT, 2017a).

On the contrary, some stakeholders have claimed that the SWN may lead to economic inefficiencies, stifle innovation and restrict take-up (GSMA, 2016). A study carried out by Frontier Economics (2016), commissioned by GMSA, suggests that there is a risk for the SWN not to remain self-sustainable if it fails to attract MVNOs that now rely on other wholesale products. In addition, they argue that the SWN will likely lead to a distortion of competition, as it is supported by the government and that network competition benefits should go beyond coverage, including innovation and embracing new technologies. In short, they argue that traditional facility-based competition could be more successful in improving coverage and reducing prices.

3. THE EVOLUTION OF THE MEXICAN TELECOMMUNICATIONS MARKET

Mexico has a population of approximately 120 million (INEGI, 2016a). The Mexican telecommunications market has evolved since the regulatory reform was approved and the regulatory body was created. This section reviews this evolution to provide some valuable insights for the discussion in section 4.

At the end of 2016, Telecommunications and Broadcasting ranked eighth in terms of economic activities with the highest contribution to the Gross Domestic Product (GDP). The contribution to the GDP to 2016 was \$15 trillion pesos, representing an annual growth of 2.4% compared to 2015. Since 2013 there has been greater dynamism in the flows of Foreign Direct Investment in the sectors of Telecommunications and Broadcasting due to the mergers and acquisitions detonated by the change in the regulatory framework (Figure 1).

November 2012 It consolidates in 95 commitments the "Pact for Mexico."	June 2013 The decree by which provisions in telecommunications are reformed is published.	March 2014 The IFT determines as Predominant Economic Agent in the telecommunications sector.
December 2014 The MVNOs that are in the	January 2015 AT&T acquires Iusacell/Unefon.	April 2015 AT&T acquires Grupo Nextel.

market are Virgin Mobile, Maz Tiempo, Tuenti and Cierito. In total four.		
July 2015	September 2015	December 2015
The general criteria of the SWN are published.	The contest terms of the call of the SWN are published.	The MVNOs that are in the market are Virgin Mobile, Kubo Cel, Maz Tiempo, Cierito and Weex. In total five.
January 2016	November 2016	December 2016
The terms of the call of the contest of the SWN is published.	Failure and award in favor of the Altán Consortium are issued.	The MVNOs that are in the market are Virgin Mobile, Kubo Cel, Maz Tiempo, Cierito, Weex, Megatel, Flash Mobile and Maxcom. In total eight.
January 2017	First quarter of 2017	TBC
The contract for the SWN Project is signed.	The MVNOs that are in the market are Virgin Mobile, Maz Tiempo, Cierito, Kubo Cel, Weex, Maxcom, Flash Mobile, Megatel, Telecomunicaciones 360, Simpati Mobile, Bueno Cell, Her Mobile and Neus. In total thirteen.	

Figure 1. Timeline of the most important Mexican market milestones in recent years.

In percentage terms, total mobile telephony revenues posted the highest growth between 2013-2014 when they increased by 14.40% (Table 2). However, during the period between 2015-2016 revenues declined 0.3% despite the growth rate of mobile phone penetration (IFT, 2015, 2016b).

Concept	Income per year				
	2012	2013	2014	2015	2016
Total mobile telephone income	\$208,268.80	\$213,029.88	\$243,712.90	\$253,528.94	\$252,848.19

Table 2. Evolution of mobile telephony income. Source: IFT (2017a).

As it can be seen in Table 3, the obligations imposed on América Móvil by the IFT have put significant pressure on their revenues in 2016 compared to 2015, and they have been reduced by 3.74%. In contrast, AT&T's and MVNO service plans have allowed them to grow by 21.86% and 46.20% over the same period. Finally, Telefónica has decreased by 8.05%.

Concept	Income per year			
	2013	2014	2015	2016
América Móvil	\$159,065.00	\$173,210.00	\$181,324.33	\$174,547.07
AT&T	\$23,355.77	\$37,203.22	\$39,162.77	\$47,723.58
Telefónica	\$30,009.85	\$33,240.56	\$32,683.17	\$30,053.14
MVNOs	\$599.26	\$59.12	\$358.67	\$524.40
Total	\$213,029.88	\$243,712.90	\$253,528.94	\$252,848.19

Table 3. Income from mobile telephony by operator. Source: IFT (2017a).

