"ASSESSING THE SOCIO-ECONOMIC IMPACT OF IDENTIFYING THE L-BAND FOR IMT SERVICES"

FINAL REPORT

Document prepared by BlueNote Management Consulting for the GSMA

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EXECUTIVE SUMMARY

An important ITU-R Resolution approved at the 2012 World Radiocommunication Conference (WRC-12) invited members to study additional spectrum requirements for IMT, and to identify potential candidate frequency bands. Members were asked to take into account the protection of existing services and the need for harmonization.

The GSMA considers the L-band (1350-1400MHz/1427-1518MHz) as a potential candidate for IMT, and has commissioned specialist spectrum consulting firm BlueNote Management Consulting (BNMC) to prepare this report. This report estimates the socio-economic impact in Latin America and the Caribbean (LAC) of using the L-band to provide mobile broadband services.

The research first investigates the current usage of the band, then briefly reviews its technical suitability, and goes on to provide quantitative modeling of the socio-economic impacts. A sample of seven countries was selected for in-depth analysis, and the results for the whole region were then extrapolated.

In line with other GSMA commissioned studies, the underlying methodology focuses on the impact on consumers. The report finds that identifying the L-band for IMT would create cost savings for telecommunications operators, who would enjoy lower capital and operational expenditures when deploying access networks. Given competitive market conditions these savings should be passed on to end users, keeping the sector returns relatively stable.

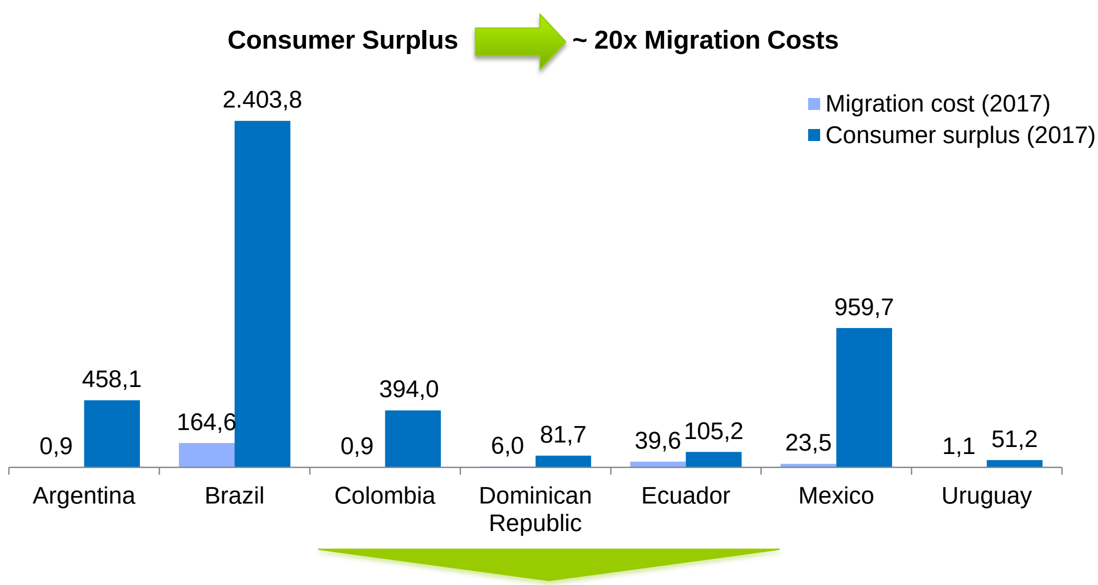
The study estimates the socio-economic impact of identifying the L-band for IMT services in each of the seven sample countries by comparing two scenarios -- having the L-band available for IMT, and not having it available. The difference between these scenarios represents the incremental value, or cost saving, of having the L-band available for IMT. The first scenario includes the migration costs of current users as a capital expenditure for clearing the band.

Having estimated the cost savings per country, the analysis assumed that competition between operators would assure those cost savings would ultimately be translated into retail price cuts. The model also assumes dynamic behavior of market demand, with additional 4G users being attracted by the lower prices. The combination of both impacts, that is additional consumers plus cost savings, represents the total consumer surplus.

As of 2017, the model estimates the combined consumer surplus at US$4.5 billion in the seven sample countries and US$6.6 billion for the whole LAC region[1]. In terms of investment payback, the consumer surplus accounts for almost 20 times the total migration costs. Having the L-band available for IMT will not only benefit the telecommunications sector, but it will also generate knock-on effects in other sectors. It will boost aggregate demand, improve economic productivity, and fuel the labor market. As of 2026, the model estimates 41.7 million new 4G users in the LAC region, resulting in US$19.8 billion of incremental GDP[2] and generating more than 13.000 new jobs in the LAC economy.

The quantitative analysis concludes that identifying the L-band for IMT will create material benefits for the telecommunications sector, individual governments and society as a whole. The evidence of the funding being available to create those benefits can be seen in the large gap between the substantial cost savings and the comparatively very small migration costs if the band were made available (the figure below graphically illustrates the gap).

Figure 1: Value gap between consumer surplus and migration costs
Million US$ at 2017, NPV, Cash flows discounted at social discount rate



- The cost of migrating the current L-band users to another band is not significant when compared to the consumer surplus generated
- The outcome of identifying the L-band for IMT is positive in each sample country

[1] Estimates based on a 10-years period and using social discount rates
[2] Including direct and indirect impacts

I. Introduction

The development of new radio-access technologies for telecommunications, coupled with the wide adoption of mobile services by consumers, has boosted spectrum requirements worldwide. Latin America and the Caribbean, in line with the rest of the world, needs to pave the way for a timely allocation of new spectrum to ensure the speedy development of advanced mobile services in the region.

The GSMA considers the low-UHF band (470-698MHz), L-band (1350-1400/1427-1518MHz), the 2.7-2.9GHz band and C-band (3.4-4.2GHz), as potential candidates for enlarging the current IMT group to ensure sufficient spectrum is available for the projected traffic growth.

In this context, the GSMA has commissioned BlueNote Management Consulting (BNMC) to estimate the socio-economic impact of identifying the L-band for mobile data services in Latin America and the Caribbean (LAC). In order to do this it has first been necessary to understand the potential efficiencies derived from using the L-band for mobile services versus alternative usages.

This report is structured as follows:

- the second chapter looks at the current situation, presenting the global spectrum demand and supply and ITU, and other stakeholders, initiatives;
- the third chapter describes the main findings of the research in the LAC region;
- the fourth chapter presents the results of the quantitative modeling, together with the conceptual background and key assumptions;
- the fifth and the sixth chapters comprise the appendix and the bibliography.

II. Background

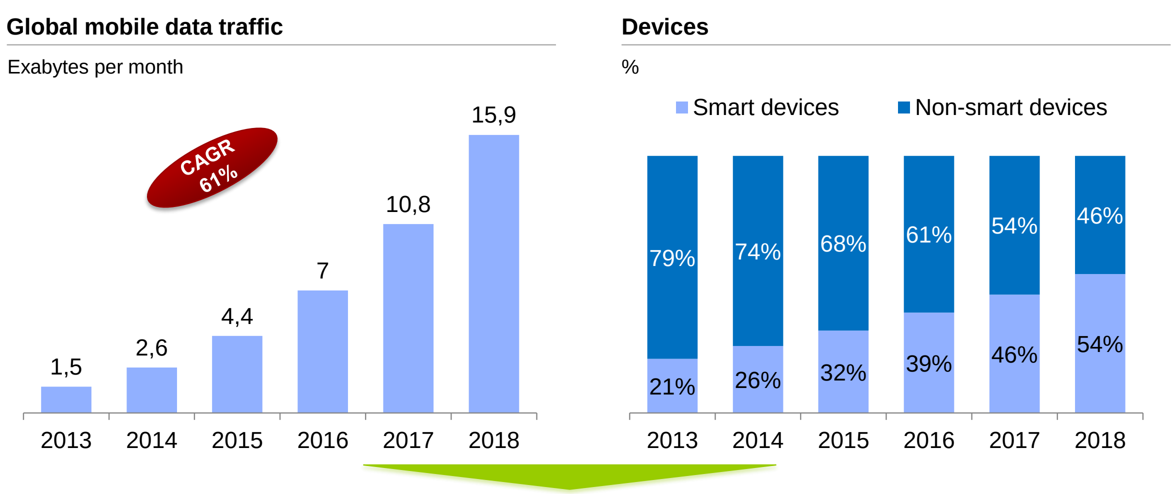
II.a. Spectrum demand projections

A few years ago consumers used their mobile devices only for voice and text communications, but in recent times the situation has dramatically changed. The introduction of smartphones, notebooks and tablets, alongside the development of innovative mobile applications, has resulted in an exponential growth of data demand. The strong demand for data is expected to continue to be a growing trend for the foreseeable future.

In 2013 global mobile data traffic grew by 81% over 2012, whilst in Latin America the figure was 105%, according to statistics compiled by infrastructure vendor Cisco[3]. Although smartphones, tablets and other mobile devices have different usage profiles, video streaming is the most important data-consumption activity. Videos account for 50% of global mobile data traffic and are expected to account for 66% by 2018.

Global data traffic is expected to grow at 61% annually from 2013 to 2018, which represents an overall ten-fold growth, climbing to almost 16 exabytes per month by 2018 (see the chart below).

Figure 2: Global mobile data traffic forecast, 2013 - 2018



- 2018 Global mobile data traffic will reach 15.9EB/month
- Global mobile data traffic CAGR (2013-2018): 61%
- Smart devices as key drivers for supporting mobile data growth

Source: Cisco VNI Mobile, 2014

[3] Cisco, 2013

LTE network deployment is accelerating the growth of data consumption as 4G users typically consume six times more[4] data than 3G user s. As well as 4G network deployment, rapid growth in smartphone sales is another key driver explaining the boost in mobile data traffic.

The Report ITU-R M.2290-0 provides a "future spectrum requirements estimate for terrestrial IMT, with projections on the spectrum requirement per country by 2020'. The required spectrum is estimated for both lower-user-density markets and higher-user-density markets, based both on data consumption levels and market development. The table below shows the ITU's spectrum estimates for 2020.

Density	Total spectrum requirements for pre-IMT, IMT-2000	Total spectrum requirements for IMT-Advanced	Total spectrum requirements
Lower-user-density settings	440MHz	900MHz	1340MHz
Higher-user-density settings	540MHz	1420MHz	1960MHz

The GSMA commissioned Coleago Consulting to develop a model to estimate future IMT spectrum requirements based on existing networks for the year 2020. Their results for five Latin American countries are in the table below.

Country	Low Usage	High Usage
Argentina	1093MHz	1628MHz
Brazil	1129MHz	1676MHz
Chile	893MHz	1327MHz
Colombia	1057MHz	1578MHz
Mexico	977MHz	1545MHz

Based on mobile data consumption projections and international estimates of spectrum requirements, an urgent need to identify additional spectrum for the provision of IMT is obvious. Any agenda for the identification procedure should factor in the significant time lags resulting both from often-lengthy assignation processes and network roll out.

[4] CISCO VNI 2014

II.b. Initiatives and new frequency bands for IMT

II.b.i. ITU initiatives

Because of spectrum demand growth and the demonstrable positive contribution of mobile broadband services to society and the economy, the ITU is planning ahead. At WRC-12, a resolution was adopted (ITU Resolution 807) to define the agenda for WRC-15. Agenda item 1.1 raises the issue of *"additional spectrum allocations to the mobile service on a primary basis and identification of additional frequency bands for International Mobile Telecommunications (IMT) and related regulatory provisions, to facilitate the development of terrestrial mobile broadband applications, in accordance with Resolution 233 (WRC-12)"*[5].

Resolution 233 (WRC-12) invites ITU-R members to study additional spectrum requirements and potential candidate frequency bands, taking into account the protection of existing services and the need for harmonization. It also stipulates that appropriate and timely availability of spectrum will be critical to support mobile broadband system growth (i.e. IMT development).

In response to this invitation, spectrum administrations, international telecoms associations, service providers and operators from around the world have submitted contributions to ITU groups WP 5D and JTG 4-5-6-7. They have recommended candidate frequencies to be used for IMT deployment, and prepared studies on the compatibility between IMT and services now operating in the proposed bands.

As administrations may deploy IMT systems only in specific portions of the band, it is useful to look at which frequency bands are already identified for IMT. These are listed in the following table.

Band (MHz)	Footnotes of RR identifying the band for IMT
450-470	5.286AA
698-960	5.313A, 5.317A
1710-2015	5.384A, 5.388
2110-2200	5.388
2300-2400	5.384A
2500-2690	5.384A
3400-3600	5.430A, 5.432A, 5.432B, 5.433A

[5] ITU, 2012

Frequency bands identified for IMT[6]

The bands which have been identified for possible future mobile broadband use by ITU-R members in response to Agenda Item 1.1 fall into the ranges which are shown below, along with their main attributes:

- lower bands for coverage: below 698MHz and above 450MHz
- central bands for capacity and coverage: above 960MHz and below 1710MHz
- upper bands for capacity: around 2200MHz and 2500MHz
- very high frequency bands for performance: above 3600MHz.

The coverage attributes of the sub-1GHz bands are crucial in developing countries, as they can provide cost-efficient broadband services in rural and low-population-density areas. The capacity offered by higher-frequency bands addresses the high-traffic demand of new services and densely-populated urban areas. Finally, the performance attribute of very high frequency bands is ideal for very-high-density hotspots and indoor areas where substantial bandwidth is needed to support high throughput.

The L-band falls in the middle and is suitable both for coverage and capacity. However in Latin America coverage is usually provided using sub-1GHz spectrum, because of its widespread geographical areas with low population densities in small rural communities.

The L-band has been the subject of often-spirited debates in international forums with existing users of the band or adjacent bands (most of them providers of passive services) demanding protection from potentially-harmful interference. This is what necessitates specific studies on compatibility between the IMT systems and the other systems in the band.

II.b.ii. Other initiatives and recommendations

In the context of the WP 5D and JTG meetings, some regional organizations, such as the European Conference of Postal and Telecommunications Administrations (CEPT), member states, technology providers and vendors, have sent contributions regarding L-band suitability for IMT services.

This section comprises a summary of the recommendation from CEPT European Communications Committee (ECC) Report 188.

[6] ITU, 2013 Recommendation ITU-R M.1036-4 about Radio Regulations (RR) edition 2008

In 2010, the CEPT instructed its ECC to review possible future uses of L-band to investigate the possibility of refarming 40MHz of spectrum for new services which might provide more social and economic benefits to Europe.

In accordance with the ITU's Radio Regulations, much of the upper part of L-band from 1452-1492MHz is allocated to fixed, mobile (except aeronautical mobile), broadcasting and broadcasting satellite services. The CEPT decided to investigate the feasibility of a range of new services in the band including terrestrial broadcasting, mobile broadband, mobile supplemental downlink, satellite digital audio broadcasting, program making and special events (PMSE), broadband public protection and disaster relief (PPDR), and broadband direct air to ground communication.

The criteria for evaluating each service were[7]:

- Compatibility with the current regulatory framework
- Possibility of sharing the band with other applications/uses
- Maximisation of social and economic benefits
- Roadmap of equipment (on a large scale) and of applications deployment
- Potential economies of scale

Having completed its analysis, the ECC proposed the sub-band 1452-1492MHz be set aside for Mobile/Fixed Communications Network (MFCN) supplemental downlink (SDL). The ECC report defines the technical conditions for band harmonization based on 8 blocks of 5MHz each, and proposes the elimination of designated sub-band 1479.5-1492MHz for Satellite Digital Audio Broadcasting[8].

In February 2013, Qualcomm, Ericsson and Orange successfully completed the world's first live demonstration of SDL in L-Band[9] in 1484-1492MHz in combination with the 2.1GHz band. Following the ECC report, 3GPP included the SDL feature in LTE and HSPA+ specifications. L-Band for SDL in E-UTRA and UTRA was included in 3GPP Release 12 and the specification was completed in June 2014[10].

Although L-Band is widely associated with the 1GHz to 2GHz spectrum range, which is known worldwide as the lower band for satellite services[11], only a portion of this frequency range is actually used for this type of service. In fact, the L-Band has a variety of other current uses including telemetry,

[7] CEPT, 2013
[8] idem
[9] ERICSSON, 2013
[10] 3GPP, 2014
[11] Marine Satellite Systems, 2010

radar, digital audio broadcasting (terrestrial and satellite), fixed links (point to point and point to multipoint) and radioastronomy.

In Region 2 the 1452-1518MHz part of L-band is already allocated to mobile services. In Region 3 there are LTE commercial networks operating in part of the L-Band in line with 3GPP specifications[12], including the two Japanese operators NTT DOCOMO and Softbank.

[12] Band 11 and Band 21 in 3GPP Specifications

III. Services currently provided in the LAC region using L-band

To evaluate a new identification of the L-band, it is necessary to consider and thoroughly understand the current usage of L-band in the LAC region. This includes current-user profiles, the feasibility of migrating them to other bands, other IMT allocations and the public agenda, if any, regarding the L-band.

BlueNote distributed information requests and held interviews with the local spectrum administrations in the seven LAC countries being sampled for this survey in order to depict current usage and public plans. Following this in-depth country-by-country analysis, results for the entire LAC region were then extrapolated. The survey was split into two areas of investigation, the first of which was to understand current IMT availability and the short-term roadmap for new assignments and the second was to develop an understanding of current uses of the L-band.

The following table summarizes the results of the first part of the investigation which was understanding the current availability and roadmap for IMT assignments in the sample countries.

Figure 3: IMT spectrum dashboard
2014

	Total current identification for IMT (MHz)	IMT bands already assigned	Current assignations (MHz)	# BTS	Assignation roadmap
Brazil	660	450MHz 850MHz / 900MHz 1800MHz / 1900MHz 2100MHz 2500MHz	529	~ 50,000	• 700MHz band (80MHz, auction to take place in 4Q 2014)
Mexico	600	850MHz / 1900MHz AWS	230	~31,000	• 700MHz band (90MHz by end 2014) • AWS band (30MHz by end 2015) • 2.5GHz band (60MHz by end 2015)
Colombia	590	850MHz / 1900MHz AWS / 2,5GHz	415	~ 20,000	• 900MHz (20MHz) and 1.9GHz (5MHz) both in early 2015 • 700 MHz (total or a portion of the band) • 2.5GHz (30MHz)
Ecuador	570	850MHz / 1900MHz AWS / 700MHz	180	~ 9,000	Late 2014 or early 2015: • 700MHz (portion) and AWS (50MHz) • 2.5GHz (190MHz) • 1900MHz (60MHz)
Uruguay	310	850MHz / 1900MHz 1800MHz / 2100MHz AWS / 900MHz	270	~2,000	• 700MHz (90MHz by 2016)
Argentina	380	850MHz / 1900MHz	136	~ 16,000	• 700MHz and AWS (auction has already been announced for 4Q 2014) • 1900MHz (remaining 20MHz, by 2014)
Dom. Rep.	710	850MHz / 900MHz / 1900MHz AWS / 2,5GHz	450	N / A	No defined agenda

Note: Figures from Dominican Republic exclude AWS extension (1755-1770MHz and 2155-2170MHz)
Current assignments estimated on national basis
Sources: Local administration survey and web research

As can be seen above, Brazil is the country that has assigned the most spectrum for the provision of IMT. The bands already assigned are 450MHz, 850MHz, 900MHz, 1800MHz, 1900MHz, 2.1GHz and 2.5GHz with the digital dividend 700MHz band scheduled for auction later in the year.

The variations in 4G spectrum assignments is a distinctive aspect of the Latin American market, although Argentina is the only country yet to assign any spectrum for 4G[13]. All the other countries have already assigned spectrum in the AWS band. Colombia, Brazil the Dominican Republic and Ecuador have also assigned the 2.5GHz while the latter has also already assigned the digital dividend band.

As for the assignation roadmap, most countries have short-term plans for assigning additional IMT spectrum[14]. However, although these new assignments will improve the region's IMT spectrum availability, it will not yet match the ITU's spectrum requirements mentioned in the ITU-R Report M.2290[15].

Our specific research on the L-band has been structured into three main categories: the current usage profile, the feasibility of migrating current users to another band (including both the operational and the legal feasibility) and the administration position and plans regarding the band.

As can be seen in the table below, the most common use for L-band spectrum is point-to-point fixed links. Although Brazil and Ecuador have significant numbers of users, there are few users in the other countries sampled. The links belong to different industries (although telecommunications is the most prevalent) and are widely-spread geographically with a significant number of users in rural areas. In Brazil, where most available licenses have been assigned, the current users – aside from telecommunications companies -- include private companies in a variety of other industries, such as utilities and energy.

[13] Though it was announced an spectrum auction for late October 2014
[14] Some countries have already formally announced their 4G spectrum assignation process (e.g., Brazil, Argentina) whilst in other countries the formal announcement is still pending (e.g., Colombia, Ecuador).
[15] According to this report, by 2020, there should be a total of 1,340MHz and 1,960MHz identified to IMT in low-density and high-density markets, respectively.

