ANALYSIS OF ITU SPECTRUM RECOMMENDATIONS IN LATIN AMERICA
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EXECUTIVE SUMMARY

The International Telecommunications Union (ITU) estimates that by 2017 there will be 7.7 billion mobile subscriptions globally, of which 4.2 billion are considered mobile broadband lines. According to this calculation, the American continent would concentrate 15 percent of mobile subscriptions (1.14 billion) and 21 percent of mobile broadband (867 million)1. Within the Americas, the mobile markets of Latin America and the Caribbean share several characteristics.

A common feature in the region is a penetration of mobile services that at the end of 2017 exceeded 110 percent2. Of the 19 markets analyzed in this report, the five markets in the top quartile present a mobile penetration level of 140 lines per 100 inhabitants or higher. Twelve markets in total have penetrations of 100 lines per 100 inhabitants (bt below 140) and seven are below a 100 percent mobile penetration.

The region also shares a low penetration of fixed broadband lines, while there is a growing base of users using smartphones and mobile broadband services.

To boost the deployment of mobile broadband technologies, it is necessary to deliver more spectrum to mobile service providers throughout the region. The solution to this need will allow to continue the technological evolution to satisfy the growing demand of the society.

North America, including Mexico, awarded capacity in the extension of the AWS 1.7/2.1 GHz band, also known as the AWS-3 (1755-1780/2155-2180 MHz) sub-band, and the United States subsequently licensed the band of 600 MHz, the second digital dividend. Argentina and Colombia analyze the feasibility of allocating the 600 MHz band to provide additional capacity, while Mexico reported that in 2018 it will complete the clearance process of the 600 MHz band, aiming for an upcoming auction in 2020.

As resulting from the works of the World Radiocommunication Conference 2015 (WRC-15), several countries in the region are making modifications to their national frequency plans to allocate bands like the 1417-1518 MHz, 2.3 GHz band to the mobile service, and parts within the 3.3-3.7 GHz range, that are rather segments that could be exploited in the future when the ecosystem of devices matures.

It is important for Latin America to work together for a harmonized spectrum plan. The region will benefit from economies of scale and the reach of a complete

2 Source: operators and regulators.
processors, terminals and infrastructure ecosystem, as well as the possibility of LTE broadband roaming.

According to the radio spectrum information available as of September 2018, the 850 MHz band was the only spectrum band common across all Latin American markets. The 1.9 GHz band is also allocated along all these markets, but in some cases it is not used entirely for mobile services. For example, in Costa Rica there is a portion of the 1.9 GHz band that is partially employed in fixed services.

The 1.7 / 2.1 GHz band (also known as AWS) is the third most important band in terms of its allocation, followed by the 700 MHz band.

### Mobile Spectrum Allocations in Latin America (September 2018)

<table>
<thead>
<tr>
<th></th>
<th>450 MHz</th>
<th>700 MHz</th>
<th>800 MHz</th>
<th>850 MHz</th>
<th>900 MHz</th>
<th>1.7/2.1 GHz (AWS)</th>
<th>AWS-3</th>
<th>1.8 GHz</th>
<th>1.9 GHz</th>
<th>2.1 GHz</th>
<th>2.5 GHz**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
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<td>Costa Rica</td>
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<td>Guatemala</td>
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<td>Paraguay</td>
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<td>Dominican Rep.</td>
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</table>

*Originally used for iDEN deployments in the region, the band is being refarmed in Argentina, Brazil, Chile, Mexico and Peru.
**In Peru, one operator acquired a group of fixed service providers and their 2.5 GHz licenses. Another mobile operator holds regional 2.5 GHz licenses, but the band will be reorganized for an upcoming auction. In Paraguay, a mobile operator agreed to return spectrum from the 2.5 GHz band after acquiring a fixed service provider.

Source: 5G Americas based on information from the regulators

There are several drivers behind government initiatives to allocate spectrum, and probably the most important is the necessity to promote technological innovation through the development of new technologies. This will deliver higher speeds for sending data, allowing users the use of mobile broadband Internet services and video-centric applications. Another factor that contributes to a greater demand of spectrum is the evolution of the Latin American mobile market, which increased from 60 million users in 2000 to 690 million in 2017.

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3 The spectrum allocation of the 700 MHz band in Bolivia and Puerto Rico corresponds to 12, 13, 14 and 18 bands of the Third Generation Partnership Project (3GPP). Ecuador and Nicaragua adopted the Asia-Pacific Telecommunity channeling (700 MHz APT), corresponding to the 28 band of 3GPP. El Salvador has not defined the scheme for segmentation.

4 Ovum, December 2017
The Mobile, Radiodetermination, Amateur and Related Satellite Services 2078 Radiocommunication Report, by the International Telecommunication Union (ITU-R M. 2078), provides suggestions for the allocation of sufficient radio spectrum to allow the appropriate development of IMT-2000 and IMT-Advanced.

The International Telecommunication Union (ITU) estimates that a range of 1280 and 1720 MHz of spectrum allocated to the mobile services will be required by 2020. While the ITU - R M.2290 stipulated between 1340 and 1960 MHz the amount of spectrum for 2020. Considering the estimation of 1300 MHz for 2015 formulated by the same agency, as of September of 2018 they had 363.8 MHz allocated on average in the region, 28 percent of this parameter. The regional situation can be summarized as follows: five countries have allocated 400 MHz or more; another six 300 MHz or more and seven more markets are below this mark.

Using as a parameter the ITU recommendation (1300 MHz for 2015), by September 2018, only eight ITU recommendation (1300 MHz for 2015), by September 2018, only eight markets exceed have allocated capacity equivalent or superior to 30 percent of that suggestion.

Taking into consideration these awards to operators for the commercial supply of services, there is still a shortage of internationally harmonized wireless spectrum in the region. In this sense, regulators must move from “showing interest” and “having plans” to the “action” of making more spectrum available for the provision of mobile services. In any case, most of the regulators of the region have expressed interest in auctioning spectrum in 700 MHz soon and eleven countries have already awarded it to operators as of September 2018.

The main obstacle Latin American government authorities have found is to ensure that those frequencies are free of interference; where appropriate, that spectrum will be available after migrating the analog TV signals to digital formats, thus releasing spectrum to obtain what is commonly known as digital dividend. This band (700 MHz) is seen as an opportunity to allocate commonly harmonized spectrum in the region.

Delays in spectrum licensing may be considered to be detrimental to the development of the market; simultaneously, they could limit the investments flows that the licensees should allocate, in addition to the acquisition of spectrum, to infrastructure, terminals, operative and administrative costs, and publicity.

Regulators in Latin America should remain diligent in understanding the importance for the citizens of having more spectrum for mobile services in the marketplace in order to boost economic growth and connectivity in their countries. Several studies have demonstrated that the investment in mobile broadband has a positive impact in the GDP. The mobile broadband is able to close the digital gap and to offer new opportunities of development in areas like education, health, government and transport. This is particularly important in rural and remote areas, where the infrastructure of fixed telecommunications

Analysis of ITU Spectrum Recommendations in Latin America
operators lacks presence, which turns wireless technologies the only alternative to offer broadband services to the population and can bridge the digital divide.
INTRODUCTION

The mobile markets of Latin America and the Caribbean share several characteristics. A common feature in the region is a mobile penetration that at the end of 2017 exceeded 100 percent. Five countries are in the highest quartile with mobile penetrations from 140 lines per 100 inhabitants. Twelve markets in total are over 100 percent mobile penetration (but below 140 percent) and seven have a level below 100 percent.