Mobile coverage

As the NRA was created recently in 2013, the existing data on mobile coverage are scarce. There is not much public information from private market research firms, either. According to OpenSignal (2017) as of March 2017, AT&T's LTE connection availability was 71.5%. While the coverage of América Móvil (Telcel) and Telefónica (Movistar) was estimated around 69.4% and 55.3%, respectively.

By 2015, for when most recent data is currently available, both indicators achieved a significant increase compared to 2010. The 95% of the population was covered with basic mobile broadband (3G). However, 4G technology only covered around 70% of the population by 2016. In this regard, the real challenge now to extend 4G broadband coverage to closing the coverage gap for the final 15% (6.5 million Mexicans), who are characterized in the majority by living in remote or poor areas, where there is an uncertain return on investment (GSMA, 2016b).

Take-up

The mobile subscriber base has seen sustained growth since 2000. From 2000 to 2015, subscriber penetration has increased from 12% to 69% (GSMA, 2016a)⁵, reaching saturation levels, as suggested by the annual growth rates. Indeed, subscriber base achieved maximum growth rates between during the years 2003, 2004, 2005, when the CAGR was around 20%. On the contrary, the growth rate between 2014 and 2015 barely reached 3%.

In contrast, mobile broadband subscriber base has increased from 7% in 2010 to 36% in 2015⁶, meaning a CAGR of 38.7%. On average, the mobile data traffic consumed per subscriber and month was 0.5 GB in 2015 (GSMA, 2016a). During the same period, local fixed telephone and mobile telephone services are those where the highest growth occurred. However, the later has shown a clearer constant growth (Table 4).

Concept	Evolution of the market				
	2012	2013	2014	2015	2016
Fixed-line subscriptions (millions)	20.10	20.60	18.60	19.30	19.60
Fixed-line penetration (subscription per 100 inhabitants)	-----	-----	58.00	59.00	59.00
Mobile subscribers (millions)	100.60	103.60	101.80	107.7	111.70
Penetration of mobile telephony (subscription per 100 inhabitants)	85.70	87.00	85.00	89.00	91.00
Prepaid mobile phone users (millions)	84.90	87.60	88.56	90.47	93.83
Post-paid mobile users (millions)	15.60	16.00	13.24	17.23	17.87
Mobile broadband subscriptions (millions)	11.30	16.60	50.90	63.60	74.50
Mobile broadband penetration (subscription per 100 inhabitants)	-----	-----	43.00	53.00	61.00
Prepaid mobile broadband users (millions)	-----	-----	37.66	48.97	55.87
Users post-paid mobile broadband (millions)	-----	-----	13.24	14.63	18.63

Note: [1] Statistical reports from 2014 do not include public telephone booths. [2] The data of the Statistical Reports of 2012 and 2013, do not specify if it disaggregates the information.

⁵ IFT reports 89 subscriptions per 100 inhabitants, as the number of subscriptions reached 107.7 million in the last quarter of 2015 (IFT, 2015). GSMA data differ from these, as they refer to number of subscribers, thus not taking into account additional subscriptions of one same user.

⁶ In the same vein, IFT reports 53 subscriptions per 100 inhabitants (63.6 million subscriptions) during the last quarter of 2015 (IFT, 2015), meaning an adoption growth rate of 9.9% in only one quarter IFT.

Table 4. Market evolution. Source: COFETEL (2012) y IFT (2013, 2014, 2015, 2016a).

Market shares

Regarding market concentration, the dominant player in the Mexican Telecommunications market is América Móvil, whose market share has decreased. In 2014 América Móvil had a market share 74.35% but in 2016 had a market share 71.80% (IFT, 2014, 2016a). Although there was a fall in service prices, the main players in the third quarter of 2016 remain to be América Móvil and Telefónica with 72 and 26 million subscriptions respectively. AT&T ranked third with 10.5 million subscriptions.

Virgin Mobile entered the market with a very competitive price that caused América Móvil to reduce the prices to match the MVNOs' offer (IFT, 2016a). MVNOs have not been limited to provide traditional voice and data services, but they are trying to barge in other markets such as mobile banking, health services, security and education, providing innovative business models (SEGOB, 2016).

In 2014, shortly two years after the entry of the first MVNO into the Mexican market, a total of thirteen MVNOs were providing services in March 2017. During the period 2014-2015, most of the MVNOs operated through the network of Telefónica. It has only been since 2016 that América Móvil began to gain ground in the MVNOs market. Currently, 38% of the MVNOs are operating through América Móvil's network, although they have only managed to have around 1.2 million mobile phone lines until March 2017, according to IFT (2017). (Table 5).