Figure 4: L-band spectrum dashboard
2014

	Current use / users	Migration operational feasibility	Migration enforcement feasibility	L-band Links	Governments position regarding L-band
Brazil	• Point-to-point and point-to-multipoint links • Large number of licences and users (telcos, oil&gas, utilities)	• Relatively complex, due to the high number of users	• Existing licenses last for 10 years (no automatic renewal)	~ 2,800	• To be proposed for IMT, in combination with other bands
Mexico	• Fixed service microwave point-to-point systems • Mainly private companies, few state entities	• Relatively simple, as the number of users is limited	• Assignments last for 15 years • Not possible to migrate users from a portion of the band	~367 (1427 to 1525 MHz)	• Potentially in agenda
Colombia	• Main use: point-to-point networks (telecommunication support) • Few number of users	• A priori, current users would agree to migrate to other bands	• Simple, almost 100% of the licenses will expire by 2020	~26 point-to-point ~67 point-to-multipoint (DECT)	• To be proposed for IMT, in combination with other bands
Ecuador	• Radio links of fixed services • Mainly wholesale carriers	• Relatively complex, due to the high number of users	• Assignments last for 5 years, thereafter they should be renewed	~ 650	• Potentially in agenda
Uruguay	• Low level of use (no more than 10 users) • Users are private and government entities	• Simple, due to the reduced number of users • Most users have obsolete equipment	• No expiration date • Awarded on a revocable basis, having the government the capacity to modify these licenses	~ 10	• To be defined
Argentina	• Point-to-point links • Digital multichannel systems (MXD) are authorized to operate	• N/A	• Rule: no expiration date • However, 10 years period for telecommunications support spectrum	N /A	• To be defined
Dominican Republic	• Aeronautic radionavigation and point-to-point links • 12 users: public services, religious organizations and government offices	• No near plans to change the allocation of this band nor to migrate its users		~ 100 (12 users)	• No near plans as for this band

Sources: Local administration survey and web research

Incumbent users of the L-band will probably be reluctant to move to other bands unless they are compensated as they have already invested in frequency-specific equipment. Faced with this opposition, administrations could either wait for the expiration of current licenses, and then migrate the users, or enforce migration prior to the license expiry dates, although this is only possibly in a handful of regulatory contexts. Some administrations might also decide to force the migration of the current users based on spectrum efficiency fundamentals – in Uruguay, Argentina and Ecuador licenses assure spectrum availability to their holders, but they do not assure a specific frequency.
None of these adversarial measures is likely however as the impact analysis shows the cost saving of using the L-band for IMT amounts to almost 20 times the migration costs of users in the entire LAC region. This means migration costs could be easily be absorbed by the reallocation beneficiaries. There would be no significant trade-off between current users and new IMT users, since both would have the spectrum they need without incurring in a net loss.

As for feasibility of migration out of the band, no major drawbacks have been identified aside from operational issues in the two countries with a large numbers of current users. And in some cases, Uruguay being an example, most of the equipment is already obsolete (and current users might have already updated their plans).

Regarding the public agenda and plans for the identification of L-band for IMT services, most countries are in favour. Brazil, Colombia, Mexico and Ecuador will presumably support such identification, whilst Argentina and Uruguay have not yet adopted a definitive position and the topic is still under analysis. The Dominican Republic is the only country not assessing the possibility so far.

Having completed the research in the seven sample countries the reports concludes there is no material barrier to identifying L-band for IMT. Indeed most of the countries are positive towards the relevant ITU-R reports and recommendations, are already assessing this initiative and are bullish about the possibility of having the L-band available in the not-too-distant future.

IV. Impact assessment of identifying the L-band for IMT

This section comprises the estimation methodology of the economic impact of having the L-band available for mobile services, the key assumptions for modelling this impact and the final results and findings.

IV.a. Conceptual background and methodology

Having the L-band available for mobile services results in benefits for mobiles operators, for the market and, ultimately, for consumers. If the band is made available, however, then incumbent users must migrate to other frequencies, and so incur migration costs. The cornerstone of the underlying approach is to compare the total benefits of reallocation against its cost, which is basically the migration cost. Our calculation of total benefits involves both the cost savings for mobile operators and the consumer surplus increment for end users.

The study first estimates the socio-economic impact of identifying the L-band for IMT in each of the seven sample countries. The model compares two scenarios for each market, a first scenario where the L-band is made available for wireless broadband, and a second scenario where it is not. The difference between these scenarios is the incremental value, or cost saving, of identifying the L-band for IMT. The first scenario includes the migration costs of current users as a capital expenditure for clearing the band.

Having estimated the cost savings per country, the analysis assumed competition between operators would assure the savings would ultimately be translated into retail price cuts. The model also assumes dynamic behavior of market demand, with additional 4G users being attracted by the lower prices. The combination of both impacts, that is additional consumers plus cost savings, represents the total consumer surplus.

In the following paragraphs it is explained the methodology used to estimate firstly the cost savings, secondly, the consumer surplus, and thirdly, the indirect impacts.

Cost saving estimates

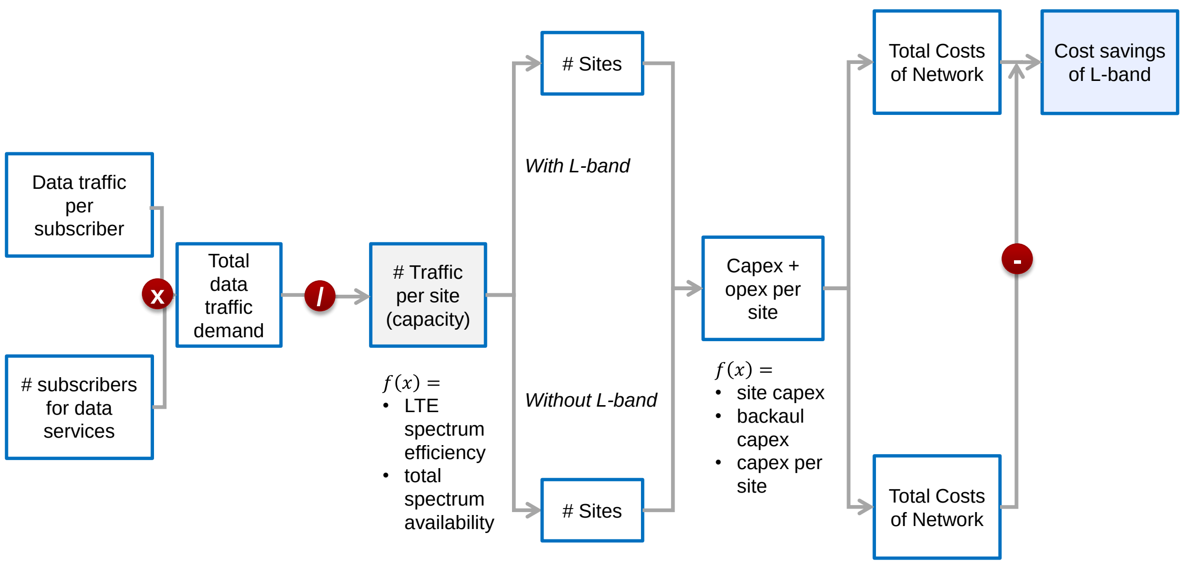
As has already been noted, the demand for mobile services is increasing rapidly and, to meet this growth, mobile operators need to expand their access network capabilities. Mobile operators can do this either by the deploying additional infrastructure in the form of new base station or by utilizing more spectrum. Many will need to do both.

The availability of new IMT bands allows mobile operators to reduce their total capital and operational expenditures on radio stations or sites. This is because spectrum and radio access infrastructure are, to some extent, substitutes[16] for each other in the delivery of mobile services.

The model calculates the cost savings for mobile operators who have more spectrum by looking at the difference in impact on their total capital and operating expenditures between a scenario having the L-band available versus a scenario of not having it.

For these estimates a network model based was developed, based on the following structure:

Figure 5: Network model structure



Total LTE data traffic demand is one of the key inputs for the model. Once the total traffic projections were developed, the total traffic per site was estimated. The per-site traffic depends on spectrum efficiency (the more efficient, the more traffic per site) and the spectrum availability (the more spectrum is available, the more traffic per site). The assumptions and considerations taken into account when calculating total traffic per site are described below, in the key assumptions section. The total traffic per site estimate enables a calculation of the number of sites an operator requires to satisfy the traffic demand with a given amount of spectrum.

[16] However, this substitution is far from perfect, due to several barriers: timing for setting up new sites, legal authorization constraints for urban sites and specific services demanding high traffic capacity (i.e., streaming).

For a mobile operator, the benefits of having more spectrum are associated with an increase in capacity and in coverage. However, these benefits depend on the specific frequency: the benefits from low-frequency, sub-1GHz bands include both coverage and a certain amount of capacity, but the benefits of high frequency bands are more associated with capacity due to their limited propagation characteristics.

This is certainly the case in Latin America, where coverage is usually provided by sub-1GHz spectrum, providing wireless broadband to low-density communities spread across large areas. So for LAC a conservative scenario was assumed where the L-Band would be used to boost network capacity. Qualcomm has proposed the L-Band be employed to increase downlink capacity through supplemental downlink (SDL).

The total number of sites required depends on the amount of spectrum available for use, so having more spectrum made available through reallocation of the L-band to mobile services will result in a lower number of sites being needed until traffic has built up again.

The gap in the number of sites needed between having use of the L-band and not having use of it points to the difference in total network costs, and, ultimately, the cost savings of having the L-band.

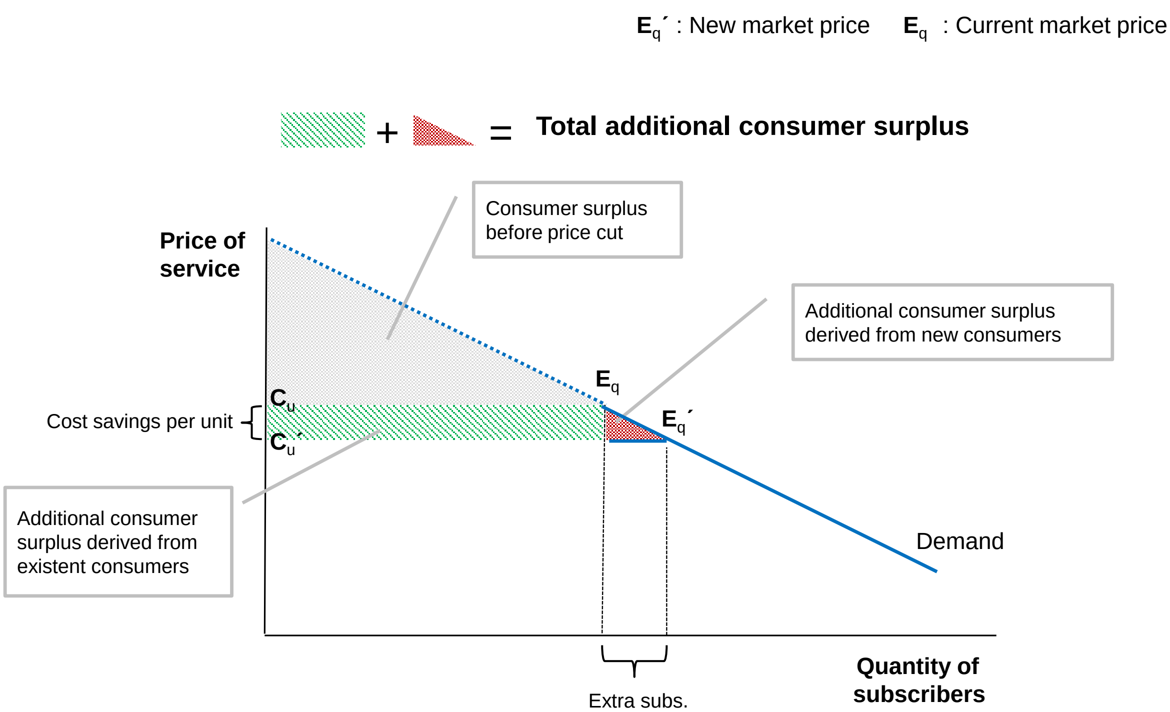
Consumer surplus

In a competitive market environment, the cost savings of having the L-band available for mobile services should result in benefits for consumers. The underlying assumption here is that, when competition is a factor, mobile operators do not enjoy extraordinary profits and are forced to pass on the benefits of lower expenditures to their customers in the form of price cuts so as not to lose market share.

In line with previous GSMA studies[17], the consumer surplus concept was used for the impact assessment methodology. Economic literature defines consumer surplus[18] as the difference between what a consumer is ready to pay for a service ("willingness to pay") and what he actually pays for it (the clear market price). The figure below describes this concept.

17 GSMA (2013) *et al.*
18 Varian Hal R. (1992)

Figure 6: Total additional consumer surplus due to cost savings and retail price cuts



As shown in the illustration above, the price a specific consumer is willing to pay (represented by the dotted portion of the demand curve in the figure) exceeds the clearing market price ("E"). The amount of this difference is consumer surplus.

Each consumer will enjoy different levels of consumer surplus. In the above illustration, the most voracious consumer enjoys the highest consumer surplus, whilst the marginal consumer enjoys a consumer surplus equal to zero. To obtain the total consumer surplus of the whole market, all consumer surplus of each consumer is aggregated (the grey shadowed triangle).

The cost savings derived from having more spectrum available will reduce the cost to operators, and, under competitive conditions, these reductions might be expected to be passed on to consumers via price reductions. Assuming that once the L-band is allocated to IMT services, the operators are able to cut prices, and so market prices fall from E to E´ (as in the figure above). The total consumer surplus will be higher than the consumer surplus prior to the price cut. The additional consumer surplus comprises two components: the net increase in the consumer surplus of each existing client (the green rectangle in the figure above) plus the consumer surplus of new subscribers (the red triangle in the figure above).

To estimate the additional demand, which comes after cost savings are translated into price cuts, consideration is given to demand price elasticity (see next section for this assumption) to estimate how many additional consumers will enter the market as the prices drop. To calculate the final retail price cuts assumption are made that the same value of cost savings to the operator is translated into price reductions for the consumer.

Finally an assumption is made of a flat supply curve at the margin, or constant productivity at the margin. That means that operators would have to pay the same cost per additional subscriber as they had to pay for their existing subscribers. This may be viewed as a valid simplification as the total number of new subscribers represents a limited portion of the total subscribers (roughly 2%).

To arrive at the net socio-economic impact of allocating the L-band for IMT, the net impact to the end user is compared with the migration costs to other frequencies of the current users. In the next section are the detailed assumptions used to arrive at the migration costs estimates.

Indirect impacts

Having the L-band available for IMT services will not only benefit the telecommunications sector and the overall economy, but it will also generate indirect impacts on other sectors to boost economic efficiency, the GDP and new employment opportunities in the labour market. The additional spectrum from L-band availability means more mobile broadband subscriptions which will have knock-on effects on domestic demand, on spending in other sectors and on the economic productivity in general.

The indirect impacts of reallocating the L-band into can be sub-divided into three categories:

- GDP impact
- Job creation impact
- Fiscal impact

The allocation of the L-band for mobile services creates economic value as it implies a better use of scarce resources, originating cost savings for the telecoms sector hence boosting the domestic economy and the total GDP.

GDP would also experience additional impacts from this reallocation because higher broadband penetration rates improve the efficiency of the economy. There are several ITU studies[19] which

[19] ITU 2012

demonstrate the positive impact broadband penetration has on productivity, economic efficiency and, ultimately, on GDP.

Identification of the L-band for IMT is expected to have a positive impact on each country's job creation capacity. Job creation happens when broadband network construction affects employment by creating direct jobs in facility construction as well as jobs in telecom equipment industries. The increase in household spending related to increased broadband activity also creates employment in the wider economy.

It should be noted no specific analysis of the impact on GDP and job creation as a result of identification of the L-band for IMT has been conducted. Instead reliance is made on the findings of existing studies[20] to set the parameters and make estimates.

Fiscal impact measures the additional taxes Governments are expected to be able to collect as a consequence of making the L-band available for wireless broadband. The identification of the L-band for IMT will, as previously noted, result in a price reduction which, considering the price elasticity, will end up in a higher number of subscribers and, consequently, in higher tax collections.

Scaling the results up for the region

Although the scope of the study is the whole LAC region, in-depth analysis has only been conducted within the stated seven countries. The results of the country-by-country analysis are used to scale up to provide a regional viewpoint and present representatives findings for the entire region.

To extrapolate the results from the data gathered in the sample countries, a multiple-variable regression analysis was used, including the explanatory variables shown in the next table.

Explanatory variable	Fundamental
• *4G subscribers*	• *The spectrum value and the impact of having more spectrum are positively linked to the traffic market demand (the more the merrier), and the 4G subscribers are the ones with a higher data consumption profile*
• *Markets size, in terms of total population*	

[20] ITU 2012 and Telecom Advisory Services 2011

	• *Estimates of consumers surplus and additional impacts included in this study depend on the market size, measured in terms of the country population*
• *ARPU*	• *The Average Revenue per User has a direct impact on the consumer surplus estimation based on the additional subscribers*

These three explanatory variables were tested to estimate the socio-economic impacts for the entire LAC region. The impacts to estimate are:

- cost savings
- additional subscribers
- efficiency impact and GDP growth
- job creation
- fiscal impact

Assessment of different combinations of explanatory variables by evaluating their level of significance and explanatory power enabled elimination of the ARPU variable due to its lack of statistical significance. The final version of the scale-up model consists of a multivariable regression based on the total population and 4G subscribers variables[21].

IV.b. Assumptions used in modeling

In this section the key assumptions underlying the modelling exercise as well as the relevant parameters for the impact assessment are presented.

The modelling key assumptions can be structured into three categories: migration costs, technology and financial and market variables.

IV.b.i. Other services operating in the band and migration costs

As previously noted, in Latin America the L-band is mostly used for fixed services (point-to-point and point-to-multipoint), with Brazil having the largest number of licenses in the band (6,000 licenses and close to 2800 radio links).

[21] The ARPU variable shows statistical significance for the GDP estimation only.

There are a negligible number of radars operating in the sub-band 1350-1400MHz and administrations in the sample countries do not have information about radars operating in this band on record. Current radar users of the band have not been taken into account. Also ignored are migration costs associated with radiolocation services because they are capable of operating below the band floor of 1350MHz. The next figure shows the current use of L-Band by service allocated in the sample countries.

Figure 7: L-band current use

	Radiolocation (1350-1400MHz)	Fixed Services (1427 – 1518MHz)	Broadcasting (Satellite and Terrestrial)	Migration Feasibility
Brazil	No Reports	~6000 licenses ~2800 links	N.a.	OK
Mexico	No Reports	367 links	N.a.	OK
Colombia	No Reports	26 links point-to-point 67 licenses point-to-multipoint	N.a.	OK
Ecuador	No Reports	650 links	1 License (200 subscriber)	OK
Uruguay	No Reports	10 links	N.a.	OK
Argentina	No Reports	N.a.	N.a.	OK
Dominican Republic	No Reports	100 links	N.a.	OK

Sources: Local administration survey

In the seven countries sampled there are 3,953 radio links and they operate in the sub-band at 1427-1518MHz. Many of the existing licenses expire by 2017 and the services could be migrated to other frequency bands. For those countries with limited or non-existent information on the expiration dates, for modelling purposes a 30% of the radio links was assumed to turn off by 2017[22].

It is technically feasible to migrate current users to other frequency bands allocated for fixed services, such as:

- Lower bands below 6GHz: namely 2GHz, 4GHz, 5GHz and 6GHz.

[22] 30% of radio links could be turned off by 2017 either because the license expires or because it is possible to remove.

- Higher bands above 6GHz: namely 7GHz, 11GHz, 15GHz, and 18GHz.

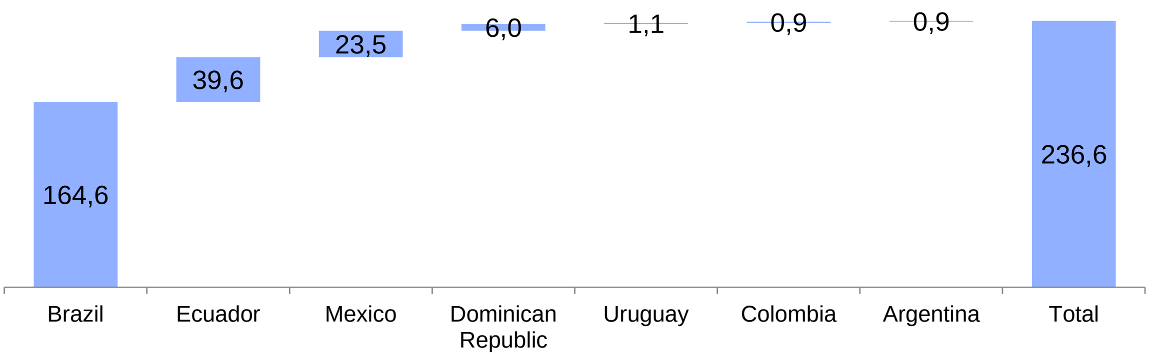
For modelling purposes, an assumption of 95% can be migrated to lower bands, while the remaining links would have to be migrated to higher bands. For the latter, new repeater stations are required to guarantee the quality of operation within the same distance between transmitter and receptor.