Latin America and the Caribbean Mobile Penetration by 4Q 2017

Sources: own elaboration with information of regulators and operators.

All Latin American markets have at the present UMTS/HSPA networks and operators that offer some option of mobile broadband. Except for Cuba, all the markets have launched commercial services using LTE technology. In at least 13 markets, the AWS spectrum band (1.7/2.1 GHz) was allocated, and in nine, 2.5 GHz frequencies band were awarded (2500 to 2690 MHz).

There are several drivers behind government initiatives to allocate spectrum, and probably the most important is the necessity to promote technological innovation through the development of new technologies. This will deliver higher speeds for sending data, allowing users the use of mobile broadband Internet services and video-centric applications. So that this is made efficiently, operators must maintain separate networks (each one with its own bandwidth requirements) with different technologies.

Another factor that contributes to a greater demand of spectrum is the evolution of the Latin American mobile market, which increased from 60 million users in 2000 to 690 million in 2017. During the same period, the use of the mobile devices
evolved from voice based services to the use of advanced applications using data and mobile broadband services. This trend will continue in the future; LTE connections will grow from 258 million by the end of 2018 to more than 504 million by 2022\(^5\). According to Cisco, the growth in data traffic will increase in Latin America from 447,991 terabytes monthly in 2016 to 2,091,073 in 2020\(^6\).

**Mobile Broadband Forecast in Latin America**

![Graph showing LTE connections growth](image)

**Latin America & the Caribbean Technology Forecast 2018-2022**


ITU MOBILE SPECTRUM SUGGESTIONS

The ITU-R M.2078 Radiocommunication Report, by the International Telecommunication Union, published in 2006, provides suggestions for the allocation of sufficient radio spectrum to allow the appropriate development of IMT-2000 and IMT-Advanced. In this sense, ITU aims to assist government authorities in efficiently allocating the spectrum with the purpose of allowing the expansion of broadband mobile services.


The ITU-RM.2243 Report published in 2011 reviews both the market and traffic projections for International Mobile Telecommunications (IMT), that were developed in previous periods of study (from 2000-2007) and evaluates the current perspective and future needs of mobile broadband that will support the IMT during the next decade (2012-2022). It also presents new traffic forecasts provided by different sources of the industry until 2015 and one source for the forecast between years 2015 and 2020 considering the new trends and the drivers of the market. The ITU-R M-2078 recommendation is given in a context of increasing pressure on operators' mobile networks, due to the fast increase in the mobile data traffic taking place on a global scale. Therefore, ITU establishes a minimum amount of spectrum allocated to IMT-2000 and IMT-Advanced, for years 2010, 2015 and 2020 based on the state of market development: lower market environment versus higher market environment. The ITU recommendation classifies the spectrum needs of Radio Technology Group Access (RATG). RATG 1 covers pre-IMT and IMT, as well as IMT improvements, and RATG 2 refers to IMT-Advanced.

The ITU-R M.2290 Report updated the spectrum forecast required for the year 2020, which results in a range between 1340 and 1960 MHz, depending on the market environment.

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ITU Recommendations: spectrum allocation for the development of IMT and IMT-Advanced technologies

<table>
<thead>
<tr>
<th>Market environment</th>
<th>Spectrum Requirement for RATG 1 (MHz)</th>
<th>Spectrum Requirement for RATG 2 (MHz)</th>
<th>Total Spectrum Requirement (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher market</td>
<td>840 880 880</td>
<td>0 420 840</td>
<td>840 1300 1720</td>
</tr>
<tr>
<td>environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower market</td>
<td>760 800 800</td>
<td>0 500 480</td>
<td>760 1300 1280</td>
</tr>
<tr>
<td>environment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: International Telecommunication Union (ITU-R M.2078 and ITU-R M.2290)

The objective of spectrum allocations represents the total amount of spectrum in a given market. These ITU suggestions allow mobile operators to see the increasing demands of the society, that use connected devices at an increasing rate.

The new services and applications, the new devices and the continuous increase of the use of smartphones, tablets and connected machines affect all the aspects of the life of the users, including government, education, transport and health. The increase in use of these applications by mobile networks is projected to exhibit an annual cumulative compound growth of 50% in the period 2015 to 2020 to increase at a monthly average of 276,416 TB monthly in 2015 to a monthly average of 2,091,703 TB in 2020.\(^8\)

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LATIN AMERICA SPECTRUM OVERVIEW

The results indicate that, at best, only 46.85 percent of the objective of the spectrum allocation for 2015 has been fulfilled. The necessity of additional spectrum allocation is demonstrated by the launching of LTE networks in all the region in the new spectrum as it is shown in the following table. The LTE FDD frequency bands corresponding to those defined by 3GPP for LTE in commercial mobile networks are the following ones: bands 12, 13, 14 and 17 for 700 MHz with the US channeling, and band 28 for the 700 MHz band with APT channeling; band 10 and 4 for 1.7/2.1 GHz, commonly referred as AWS and band 7 for 2500 MHz (2500-2570/2620-2690 MHz); band 3 for 1700 MHz and band 2 for 1900 MHz.

Most of LTE commercial mobile services in these markets has had an auction process in the recent past.

It is important to understand that Latin America has characteristics different from other zones of the Western Hemisphere. Regionally, GSMA Intelligence calculated monthly income average by subscriber (ARPU) of US$ 9.19 for 2014 (for 2015 the estimates were US$ 7.54). Connectivity to Internet has been low and the regional GDP per capita in that same year was approximately US$ 8,990, according to the World Bank.

Therefore, providing new spectrum in the market allows mobile operators to efficiently increase network capacity to support the new world of connectivity in smartphones, which currently use 35 times more spectrum than traditional cell phones, and tablets use 121 times more spectrum. On the other hand, several technological and economic studies have shown that the increase of mobile broadband penetration and the higher speed of performance increase the GDP and the use (Ericsson, Arthur D. Little and Chalmers University of Technology). A Credit Suisse wireless technology report showed that Latin American networks are on the threshold of usage levels and forecasts an increase in congestion (Credit Suisse, July 2011).

Taking the ITU recommendation of 1300 MHz for 2015 as a reference point, the situation in the region can be summarized as follows as of September 2018: the average spectrum allocated in the region for mobile services was 363.8 MHz (28 percent of the 2015 recommendation) and only eight markets had licensed 390 MHz or more (30 percent of the 2015 recommendation).

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Five countries had licensed 400 MHz or more of spectrum for mobile services; another six were in the 300-400 MHz range and the rest remained below the 300 MHz mark.