Retailer name	Network with which it operates	Beginning of operations
Virgin Mobile Mexico S. DE R.L. DE C.V.	Telefónica	2014
Maz Tiempo, S.A.P.I. DE C.V.	Telefónica	2014
Teligentia, S.A. DE C.V. (EKOFON-CIERTO)	Telefónica	2014
Tuenti [2]	Telefónica	2014
Kubo Cel, S.A.P.I. DE C.V.	Telefónica	2015
Truu innovation, S.A.P.I. DE C.V. (WEEX)	Telefónica	2015
Radiomóvil Dipsa, S.A. DE C.V. (Aló) [3]	América Móvil	2015
Maxcom Telecomunicaciones, S.A.B. DE C.V. (MAXCOM)	América Móvil	2016
Logística ACN Mexico, S. DE R.L. DE C.V. (FLASH MOBILE)	Telefónica	2016
Quickly Phone S.A. DE C.V. (MEGATEL).	América Móvil	2016
Telecomunicaciones 360, S.A. DE C.V.	América Móvil	2017
Celmex Innova, S.A.P.I. DE C.V. (SIMPATI MOBILE)	Telefónica	2017
Ibo Cell, S.A.P.I. DE C.V. (BUENO CELL)	América Móvil	2017
Her Mobile, S.A. DE C.V.	Telefónica	2017
Neus Mobile, S.A.P.I. DE C.V. (NEUS)	América Móvil	2017

Note: [1] Started operations with the Telefónica network. [2] Tuenti leaves the market in 2016. [3] Aló does not show disaggregated data. In the thirteen MVNO that registers the IFT to the month of March of 2017 is not counted.

Table 5. MVNOs in Mexico. Source: IFT (2014a, 2015b, 2016b, 2017a, 2017c, 2017d).

The market for mobile telephony and mobile broadband services are concentrated in three operators. The primary player remains América Móvil with a quote for 2016 of 64.90% in the mobile segment and 71.80% in the mobile broadband market. However,

Telefónica and AT&T continue to gain market share. MVNOs have maintained a conservative but steady growth rate since 2014. As of March 2017, according to IFT (2017), there are more than 1.2 million mobile telephone lines. Also, 5 MVNOs have been incorporated into the Mexican market, Telecomunicaciones 360, Neus Mobile, Simpati, Bueno Cell and Her Mobile, totaling 13 MVNOs (Table 6).

Operators	Market share in the mobile telephone market			Market share in the mobile broadband market		
	2014	2015	2016	2014	2015	2016
América Móvil (Telcel)	66.91%	68.00%	64.90%	74.35%	70.70%	71.80%
Nextel	2.85%			4.05%		
Telefónica (Movistar)	21.01%	23.10%	23.30%	15.46%	18.50%	14.20%
Iusacell-Unefon	9.09%	-----	-----	6.10%	-----	-----
AT&T	-----	8.10%	10.70%	-----	9.90%	12.40%
MVNOs	0.14%	0.80%	1.10%	0.04%	0.90%	1.60%

Notes: [1] Participation in the mobile phone market. Composition of MVNOs in 2014: Virgin Mobile 0.12% and Maz Time 0.02%. Composition of OMV in 2015: Virgin Mobile 0.60%, Qbo Cel 0.10%, Maz Weather 0.03%, True 0.02% and Weex 0.02%. Composition of OMV in 2016: Virgin Mobile 0.80%, Qbo Cel 0.10%, Maz Weather 0.05%, True 0.01%, Weex 0.10%, Maxcom 0.004%, Flash Mobile 0.05% and Megatel 0.01%. In the year 2015 the data of Nextel, Iusacell-Unefon are integrated into AT&T [2] Participation in the mobile broadband market: Composition of MVNOs in 2014: Virgin Mobile 0.04%. Composition of MVNOs in 2015: Virgin Mobile 0.70%, Qbo Cel 0.20%, Maz Tiempo 0.10%, Cierto 0.01% y Weex 0.005%. Composition of MVNOs in 2016: Virgin Mobile 1.10%, Qbo Cel 0.20%, Maz Tiempo 0.10%, Cierto 0.01%, Weex 0.20%, Maxcom 0.006%, Flash Mobile 0.10% y Megatel 0.01%. In the year 2015 the data of Nextel, Iusacell-Unefon are integrated into AT&T.