The model includes three main items for cost estimation:

- engineering services (including survey, zoning, new equipment installation or retuning of current equipment) estimated for each country[23].
- radio link equipment: US$64,000 per link (New equipment for transmission and reception stations)[24]
- infrastructure for a new repeater station: US$200,000 per site[25]

On this basis, and considering the current price level of equipment and services in the market, the next figure shows an estimate of the total migration cost per country.

Figure 8: Total migration costs per country
2017, US$ million, point-to-point radio links



Source: FCC (2010), U.S. Bureau of Labor Statistics, World Bank, IMF, radio link vendors benchmarking, ANATEL spectrum database, ANE Colombia, IFT, INDOTEL, SENATEL, CNC, BNMC estimates

IV.b.ii. Network design parameters

The core benefit of 4G technologies is the improvement in spectral efficiency, meaning more capacity in the same bandwidth. Spectral efficiency parameters are determinant for network design and sizing,

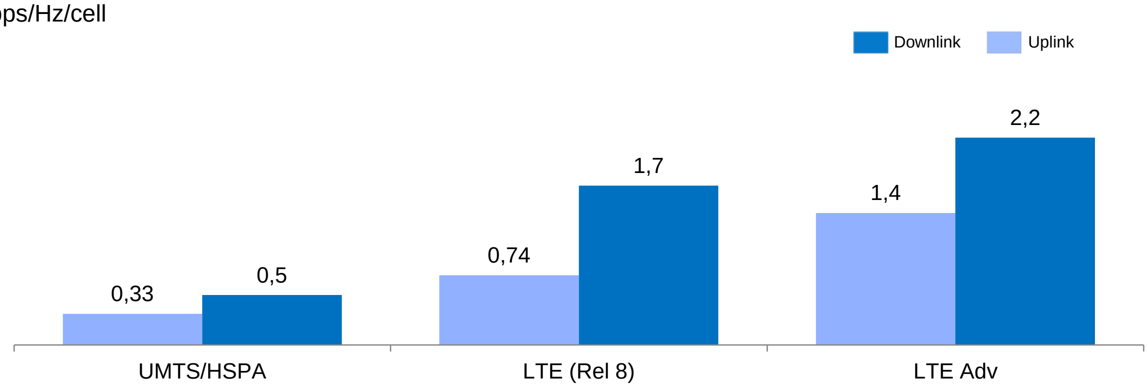
[23] FCC, "A Broadband Network Cost Model", and BNMC analysis (benchmarking of engineering companies). The cost was adjusted to each country using PPP (Purchasing Power Parity).
[24] FCC "A Broadband Network Cost Model" and BNMC estimates.
[25] Benchmarking COFETEL, OfCom, ACMA, OPTA and BNMC analysis.

as they allow an accurate estimate of the number of base stations required to support a given traffic demand.

In addition to spectral efficiency, there are other design parameters which have a dramatic impact on the number of base stations required. These include the traffic distribution factor, network load factor for an appropriate performance, traffic concentration in peak hours, number of cells per site and the traffic distribution between uplink (UL) and downlink (DL).

The next figure shows the spectral efficiency underlying the modelling exercise, in line with the 3GPP TR 25.912 document and the assumptions mentioned above.

Figure 9: Network efficiency (IMT systems) and design parameters
bps/Hz/cell



Additional Parameters

- Distribution Factor: 15% of sites carry 50% of traffic (15%/50% = 0.3)
- Load Factor: It's inconvenient to operate a LTE network with 100% of load (SINR decreases in a high load scenario), the design recommendation is to consider a factor of 50% - 70% in DL and 50% in UL.
- Relation UL/DL: 70% of total traffic is flowing in DL
- Cells per site: 3 cells per site is a common factor in mobile networks in Latam
- Traffic in BH/Daily traffic: 7%

Source: 3GPP TR 25.912 / ITU-T M.2135 / NSN - "Mobile broadband with HSPA and LTE: Capacity and Cost aspects

A band plan of 2x35MHz is assumed (Option A, as described in the Annex), due to its higher probability of equipment availability, as it is already commercially launched.

Finally, below is the formula to estimate the number of base stations (BTS) required to support the traffic forecast and the design parameters mentioned above.

$$\#BTS = \frac{Total\ DL\ \ Data\ Traffic\ in\ Busy\ Hour\ (Mbps)}{Spectral\ Effic.in\ DL\left(\frac{\frac{bps}{Hz}}{Sector}\right) * Spectrum\ bandwidth\ in\ DL(Hz) * \frac{cells}{site} * Load\ Factor * Distribution\ Factor}$$

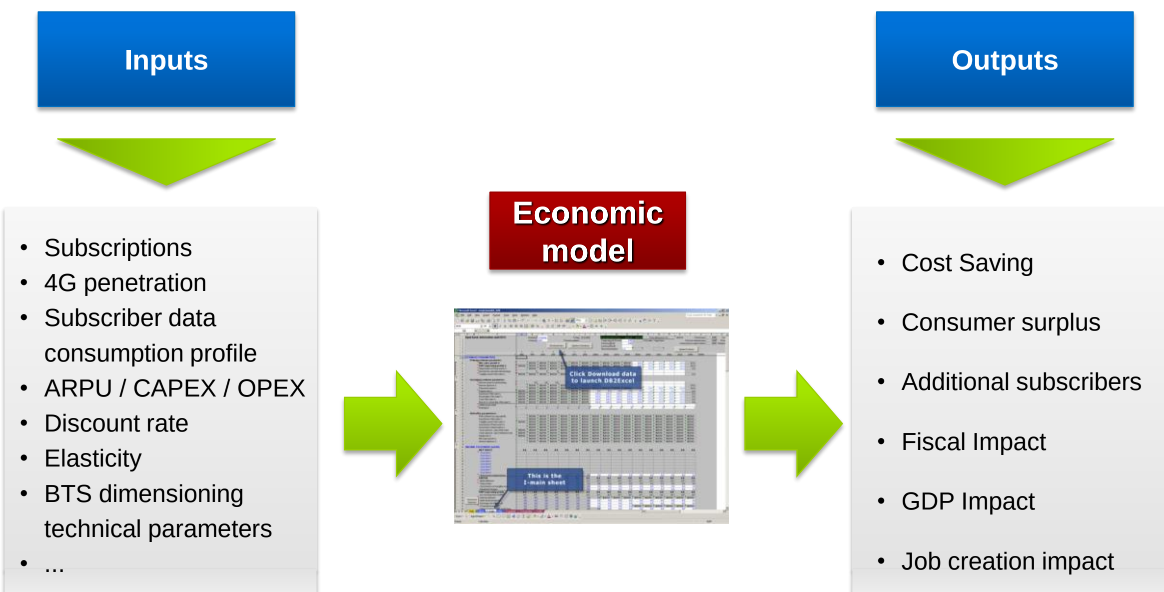
Where the total DL Data Traffic is calculated using the next formula

$$Total\ DL\ Data\ Traffic\ BH = \frac{Users * Profile\ Users\ \left(\frac{GB}{Month}\right) * 7\%(Busy\ Hour) * 70\%(Dl\ Traffic)}{30\ \left(\frac{days}{month}\right) * 3600Sec * 8192(\frac{Mbits}{GB})}$$

IV.b.iii. Capex, opex and market parameters

A bottom-up model was developed based on cash-flow projections for a 10-year period (from 2017 until 2026) to estimate the impact of reallocating the L-band to IMT services. The model outcome is fully dependent on the methodology previously detailed and on the assumptions and inputs adopted. The key inputs for the model are those related to the BTS sizing (e.g., subscribers, traffic), the technical inputs, the operational and capital expenditure amounts and the macroeconomic projections. The following chart lists the key inputs feeding the model:

Figure 10: Key inputs and outputs



The model has six main outcomes: cost saving and consumer surplus, additional subscriber impacts, fiscal impact, GDP indirect impact and job creation impact.

The following figure summarizes the main information sources that have been considered for the inputs in the model build-up.

Figure 11: Information sources for modeling

Module	Variables	Sources
BTS sizing	• Subscriptions • Traffic • 4G penetration • Technical specifications	• OVUM • 3GPP • Informa • GSMA Intelligence • Ericsson traffic exploration • Cisco VNI
Opex	• Urban and non-urban BTS cost • Urban and non-urban infrastructure • BTS sharing	• Deloitte • Informa • Ministerio de las tecnologías y la información
Capex	• BTS cost • BTS cost annual price erosion • Migration cost per country	• Benchmarking COFETEL, OFCOM, ACMA, OPTA • Ministerio de las tecnologías y la información • FCC
Macroeconomic	• Inflation and PPP • Exchange rate • GDP • Social discount rate • Taxes • Price-demand elasticity • Multipliers	• World Bank • IMF • U.S. Bureau of Labour Statistics • United Nations • Telecom Advisory Services • KPMG • Deloitte • Bank of America • Merrill Lynch • CRC • ITU

The key BTS sizing drivers included in the model are:

- *Data traffic subscriber profile*: two different data traffic consumption profiles have been addressed; smartphones and mobile PCs / routers / tablets (M/R/T). A typical subscriber profile was assumed (expressed in terms of MB/month/subscriber) for the seven sample countries. An Ericsson report[26] was the main information source for traffic projections. Based on Latin America's subscriptions and data traffic total projections, and a 4G to 3G consumption ratio of x6.3[27] (a 4G subscriber uses 6.3 times the data as a 3G one), the average traffic generated by smartphones and M / R / T users is calculated. As the Ericsson forecast goes only to 2019, projections from 2020 to 2026 were forecast using 2019 as the baseline year and growth was predicted using the CAGR (compound annual growth rate) of previous years for each country.

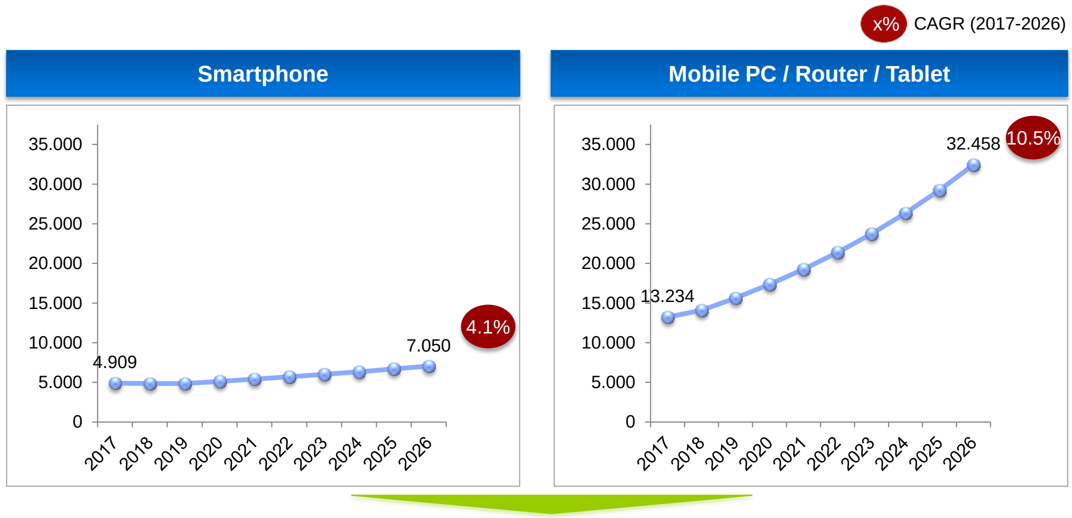
- *Subscribers*: Based on the GSMA Intelligence forecast to 2021. For the period going from 2021 to 2026, the growth rate was estimated based on the subscriber CAGR from previous years and using an adoption curve that mimics the 3G adoption rate (+50% in 10 years).

[26] Ericsson 2014
[27] Based on 2018 data consumption per technology obtained from CISCO VNI 2014

- *Technical BTS sizing:* such as efficiency, sectors, load factor, distribution factor, % downlink and % peak hour (as described in the technology section).

The next figure shows the traffic forecast per subscriber and the different behaviour and consumption patterns for smartphone users and M/R/T users,

Figure 12: Data traffic consumption profile
MB/sub/month

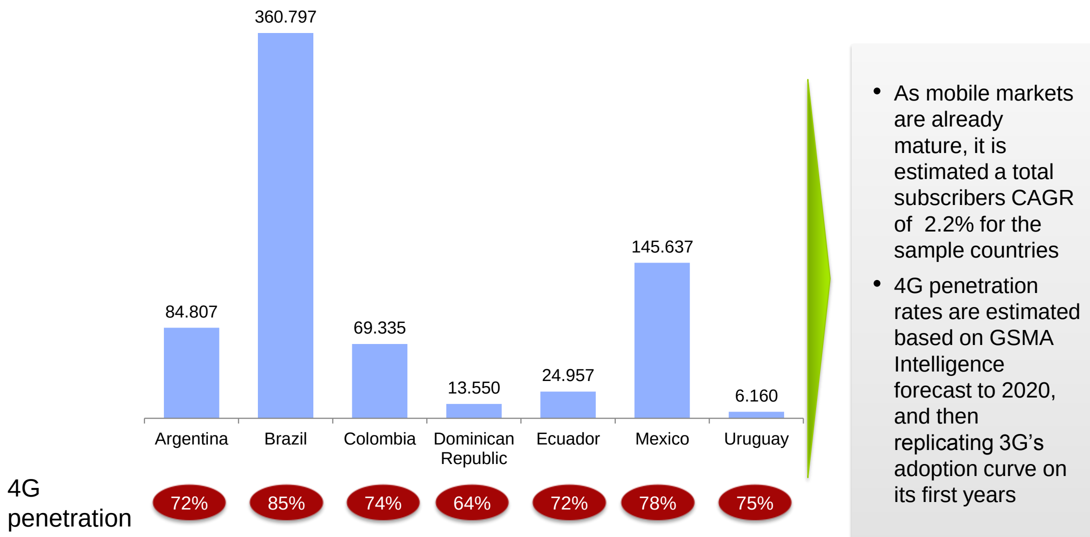


- Data traffic reaches 7,000 MB/sub/month for smartphones in 2026 and 32,000 MB/sub/month for mobile pc, router, tablet in 2026
- Mobile PC / Router / Tablet still shows bigger place for additional growth per user, which can be seen in the 2017-2026 expected growth CAGR
- Mobile PC / Router / Tablet have a higher per user data consumption, expected to reach a x4.6 ratio by 2026

In 2026, data traffic per user reaches the 7,000 MB/subscriber/month level for smartphone users and 32,000 MB/subscriber/month for M/R/T users. Both because they are at a different stage of development to smartphones and the broader functionality they provide, there is still room for a lot of growth in data per user for M/R/Ts. This can be seen in the 2017-2026 expected CAGR (10.5% for M/R/T as opposed to 4.1% for smartphones).

The number of subscribers is the second key assumption to estimate the required number of BTS to support expected traffic growth. The following chart shows the expected number of subscribers and 4G penetrations.

Figure 13: Subscribers and 4G penetration forecast (2026)
Thousand subscribers, 4G penetration vs. total subscribers



Source: GSMA Intelligence, Ericsson - Traffic exploration (Latam) - June 2014, BNMC estimate

The chart above shows subscriber projections for the last year of the period of analysis (2026). Taking into account the current mobile services penetration rate, based on an Ericsson estimate, the number of subscribers is expected to grow in the selected countries by a 2.2% annual rate. But 4G technology is undergoing its start-up stage in the region, so 4G penetration rates are still low. 4G projections are based on the GSMA Intelligence forecast to 2020, with the 3G historic adoption curve for later years. By 2026 the 4G penetration rates are expected to be in the range of 64% to 85%.

Estimated Capex requirements are based on the following components:

- Initial Capex: US$90,000 for a 4G BTS, which includes: radio access, backhaul, core network, backbone and installation costs. This amount has been estimated drawing on models from Colombia's MinTic, COFETEL, Ofcom, ACMA, Opta and the FCC.

- BTS Capex annual erosion. A 4.0% annual erosion cost to take into account the falling cost of equipment has been factored into deployment of new BTSs in the future. The 4.0% erosion figure is obtained from COFETEL, Ofcom, ACMA and Opta benchmarking models.

- Migration cost: the cost of migrating current L-band users was estimated for each of the seven selected countries. The estimated amounts take into consideration the different cost components required for the migration of these users namely backhaul, e-utran, infrastructure, core network and spare parts.

As operational expenditures have a significant portion of non-tradable elements, the required Opex on a per-country basis, adjusted by PPP[28] is estimated. The Opex is estimated for urban and non-urban BTSs, and the infrastructure operational costs can be shared with other existing BTSs in the urban areas is assumed.

The following figure shows other key parameters that have been also considered in creating the estimates, their use in the model and their source.

Figure 14: Coefficient and multipliers

Coefficient / multiplier	Description	Source
Demand price elasticity	Used to estimate the additional subscribers the price reduction brings as a consequence of the cost savings	Katz, R. and Berry, T. Driving demand for broadband networks and services (2014)
GDP multiplier	Estimates the impact on GDP the increase in broadband penetration originates Per 1% increase in broadband penetration, GDP grows 0.0158 pp	ITU. Impact of Broadband on the economy. Broadband series. April (2012).
Job creation multiplier	Estimates the impact on jobs the increase in the number of subscribers originates The job creation multiplier is different for each country.	Telecom Advisory Services. Economic Benefits of Digital Dividend for Latin America (2011).
Social discount rate	Used in computing the value of funds spent on social projects. Different rate for each country. In Latin America the SDR ranges from 2.9% to 5.1%	The Social Discount Rate: Estimates for Nine Latin American Countries. Humberto Lopez. The World Bank Latin America and the Caribbean Region Office of the Chief Economist. June (2008)

Note that the GDP and jobs creation multipliers from previous estimates are based on the impact of new users of mobile broadband, however an assumption that new 4G subscribers will originate similar impacts was made[29].

Elasticity measures how sensitive a variable is to changes in related variables. In this case, demand price elasticity estimates the number of additional 4G subscribers entering the market once prices are cut. Elasticity is calculated using the following formula:

$$Price\ vs.demand\ elasticity = \frac{\frac{\Delta\, subscribers}{subscribers}}{\frac{\Delta\, price}{price}}$$

[28] Purchasing Power Parity
[29] Though they are not the same, this assumption was made since the traffic demand of a 4G subscriber is 6.3x the traffic demand of a 3G user, and hence having a new 4G subscriber is more close to having a new subscriber than upgrading the traffic capacity of a 3G subscriber only.

In the model a demand price elasticity of -0.6x (the negative sign implies a reduction if one of the variables results in an increase in the other variable) is assumed. The elasticity estimation is based on a study from Katz and Berry[30].

According to a report commissioned by ITU titled "Telecommunication Development Sector. Broadband Series. Impact of Broadband on the Economy" (2012) there is consistent evidence of the positive economic impact of mobile broadband services. They enhance economic efficiency, boost GDP and activate job creation. The positive economic impact of broadband derives from higher revenues for telecom operators, gains in productivity, employment generation and an increase in consumer surplus. Drawing on this report, the Latin American multiplier is used, which indicates a 0.158x contribution to GDP growth derived from every increase of 10% in broadband penetration. This impact includes direct effects from the telecommunications industry and indirect spill-overs.

Together with a positive impact on the economy, broadband penetration aids in job creation. In this case, the multiplier estimates how many additional jobs will be created based on the number of additional subscribers. A different ratio is used for Brazil, Mexico, Colombia and Argentina as specific information was available for those countries.

The social discount rate measures the rate at which a society is willing to trade present for future consumption. As such, it is one of the most critical inputs used in cost-benefit analysis of public projects (and more generally public policies) and is used in computing the value of funds spent on social projects. For the purposes of this report, a World Bank report, 'The Social Discount Rate: Estimates for Nine Latin American Countries" was used. The average social discount rate for the nine countries considered in the report is 3.1%. Four of those countries are also the same sample countries and enable use of exact figures but used the average regional discount rate for the other three. These are the rates used

- Argentina: 2.9%
- Brazil: 5.1%
- Colombia: 4.2%
- Mexico: 3.3%
- Ecuador, Dominican Republic and Uruguay: 3.1% (average)

IV.c. Key results and findings

[30] Katz, R. and Berry (2014)

The quantitative analysis concludes that allocating the L-band to IMT services will originate material benefits for the telecommunications sector, the government and society.