**Percentage of Spectrum Allocated according to the ITU Recommendation for 2015 and 2020**

<table>
<thead>
<tr>
<th>Country</th>
<th>Spectrum (MHz)</th>
<th>2015 Goal</th>
<th>2020 Goal (high scenario)</th>
<th>2020 Goal (low scenario)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>390</td>
<td>30.0%</td>
<td>19.9%</td>
<td>29.1%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>284</td>
<td>21.8%</td>
<td>14.5%</td>
<td>21.2%</td>
</tr>
<tr>
<td>Brazil</td>
<td>609</td>
<td>46.8%</td>
<td>31.1%</td>
<td>45.4%</td>
</tr>
<tr>
<td>Chile</td>
<td>490</td>
<td>37.7%</td>
<td>25.0%</td>
<td>36.6%</td>
</tr>
<tr>
<td>Colombia</td>
<td>362.5</td>
<td>27.9%</td>
<td>18.5%</td>
<td>27.1%</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>400</td>
<td>30.8%</td>
<td>20.4%</td>
<td>29.9%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>290</td>
<td>22.3%</td>
<td>14.8%</td>
<td>21.5%</td>
</tr>
<tr>
<td>El Salvador</td>
<td>244</td>
<td>18.8%</td>
<td>12.4%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Guatemala</td>
<td>210.6</td>
<td>16.2%</td>
<td>10.7%</td>
<td>15.7%</td>
</tr>
<tr>
<td>Honduras</td>
<td>290</td>
<td>22.3%</td>
<td>14.8%</td>
<td>21.5%</td>
</tr>
<tr>
<td>Mexico</td>
<td>584.3</td>
<td>44.9%</td>
<td>29.8%</td>
<td>43.6%</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>420</td>
<td>32.3%</td>
<td>21.4%</td>
<td>31.3%</td>
</tr>
<tr>
<td>Panama</td>
<td>240</td>
<td>18.5%</td>
<td>12.2%</td>
<td>17.9%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>350</td>
<td>26.9%</td>
<td>17.9%</td>
<td>26.1%</td>
</tr>
<tr>
<td>Peru</td>
<td>394.4</td>
<td>30.3%</td>
<td>20.1%</td>
<td>29.4%</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>270</td>
<td>20.8%</td>
<td>13.8%</td>
<td>20.1%</td>
</tr>
<tr>
<td>Uruguay</td>
<td>395</td>
<td>30.4%</td>
<td>20.2%</td>
<td>29.5%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>324</td>
<td>24.9%</td>
<td>16.5%</td>
<td>24.2%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>363.8</strong></td>
<td><strong>28.0%</strong></td>
<td><strong>18.6%</strong></td>
<td><strong>27.1%</strong></td>
</tr>
</tbody>
</table>

There are two events that affect the amount of spectrum allocated in Latin America regional markets. The first one refers to the direct allocation of spectrum. Since 2000, there has been an increase in the number of spectrum allocated directly (without process of spectrum auction) to state-owned companies. For example, from 1Q 2013, eight markets had allocated spectrum to a state operator; that is the case of Argentina, Bolivia, Costa Rica, Ecuador, Honduras, Paraguay, Uruguay and Venezuela. In Mexico, the legal reform of the regulatory framework for telecommunications ordered the creation of a network of mobile wholesale services. The amount of MHz allocated is different in each case and ranges from 30 to 130 MHz.

The second event is the spectrum allocated that is not used in a timely manner. The allocation of more spectrum to service providers must address the greater and better use of the spectrum. It is understood that there are legitimate reasons for the decisions of the operators to postpone the mobile services deployment in a spectrum band: the delay of the conclusion of the technology standards or interference. In the last years, it has become clear in Latin America that part of the spectrum allocated by the regulators remains unused today.
**FUTURE OF THE RADIO SPECTRUM IN LATIN AMERICA**

Although the maximum spectrum allocated to telecom operators for the commercial offer of mobile services represents only 46.85% of the ITU suggestion for 2015, several spectrum licensing processes are expected between 2018 and 2020 in different markets in the region. This is a first step in reducing the level of congestion of mobile networks and to increase mobile broadband services to reach higher levels of quality.

<table>
<thead>
<tr>
<th>Country</th>
<th>Potential spectrum capacity (in MHz)</th>
<th>Tentative bands</th>
<th>Status / tentative dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>90</td>
<td>700 MHz, 900 MHz &amp; AWS</td>
<td>No tentative dates; remaining capacity in 700 MHz, 1.9 GHz and AWS.</td>
</tr>
<tr>
<td>Brazil</td>
<td>270</td>
<td>700 MHz, 2.3 GHz &amp; 3.5 GHz</td>
<td>The Government has announced potential for new tenders between 2018 and 2020.</td>
</tr>
<tr>
<td>Colombia</td>
<td>75</td>
<td>700 MHz &amp; 1.9 GHz</td>
<td>No tentative dates; the 700 MHz and 900 MHz bands are mentioned in spectrum planning documents.</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>130</td>
<td>700 MHz &amp; 900 MHz</td>
<td>No tentative dates. The Government has proposed new band plans.</td>
</tr>
<tr>
<td>Ecuador</td>
<td>100</td>
<td>900 MHz &amp; AWS</td>
<td>No tentative dates. 1.9 GHz and AWS subject to a process of interest Manifestation from operators.</td>
</tr>
<tr>
<td>El Salvador</td>
<td>140</td>
<td>1.9 GHz &amp; AWS</td>
<td>1.9 GHz and AWS subject to a process of interest Manifestation from operators.</td>
</tr>
<tr>
<td>Guatemala</td>
<td>90</td>
<td>AWS</td>
<td>No tentative dates. The Government announced that AWS spectrum would be available for a new tender.</td>
</tr>
<tr>
<td>Honduras</td>
<td>310</td>
<td>700 MHz, 900 MHz &amp; 2.5 GHz</td>
<td>The regulator tendered a contract for a third party to design a multi-band tender between 2016-2017, but no tentative dates have been announced.</td>
</tr>
<tr>
<td>Mexico</td>
<td>80</td>
<td>AWS-3, 2.5 GHz &amp; 600 MHz</td>
<td>The 600 MHz would be tendered in 2020. No tentative dates for the remaining AWS-3 block. The 2.5 GHz was auctioned in 2018.</td>
</tr>
<tr>
<td>Panama</td>
<td>90</td>
<td>AWS</td>
<td>No tentative dates. The Government announced that AWS spectrum is available.</td>
</tr>
<tr>
<td>Paraguay</td>
<td>190</td>
<td>2.5 GHz</td>
<td>No tentative dates. 2.5 GHz is mentioned as the next band that could be awarded, according to spectrum planning documents.</td>
</tr>
<tr>
<td>Dominican Rep.</td>
<td>30</td>
<td>AWS</td>
<td>AWS auction of 2018 was suspended temporarily.</td>
</tr>
<tr>
<td>Uruguay</td>
<td>30</td>
<td>AWS-3</td>
<td>2019</td>
</tr>
<tr>
<td>Venezuela</td>
<td>251</td>
<td>700 MHz, 900 MHz, AWS, 1.8 GHz &amp; 2.5 GHz</td>
<td>No tentative dates. A 2016 resolution considers these bands for new tenders.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,876</strong></td>
<td></td>
<td><strong>The regulators of these countries have not made a formal announcement about the total capacity that could be tendered. The amount reflects an estimate of 5G Americas based on recent auction processes and the current ownership of the bands. The final amount is subject to changes by the national authorities.</strong></td>
</tr>
</tbody>
</table>

**Source: 5G Americas**

In addition to bands that have been placed for the short term, there is the opportunity to award new spectrum in bands that will be incrementally being incorporated into the ecosystem of devices such as AWS-3 (1755-1780/2155-2180 MHz) or 2.3 GHz. For example, Mexico allocated from 2016 the AWS-3 extension and Colombia sees this segment as a capacity source towards 2017-2019. The 2.3 GHz band has also been contemplated in these countries and others like Brazil, where, towards the end of 2016, a proposal was consulted for its clearing and next use, but this process has not yet been defined.