Table 6. Concentration of suppliers. Source: prepared using information from COFETEL (2012) and IFT (2014a, 2015, 2016b).

Affordability

The regulatory reform has caused steady price decline in the mobile sector, as a consequence of aggressive pricing strategies of the new entrants, in particular AT&T and some MVNOs.

Table 7 shows the evolution of the price indexes of communications services and mobile phone services. Starting in 2013, the Communications Price Index has maintained a downward trend. The changes can be explained by several factors including the elimination of domestic long distance as well as price reduction in both international long distance and mobile phone. On the other hand, the shifts downwards of the Mobile Telephone Price Index 2013 can be explained mainly by the entry of AT&T into the Mexican market with an intensive pricing strategy, which along with the entry of many MVNOs led América Móvil to adapt its service plans.

Concept	2013	2014	2015	2016	2017
Communications Price Index	1210.2	1184.8	1030.9	902.9	220.9
Mobile Telephone Price Index	1209.1	1170.6	1013.9	770.1	184.5

Note: [1] Base 100 to December 2013. The Communications Price Index integrates the price indices of mobile telephone, fixed telephony, the Internet, national long distance, international long distance and fixed telephony equipment.

Table 7. Evolution of the Communications Price Index and the Mobile Telephone Price Index. Caveat: data for 2017 are for March 2017. Source IFT (2017a).

In addition to the overall increase in service affordability, the popularity of zero-rated plans probably brings additional consumer benefits regarding prices. América Móvil

and AT&T have expanded their data plans to include zero-rated social networks, messaging applications and other online services. In this regard, a recent study analyzed the direct relationship between zero-rating plans and broadband adoption in Mexico (De & Berglind, 2016).

Table 8 shows the ARPU per mobile operator. It is noteworthy that, although América Móvil subscribers ARPU were higher in 2016 than in 2015, for the rest of the mobile operators the ARPU decreased. This effect might be the result of the combination of several factors, such as price reductions and the penetration of mobile telephony services. This ARPU is expected to continue to decline, as a result of competitive pressures posed the MVNOs and its strategy centered on low prices. Indeed, the differences between the MVNO's and the incumbent ARPUs are significant, as shown in Table 8.

Concept	ARPU (mobile telephone)		
	2014	2015	2016
AT&T	----	440	397
Iusacell-Unefón	158	----	----
Nextel	503	----	----
América Móvil	209	224	226
Telefónica	129	102	97
Qbo Cel	----	115	54
Virgin Mobile	----	40	36
Weex	----	13	32
Megatel	----	----	22
Maz Tiempo	----	9	5
Cierto	----	233	----

Table 8. Average Revenue per User (mobile telephone). Source IFT (2017a).

4. DISCUSSION

SWN is the Mexican Government initiative to build a wholesale mobile high-speed network covering over 85% of the population. This paper aims to explore the potential of the SWN to connect the unconnected and help fight the digital divide in Mexico.

Regarding mobile broadband subscriptions (millions) the data show growth during the period 2012 to 2016, from 11.30 to 74.50 (COFETEL, 2012; IFT (2013, 2014, 2015, 2016a). The Mexican Government has often presented the SWN as the way to rapidly expand 4G coverage across Mexico, which will foreseeable reach 92.2% population by 2024. This is well above current 4G coverage of an incumbent provider (70%) that is hardly motivated to expand its network in a market where it enjoys 65% of the market share in mobile telephony (IFT, 2017b).

AT&T is growing fast and is increasingly becoming an alternative platform for mobile Internet access. In the OpenSignal report of March 2017, AT&T registered 71.5% of broadband 4G coverage, taking the lead over América Móvil and Telefónica 4G networks (OpenSignal, 2017). However, neither of them provide a real alternative when it comes to seamless voice coverage, which is above 95% for América Móvil.

Telefónica, on the other hand, has been losing ground not only in coverage, but in market share and revenues.

From a supply-side perspective, the SWN may appear as a promising alternative to expand mobile broadband network coverage. However, as a novel approach, there is no evidence regarding the benefits or damages of this policy option as compared to the classical approach. Thus, it turns difficult to assess whether and how potential benefits may be balanced against potential future downsides.