The report's economic model estimates the impact of identifying the L-band for IMT according to the following categories:

- Economic value
    - Additional cost savings and consumer surplus to the sector
    - Additional 4G subscribers
- Direct and indirect impact on:
    - GDP and economy efficiency
    - Job creation
    - Fiscal and tax collections

The following table lists the key results of the quantitative analysis:

Variable	Quantitative impact
Cost savings to the sector	**US$6.3 billion** (NPV at 2017, cumulative impact for the 10-year period)
Additional 4G subscribers	**41.7 million new 4G subscribers** (by 2026)
GDP indirect impact (through more efficiency)	**US$19.8 billion** (NPV at 2017, cumulative impact for the 10-year period)
Job creation	**13,120 jobs,** to be created in the 10-year period
Fiscal impact	**US$3.2 billion** (NPV at 2017, cumulative impact for the 10 years period)

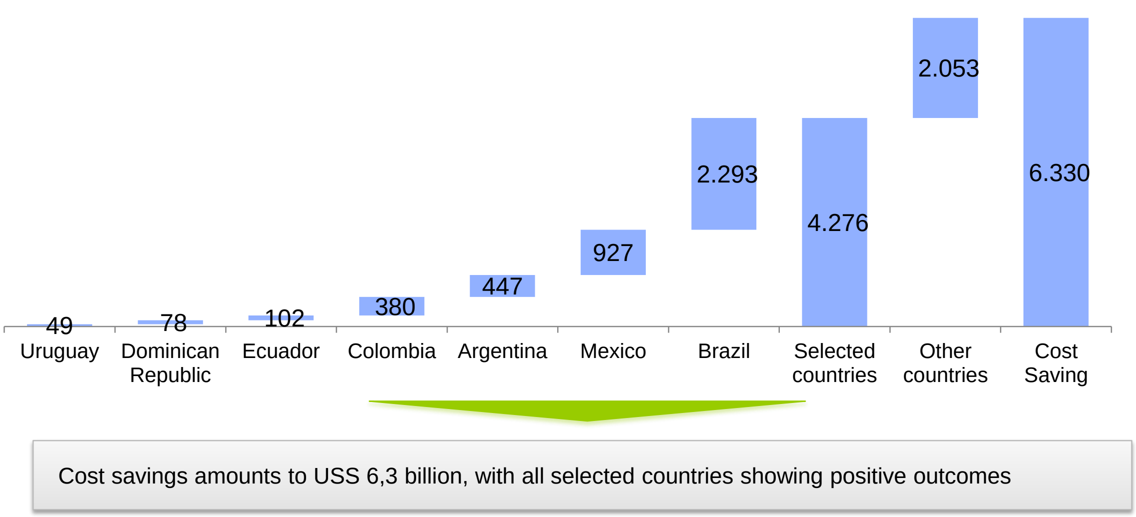
Cost savings to network operators

The cost savings to network operators incorporate savings from Capex and Opex resulting from a lower number of BTS to be deployed. The main assumption here is that, if the L-band were not identified for IMT, telecom operators would have less spectrum available and have to compensate with additional BTSs.

The impact was estimated for every sample country for a 10-year period, starting in 2017 and ending in 2026, and then extrapolating the findings for the entire LAC region. Final results have been discounted as of 2017 at the social discount rate.

The following figure shows the economic impact of the L-band reallocation on the consumer surplus based on cost savings only.

Figure 15: Cost savings to network operators
US$ million, Net Present Value at 2017, cash flows discounted at social rate



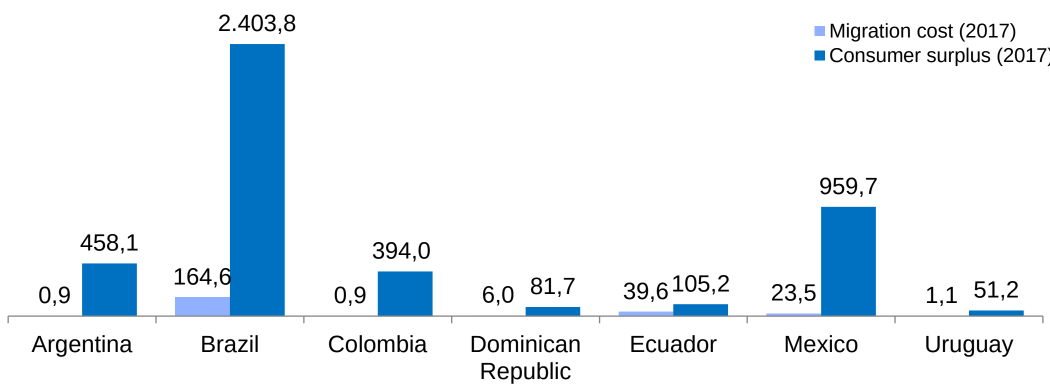
As shown above, the cost savings amount to US$6.3 billion for the whole region. This is the net present value (NPV) in 2017 of the cost savings in year-to-year cash flows. The cost savings comprise operational expenditure and capital expenditure reductions, caused by the availability of extra spectrum meaning less BTS to deploy.

If a total of 70MHz of the L-band were to be identified for IMT, the total estimated cost savings are far above the total migration costs. None of the sample countries would experiences a loss from the identification of the L-band for IMT, and all show positive outcomes, although some are more positive than others

There is a strong correlation between total savings and 4G connections and the estimated traffic. Brazil and Mexico account for most of the cost savings, particularly Brazil which accounts for more than 35% of the total.

It is also important to highlight the fact migration costs are not significant when compared to consumer surplus derived from the cost savings passed on to end users. The next chart compares migration costs to discounted consumer surplus over a 10-year period.

Figure 16: Value gap between consumer surplus and migration costs
Million USD at 2017, NPV, Cash flows discounted at social discount rate

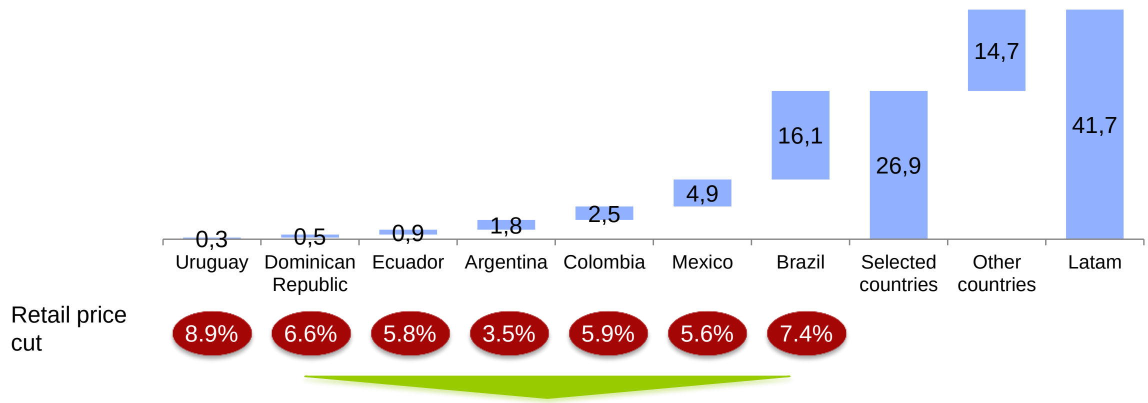


- The cost of migrating the current L-band users to another band is not significant when compared to the consumer surplus generation
- The outcome of identifying the L-band for IMT is positive in each sample country

Additional net 4G subscribers

As the model assumes cost savings are passed on to consumers under competitive conditions, this will result in retail price cuts. Estimated retail price through ARPU levels and assumed cost savings per subscriber imply a similar reduction in the retail price of 4G services. This price reduction motivates the adoption of 4G by more subscribers, but by how many ultimately depends on the price elasticity, which is -0.6 in this case. The following figure shows the impact in terms of price cuts and the resultant additional subscribers for each sample country.

Figure 17: Additional subscribers obtained from cost savings translated into retails price cut
Million of additional 4G subscribers by 2026

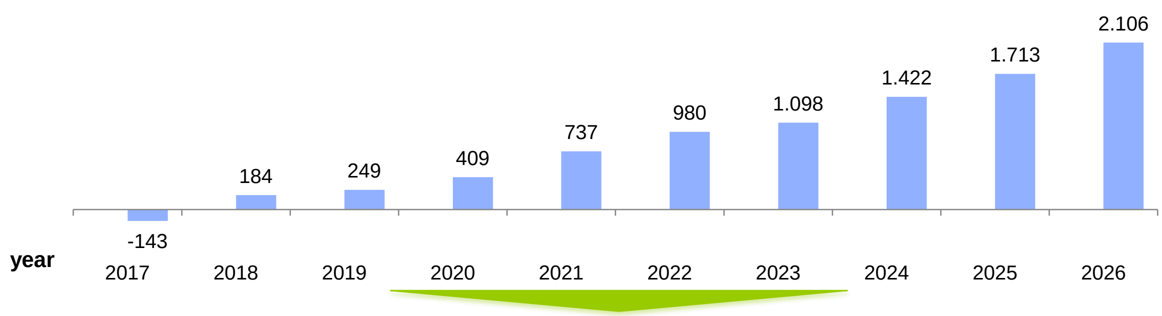


- Based on demand price elasticity, price reduction leads to increase in subscribers
- Additionally, the new subscribers will originate US$ 283 million of additional consumer surplus

By 2020, an increase in almost 42 million subscribers in the region as a consequence of the cost savings derived from the identification of the L-band for IMT. These new subscribers would originate an additional economic surplus of US$283 million, bringing the total savings to US$6.6 billion. The retail price cut differs from country to country and ranges from 3.5% to 8.9%.

Highlighting the time scale of the cost savings and of the additional consumer surplus is also relevant, as the benefits increase year after year with the major impact coming in the latter years. See the chart in next page for the year to year consumer surplus evolution.

Figure 18: Cost savings plus additional consumer surplus over time
Current US$ million



- Consumer surplus increases year-by-year as Opex and recurrent Capex cost savings start to impact on the cumulative BTS deployment which is not required as a consequence of the L-band's identification for IMT
- First year negative value shows current L-band users' migration costs

Direct and indirect impacts

Finally, it is important to highlight the positive impact the identification of the L-band for IMT can have on society because it causes an increase in the economic efficiency, GDP growth, job creation and tax collection.

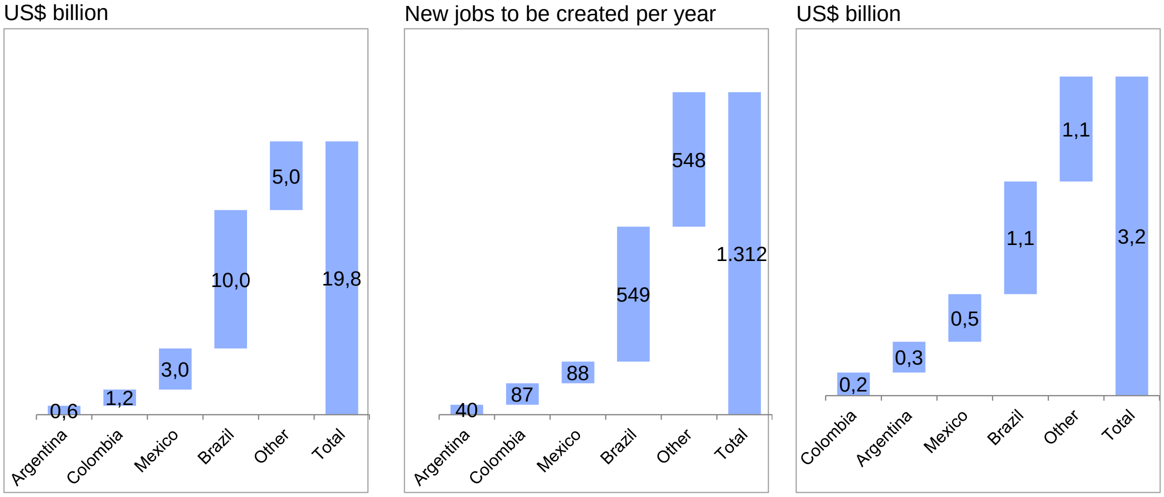
The estimates of the GDP[31] and the job creation impacts based on multipliers to broadband penetration and subscribers respectively, whilst the fiscal impact leading to an increase in VAT[32] payments and income tax collection, is a consequence of the additional revenue generated by new subscribers.

Figure 19: Indirect impact from L-band´s identification for IMT

Cumulative GDP growth
Net present value at 2017
US$ billion

Yearly job creation
Yearly average
New jobs to be created per year

Cumulative fiscal impact
Net present value at 2017
US$ billion



- Additional GDP accounts for US$20 Billion, obtained through higher efficiency ratios resulting from more mobile broadband
- 1,312 jobs to be created on average per year in Latin America as a consequence of identifying the L-band for IMT. Total jobs to be created during the 10-year period (2017-2026) is 13,120
- Extra tax collection: US$ 3.2 billion (VAT and income tax)

13,120 new jobs could be created through the identification of the L-band for IMT, as well as an increase of US$13.2 billion in the GDP of the region and US$ 2.2 billion in extra taxes.

A relevant assumption in this modelling is that 100% of the cost savings are passed on to end users. But even if assuming just a portion of the total cost savings were transferred to retail prices that would

[31] Including both direct and indirect impacts
[32] Value added tax

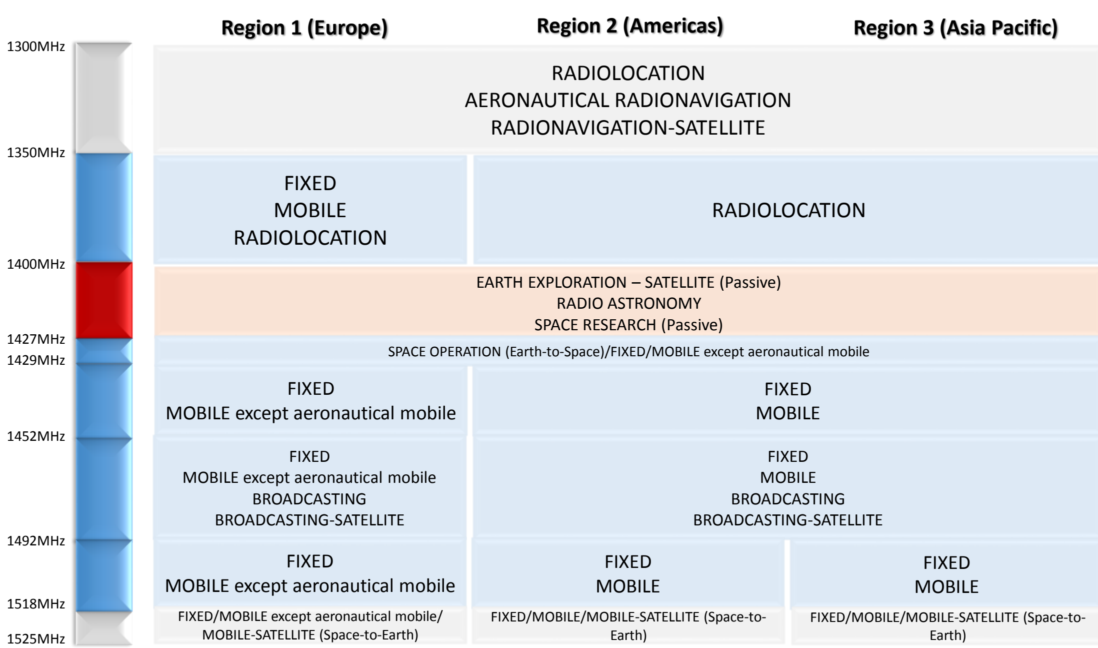
still have a major impact although, of course, the number of new subscribers and the three indirect impacts will be reduced proportionally.

V. Appendix

V.a. Technical highlights

Current services

The following figure shows the allocation of L-Band (1350-1518MHz) in each region, in accordance with the ITU's Radio Regulations of 2012.



Note 1: The grey boxes are the adjacent bands to the spectrum range under analysis.

Note 2: The red box corresponds to the internationally-protected spectrum used for radioastronomy and passive services. According to RR's footnote 5.340, all emissions are prohibited in this band. Some countries are also conducting passive research under a programme to search for intentional emissions of extra-terrestrial origin (RR footnote 5.341).

Note 3: In the USA and Canada, the sub-band 1350-1370MHz is also allocated for aeronautical radio navigation services (RR footnote 5.334).

Note 4: The bands 1370-1400MHz, 2640-2655MHz, 4950-4990MHz and 15.20-15.35 GHz are also allocated to space research (passive) and Earth exploration-satellite (passive) services on a secondary basis (RR footnote 5.339).

To protect the Earth Exploration-Satellite Service (EESS) from potential interference from active services in adjacent bands, the Radio Regulations recommend mobile services operating in the bands

1350-1400MHz and 1427-1452MHz, comply with the emission limits from stations along the 27MHz of the EESS (Passive) band[33]:

- -60dbW for mobile service stations, except transportable radio-relay stations.
- -45dBW for transportable radio-relay stations.

In any case, however, mobile services based on IMT systems are likely to comply with these emission limits[34].

For ITU Region 2 (America), RR footnote 5.343 has prioritized the use of the 1435-1.535 MHz band for aeronautical mobile service (for telemetry) over its being used for mobile services.

In the following sections, we outline the most relevant features of the allocated services.

Radiolocation

Radiolocation is a location service able to perform radiolocating[35], that is finding a specific location through the use of radio waves. Long-range radars and terrestrial radio relay are examples.

Radiolocation services include long-range aeronautical radionavigation radar systems. These radar systems are used to monitor aircraft and other aerial objects inside the national airspace, along border areas, and around military bases and airfields.

As well as radar systems used for aeronautical radionavigation, the armed forces of some countries operate tactical radar systems in the 1300-1350MHz band[36]. Tactical radars are often used to operate in a battlefield environment, alongside other systems. One such system is the Tethered Aerostat Radar (TAR) system, which also operates in the band. The TAR consists of balloon-mounted radars used for monitoring the US southern borders and Caribbean airspace for drug interdiction.

But long-range radars could also operate in the band 1215-1400MHz according to the technical features mentioned in ITU-R M 1463-2 “Characteristics of and protection criteria for radars operating in the radio-determination service in the frequency band 1215-1400MHz”.

33 ITU, Resolution 750 (Rev. WRC-12), 2012
34 Idem. Footnote 3
35 ITU, Radio Regulations Vol I, 2012
36 Specially from USA, Canada and Europe

There are also different types of radars, with land-based fixed or transportable platforms, operating in the band 2700-2900MHz. The uses of these radar systems include Air Traffic Control and weather observation. These radars use continuous wave (CW) pulses and frequency modulated (chirped) pulses with typical transmitter RF emission bandwidths from 66 kHz to 6MHz.

Land-based radar systems could also operate at 3110-3400MHz; as already do, for example, radars employed by US Army Field Artillery Units to detect and track incoming projectiles and provide the locations of both the source and the point of impact[37].

Broadcasting and Broadcasting-Satellite

According to the ITU's Radio Regulations of 2012, broadcasting services are radio communication services, whose transmissions are intended for direct reception by the general public. These services may include sound transmissions, television transmissions and others (CS)[38].

In broadcasting-satellite services, the signals are transmitted or retransmitted by space stations, and therefore require international coordination. Satellite Digital Audio Broadcasting (S-DAB) is a satellite-enabled system for the digital broadcasting of a wide variety of audio content to fixed and mobile receivers (including portable, handheld and vehicular). The three main types of S-DAB operation are:

- Standalone satellite component (i.e., without complementary terrestrial component);
- Satellite component of a hybrid solution with complementary terrestrial broadcasting networks operating in the spectrum used by the satellite.
- Standalone satellite component, complementing nationally-licensed terrestrial broadcast networks.

Fixed Services

A fixed service is a radio communications service between specific fixed points such as the microwave links between two transmitter/receptor stations. The most-used bandwidths for these services in the 1.5GHz band are 250KHz, 500KHz, 1MHz, 1.75MHz and 3.5MHz.

[37] NTIA TR-99-361. Technical Characteristics of radiolocation system operating in the 3.1-3.7GHz band. (1999)
[38] ITU, Radio Regulations Vol I, 2012

If L-Band is identified for IMT, current users operating fixed services in this band can be migrated to other bands allocated to fixed services including 1.8GHz, 2GHz, 3.8GHz, 4.2GHz, 6GHz, 7GHz, 11GHz and 15GHz.

Mobile Service

According to the ITU Radio Regulations definitions, a mobile service is a radio-communication service between mobile and land stations, or between mobile stations such as, for example, mobile broadband based on IMT systems.

Mobile broadband is a terrestrial radio communications service connecting base stations with mobile devices to provide various services and applications to end-users, including mobile Internet, entertainment, and video on-demand.

In the figure below, we show a non-exhaustive list of technologies available for mobile broadband based on IMT systems, and the spectrum required for their operation.

Technology	Carrier Size (Spectrum Quantity)
• HSPA+	• FDD and TDD operation • Carriers of 5MHz and 10MHz (Dual Carrier) • Up to 20MHz in 3GPP Rel 9 and beyond
• LTE	• FDD and TDD operation • Carriers of 1.5MHz, 3MHz, 5MHz, 10MHz, 15MHz and 20MHz
• LTE - Advanced	• FDD and TDD operation • Same carriers supported by LTE and up to 100MHz in 3GPP Rel 10 and beyond

Radioastronomy

A Radioastronomy service is used for studies of astrophysical objects through radio frequencies and as such the ITU invites administrations to cooperate in protecting radioastronomy services from interference.