The 600 MHz band is not considered by all the countries of the region still and many of them are in process of planning or executing plans to travel to DTT and realize the analog blackout. Mexico, Argentina and Colombia have been some of the countries where the viability is analyzed to allocate this capacity by 2020.
On the other hand, several countries of the region are making changes to the national frequencies plans to comply with some of the WRC-15 agreements. In this sense, several markets have modified some bands already to award them to mobile services, as it is observed in segments like 1417-1518 MHz, 2.3 GHz and parts within the range 3.3-3.7 GHz. These bands represent a bet for the future and the ecosystems of devices and equipment must mature first.

When considering spectrum allocations, the regulators must account for the benefits of spectrum harmonization, including economies of scale, lower price of devices for consumers and improved roaming. New spectrum allocations should set up bandwidth licenses in contiguous spectrum, without interferences and the grouping of other similar services.

The participation in many of these next spectrum auctions can be limited, possibly preventing the investment and the economic growth, due to the present limits of the spectrum that are present in several markets of the region.

Although spectrum limits could be a useful tool to stimulate competition in the beginnings of the mobile industry, they are now obsolete because the mobile market has matured, with a mobile penetration in the region superior to the 100%.

Concerns about competition can be met by releasing new spectrum under conditions designed to stimulate competition.

The definitive elimination of “spectrum caps”, would give more “air” to several operators in the region who may suffer or are undergoing congestion in their networks because of the growth of the number of users, preventing quality services or the implementation of services that may require greater bandwidth.

The experiences of other regions of the world could serve as guidelines for the Latin American regulators. In the United States, Canada and Europe, the evolution of mobile broadband services has led to the flexibility -and even elimination, in some cases- of the spectrum limits. It should be considered that when spectrum quotas were imposed, the market was very different from the current one. Spectrum boundaries imply a given number of operators that would increase competition. Nevertheless, the nature of the telecommunications industry, with demands for intensive investment and permanent technological updating, led to a consolidation of the market that resulted in increased competitive pressure that expanded the limits of mobile services.

Several regulatory authorities and consumer protection agencies in Latin America have reacted to market concentration by taking preventive actions in the name of consumer advocacy. In some cases, the requirements included repayment or transfer of the spectrum obtained through the consolidation process. Changing the rules on spectrum rights after acquisition of additional spectrum through a purchase, or after having announced it as available at the beginning of a tender distorts the system of free market and denies access to the most attractive and valuable resource acquired (or going to be acquired, in the
case of the tender) by the purchasing company. To institute new rules that restrict or deny the use of that resource after completed the purchase or initiation of the bid distorts severely the principles of free market and is detrimental for the investors’ need for a regulatory certainty.

The conventional belief about market concentration suggests this leads inevitably to increases of prices, when in fact the case can be the opposite. Because the concentration of the market is accompanied of multiple participation in the market, the power of the efficiency and the economies of scale can reduce the costs and generate savings for the consumers. This is especially certain in the mobile industry because the biggest companies benefit from costs of investment per customer and lower operating expenses. Lower costs allow consolidated operators to provide a higher level of services at lower prices. Proof of this is the arrival to Latin America of new smart mobile terminals with prices that tend to low and new data plans with flat rate. In most cases, the arrival of 4G LTE did not imply an increase of prices with respect to 3G plans.

Often, one of the consequences of the existence of spectrum caps is the reserve of bands for new entrants. Nevertheless, the processes of radio spectrum allocation should not be discriminatory for the operators already present in the market. Often, those regulators that reserve a block of radio spectrum for a new entrant see their expectations frustrated, either because of the lack of interest of the companies to enter the market or by the long times that new players take to initiate operations.

On the other hand, the lack of interest of operators to enter the market through a reserved spectrum auction entails that the state may obtain new financial resources. This is also inefficient, since the radioelectric resource remains idle since it cannot be used by the operators already present in the market. In this way, the consumer may suffer a deterioration in the quality of the service due to network congestion or feel crippled to enjoy new mobile broadband services. If the operators could have the “reserved” spectrum, the State could see increased its collection by charging fees for the use of the spectrum.
CHALLENGES TO AWARD THE RADIO SPECTRUM

Currently, macroeconomic conditions of many Latin American markets are not favorable for radio spectrum auctions. Worldwide economies are still recovering slowly of the pressures of the recession that began the 2008 worldwide financial crisis. Therefore, the postponement of licenses has become a possibility in Latin America, since governments are trying to avoid problems like lower than expected bids or simply absenteeism in the process.

Of course, the granting of spectrum licenses is not as simple as it seems, since many interests, as much internal as external, are at stake in this process. Without doubt, spectrum licensing must continue in a region with asymmetric rates of adoption of wireless technologies.

One point where there is no divergence between governments, operators, suppliers and industry associations is the postponement of spectrum licensing, that has become detrimental for the market development:

- It limits the flow of investment, since the possible awardees will not invest in the spectrum acquisition, but either in infrastructure, operative and administrative costs, and publicity. In addition to the negative statistical impact on the GDP, the immediate social impact is the non-creation of numerous direct and indirect jobs in a region characterized by high rates of unemployment.

- It may lead to congestion in the radio spectrum auctions schedule; national regulators will have to determine how the deferral will affect the rest of its spectrum auctions schedule. The regulators will have to prioritize the spectrum licenses to auction first or take the risk of executing simultaneous auctions of different spectrum bands. Since many operators have expressed their interest in the acquisition of licenses in different parts of the spectrum, the lack of a coherent programming limits the number of parties submitting their bids during the auction process, the financial constraints will force the companies to choose quickly what licenses to acquire.

Regulators in the region should focus on creating fair and transparent auctions that support the investment in networks and allow the deployment of mobile access technologies and their integration into public policies programs that promote the adoption of ICT.

On the other hand, the decision of the government to make auctions for 2.5 GHz and AWS presents an opportunity for other markets in the region to improve the
economic scale of LTE services in these bands throughout Latin America and the Caribbean. As digital terrestrial television gains ground in the region and analog networks are being eliminated, more spectrum in 700 MHz will be available (that is to say, digital dividend spectrum) and will be allocated to the different players in the market.
CONCLUSION

None of the Latin American markets reached 50 percent of the 1300 MHz spectrum suggestion for 2015 (as of September 2018) contained in ITU-R M.2078, which establishes spectrum allocation requirements for IMT-2000 and IMT-Advanced to work optimally.