Nonetheless, from the demand-side, the SWN may increase some benefits in the short-term. As stated at the beginning of the paper, when asked about the reasons for not having an Internet access connection, Mexicans overwhelmingly point out that they cannot afford it. In Mexico, incomes remain highly concentrated. According to the OECD (2017 p. 21) *“the richest 10% of the population in Mexico earns 20 times more than the poorest 10%”*.

Although affordability is probably closely related to competition dynamics, service based competition may expedite the proliferation of zero-rated or sponsored data plans that may lead to consumer benefits (Frieden, 2016). This may decrease prices being actually paid by consumer and thus contribute to affordability.

It can be concluded that the Mexican telecommunications policy has been focused on boosting competition and ease to invest, aiming to expand broadband coverage and increase affordability. However, the main challenges remain: how to promote Internet adoption to the digitally excluded, especially those living in rural areas and being in the lowest ranges of income. As demand stimulating measures are missing, the SWN may play a significant role. The SWN would permit that, players of the Internet value chain other than the mobile service providers might be interested in offering connectivity services. This will possibly allow for new business models so far unexplored.

Some examples of new business models that Over-The-Top providers (OTTs) might be interested in to promote Internet adoption include i) initiatives that allow users to get a reward after downloading and testing specific apps ii) zero-rated services. These initiatives may strengthen strategic alliances to cover the cost of promotional packages such as free messaging.

5. CONCLUSIONS AND FUTURE WORK

This paper is intended to explore the potential of the Shared Wholesale Network to bridge the digital divide in Mexico, analyzing both supply and demand-side factors. The research question we addressed is: *“How may the SWN contribute to mobile Internet broadband adoption in Mexico?”* To answer the question, we have analyzed the most important barriers to Internet services adoption, including lack of economic resources, lack of Internet access service, and lack of digital literacy skills, and discussed how the SWN may influence them.

An in-depth analysis of the evolution of the telecommunication sector in Mexico shows that, since the Reform was initiated in 2013, telecommunication policies have been engaged in promoting competition and affordability of Internet broadband services. Indeed, 4G coverage has reached over 70% of the population in the last year and the incumbent has lost ground regarding both market share and income, but maintaining the preponderance. Regarding affordability in the mobile sector, the price index registered a decrease in 2016. The ARPU of the great majority of operators also reported a decrease. This effect might be the result of the combination of several factors, such as price reductions, the entrance of MVNO and the penetration of mobile telephony services. The ARPU is expected to continue, as a result of competitive pressure.

Despite the fact that similar projects as the Mexican SWN didn't meet the expectations raised, the Mexican Government firmly believe in this project as a solution to increase 4G coverage and lower prices. Although it is too early to assess the results, so far, the advances seem to be as planned and in line with the Reform schedule.

However, the main challenges remain: how to promote Internet adoption among the digitally excluded, particularly among those living in rural areas and having low income levels. Although demand stimulating measures are missing in Mexican broadband policies, the SWN can play a significant role if it succeeds at enabling new business models that are able to increase services affordability, reported as the main barrier to Internet adoption. Service-based competition promoted by the SWN may permit that in the short term, other players of the Internet value chain than the mobile service providers, can be interested in providing connectivity services.

REFERENCES

- Álvarez, C. L. (2017). *Telecomunicaciones en la constitución*. Ciudad de Mexico.
- Aron, D. J., & Burnstein, D. E. (2006). Broadband Adoption in the United States : An Empirical Analysis There is growing concern over the rate at which the Internet and broadband access to the Internet are being adopted in the U . S . By historical standards of new product, (March 2003).
- BID. (2016). ME-T1236 : Plan Nacional de Banda Ancha de Mexico. Retrieved August 14, 2017, from <http://www.iadb.org/es/proyectos/project-information-page,1303.html?id=ME-T1236>
- Cave, M., & Martin, I. (2010). Motives and means for public investment in nationwide next generation networks. *Public-private Interplay in next Generation Communications*, 34(9), 505–512. <https://doi.org/10.1016/j.telpol.2010.07.003>
- COFETEL. (2012). *Comunicado de Prensa No. 07/2013*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/comunicacion-y-medios/informes/itelcuartotrimestre2012.pdf>
- De, O. S., & Berglind, M. (2016). The Effect of Zero-Rating on Mobile Broadband Demand: An Empirical Approach and Potential Implications. *International Journal of Communication*, 10, 2442–2459.
- Frieden, R. (2016). Grey nuances in the black and white debate over subsidized Internet access. *Telecommunications Policy*, (April), 0–1. <https://doi.org/10.1016/j.telpol.2016.10.002>
- Galperin, H., Mariscal, J., & Vicens, M. F. (2013). One goal, different strategies: an