Administrations must take into account the extremely high sensitivity which is a feature of radioastronomy stations as well as the need for long periods of observation without harmful interference. Because of these constraints, there are only a small number of radioastronomy stations in each country[39].

Article 29 of the ITU Radio Regulations specifies special considerations for radioastronomy services in order to protect them from harmful interference. It is specified, for example, that the locations of radioastronomy stations should be selected with due regard to the possibility of harmful interference, and in the adjacent bands the administrations are urged to take all practicable steps to protect radioastronomy services from harmful interference.

Passive Services: Earth Exploration-Satellite Service (EESS) and Space Research Service

The ITU Radio Regulations define EESS as a radiocommunication service between earth stations and one or more space stations, including links between space stations[40].

EESS provide information about characteristics of the planet and natural phenomena. This is obtained from sensors on Earth Satellites as well as collected from airborne or Earth-based platforms. The information is then distributed to earth stations.

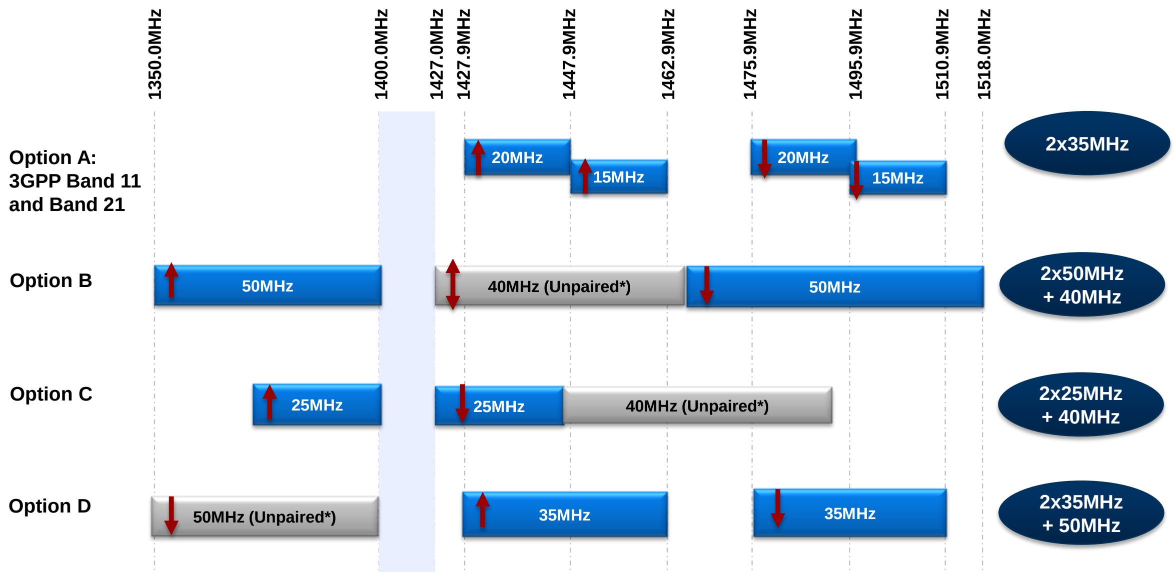
Resolution 673 (Rev.WRC-12), concerning the importance of earth observation radiocommunication applications, states that the use of spectrum for earth observations has a material socio and economic value, and urges administrations to protect these systems from harmful interference[41].

Channelization plan options

Based on the spectrum range under analysis (i.e. 1350-1400/1427-1518MHz), we propose different band plan scenarios, as shown in the next figure.

[39] ITU, Radio Regulations Vol I, 2012
[40] ITU, Radio Regulations Vol I, 2012
[41] ITU, Radio Regulations Vol III - Resolutions, 2012

Figure 20: Band plan options for L-band



Note: *Unpaired spectrum available for Supplemental Downlink (SDL) o TDD Radio Access

The worst scenario in terms of the quantity of spectrum made available is the identification of 2 x 35MHz for IMT (Option A: 3GPP band 11 + band 21), while the best scenario is Option B: 100MHz (2 x 50 MHz) paired and 40MHz unpaired. Following are special considerations which need to be taken into account for each option.

- Option A: Band Plan based on 3GPP specifications for band 11 and band 21

This option allows the use up to 2 x 35MHz for IMT systems deployment. It does not allow taking advantage of the spectrum available below 1400MHz.

The main advantage of this option is related to commercial availability of the equipment and terminals ecosystem[42].

- Option B: Band Plan includes all spectrum within the spectrum range under analysis.

It provides for 100MHz of paired spectrum and 40MHz of unpaired spectrum for use either with Supplemental Downlink (SDL) or TDD technologies. Although this proposal allows using the entire

[42] There are two LTE networks in this frequency band in Japan.

spectrum of frequency band 1350-1400 MHz and 1427-1518MHz, there are no technological developments or any related trials or proposals linked with this channelization.

- Option C: Based on CEPT studies and Qualcomm's proposal for SDL

Option C adopts the Qualcomm proposal for SDL development in frequency band 1452-1492MHz, and additionally considers the results of a trial conducted by Orange, Qualcomm and Ericsson.

This option is also aligned with a proposal from Orange focusing on the utilization of 1375-1400 MHz to accomplish harmonization and promote economics of scale.

- Option D: Based on 3GPP specification for band 11 and band 21

This option adds the band 1350-1400 MHz to the channelization defined by 3GPP. In this context, the additional 50 MHz could be used as unpaired spectrum for SDL or TDD. Thus, it is possible to leverage the technology development available for LTE in this frequency band, and use the spectrum available below 1400 MHz.

Terminals ecosystem at a glance

In 2009, Japan assigned 70 MHz of spectrum within L-Band to mobile operators (i.e., Softbank and NTT DoCoMo) to deploy LTE networks. Both operators launched their commercial networks between 2010 and 2012. So there are already two commercial LTE networks operating in the 1.5 GHz band in accord with 3GPP specifications[43], and so a limited amount of equipment for IMT services in L-Band is already available.

[43] Band 11 (1427.9-1447.9 MHz/1475.9-1495.9 MHz) and Band 21 (1447.9-1462.9 MHz/1495.9-1510.9 MHz) in 3GPP Specifications since Release 8.

V.b. Per country analysis

This section outlines the findings of the per country research, which entailed the review of public sources as well as direct interviews with local administrations.

For each sample country there are a brief description of the IMT spectrum, a glance at the mobile market and specific findings on the L-band.

Brazil

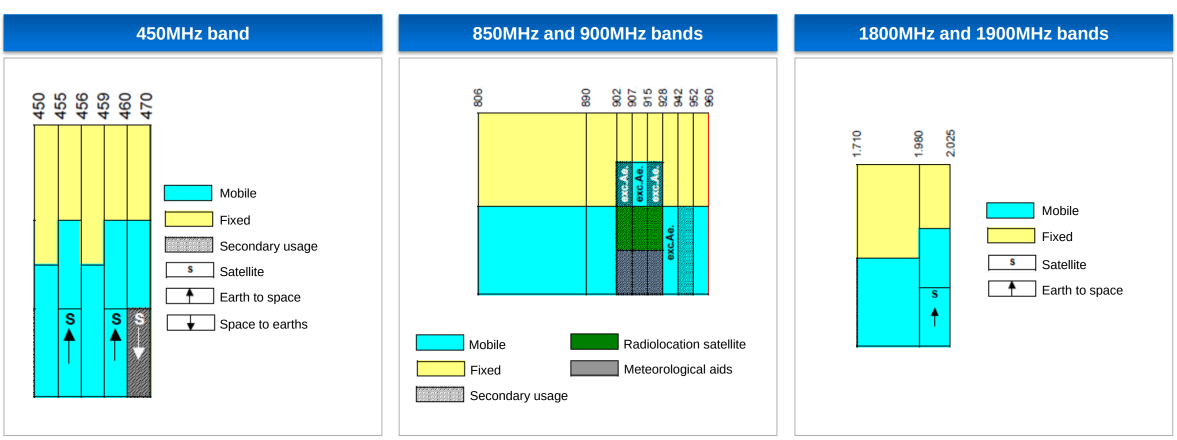
Frequency allocation and IMT services

Current allocation

In Brazil the ‘Agencia Nacional de Telecomunicaciones’ (Anatel) is responsible for the spectrum management and planning. The bands identified for IMT services are: 450MHz, 700MHz, 850MHz, 900MHz, 1800MHz, 1900MHz, 2100MHz and 2500MHz.

The figure below shows the services allocation in the already assigned IMT bands [44].

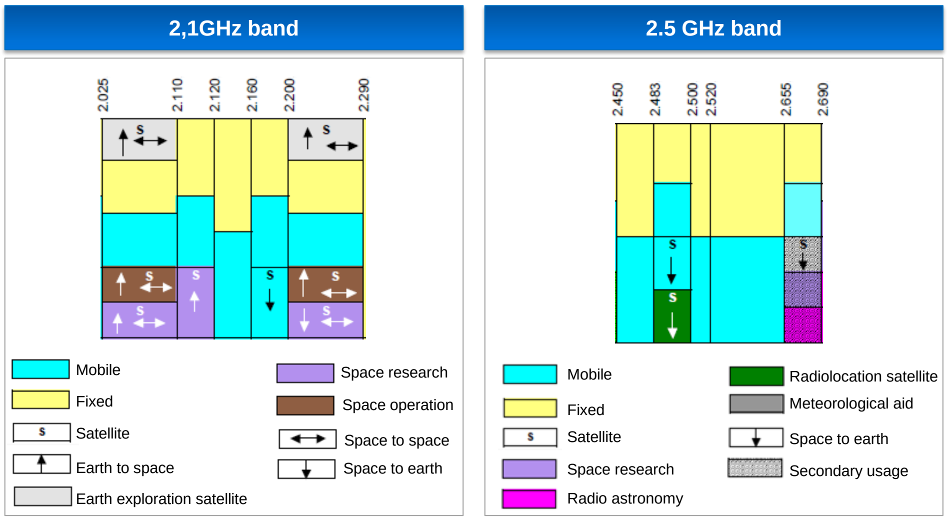
Figure 21: Services allocation in bands mostly used for IMT in Brazil
MHz



Source: Anatel

[44] The figure includes only the already assigned bands.

Figure 22: Services allocation in bands mostly used for IMT in Brazil (Cont.)
MHz



Source: Anatel

Brazil has a total of 660MHz identified for IMT services, positioning Brazil as one of the country with most spectrum identified for IMT. However, to date Brazil reaches only between 34% and 49% of the total spectrum requirements estimated by ITU[45], for the high and low-density settings, respectively. In the same line, when compared to the spectrum demand forecasted by GSMA[46], Brazil reaches only between 39% and 58% of the high or low total spectrum demand forecast, respectively.

IMT assignments

The bands of 450MHz, 850MHz, 900MHz, 1800MHz, 1900MHz, 2100MHz y 2500MHz have been assigned to four national mobile operators (Vivo, TIM, Claro and Oi), to two regional mobile operators (Algar and Sercomtel), and one yet to commence service as national mobile operator (Nextel).

In Brazil the IMT spectrum licensing is structured in 3 regions, 10 services areas and 34 sectors; therefore, the assignments have regional reach, resulting in different spectrum holdings per region per operator. Most of the current spectrum identified for IMT has been already assigned (i.e. approximately 529 MHz).

The licenses timeframe is 20 years maximum; however, most of the IMT spectrum has been assigned for a 15 years period, with a one-time renewal at finish.

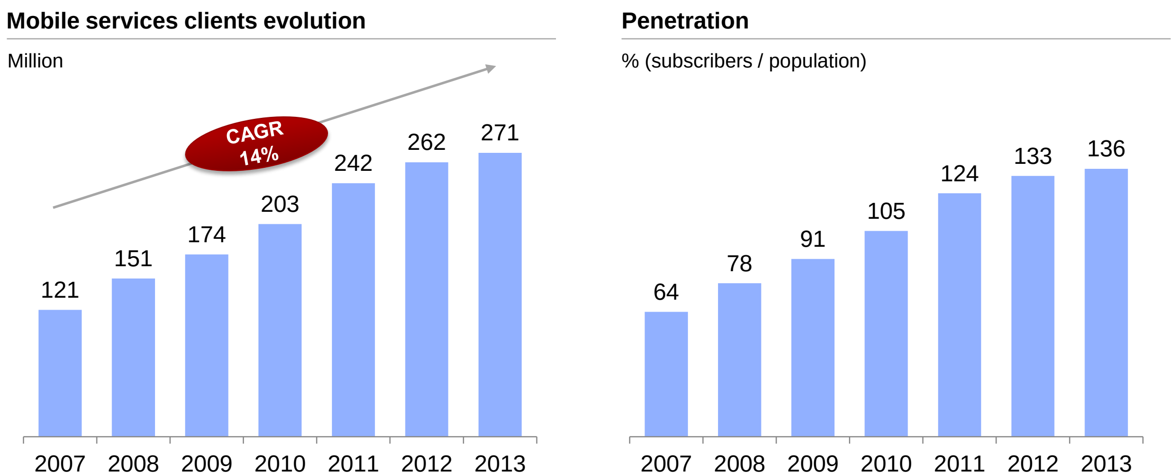
[45] Report ITU-R M.2290-0
[46] Revised spectrum forecasts using the new spectrum model, prepared for GSMA by Coleago Consulting (2013)

There are more than 50 thousand base stations, with TIM, Vivo and Claro having approximately 15 thousand base stations each and Oi having approximately 4 thousand base stations.

The economic compensation for the IMT licenses comprises an up-front payment to be ultimately determined through an auction process; thereafter, there are no additional economic obligations. However, after the first (and unique) renewal, incumbent operators shall pay a biennial fee of 2% on previous year gross income (net of taxes and contributions) and the TFI[47].

The Brazilian mobile telecommunications market accounts for 271[48] million subscribers (136% mobile penetration). As most markets of the region, the Brazilian market has experienced a dramatic growth in last years; it has more than doubled its number of subscribers between 2007 and 2013.

Figure 23: Brazil´s mobile market evolution



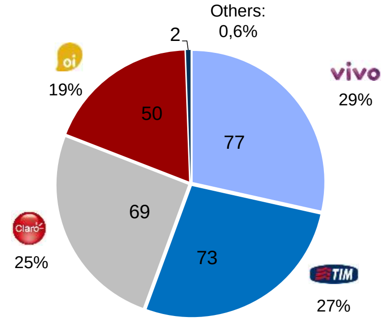
As a consequence of the market saturation, in last years the mobile market has slowed down its growth rate.

There are four national operatores (Vivo, Claro, TIM and Oi) and two regional operators (Algar and Sercomtel), while one national operator is yet to commence service (Nextel).
The following figure shows the current market structure in terms of subscribers.

Figure 24: Brazil mobile market structure

47 'Tasa de Fiscalización de Instalación'
48 Anatel, December 2013.

In subscribers



Source: Anatel

The Brazilian market is featured by its well-balanced structure and the absence of a dominant player as Claro, TIM and Vivo have similar market shares (Oi is the fourth player in the market with 19% market share).

IMT roadmap and new bands under study

The Brazilian administration has announced an auction of 80MHz in the 700MHz band (digital dividend) to take place in late September 2014. In addition, Anatel is assessing new spectrum bands for identification for IMT: 1350-1400MHz, 1427MHz-1518MHz and the 3400–3600MHz.

L-band frequencies (1350-1525 MHz)

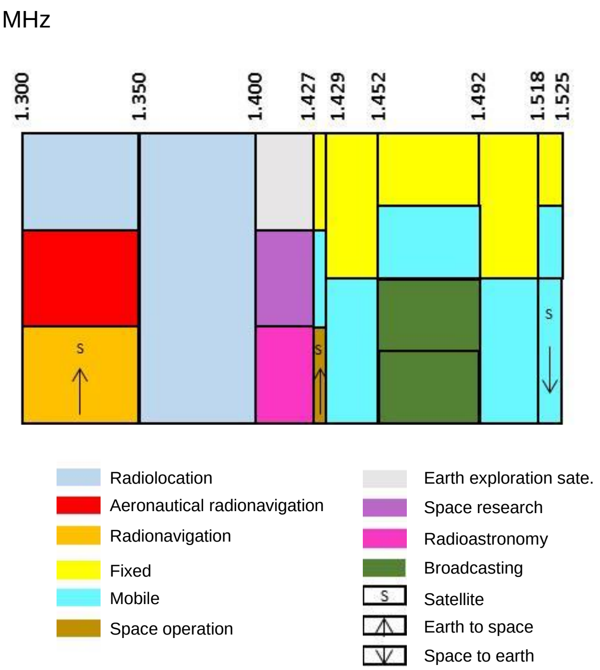
Current allocation

L-band includes the frequencies from 1350MHz to 1525MHz, with this service allocation:

- 1350-1400MHz: radiolocation
- 1400-1427MHz: earth exploration satellite, radio astronomy, space research
- 1427-1429MHz: fixed, mobile, space operation (earth to space)
- 1429-1452MHz: fixed and mobile
- 1452-1492MHz: fixed, mobile, broadcasting and broadcasting-satellite
- 1492-1518MHz: fixed and mobile
- 1518-1525MHz: fixed, mobile and mobile-satellite (space to earth)

The figure below depicts the allocation ofr the L-band.

Figure 25: L-band´s services allocation in Brazil



- The range from 1427MHz to 1525MHz is allocated to mobile services
- The mobile services allocation is shared with fixed services (1427MHz to 1525MHz)
- In compliance with international standards, spectrum in the range 1350-1400MHz is allocated to radiolocation
- Spectrum from 1400MHz to 1427MHz is reserved for earth exploration satellite, radioastronomy and space research

Source: Anatel

The allocation to mobile services is shared with the allocation to fixed services (range 1427-1525MHz), space operation (1427-1429MHz) and broadcasting (1452-1492MHz). In line with international guidelines, the spectrum between 1350MHz and 1400MHz is allocated to radiolocation. The frequencies ranging from 1400MHz to 1427MHz are reserved for earth exploration satellite, radioastronomy and space research.

Assignments and actual use

The L band is used by a high number of stakeholders for point-to-point and point-to-multipoint links, who belong to different industries including: telecommunications, oil and electricity and utilities. Today, there are more than six thousand licenses assigned in the L-band; the vast majority being old assignments with obsolete equipment deployed throughout the country and focused on rural areas.

Potential migration

Although feasible, the migration of existing users of the L-band to other bands faces some barriers: the large number of users to migrate and the migration of users whose licenses that have not yet expired[49]. However, note that while licenses could be assigned for a period of up to 20 years[50] they had instead been awarded for a period of 10 years only, excluding automatic renewal.

Public agenda regarding for the L-band

Anatel has pointed out that the bands 1350-1400MHz and 1427 MHz1525MHz should be taken into account among the candidates bands for the provision of IMT services (to be proposed at the next World Radiocommunication Conference (WRC-15)). Brazil has already submitted to CITEL a proposal for identification of the L-band for IMT in Region 2.

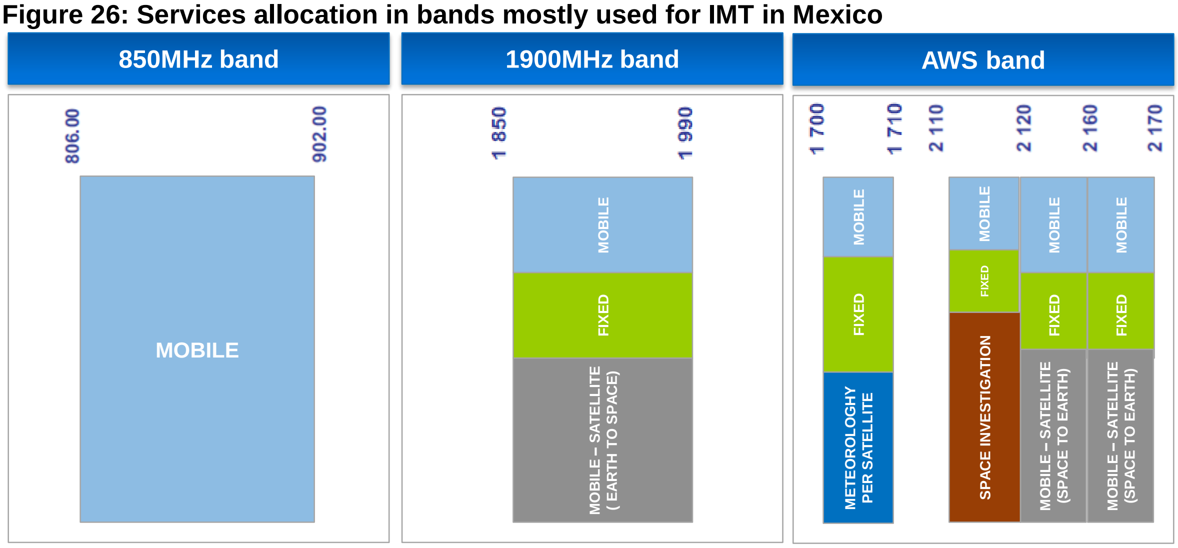
Mexico

Frequency allocation and IMT services

Current allocation

In Mexico the Federal Telecommunications Institute (IFT) is responsible for the spectrum management and planning. The following figure shows the services allocation in the currently assigned IMT bands:

Figure 26: Services allocation in bands mostly used for IMT in Mexico



Source: Instituto Federal de Telecomunicaciones

[49] Similar to the barriers for the assignation of the 700 MHz band.
[50] Lei n.º 9.472/1997 (Lei Geral de Telecomunicações – LGT)

The mobile market in Mexico comprises four operators (Iuscacell, Movistar, Nextel and Telcel) and two MVNO (Maxcom and Megacable). All operators offer mobile broadband through UMTS / HSPA+ networks whilst Movistar and Telcel have already launched LTE services in 2012.