The lack of sufficient spectrum for the development of these services has negative consequences for the consumers and limits the potential of growth of the telecommunications industry. Without more spectrum, the technological development will satisfy the growing broadband needs of the society, which is a risk since the broadband connectivity is crucial for the progress of a country. More spectrum internationally harmonized in all the region is needed.

The regional average of spectrum awarded for mobile services is equivalent to 28 percent of the 2015 suggestion of 1300 MHz. Of the markets analyzed in this report, only eight have licensed 30 percent or more of the ITU recommendation of 1300 MHz for 2015: Argentina (30 percent), Brazil (46.8 percent), Chile (37.7 percent), Costa Rica (30.8 percent), Mexico (44.5 percent), Nicaragua (32.3 percent), Peru (30.3 percent) and Uruguay (30.4 percent). Of these, Costa Rica is the only one that has not awarded the 700 MHz band.

The ITU is not alone in its request of more spectrum, most of the studies made on the spectrum requirements show the necessity of more spectrum. A 2007 NGMN study determines that the net spectrum requirements would be between 500 MHz and 1 GHz for 2020, depending on the region of the world. In the United States, a 2010 National Broadband Plan developed by the Federal Communications Commission called for 500 MHz of new spectrum to be allocated by 2020. The governments of some countries are realizing that today's spectrum is the parallel to the need for highways, railroads, airports, water infrastructure and sewage system of the last years. Spectrum is a key ingredient for development and progress of the society, as well as drinking water, sewerage and highways were in the past.

In addition, the progress of 5G trials and the standardization process means that some deployments will occur even before 5G, as some mobile operators in the United States suggest. This requires a policy to identify and access new “spectrum reserves” in bands such as 600 MHz or the range 3.3-3.7 GHz and millimeter bands (mmWave) over 24 GHz. 5G will utilize different bands (low, medium and high) to deploy new services with coverage and capacity.

One result of increased spectrum allocation would be the efficient performance of mobile networks, especially in densely populated urban areas where spectrum limitations are aggravated by other restrictions, as the delay in authorizing new deployments of towers or new technologies. For example, LTE will be more efficient in the use of spectrum. It is necessary to emphasize that, in many cases,
new spectrum for the deployment of new technologies is preferred in as much the allocated bandwidth is already being used by the mature mobile technologies as GSM or UMTS/HSPA +.

The largest number of new LTE deployments in the world has taken place after operators get new spectrum. Technologies such as LTE benefit from broader radio channels, because they allow greater efficiencies than they are reflected in aspects such as higher data rates. With an ARPU in the region of US$7.54 to 2015\(^\text{10}\), a limited CAPEX and bureaucratic delays for the installation of towers, to grant new spectrum is the most efficient way of advancing for operators in order that they deploy new technologies and increase the performance of their networks.

On the other hand, spectrum allocation to dedicated data channels can allow mobile operators to offer better speeds of transmission of mobile broadband, which increases customer satisfaction, as well as government objectives to extend broadband coverage in their markets. The lack of robustness of mobile broadband connections delays to the adoption of advanced applications, which seek to solve coverage problems in education, health, transport and government services.

A 2011 study by Ericsson, Arthur D. Little and Chalmers University of Technology quantified the isolated impact of broadband speed in 33 OECD countries, demonstrating that doubling broadband speed for an economy increases GDP by 0.3%. A 2010 study of the Broadband Commission showed that for every 10 percentage points increase in broadband penetration, a country's GDP is increased by 1%. In turn, a 2012 ITU study indicates that for every 10 percentage points increase in broadband penetration, there has been a direct impact on efficiency (up to 3.6% increase, according to the University of Ohio), and economic growth (between 1.21% and 1.36% increase of GDP growth, according to the World Bank).

Regulators in Latin America should remain diligent in understanding the importance for citizens of having more spectrum for mobile services in the marketplace to boost economic growth and global connectivity in their countries. This is especially important in rural and remote areas, where the wired infrastructure of fixed services providers is not present, so wireless technologies are the only viable alternative to offer broadband services to the population. It is extremely important for the Americas region to work together for a harmonized spectrum plan for all the region to benefit from economies of scale, with a reach for all the chipsets, devices and infrastructure ecosystem, as well as LTE mobile broadband roaming.

\(^{10}\) Source: GSMA Intelligence. In: http://www.mintic.gov.co/portal/604/articles-14374_pdf.pdf
APPENDIX A: LATIN AMERICA MARKETS PROFILES

ARGENTINA

Argentina had 61.9 million mobile subscriptions in 2017 and a population of 44.27 million people for a mobile penetration of 139.8 percent in a space of 2,780,400 km². In this market there are three mobile network operators (Claro, Movistar and the merged entity of Personal and Nextel). Telecom Argentina and Cablevisión (controllers of Personal and Nextel) announced a merger agreement in 2017. In addition, there is an MVNO, Nuestro, which belongs to the cooperatives that operate in the interior of the country.

In Argentina, 390 MHz of spectrum have been awarded for mobile services. This amount takes into account an obligation to return the spectrum for the merger of Telecom Argentina and Cablevisión. It should be taken into account that this obligation could be withdrawn if the government announces new changes to the spectrum cap regulations (currently at 140 MHz).

There is potential to award up to 90 MHz in the bands of 700 MHz, AWS (not counting the AWS-3 extension) and 1.9 GHz. This capacity would come from two different events: 60 MHz returned by Arlink after the operator failed to pay for the licenses of the 4G Auction of the 4Q14, and 30 MHz of Arsat that now would be offered in the primary market to private operators (subject to legal changes and administrative resolution). This amount may be higher, depending on changes to spectrum cap regulations that currently are the base of the obligation to return the spectrum for Telecom Argentina – Cablevisión.

The most recent spectrum tender took place in mid-2017. In July of that year, the Government confirmed that 100 MHz of the 2.5 GHz band was awarded through an on-demand tender to the three mobile network operators. These blocks were allocated on a municipal level.

Before the tender, the resolution 171/2017 of the Ministry of Communications issued new rules to allow the refarming of the 900 MHz and 2.5 GHz band and increased the spectrum cap from 60 to 140 MHz per operator. The refarming plan allowed Nextel to pay for the use of paid 20 MHz of the 900 MHz band and 40 MHz of the 2.5 GHz band for mobile services.

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11 The population comes from the United Nations estimates for 2017. Subscriber figures were provided by regulators and operators. Subscriber figures of 2016 were provided by the ITU.
The same resolution of the Ministry of Communications, ruled that ENACOM should analyze the technical feasibility to allocate mobile spectrum segments for mobile broadband. Specifically, 450 MHz (450-470 MHz), 698-960 MHz and 2300-2400 MHz are included. In addition, a preventive suspension of procedures in the 1427-1528 MHz and 3.3-3.6 GHz segments was established. The purpose of this resolution is to identify more capacity for mobile broadband, although not all bands would be contemplated in the short term due to the lack of an ecosystem of devices.