- analysis of national broadband plans in Latin America. *Info*.
- GSMA. (2016a). Country overview: Mexico. El móvil empujando el crecimiento, la innovación y atrayendo nuevas oportunidades. London: GSMA. Retrieved from <https://www.gsmainelligence.com/research/?file=4daa1df8c4363e92c708ba2c13c2c94a&download>
- GSMA. (2016b). Wholesale Open Access Networks. London: GSMA.
- Hoffman, D. L., Novak, T. P., & Venkatesh, A. (1997). Diversity on the Internet- The relationship of race to access and usage.
- IFT. (2013). *Comunicado de Prensa No. 10/2014*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/comunicacion-y-medios/informes/comunicado-itel-280214.pdf>
- IFT. (2014a). *INFORME ESTADÍSTICO 4 TRIMESTRE 2014*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/4ite14-vf.pdf>
- IFT. (2014b). *RESOLUCIÓN MEDIANTE LA CUAL EL PLENO DEL INSTITUTO FEDERAL DE TELECOMUNICACIONES DETERMINA AL GRUPO DE INTERÉS ECONÓMICO DEL QUE FORMAN PARTE AMÉRICA MÓVIL S.A. B. DE C.V., TELÉFONOS DE MEXICO, S.A. B. DE C.V., TELÉFONOS DEL NOROESTE, S.A. DE C.V., RADIOM*. Mexico. Retrieved from http://apps.ift.org.mx/publicdata/P_IFT_EXT_060314_76_Version_Publica_Hoja.pdf
- IFT. (2015). *CUARTO INFORME TRIMESTRAL ESTADÍSTICO 2015*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/informeestadistico4to2015accesible.pdf>
- IFT. (2016a). *Comparativo sobre el mercado de operadores móviles virtuales (OMVS)*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/comparativo-delmercadodeomvs130116.pdf>
- IFT. (2016b). *CUARTO INFORME TRIMESTRAL ESTADÍSTICO 2016*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/informetrim-estral4q2016.pdf>
- IFT. (2017a). *Banco de Información de Telecomunicaciones (BIT)*. Mexico. Retrieved from <https://bit.ift.org.mx/BitWebApp/>
- IFT. (2017b). *Comunicado de Prensa No. 58/2017. RESULTADOS A TRES AÑOS Y MEDIO DE LA REFORMA EN TELECOMUNICACIONES*. Mexico. Retrieved from http://www.ift.org.mx/sites/default/files/comunicacion-y-medios/comunicados-ift/comunicado-a3anosymedio-11062017_1.pdf
- IFT. (2017c). *Comunicado de Prensa No. 75/2017 - EL IFT ACTUALIZA LA SECCIÓN DE TELECOMUNICACIONES MÓVILES DEL BIT, AL PRIMER TRIMESTRE DE 2017*. Mexico. Retrieved from <http://www.ift.org.mx/sites/default/files/comunicacion-y-medios/comunicados-ift/comunicadoift75actualizacionbit100717es.pdf>
- IFT. (2017d). Registro público de concesiones. Retrieved August 9, 2017, from <http://ucsweb.ift.org.mx/vrpc/>
- INEGI (Instituto Nacional de Estadística y Geografía). (2016). ENDUTIH (Encuesta Nacional sobre Disponibilidad y Uso de las Tecnologías de la Información en los Hogares 2015).
- LaRose, R., Gregg, J. L., Strover, S., Straubhaar, J., & Carpenter, S. (2007). Closing the rural broadband gap: Promoting adoption of the Internet in rural America.