The country has assigned approximately 230MHz of IMT spectrum. Licenses are structured on a regional basis, with 9 regions for the entire country.

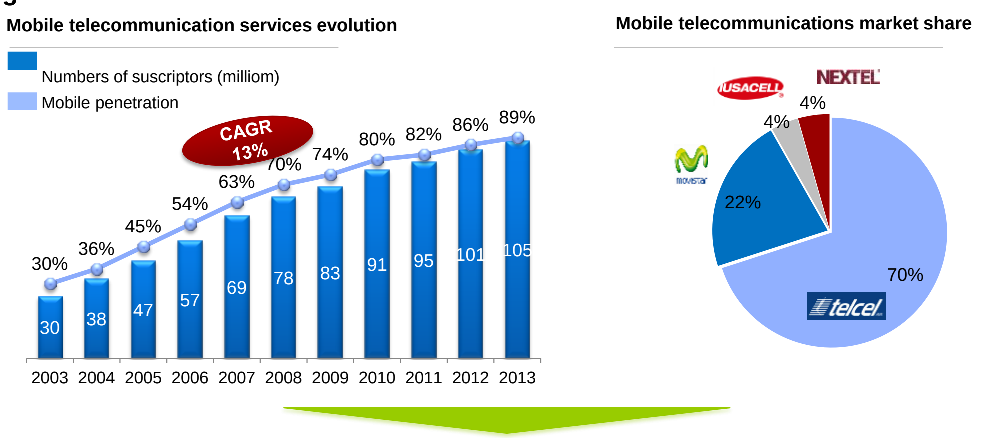
The 600MHz of the spectrum already identified for IMT services accounts only for a portion (between 31% and 45%, depending on the market density) of the total spectrum requirements estimated by ITU[51]. According to GSMA estimates[52], the 600MHz already identified for IMT represent between 39% and 61% of the total spectrum requirements by 2020.

As for the radio access infrastructure, incumbent operators have deployed almost thirty thousand (29.249) radio stations throughout the country.

The economic compensation for the use and operation of radio spectrum is established on a year basis and takes into account the parameters contained in the Federal Law Rights, articles 244-B, 244- D and 244-E.

In last years, the penetration of mobile market has reached a two-digit rate of growth, approaching a saturation stage at the present time.

Figure 27: Mobile market structure in Mexico



- Mobile telecommunication penetration has grown at a compound annual growth rate of 13%
- Over 90% of the market is concentrated in two operators

[51] Report ITU-R M. 2290-0
[52] Coleago Study (2013)

The mobile market penetration has grown from 30% in 2003 to 89% in 2013. The market is highly concentrated with 90% of the total at hands of two operators.

Spectrum roadmap and new bands under study

Even though the administration has not yet announced an assignation process, the following bands are being considered for potential assignations:

Figure 28: Assignation roadmap for IMT bands in Mexico

Band (MHz)	Sub band (MHz)	IMT assignment date
450-470	--	To be defined
698-960	698-806	Before the end of 2014
	814-824/859-869	To be defined
1710-2025	1710-1725	Tentatively 2015
	1755-1770	To be defined
2110-2200	2110-2125	Tentatively 2015
2300-2400	2155-2170	To be defined
2500-2690	2500-2530	Tentatively 2015
	2530-2570	To be defined
	2570-2620	To be defined
	2620-2650	Tentatively 2015
	2650-2690	To be defined

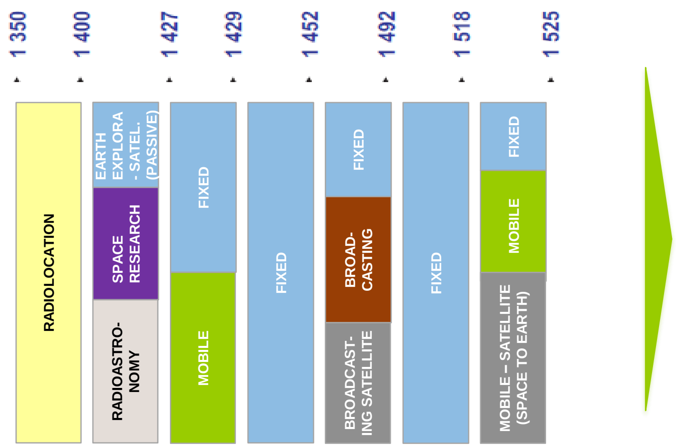
Source: Instituto Federal de Telecomunicaciones

In addition, the 614-698MHz and the 1452-1492MHz bands will be proposed for identification for IMT services.

Current allocation

In Mexico, the bands 1350-1400MHz and 1427-1518MHz are considered in the scope of the L-band. The figure below shows the frequency allocation in the L-band.

Figure 29: L-band´s services allocation in Mexico
MHz



- Most of the band, 98MHz (1427 – 1525MHz) is allocated to fixed services
- Only 9MHz are allocated to mobile service (on a shared basis with fixed service)
- Radio spectral range between 1350 - 1400MHz follows the international trend of radiolocation allocation

Source: Instituto Federal de Telecomunicaciones

The figure above shows that most of the band (i.e., 98MHz in the range 1427-1525MHz) is allocated to fixed services whilst only 9MHz are allocated to mobile services. The range between 1350-1400MHz follows the international trend of radiolocation allocation.

Assignments and actual use

The range 1427-1525MHz includes licenses for fixed services. The licenses were directly assigned and have a different expiration timetable. The band is mostly used for microwave point to point links, where the private companies are the main users and there is a handful of state-owned companies.

Figure 30: Actual use of L-band in Mexico

Frequency band (MHz)	Current uses
1350-1400	Aeronautical radionavigation systems, aeronautical communications and related uses.
1427-1429	Point to point fixed service systems
1429-1452	Point to point fixed service systems
1452-1492	Point to point fixed service systems According to the note 5.345 of radio regulations this frequency band is limited to digital audio broadcasting satellite service. However it is not expected to use the band for such services in Mexico.
1492-1518	Point to point fixed service systems
1518-1525	This range is in the Mexico's records that are being precessed by ITU for mobile satellite service. However it is not expected to use the band for such services in Mexico

Source: Instituto Federal de Telecomunicaciones

Potential migration

The migration of users in the range 1300-1427MHz is not deemed possible as they operate protected services. However, it would be possible migrating fixed service operating in the range 1427-1525MHz

As mentioned before, there are few licenses of fixed services in the range 1427-1525MHz. Nevertheless, some of those users have also microwave point to point systems operating in other bands: 928-960MHz, 7GHz, 15 GH and 23GHz.

Position regarding future use of the L-band

According to the answer submitted by the delegation of Mexico to the decision CCP.II / DEC. 162 (XXII-13)[53], although it is not expected a modification of the current allocation of the range 1350-1400MHz, the possibility of identifying the range 1427-1525MHz for IMT services is under analysis.

It is worth mentioning that there are no definite plans to migrate current users to another band. The table below summarizes the plans for each portion of the L-band.

Figure 31: Plans for L-band in Mexico

Frequency band (MHz)	Action
1350-1400	No changes are expected
1427-1429	The possibility of identifying this frequency range for IMT is under analysis
1429-1452	The possibility of identifying this frequency range for IMT is under analysis
1452-1492	The possibility of identifying this frequency band for IMT is under analysis (according to the discussions that are being held within the ITU-R and 3GPP.)
1492-1518	The possibility of identifying this frequency range for IMT is under analysis
1518-1525	The possibility of identifying this frequency range for IMT is under analysis

Source: Instituto Federal de Telecomunicaciones

Colombia

[53] Information request on current and planned uses of the bands 1350 - 1524 MHz and y 1427 – 1524 MHZ for satellite and land services to be submitted by OEA/CITEL administrations

Frequency allocation and IMT services

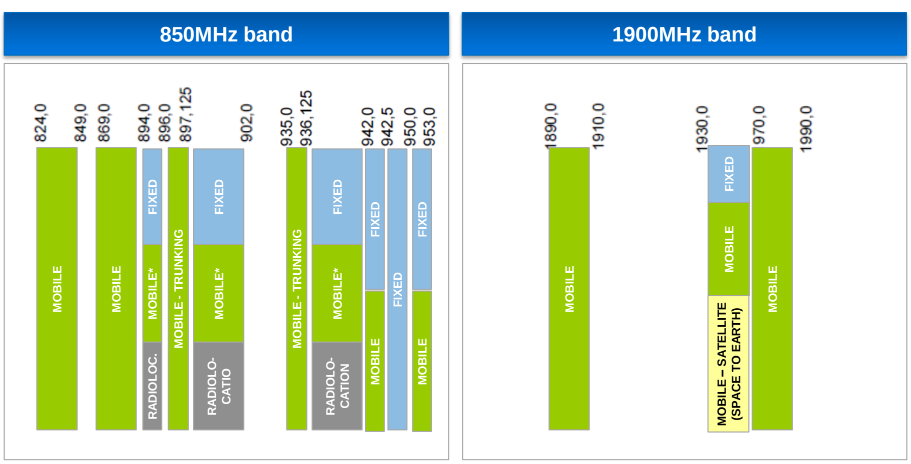
Current allocation

Law 1341 of 2009 defines the structure and basic concepts of the telecommunications industry in this country. This law establishes the framework of the telecommunications sector, the competition rules and consumer protection, the coverage and quality of services, the promotion of domestic and foreign investment in the sector, paving the road for the development of new technologies, the guidelines to assure the efficient use of radio electronic spectrum as well as identifies the public entities responsible for the sector administration.

The regulatory entities are described in the Law 1341/2009 and its structure follows a hierarchal framework. At the top of the pyramid there is the Ministry of Information and Communications Technologies (MINTIC), followed by the National Spectrum Agency (ANE). Article 26 of Law 1341/2009 describes the 13 functions of the National Spectrum Agency. The purpose of the ANE is to provide technical support for the management, monitoring and control of the radio spectrum, in coordination with other entities.

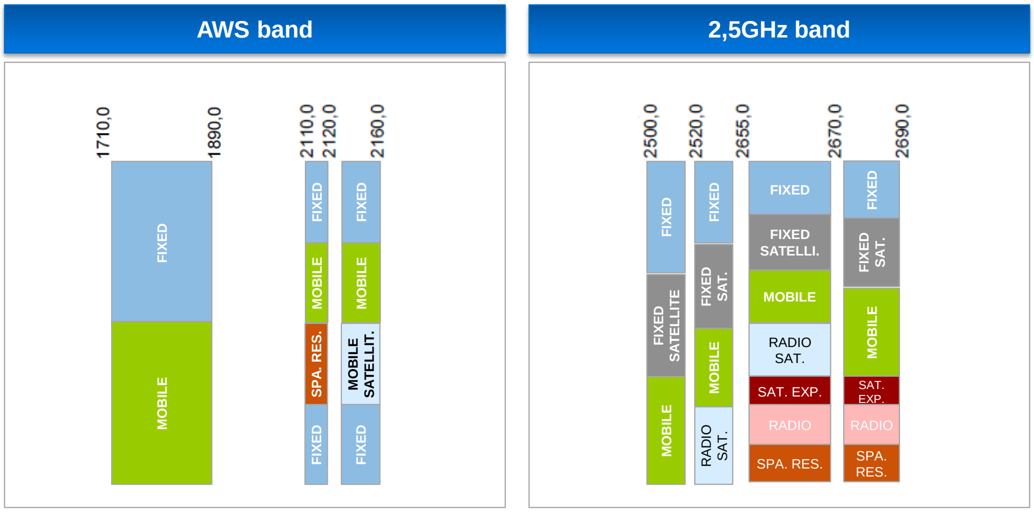
Colombia has identified for IMT the bands: 850MHz, 1900MHz, AWS, 700MHz, 900MHz and 2.5GHz bands. The following figure shows the services allocations in the IMT bands currently assigned.

Figure 32: Services allocation in bands mostly used for IMT in Colombia
MHz



* Excludes aeronautical mobile
Source: ANE - CNABF, 2013

Figure 33: Services allocation in bands mostly used for IMT in Colombia (Cont.)
MHz



Source: ANE - CNABF, 2013

Colombia is using 415MHz out of the total spectrum identified for IMT in the bands 850MHz (824-849 / 869-894 / 894-905 / 894-905 / 939-950MHz), 1900 MHz (1850-1910 / 1930-1990MHz), AWS (1710-1755 / 2110-2155MHz) and 2.5GHz (2500-2690MHz).

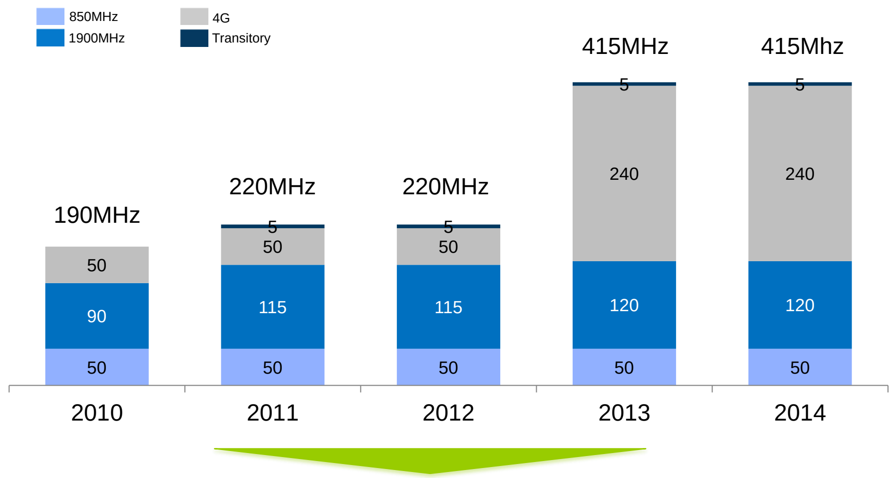
IMT assignments

The Colombian mobile market includes five mobile network operators (Claro, Movistar, Tigo-UNE, Directv and Avantel[54]), and five MVNOs (ETB, Éxito, UNE, Uff! Mobile and Virgin Mobile). The number of mobile operators has increased recently as a result of the spectrum auction held in June 2013, in which three entrants won licenses: Avantel (2 x 15MHz in the AWS band) consortium ETB-Tigo (2 x 15 MHz AWS) and DirecTV (2 x 15MHz and 40MHz TDD in 2.5GHz band). In June 2012 UNE has already began marketing LTE services. Additionally, the five companies that won spectrum blocks in the 2013 4G auction (Avantel, Claro, Tigo ETB-Consortium, DirecTV and Movistar) will launch own 4G services during 2014.

Colombia has achieved a significant increase in the total assigned spectrum, climbing from 190MHz in 2010 to 415MHz in 2014.

Figure 34: IMT spectrum holdings in Colombia

[54] Also an iden operator

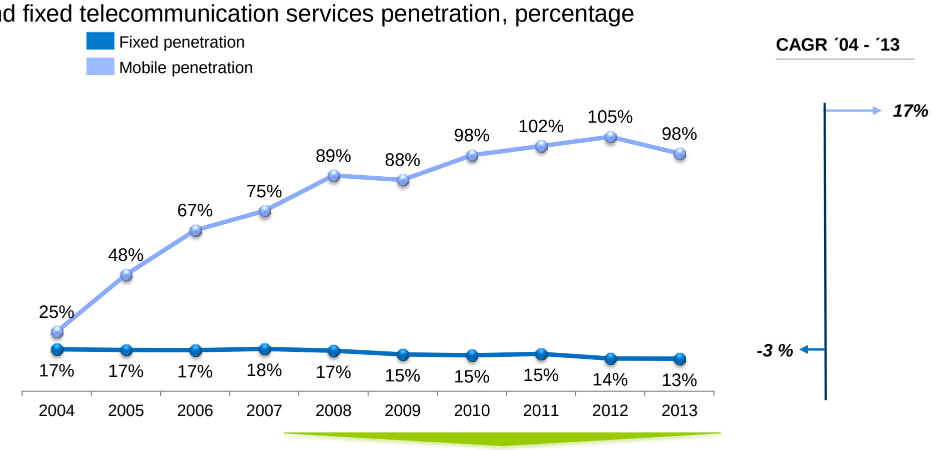


- The IMT assigned spectrum has more than doubled in last five years: 225MHz has been assigned

Source: Agencia Nacional de Espectro

The auction from June 2013 allowed increasing the assigned spectrum from 225MHz to 415MHz. Even though its progress, the spectrum identified for IMT in Colombia (i.e., 590MHz) still accounts only for a portion (between 30% and 44%) of the total spectrum requirements as estimated by ITU by 2020 (Report ITU-R M. 2290-0) as well as a portion (between 37%-56%) of the GSMA total spectrum demand estimates[55].

Figure 35: Mobile market evolution of Colombia
Mobile and fixed telecommunication services penetration, percentage



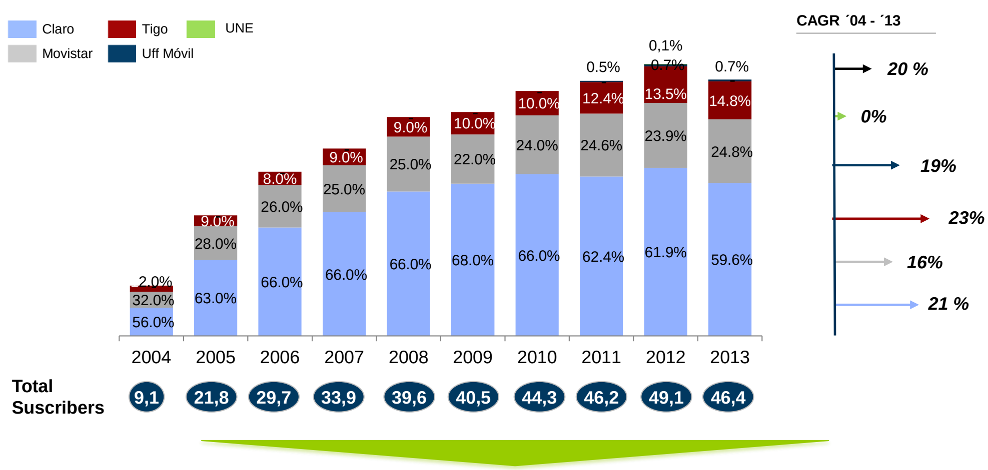
- The mobile penetration climbed from 17% in 2004 to 98% in 2013
- Fixed penetration in the first quarter of 2013 was 13%, falling from 2003 at a 3% annual rate

Source: EIU, World Celular Information Service, Informa T&M, Informe Primer Trimestre 2013 - MINTIC

[55] Coleago (2013)

The mobile market penetration experienced a dramatic growth between 2004 and 2013, climbing from 25% to 98%. Between 2004 and 2013 the number of mobile subscribers grew at 17% annual rate, increasing from 9.1 million in 2004 to 46.4 million in 2013. Note that between 2012 and 2013 the number of subscribers fell around 5%, reducing the customer base from 49.1 to 46.4 million users. However this drop of 2.7 million subscribers was due to a decrease of Claro's customers, as a result of a purge of its database.

Figure 36: Main operators of the Colombian mobile market
Million of subscribers, percentage



- The market structure remained stable throughout the years
- Claro in the main operator with 59.6% market share, though its share has been decreasing since 2009

Source: Informa T&M, MINTIC

As shown in the figure above, the market shares have remained stable throughout the years. During the first quarter of 2013, Claro held 59.6% of mobile voice market having 27.7 million subscribers; Movistar concentrated 24.8% of the total base with 11.5 million users; Tigo accounts for 14.8% of the market with 6.9 million users; Uff Móvil has 0.7%, with 0.3 million customers; and finally, UNE has an estimated of 0.05 million of subscribers.