The spectrum awarded in Argentina amounts to 30 percent of the suggestion indicated by ITU-R M.2078 for 2015, and 19.9 percent of the 2020 suggestion (high scenario).
BOLIVIA

It is estimated that in 2017 Bolivia had approximately 10.35 million mobile subscribers and a population of 11 million people for a mobile penetration of 93.7 percent in a territory of 1,098,581 km².

The market has three network operators: the Empresa Nacional de Telecomunicaciones (Entel), Tigo and Viva Nuevatel. The scene is complete with Comteco's MVNO, Mine.

In 2013, it was planned to allocate licenses for the use of the 2500 MHz band in the form of regional authorizations. In March 2017, the 2500 MHz band was not used still for mobile networks and no plan or call had been published to allocate more spectrum. The national frequency plan assigns the 2500-2570 MHz and 2620-2690 MHz segments to mobile use at national level, and the 2570-2620 MHz segment for fixed services.

The 284 MHz awarded for mobile services in Bolivia amount to 21.8 percent and 14.5 percent of the spectrum ITU-R M.2078 suggestions for 2015 and 2020, respectively.
BRAZIL

By the end of 2017, Brazil had 236.5 million mobile subscriptions and a population of 209.3 million people for a mobile penetration of 113 percent in a territory of 8,515,770 km².

The market has five national operators (Claro, Nextel, Oi, TIM and Vivo), in addition to two regional mobile operators (Algar -CTBC- and Sercomtel). There are also several companies with MVNO license.

In this country, the "leftover auction" was the latest tender process. It started during the last quarter of 2015 and finished in the first quarter of 2017. In this process, some remaining blocks of the 1.8, 1.9 and 2.5 GHz bands were awarded on a local and municipal basis. The authorities considered including the 3.5 GHz band in the tender and the band was removed from the final plans of the process due to potential interferences with other communication systems.

The National Telecommunications Agency (ANATEL) has been active in identifying new spectrum resources. Specifically, the 700 MHz, 2.3 GHz and 3.5 GHz bands have been identified and amount to 270 MHz of potential new capacity. The 3.5 GHz band is considered for the development of 5G networks in Brazil and could be awarded in 2019.

The available spectrum of the 700 MHz consists of blocks of that remained unawarded after the 2014 auction. Since the analogue switch-off process is expected to be completed by the end of 2018, this band would become additional capacity for LTE networks in the short term.

The 2.3 GHz band would provide an additional 100 MHz for mobile services and since November 2017 ANATEL ordered the release of this band within 2018-2020.

Brazil has licensed 609 MHz for mobile services, amount that represents 46.8 percent of the capacity suggested by ITU-RM 2078 for 2015, and 31.1 percent of the recommendation for 2020.
CHILE

Chile had approximately 23 million mobile subscriptions and a population of roughly 18 million people for a mobile penetration of 127.5 percent in a territory of 756,102 km².

The market has five operators with spectrum (Claro, Entel, Movistar, VTR - in process to become MVNO- and WOM), in addition to several MVNO, such as Telsur-GTD and Virgin Mobil.

One of the operators (WOM) announced the shutdown of the Iden network on the 800 MHz band on December 31, 2016, but it has not confirmed if it will use this capacity for the deployment of mobile broadband.

One of the licensees of the AWS band (VTR) showed in April 2017 that it will use this capacity to provide residential broadband and that it will remain as a MVNO. Chile has not yet resolved the approval of a secondary spectrum market that would allow new movements in spectrum ownership. The government has not announced new spectrum tenders for 2018.

The Chilean Supreme Court ruled that the winners of blocks in the 700 MHz tender will have to return spectrum to the Government. This ruling was the product of a lawsuit filed by a complaint who argued that the tender produced a higher spectrum concentration and resulted in a detriment of competitive conditions. The network operators can return spectrum from other bands to comply, according to the Judiciary.

On the other hand, Subtel (the regulatory agency of Chile) ordered to "freeze" the 3.5 GHz band in the country to study it as a spectrum resource to develop 5G. This band was licensed for wireless access services. Subtel claimed that the band was being underutilized by the license holders.

The 490 MHz of licensed spectrum for mobile services in Chile represent 37.7 percent of the recommendations established by ITU-RM 2078 for 2015 and 25 percent for 2020.
COLOMBIA

Mobile subscriptions in Colombia exceeded 62.2 million in 2017 with a population of 49 million, equivalent to a mobile penetration of 126.8 percent in a territory of 1,141,748 km².

Colombia has five mobile operators (Claro, Movistar, Tigo/UNE, Avantel and ETB). Additionally, at least five MVNO are currently active (Exito, Metrotel, Telebucaramanga, Uff! Móvil and Virgin Mobile).

The Ministry of Information and Communications Technologies (MINTIC) plans to tender 75 MHz of the 700 MHz and 1.9 GHz bands in 2018. This auction has had a long consultation process that began in the first quarter of 2017. A new version of the tender documents and rules was proposed in the first quarter of 2018 and the consultation phase is set to end in May 2018.

Specifically, the tender comprises 70 MHz of the 700 MHz band (713-748 / 768-803 MHz) and 5 MHz of the 1.9 GHz band (1865-1867.5 / 1945-1947.5 MHz). The definitive timetable for this tender has not been issued.

Colombia has spectrum caps for "high" and "low" bands (above or below 1 GHz, respectively). The caps were modified during 2018 and remain as follows: for “high bands”, the cap went from 85 to 90 MHz per operator and for “low bands” went from 30 to 45 MHz per operator.

The National Spectrum Agency (ANE) has mentioned that short term planning (2019-2020) includes as prospects the 600 MHz, 900 MHz, AWS-3 and 2.5 GHz bands. In addition, the 3.4-3.7 GHz range is studied as a “spectrum reserve” for 5G development in Colombia.

Other important developments regarding spectrum planning for mobile services include consultation processes to utilize the 2.3 and 3.5 GHz for small cells with some sharing mechanisms.

It has been also proposed to eliminate the reserve of the 450 MHz band for IMT. Other recent developments include the limit to the issuance of new permits in the 1427-1518 MHz band aiming to use it for mobile services after 2023. Similar provisions have been established for the 2.3 GHz recently.

The 362.5 MHz licensed nationally for mobile services in Colombia is equivalent to 27.9 percent of the amount of spectrum suggested by ITU-RM 2078 for 2015 and 18.5 percent of that for 2020.
COSTA RICA

Estimates for 2017 show that Costa Rica had 8.7 million mobile subscriptions and a population of 4.9 million, equivalent to a mobile penetration of 178.1 percent in a territory of 51,100 km².

There are three network operators (Claro, ICE-Kolbi and Movistar) and two MVNO (Tuyo Móvil and Full Móvil).

The most recent spectrum auction took place in July 2017 and awarded 70 MHz of the 1.8 GHz and 1.9 / 2.1 GHz bands between Claro and Movistar, the only two participants.