- Telecommunications Policy*, 31(6), 359–373.
- Li, G. (2012). The return of public investment in telecommunications: Assessing the early challenges of the national broadband network policy in Australia. *Computer Law and Security Review*, 28(2), 220–230.
<https://doi.org/10.1016/j.clsr.2012.01.008>
- Lin, M. S., & Wu, F. S. (2013). Identifying the determinants of broadband adoption by diffusion stage in OECD countries. *Telecommunications Policy*, 37(4–5), 241–251.
<https://doi.org/10.1016/j.telpol.2012.06.003>
- Ludlow, J. (2013). *Infraestructura para el desarrollo: la red compartida mayorista de servicios de telecomunicaciones en Mexico*. Ciudad de Mexico.
- Mckinsey & Company. (2012). *Proyecto Concordia*.
- OECD. (2012). *OECD Review of Telecommunication Policy and Regulation in Mexico*.
<https://doi.org/http://dx.doi.org/10.1787/9789264060111-en>
- OECE. (2017). *Estudios Económicos de la OCDE: Mexico*. Mexico. Retrieved from <https://www.oecd.org/eco/surveys/Mexico-2017-OECD-Estudios-economicos-de-la-ocde-vision-general.pdf>
- OpenSignal. (2017). State of Mobile Networks: Mexico (March 2017). Retrieved August 14, 2017, from <https://opensignal.com/reports/2017/03/Mexico/state-of-the-mobile-network>
- Ovando, C., Pérez, J., & Moral, A. (2015). LTE techno-economic assessment: The case of rural areas in Spain. *Telecommunications Policy*, 39(3–4).
<https://doi.org/10.1016/j.telpol.2014.11.004>
- PactoporMexico. (2012). Los cinco acuerdos. Mexico. Retrieved from <http://pactoporMexico.org/acuerdos/>
- SCT. (2016a). Bases del concurso internacional número APP-009000896-E1-2016 para la adjudicación de un proyecto de asociación público-privada, conforme a la ley de asociaciones público privadas, para la instalación y operación de la red pública compartida de telecomuni. (S. de la F. Pública, Ed.). Mexico. Retrieved from <https://compranet.funcionpublica.gob.mx/esop/toolkit/opportunity/opportunityDetail.do?opportunityId=791252&oppList=PAST>
- SCT. (2016b). La Secretaría de Comunicaciones y Transportes da a conocer el fallo del concurso de la red compartida. (SCT, Ed.). Mexico. Retrieved from http://www.sct.gob.mx/red-compartida/boletin_prensa/16-11-16_Comunicado_POST_Dictamen_Economico_ESP_v1.pdf
- SCT. (2017a). *Banda ancha para todos. Programa de conectividad digital*. Ciudad de Mexico.
- SCT. (2017b). Expediente 985989 Licitación Pública Red Compartida. Acta de Fallo Red Compartida. (S. de la F. Pública, Ed.). Mexico. Retrieved from <https://compranet.funcionpublica.gob.mx/esop/toolkit/opportunity/opportunityDetail.do?opportunityId=791252&oppList=PAST>
- SEGOB. (2013). DECRETO por el que se reforman y adicionan diversas disposiciones de los artículos 6o., 7o., 27, 28, 73, 78, 94 y 105 de la Constitución Política de los Estados Unidos Mexicanos, en materia de telecomunicaciones. Retrieved from http://www.dof.gob.mx/nota_detalle.php?codigo=5301941&fecha=11/06/2013
- SEGOB. (2014). *Programa Nacional de Infraestructura 2014-2018. (Continúa en la Tercera Sección)*. Mexico. Retrieved from http://www.dof.gob.mx/nota_detalle.php?codigo=5342547&fecha=29/04/2014
- SEGOB. (2016). Acuerdo mediante el cual el pleno del Instituto Federal de Telecomunicaciones emite los lineamientos para la comercialización de servicios móviles por parte de operadores móviles virtuales. Retrieved from

Ovando, Catalina and Frias, Zoraida and Bocarando, Juan Carlos, Connecting the Unconnected: The Case of Mexico's Wholesale Shared Network (August 15, 2017). Available at SSRN: <https://ssrn.com/abstract=2943921> or <http://dx.doi.org/10.2139/ssrn.2943921>

http://www.dof.gob.mx/nota_detalle.php?codigo=5429202&fecha=09/03/2016

Stern, P. (2006). New Models for Universal Access in Latin America. *Regulatel and World ...*, (August).

Stern, S. E., Gregor, S., Martin, M. A., Goode, S., & Rolfe, J. (n.d.). A classification tree analysis of broadband adoption in Australian households. In *Proceedings of the 6th international conference on Electronic commerce* (pp. 451–456). ACM.

WEF. (2016). *The Global Competitiveness Report 2016–2017*. *World Economic Forum Reports 2016*. <https://doi.org/92-95044-35-5>