As for economic compensation, there are two different types of fees related to the spectrum licenses:

- up-front payment at the assignation
- periodic payment, calculated on the operator gross income

IMT Roadmap and new bands under study

In last years, the local administration has been assessing new bands to be identified for IMT services, taking into account the next WRC coming in 2015; the ANE[56] has carried out a study on six selected bands, in order to analyse the suitability and opportunity of its potential future identification for IMT. The frequency bands under analysis are:

- 512 - 698MHz
- 1400 - 1600MHz
- 2050 - 2110MHz
- 2700 - 2900MHz
- 3300 - 3400MHz
- 3600 - 3800MHz

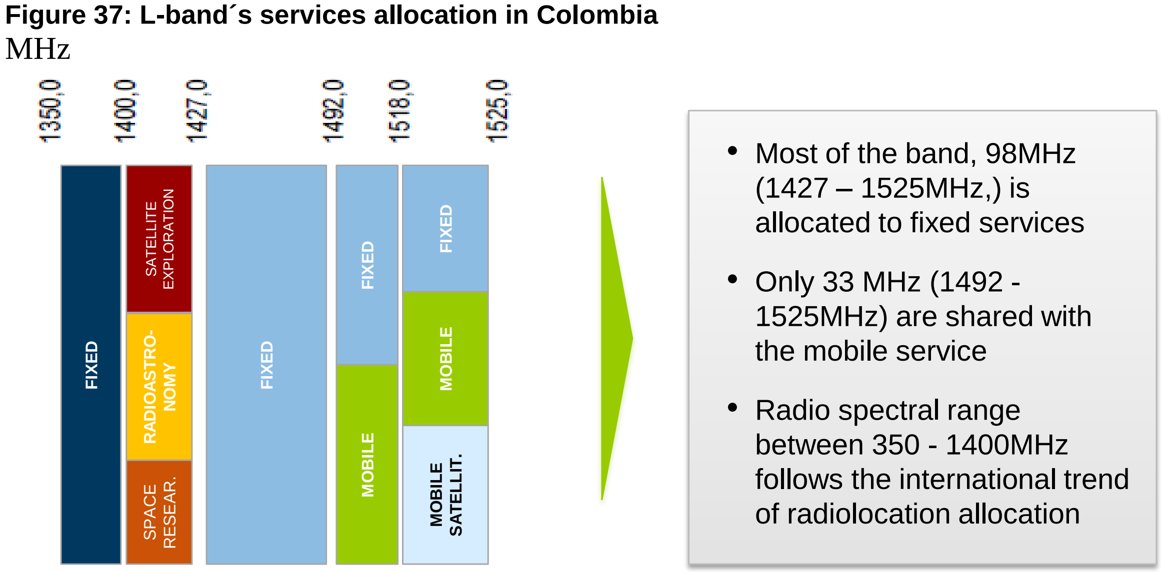
The next step is recommending the strategy to implement the effective, timely and efficient release of those frequency bands, with the core target that Colombia meeting the spectrum requirements by 2023.

L-band frequencies (1350-1525MHz)

Current allocation

For Colombia this study considers the ranges 1350-1400MHz and 1427-1518MHz. The figure below shows the frequency allocation for different services in the band under analysis.

Figure 37: L-band´s services allocation in Colombia



Source: ANE - CNABF, 2013

[56] Agencia Nacional del Espectro, the local technical entity responsible for the spectrum planning and management

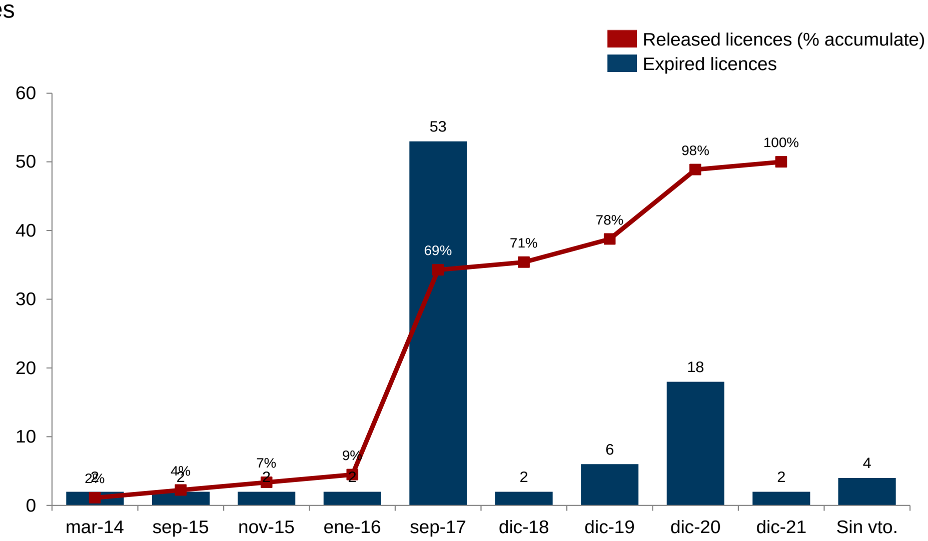
Most of the band under analysis, 98MHz in the range of 1427-1525MHz, is allocated to fixed services and only 33MHz (1492-1525MHz) are shared with mobile service. The band 1350-1400MHz follows the international trend of radiolocation allocation.

Assignments

Today seven companies are operating in the range 1427-1530MHz. The band is being mostly used for microwave transmission systems point to point and point to multipoint links for support services to the mobile telecommunication operators. There is also another service operated by a local television company that has two stations transmitting at the same frequency.

The figure below shows the number of licenses according to their expiration dates timetable during the period 2014-2021.

Figure 38: Timetable for L-band's licenses expiration dates in Colombia
licenses



Source: Agencia Nacional de Espectro

According to the previous figure, most licenses will expire by 2017. By 2020 more than 90% of the licenses will automatically expire, and by the end of 2021 the total band will be clear[57], paving the way for the reallocation plans.

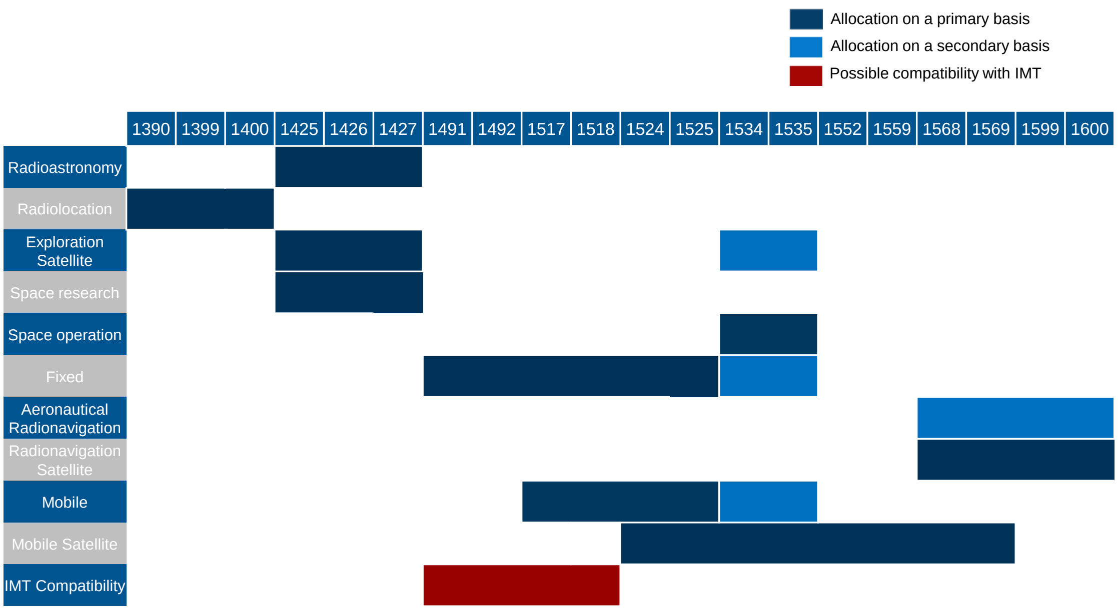
Actual use and potential migration

[57] With an uncertainty of 4.3% since there are assignments with unknown due dates.

According to a survey completed by the ANE in 2014, only one operator, the largest user of the L-band, would be still interested in continuing operating within this band. However, the other point to point links users would agree to migrate to other bands: 5GHz, 7GHz and 8GHz. From year 2021 onwards, there would be no migration barriers since 100% of the current licenses would be expired.

The following figure briefly shows the findings of the ANE´s study regarding the compatibility between current services and IMT

Figure 39: Compatibility L-band current services and IMT
MHz



Source: Agencia Nacional de Espectro

Additionally, it is worth mentioning that the range 1427-1518MHz is fully compatible with the industry initiatives aimed at implementing Supplemental Downlink in 1452-1492MHz.

The identification for IMT services would provide about 91MHz of bandwidth, allowing for the specification of very wide carriers. This would improve networks performance, coming close to the estimated needs of data traffic.

<u>Position regarding future use of the L-band</u>

It would feasible to identify the L-band for the provision of IMT services, and the administration would presumably propose this band for its identification to IMT.

As a matter of fact, the ANE has already conducted a preliminary assessment on the compatibility with IMT services provision in this band and the involved migration costs.

Ecuador

Frequency allocation and IMT services

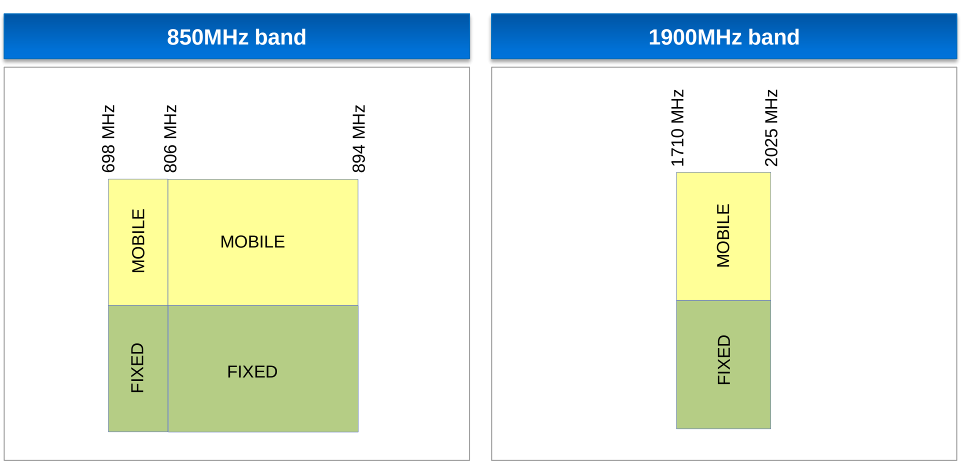
Current allocation

The telecommunications sector in Ecuador is ruled by the Special Telecommunications Law enacted in August 1992 together with its subsequent reforms. The Ministry of Telecommunications and of Society Information (Mintel), the National Telecommunications Council (CONATEL) and the National Telecommunications Secretary (SENATEL) are the main public agencies responsible for the sector regulation and for the spectrum management and planning.

The National Telecommunications Council (CONATEL), in exercise of its authority set out in the Special Telecommunications Reform Law, has approved[58] the reforms and updates of the National Frequencies Plan (NFP) of September 2008.

The figure below shows the services allocations in the currently assigned IMT bands.

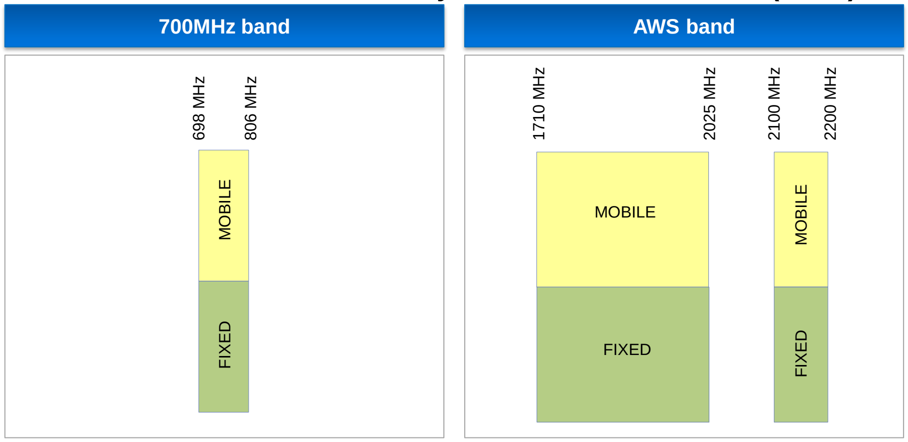
Figure 40: Services allocation in bands mostly used for IMT in Ecuador



Source: CNAF - CONATEL

[58] Resolution No.TEL-391-15-CONATEL-2012 of July 2012

Figure 41: Services allocation in bands mostly used for IMT in Ecuador (Cont.)

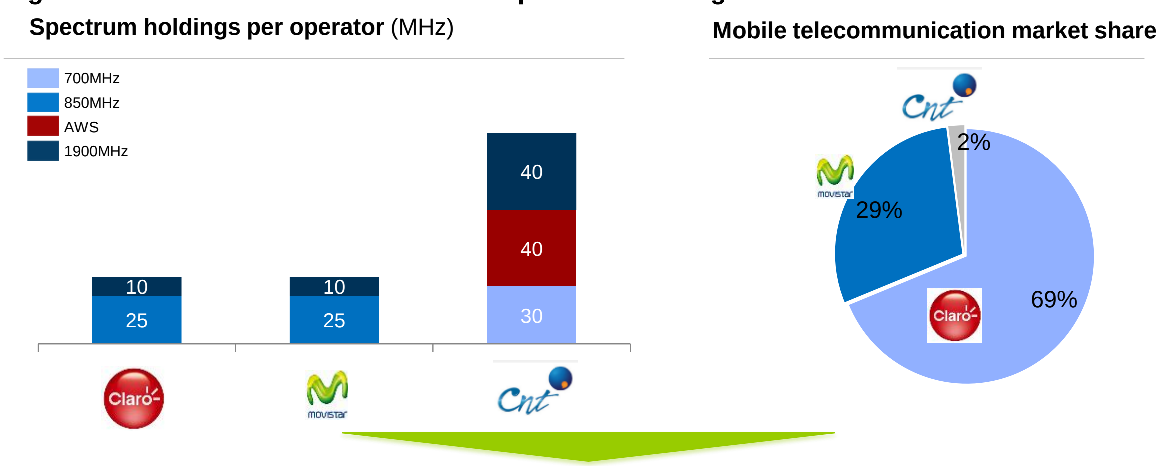


Source: CNAF - CONATEL

IMT assignments

Mobile telecommunication operators providing services in Ecuador are CONECEL SA (CLARO) OTECEL (MOVISTAR) and CNT. Ecuador has 180 MHz of IMT spectrum currently assigned. The following figure shows the spectrum holdings per operator and the market structure.

Figure 42: Mobile market structure and spectrum holding in Ecuador



- CLARO y MOVISTAR operate only in the 850MHz and 1900MHz bands
- CLARO is the operator with the highest penetration, with nearly 70% market share

Source: SENATEL

CLARO and MOVISTAR operate only in the bands 850MHz and 1900MHz, holding each one a total of 35MHz. CLARO is the operator with the highest penetration with almost 70%, followed by MOVISTAR, and finally, by the state owned company, CNT.

Mobile telecommunication bands should be assigned to the private operators by auction, procedure known as *Competitive Process.* However, the radio spectrum for LTE services was assigned directly to CNT, a public owned operator (in December 2012, the government assigned 70MHz of spectrum - 30MHz in 700MHz band and 40MHz in AWS – to CNT). In addition, the spectrum cap per operator is 65MHz; nevertheless this cap does not apply to state-owned operators.

Regarding the economic compensation for the licenses, the conditions included in last spectrum renewal (2008) were:

- a fixed value for the renewal
- a monthly fee called 'Tarifa A', calculated according to the number of radio stations and bandwidth as well as a payment per active customer
- a variable payment on the operator gross revenues (2.93%)

Regarding the number deployed base stations, Claro has almost 4,800 whilst Movistar around 3,000, including in both cases GSM 850, GSM 1900 and UMT 850 technologies. In the case of CNT, it has roughly 1,050 base stations with CDMA, UMTS 1900, LTE and LTE AWS 700 technologies.

In February 2013, Ecuador became the fourth country in Latin America (after Colombia, Chile and Mexico) to adopt the APT band plan for the implementation of LTE technology in the 700 MHz band, known as the Digital Dividend. However, this spectrum is still occupied by broadcasting systems and will be released once the TV switch over is completed (analogue switch off commenced in 2010 and should be completed by 2017, with a potential period extension to 2021).

IMT roadmap and new bands under study

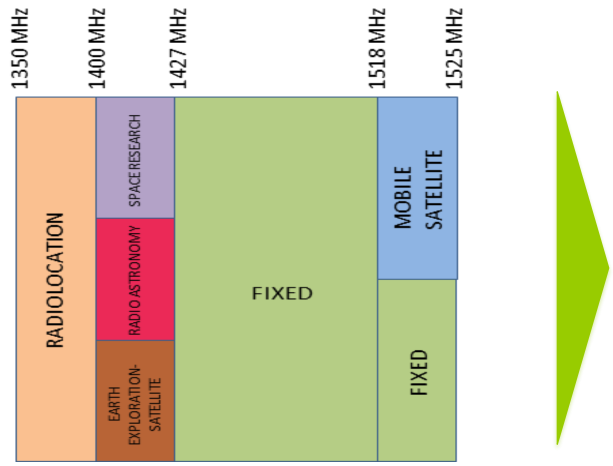
Ecuador has a national broadband plan aimed at having at least 75% of the total population connected by 2017. In order to meet the objectives outlined in this plan, the Ministry of Telecommunications would have to ally with mobile operators to cover remote areas and hence more IMT spectrum assignments are expected.

L-band frequencies (1350-1525 MHz)

Current allocation

The range of frequencies 1350-1400 and 1427-1518 MHz were considered for this study. The figure below shows the current frequency allocation for different services in the band under analysis.

Figure 43: L-band´s services allocation in Ecuador



- Most of the band, 98MHz (1427 - 1525MHz) is allocated a fixed services
- There is no mobile service allocation in the band
- Radio spectral range between 1350 - 1400MHz follows the international trend of radiolocation allocation

Source: SENATEL

The figure above shows that most of the band, 98 MHz (1427-1525MHz) is allocated to fixed services, with no allocation to mobile service. The range between 1350-1400MHz follows the international trend of radiolocation allocation.

Assignments and actual use

The band is being mostly used for national radio links of land fixe service, as detailed in the figure below.

Figure 44: L-band current usage in Ecuador

Frequency band (MHz)	Current use
1350-1400	None
1427-1429	Radio electronic links of land fixed service
1429-1452	Radio electronic links of land fixed service
1452-1492	Radio electronic links of land fixed service
1492-1518	Radio electronic links of land fixed service
1518-1525	Radio electronic links of land fixed service and mobile satellite

Source: SENATEL

As shown in the figure above, the frequency range between 1350-1400MHz is not used, and the rest of the band is being used by radio electronic links from fixed services. Note that these licences have a 5-year timeframe. The L-band links are used mainly by carriers and private and state-owned companies.

There are approximately 650 links in the L-band. In the satellite mobile service there is a satellite broadcaster operator with around 200 subscribers.

Potential migration

The following figure shows the plans for the L-band as informed by Senatel.

Frequency band (MHz)	Plans
1350-1400	The possibility of identifying this frequency range for IMT services is being analyzed
1427-1429	The possibility of identifying this frequency range for IMT services is being analyzed
1429-1452	The possibility of identifying this frequency range for IMT services is being analyzed
1452-1492	The possibility of identifying this frequency range for IMT services is being analyzed
1492-1518	The possibility of identifying this frequency range for IMT services is being analyzed
1518-1525	None

Source: SENATEL

In brief SENATEL is assessing the identification of almost the entire L-band for IMT, just excluding the portion 1518-1525MHz.

Position regarding future use of the L-band

According to the answer submitted by the delegation of Ecuador to the decision CCP.II / DEC. 162 (XXII-13)[59], the possibility of identifying the band for IMT is under analysis, and the administration will presumable proposed such identification.

[59] Information request on current and planned uses of the bands 1350 - 1524MHz and y 1427 – 1524MHZ for satellite and land services to be submitted by OEA/CITEL administrations

Uruguay

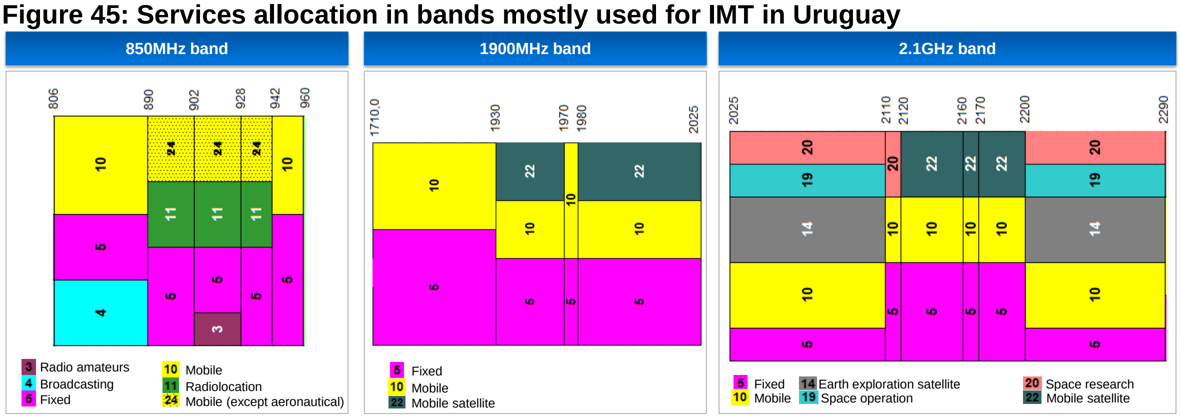
Frequency allocation chart and IMT services

Current allocation

In Uruguay, the 'Unidad Reguladora de Servicios de Comunicaciones' (URSEC) is the responsible entity for the management and planning of radio spectrum.