In Costa Rica new auctions of spectrum are still not announced, the Superintendency of Telecommunications (SUTEL) has mentioned in spectrum planning documentation that the 700 and 900 MHz bands would be available for upcoming processes, which implies a potential capacity of approximately 130 MHz.

In the 900 MHz band, the 895-915 MHz and 940-960 MHz sub bands are allocated for the development of IMT systems and the beginning of reassignments of frequencies to the present concessionaires (mainly, radio-relay companies) was programmed for July 1, 2015.

On the other hand, the 2.5 GHz band is used by the state operator ICE-Kolbi to provide LTE, but the SUTEL has recommended that approximately 150 MHz of this band may be considered for future auctions, but this is still tentative.

The 400 MHz licensed spectrum for mobile services in Costa Rica represent 30.8 percent of the ITU-RM 2078 suggestion for 2015 and 20.4 percent for 2020.
ECUADOR

In 2017, Ecuador had over 15 million mobile subscriptions and a population of 16.6 million, equivalent to a mobile penetration of 90.6 percent in a territory of 283,560 km².

There are three mobile operators in the market (Claro, Corporación Nacional de Telecomunicaciones -CNT- and Movistar).

The Telecommunications Regulation and Control Agency (ARCOTEL) has proposed between 2017 and 2018 new band plans for the 900 MHz, AWS and 3.3-3.6 GHz bands, which could be subject to licensing for mobile services. The 900 MHz and AWS bands would provide an additional 100 MHz for mobile services.

In the case of the 3.3-3.6 GHz range, the 3.3-3.4 GHz band is not in use, but there are 71.5 MHz occupied in the 3.4-3.6 GHz range by two state companies. ARCOTEL proposed repealing the previous resolutions and utilize this spectrum for mobile services. However, these actions have not yet been carried out.

There are still no plans or timelines for upcoming spectrum auctions in Ecuador.

Meanwhile, the 2500-2686 MHz band lodges fixed systems and codified television terrestrial without any clearing and relocation plan known that may allow to use this band for mobile services in the future. The RTV-390-15-CONATEL-2012 resolution anticipated that MMDS systems and other audiovisual services would maintain their operation until the date indicated in the concession.

The 290 MHz in use for mobile services in Ecuador represent 22.3 percent of the amount of spectrum suggested in ITU-RM 2078 for 2015, and only 14.8 percent of the suggestion for 2020.
EL SALVADOR

The most recent figures available for El Salvador (2016) indicate the mobile subscriptions reached 9.6 million in a population of 6.3 million for a mobile penetration of 152.4 percent in a territory of 21,041 km².

The market has four mobile operators (Claro, Digicel, Movistar and Tigo) and an operator who serves over an IDEN network (RED Intelfon).

In April 2018, the General Superintendence of Electricity and Telecommunications (SIGET) awarded 50 MHz of the 2.5 GHz (TDD blocks) band to one of the operators. This was the result of a spectrum auction announced during the 1Q 2018.

Also in April, SIGET confirmed that new authorizations in the 2500-2570 / 2620-2690 MHz are suspended to determine if there is technical feasibility for the deployment of mobile services in the band.

New permits and authorizations regarding the 2.3 GHz band were also suspended by SIGET. This band is considered as a spectrum resource to further develop mobile services in El Salvador.

By the end of March 2018, SIGET opened a process to receive expressions of interest on a possible offer of 140 MHz in the AWS and 1.9 GHz bands. The consultation process ended recently, but there are no tentative dates for a new auction.

SIGET has been processing renewal petitions on the 800, 850 and 900 MHz bands as well as 1.9 and 3.5 GHz bands. Not all these renewals allocate new spectrum for the mobile broadband environment, as the bands 800 MHz and 3.5 GHz, which are used for different services.

The 244 MHz of spectrum awarded for mobile services in El Salvador represent 18.8 percent of the amount of spectrum suggested by ITU-RM 2078 for 2015, and only 12.4 percent of the 2020 suggestion.
GUATEMALA

Guatemala had almost 20 million mobile subscriptions in 2017 and a population of almost 17 million for a mobile penetration of 118.2 percent in a territory of 108,889 km².

There are three mobile network operators in the market (Claro, Movistar and Tigo), in addition to an iDEN operator (RED Intelfon).

The government of Guatemala announced intentions to auction the AWS band since 2016, but no official plans have been made. This band would add 90 MHz of spectrum for mobile services, but there is a dispute over which entity has the legal powers to allocate the spectrum between the Telecommunications Superintendence (SIT) and the Guatemalan Telecommunications Company (Guatel).

There is not yet a judicial resolution that resolves the dispute.

The 210.6 MHz spectrum in use for mobile services in Guatemala represents 16.2 percent of the recommended amount established in ITU-RM 2078 for 2015 and only 10.7 percent of the recommendation of the international organization for 2020.
HONDURAS

In 2017, Honduras had approximately 7.8 million mobile subscriptions and 9.2 million inhabitants for a mobile penetration of 84 percent in a territory of 112,492 km².

The market is composed of three operators (Claro, Hondutel and Tigo). Since 2016, the government started the process to hire an external consultant to design a multi-band auction tentatively in 2017, but in 2018 no definitive plans for the process have been published.

The tender would include blocks from the 700 MHz, 900 MHz and 2.5 GHz bands. It is estimated that over 300 MHz could be added by this auction alone.

Honduras consulted at the end of October of 2017 a modification to the national note HND36 of the National Plan of Frequency Allocation. The government proposed to allocate the 806-814 / 851-859 MHz band for trunked radio systems and attribute to the the 814-824 / 859-869 MHz range for mobile services, thus establishing a segment of 10 + 10 MHz within the 800 MHz band for IMT. The consultation process ended, but no resolutions have been published on the matter.

The 290 MHz currently in use in the Honduras market represent 22.3 percent of the amount of spectrum suggested in ITU-RM 2078 for 2015, and 14.8 percent of the 2020 estimate.
MEXICO

Mexico had approximately 114.3 million mobile subscriptions in 2017 and a population of 129.1 million inhabitants for a mobile penetration of 88.5 percent in a territory of 1,964,375 km².

Mexico has three mobile network operators (AT&T, Movistar and Telcel) and more than 10 MVNO brands (QboCel, Virgin Mobile, Maxcom, Megacable, Maz Tiempo, Cierto, Weex, Megatel, Neus Mobile, Bueno Cell, Flash Mobile, Chedraui, Simpati, Freedom Pop, Her Mobile, Telecomunicaciones 360 and Toka). In addition, Red Compartida, the public-private wholesale LTE network on the 700 MHz band, started operations during the 1Q18.

Mexico successfully allocated the 2.5 GHz band (120 MHz divided in six national blocks) in an auction conducted in August 2018. There are 10 MHz of the AWS-3 band that went unsold in the last "4G Auction" (2016), but the block was not included in the 2.5 GHz auction of 2018.

The Federal Institute of Telecommunications (IFT) announced that the 600 MHz band will be cleared in 2018 and is considered a spectrum resource for 5G. However, the band would be auctioned until 2020. The 2.3 GHz is also considered for upcoming auctions.

In September 2016, the IFT published the agreement to reorganize the 800 MHz band (806-824/851-869 MHz) to guarantee the use of 20 MHz for mobile broadband services. Currently, AT&T holds licenses in that band derived from Nextel's iDEN network. The regulator will establish soon if in the transition to this new scheme there will be availability of additional capacity to bid.

The 584.3 MHz currently in use for mobile services in Mexico represent 44.9 percent of the amount suggested by ITU-RM 2078 for 2015, and 29.8 percent of the 2020 estimate.
NICARAGUA

In 2017, Nicaragua had approximately 8.3 million mobile lines and a population of 6.2 million for a mobile penetration of 133.5 percent in a territory of roughly 130,375 km².

The market has three mobile operators (Claro, Movistar and Xinwei). There are no new announcements of new spectrum allocation processes.

The 2.5 GHz band is allocated to subscription television services and operates point to point links over the backbone network. Allocations have been made in the band to an operator (60 MHz for Yota in 2009) and the State has sent resolutions of spectrum recovery in the band because of requests of completion of licenses.

The 420 MHz currently in use in Nicaragua represent 32.3 percent of the amount suggested by ITU-RM 2078 for 2015, and only 21.4 percent of the ITU recommendation for 2020.
PANAMA

Panama had approximately 5.9 million mobile subscriptions in 2017 and a population of 4.1 million people for a mobile penetration of 145.8 percent in a territory of 75,420 km². The market has four operators (Cable & Wireless, Claro, Digicel and Movistar).

The National Authority of Public Services of Panama (ASEP) indicated since January 2017 that the AWS band is available to telecommunications operators. It is estimated that the 90 MHz of this band (without its extension) would be the additional capacity available in the short term.

Although the band is available for use, there has been no demand for mobile operators.

In this market, an additional block (20 MHz) of the 700 MHz band was awarded during the first quarter of 2018 to a mobile network operator.

On the other hand, the 2.5 GHz band is assigned for telecommunications services, but not for mobile broadband. The operation of restricted television systems is considered instead.

The 240 MHz in use in Panama represent 18.5 percent of the spectrum suggestion for by ITU-RM 2078 for 2015 and only 12.2 percent for 2020.
PARAGUAY

The most recent figures for Paraguay (2016) indicate that there were 7.5 million mobile subscriptions and a population of 6.7 million for a mobile penetration of 98.7 percent in a territory of approximately 406.752 km². The market has four operators (Claro, Personal, Tigo and Vox).

The National Telecommunications Commission (Conatel) concluded the auction of the 700 MHz band in the 1Q18, in which 70 MHz were licensed. The regulator considers that the 2.5 GHz (190 MHz) band could be awarded in an upcoming auction, but there are no official plans for a new process.

In the AWS auction at the end of 2015, Tigo agreed to return to the 50 MHz of the 2.5 GHz band that it had obtained after the purchase of a fixed competitor. In this same process, the state operator (Vox) swapped 10 MHz of the AWS band for the same capacity in the 700 MHz band.

The 350 MHz in use in Paraguay represents 26.9 percent of the amount suggested by ITU-RM 2078 for 2015 and 17.9 percent for 2020.
PERU

Peru had more than 38.9 million mobile subscriptions in 2017 and a population of 32.1 million for a mobile penetration of 121 percent within a territory of 1,285,215 km². The Peruvian market has four mobile operators (Claro, Movistar, Entel and Bitel).

Peru awarded the 700 MHz band (90 MHz) in May 2016 and it has not made new announcements of spectrum auctions. The Peruvian authorities will initiate the refarming of several bands to auction them in the following years. This process Will include bands such as 2.5 GHz, 800 MHz and 3.5 GHz.

The 394.4 MHz of spectrum in use for mobile services in Peru represents 30.3 percent of the amount suggested by ITU-RM 2078 for 2015 and 20.1 percent for 2020.
DOMINICAN REPUBLIC

The Dominican Republic had 8.7 million mobile subscriptions in 2017 and a population of 10.7 million inhabitants for a mobile penetration of 81.4 percent in a territory of approximately 48,442 km². The market has three mobile operators (Claro, Altice and Viva).

The Dominican Institute of Telecommunications (INDOTEL) initiated the 30 MHz tender for the AWS band in May 2018, in which Viva was the only company qualified to participate. INDOTEL’s resolution 70-17 ordered the public offering of the 30 MHz of the AWS auction of 2014.

However, INDOTEL stopped this tender because another company, Satel, claimed to hold the rights of use of AWS blocks. The regulator suspended the process to review the case, but the dispute has not been resolved.

INDOTEL authorized a merger in favor of Altice (by which Tricom was acquired) that included an obligation to return 30 MHz of spectrum from the 1.9 GHz band, but this condition was annulled by Resolution 77-17.

As a result, Altice was able to retain the spectrum, but was obliged to return spectrum from several bands (including 20 MHz of the 1.8 GHz band) whose channelization was not compatible with the national frequency plan. In return, INDOTEL will compensate the new entity with 20 MHz of the AWS band.

The 270 MHz in use for mobile services in the Dominican Republic represents 20.8 percent of the amount suggested by ITU-RM 2078 for 2015 and only 13.8 percent for 2020.
URUGUAY

Uruguay had almost 5.4 million mobile subscriptions in 2017 and a population of 3.4 million for a mobile penetration of 156 percent in a territory of 176,215 km². The market has three operators (Antel, Claro and Movistar).

In August 2017, the results of the most recent auction (700 MHz, AWS-3, as well as available blocks of the AWS and 2.1 GHz bands) were announced. In total, the auction awarded 125 MHz of the 700 MHz, AWS-3, AWS and 2.1 GHz bands. 30 MHz of the AWS-3 band went unsold and will be available for the next auction that could take place in 2019. However, as of May 2018, there are no definitive plans for a new tender in Uruguay.

The private operators (Claro and Movistar) presented valid offers for 70 of the 100 MHz that were available to them, while the state operator Antel acquired 55 MHz of reserved blocks.

In 2011, decree 136/2011 identified the sub-bands 2500-2570 MHz and 2620-2690 MHz for the future deployment of advanced telecommunications services. The relocation and plan for this purpose of the MMDS signals of sub-band 2570-2620 MHz is pending.

The 395 MHz licensed in Uruguay for mobile services represent 30.4 percent of the spectrum suggested by ITU-RM 2078 for 2015 and 20.2 percent for 2020.
VENEZUELA

Venezuela had 26.9 million mobile subscriptions in 2017 and a population of 31.9 million for a mobile penetration of 84.2 percent in a territory of more than 714,445 km². The market has three operators (Digitel, Movistar and Movilnet).

The regulator identified through an administrative providence a series of bands that would be subject to public offer, but no blocks, capacity or deadlines have been defined for a new contest. Among the bands stand out those of 700 and 900 MHz, as well as AWS, 2.5 GHz, 1.8 GHz and 1.9 GHz.

The 324 MHz of spectrum in use for mobile services represent 24.9 percent of the resource recommended by ITU-RM 2078 for 2015, and only a 16.5 percent of the ITU recommendation for 2020.
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