The next figure shows the services allocation in the already assigned IMT bands.

Figure 45: Services allocation in bands mostly used for IMT in Uruguay



Source: URSEC

The 850MHz, 1900MHz and AWS bands are used for IMT services. Spectrum in those bands has been awarded in different processes, having the first one occurred in 2002, when, as per Resolution No. 490, the provision of mobile telecommunications services was licensed for a 20 years period. Subsequent assignations have taken place in 2004 and 2013, in both cases also for a 20 years period.

So far 310MHz are identified for IMT, accounting only for 16%-23% of the total spectrum requirements as estimated by ITU (Report ITU-R M.2290-0).

IMT assignments

The following figure shows the spectrum holdings in Uruguay.

Figure 46: IMT spectrum holdings in Uruguay

	Digital dividend	850 MHz	900 MHz	1800 MHz	1900 MHz	AWS	2,1 GHz	2.5GHz	Total
Claro	-	-	-	-	50	20		-	**70**
movistar	-	25	-	-	60	-		-	**85**
antel	-	25	10	30	-	40	10	-	**115**
Non-assigned	90	-	10	-	10	30*	-	190	**330**

- Last assignation took place in March 2013
- Antel holds 43% of the assigned spectrum, followed by Movistar (31%) and Claro (26%)
- Digital dividend and 2.5 GHz bands still to be assigned

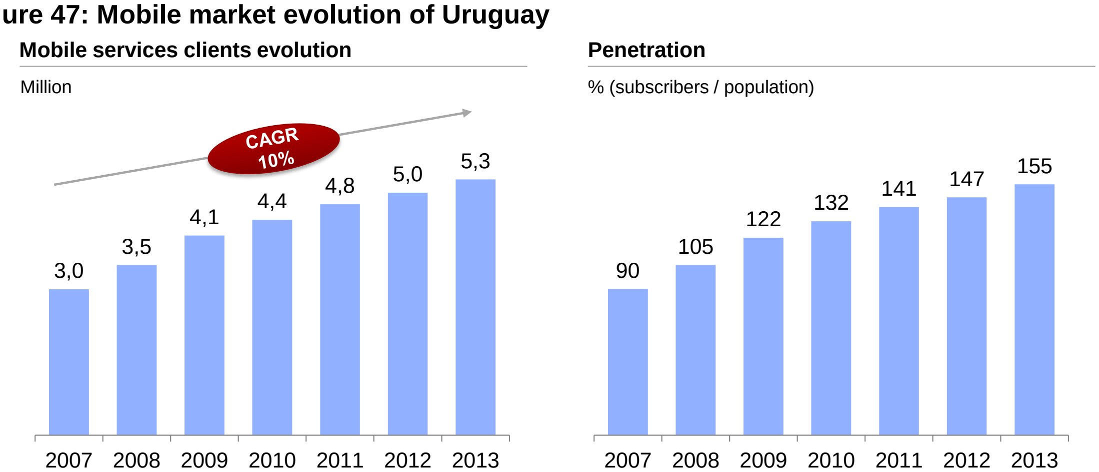
* Extended AWS
Source: URSEC, Dinatel

As shown, 270MHz have been assigned for the provision of IMT services. Whilst all the assignments to private operators have been awarded through auctions, Antel, the state-owned operator, has been directly awarded 115MHz. Taking into account that the licences have a period of 20 years, the expiration of those licenses will take place in 2022, 2024 and 2033 respectively, having no precedents for renewals.

There are around 700 base stations deployed by each operator in the country, totalling approximately 2,000 nationwide. Co-location ratio is low (below 20% of the installed base stations). Finally, the economic compensation is an up-front payment at commencing the license with no additional fees or annual payments.

The mobile market includes 5.3 million subscribers and the penetration reaches 155%. The following figure shows the evolution of the mobile market.

Figure 47: Mobile market evolution of Uruguay



Source: URSEC, World Bank

The mobile market has three operators Antel (state-owned company), Movistar and Claro, with one of them (Antel) concentrating more than 50% of the total market, followed by Movistar with 35% market share and Claro with 16% market share.

Finally, as for new assignments, the Uruguayan government has already announced its decision to bid additional spectrum in the digital dividend band (700MHz). However, so far there is no detailed information about the plan.

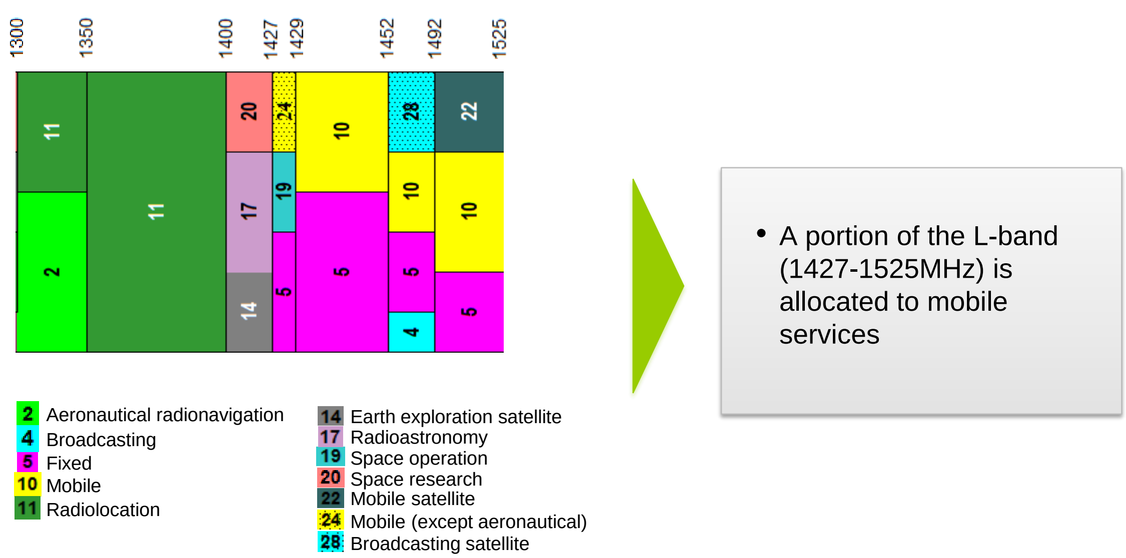
IMT roadmap and new bands under study

Currently no new bands are being assessed by URSEC for the provision of IMT services.

Current allocation

The analysis of the L-band in Uruguay involves the 1350-1400MHz and 1427-1525MHz ranges. The first range (i.e. 1350-1400MHz) has been allocated to radiolocation services. On the other hand, the frequencies 1427-1429MHz have been allocated to space operation, fixed and mobile (except aeronautical); the frequencies 1429-1525MHz has been allocated to fixed and mobile services, note that frequencies 1452-1492MHz are also allocated to broadcasting and broadcasting-satellite services and that the range going from 1492-1525 MHz is also allocated to mobile satellite services. The following figure shows the services allocation in the L-band.

Figure 48: L-band´s services allocation



Source: URSEC

The figure shows that mobile services are already included in the current services allocation of the L-band (1427-1429MHz, 1429-1452MHz, 1452-1492MHz and 1492-1525MHz).

The band 1350-1400MHz is allocated to the radiolocation service while the band 1400-1427MHz are reserved, as internationally recommended, to the following services: earth exploration-satellite, radioastronomy and space research, and therefore cannot be identified for the provision of IMT services.

Assignments and actual use

The utilization of the L-band is low, just used by private and government stakeholders for low capacity point-to-point links (lower than 2 Mbps or 4 Mbps) in the range 1427-1525MHz. Although no in-depth analysis of the actual usage of the band has been conducted it is estimated that the number of incumbents is less than ten.

The assignments have occured during the 90s, under a FIFO (first in - first out) scheme and with no expiration date. Nevertheless, these assignments have been awarded on revocable basis, having the government the alternative to terminate these licenses at any time.

Finally, as for the economic compensation, it consists of a monthly payment based on the total spectrum holding. The structure and calculation method for the fees date from 1993, having its prices been updated but not its structure.

Potential migration

No relevant barriers to migrate have been identified. Nevertheless, once considered the technological obsolescence of the installed equipment, it can be expected that the incumbents would voluntarily migrate to other technological solutions in a non-distant future.

Position regarding future use of the L-band

Neither operational nor economic barriers were identified to use the L-band for the provision of IMT services.

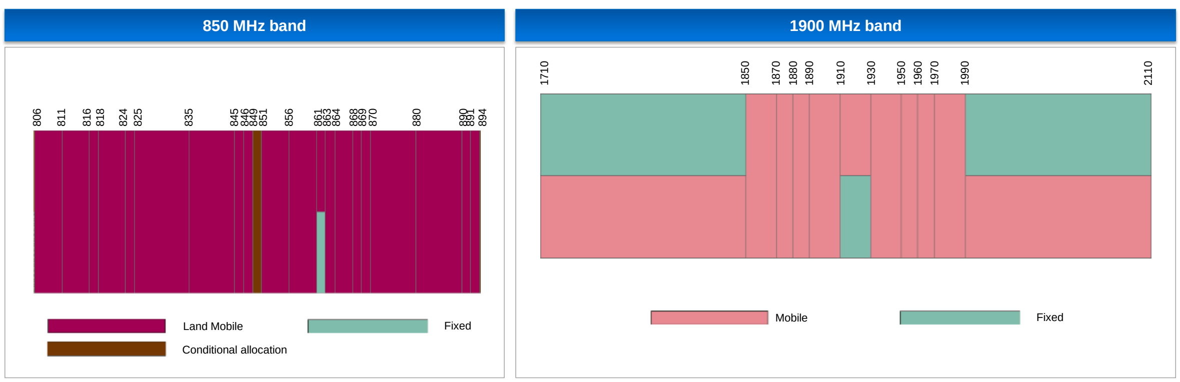
Argentina

Frequency allocation and IMT services

Current allocation

The National Communications Commission (CNC per its acronym in Spanish) is responsible for the management and planning of the radio spectrum in Argentina. The following figures show the services allocation of the IMT bands already assigned.

Figure 49: Frequency allocation in bands mostly used for IMT in Argentina



Source: CNC

Argentina has a total of 380MHz identified for IMT; based on the ITU's report on spectrum requirements (Report ITU-R M.2290-0), it represents only 19%-28% of the total spectrum the country should achieve by 2020. In the same page, according to GSMA[60], the current spectrum identified for IMT account for 23%-35% of the required spectrum by 2020.

IMT assignments

The licenses are structured on a regional basis. The regions considered for the spectrum assignment are: Region I (North of the counry), Region II (Extended Greater Buenos Aires) and Region III (South of the country).

The following figure shows the spectrum holdings per operator per region.

[60] Coleago study (2013)

Figure 50: IMT spectrum holdings in Argentina
MHz

	Region	Movistar	Claro	Personal	ARSAT	Non – assigned	Total
850MHZ	I	-	25	25	-	-	50
	II	30	-	12,50	7,50	-	50
	III	25	25	-	-	-	50
1900MHz	I	50	20	20	30	-	120
	II	20	40	30	30	-	120
	III	25	20	40	35	-	120

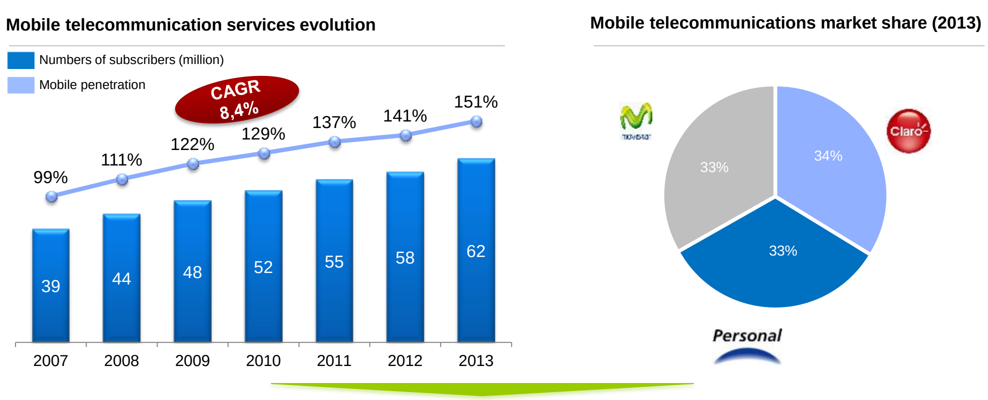
- The spectrum in the 850MHz and 1900MHz have mostly been assigned in the three regions
- The three incumbent private operators have similar spectrum holdings in the three regions

Source: CNC

The entire spectrum in the 850MHz and 1900MHz bands has been assigned, totalling 170MHz per region (50MHz in the 850 MHz and 120 MHz in the 1900 MHz band).

The last spectrum auction in Argentina was held in the year 1999. In 2012, the government called for a new auction in order to award the remaining spectrum from Movistar acquisition of Movicom, as he had surpassed the 50 MHz per region spectrum cap. However, the auction was cancelled and the spectrum assigned to ARSAT. Today, Argentina is one of the countries with less spectrum assigned for IMT services. However, in mid-2014 the government announced a new auction to be held by the end of 2014, in order to promote the deployment of LTE technologies and increase the current available radio spectrum. The auction process has already started and the following frequencies are included: 698-806 MHz (700MHz band) and 1710-1770MHz paired with 2110-2170MHz (AWS band), having the spectrum cap per region been set at 60 MHz for the advanced wireless services (LTE).

Figure 51: Mobile market evolution and structure in Argentina



- The mobile penetration has climbed from 99% un 2007 to 151% in 2014
- The Argentine market shows an evenly split market with three payers

Source: Merrill Lynch Global Wireless Matrix 2Q 2014

The mobile market has been growing at an 8.4% compound annual growth rate, having in 2008 surpassed the 100% penetration rate. Three players evenly share the market, having approximately 20 million subscribers each.

IMT Roadmap and new bands under study

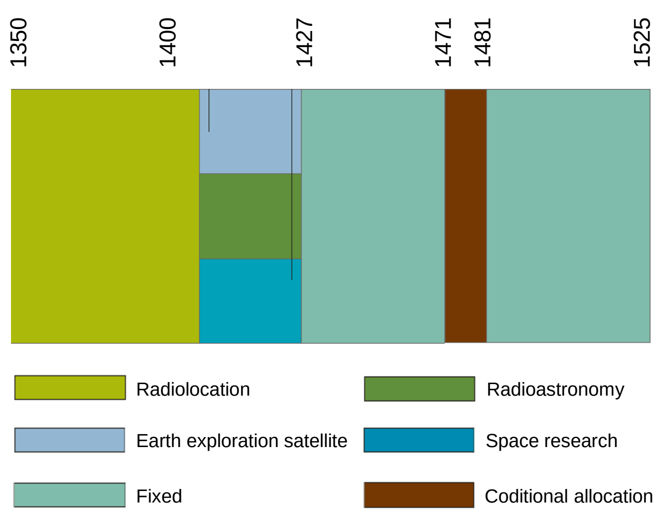
Argentina shows a significant IMT spectrum shortfall, which is expected to be counteracted with the forthcoming 4G auction. In this context and considering that Argentina is one of the few countries with no spectrum assigned to 4G services, it is expected a focus on the 4G bands rather than already assessing new IMT bands.

For the time being, the regulator has not formally provided definitive information with regards to the assessment of new bands for the provision of IMT services.

Current allocation

In Argentina, the L- ranges from the 1350MHz to 1525MHz. The CNC has allocated 1350-1400 MHz, in accordance with international guidelines, to radiolocation services. The following figure shows the radio spectrum allocation for the L-band in Argentina.

Figure 52: L-band´s services allocation in Argentina
MHz



- The L-band has no mobile services allocation
- The 1427-1525MHz is almost fully allocated to fixed services

Source: CNC

Note that the L-band has no allocation to mobile services whilst the range 1427-1525MHz is almost fully allocated to fixed services.

Assignments and actual use

The National Frequency Allocation Chart[61] show that ranges 1427-1471MHz and 1481-1525MHz are used by digital multichannel systems[62] (MXD).

The authorization to operate digital multichannel systems has no expiration date and remains in effect while complying with the provisions of the regulation. On the other hand, when assigned to providers of telecommunications services, these licenses have a 10 years period.

Potential migrations

There is no formal evidence of relevant barriers to migrate.

Position regarding future use of the L-band

The regulator has not yet formally submitted an answer.

Dominican Republic

Frequency allocation and IMT services

Current allocation

The Dominican Republic has 710MHz identified for IMT services on a primary basis.

When compared to other LAC countries, Dominican Republican has a relatively high amount of spectrum identified for IMT. However, it is still below the ITU estimates for 2020; accounting for 36%-53% of those estimates.

The following figure shows the bands identified for IMT in the Dominican Republic.

[61] As set on 'Disposición GI Nº 734/04'
[62] As per resolutions Nº 2860 CNT/92 and Nº 228 CNT/94

Figure 53: Bands identified for IMT in the Dominican Republic

Band (MHz)	Mobile spectrum 2002 (MHz)	Mobile spectrum 2011 (MHz)
450	0	10
700	0	108
850	50	50
900	0	40
1700/2100	0	90
1900	120	120
2300	0	100
2500	100	200
3500	0	100
TOTAL	**270**	**818**

Source: INDOTEL

The 700MHz band will be effective once the switch over to Digital Terrestrial Television (DTT) is completed.

IMT assignments

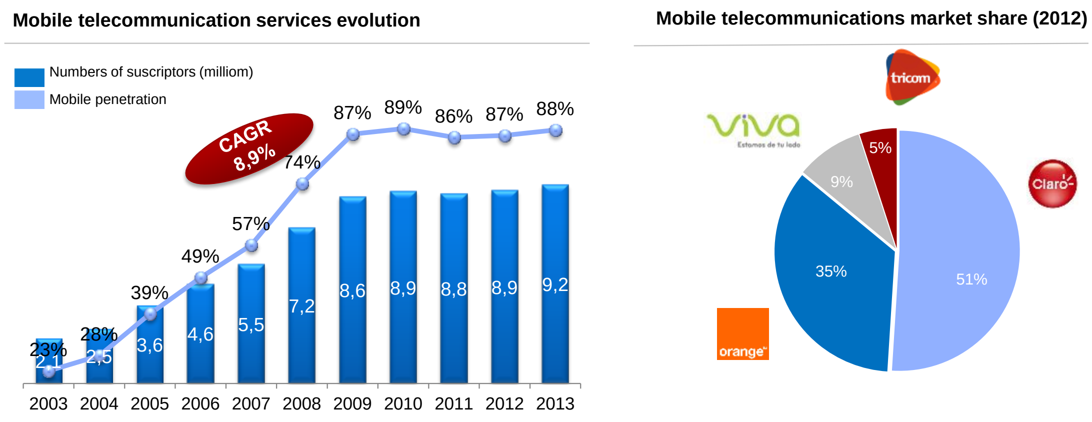
The total spectrum currently assigned to mobile services operators in Dominican Republic are 450MHz: 50MHz in the 850MHz band, 40MHz in the 900MHz band, 40MHz in the 1700/2100MHz band, 120MHz in the 1900MHz band and 900MHz in the 2500MHz band.

At the moment, there is no certain date for new assignments. However, there are still 50MHz in AWS band available for future assignments.

As for economic compensation for the use of radio spectrum, as established by the General Telecommunications Law No. 153-98, the use of spectrum will be taxed at an annual fee and its calculation methodology is set out in the General Regulations of Radio Spectrum Use, approved by Resolution No. 128-04

The mobile services market in Dominican Republic has grown at an 8.9% compound growth rate since 2003, reaching a penetration of almost 90% in 2013.

Figure 54: Evolution and structure of the mobile market in the Dom. Republic



- Mobile subscribers have grown at a 8,9% compound annual growth rate in the period 2003 to 2013, climbing from 23% penetration in 2003 to 88% in 2013
- The Dominican market has a dominant player, Claro, that accounts for more than half of the total subscribers

Source: Indotel statistics, World Bank, Pyramid Research

The Dominican Republic market shows a dominant player, Claro, accounting for more than 50% of the market. Orange has 35% of market share and Viva and Tricom share the remaining 14%.

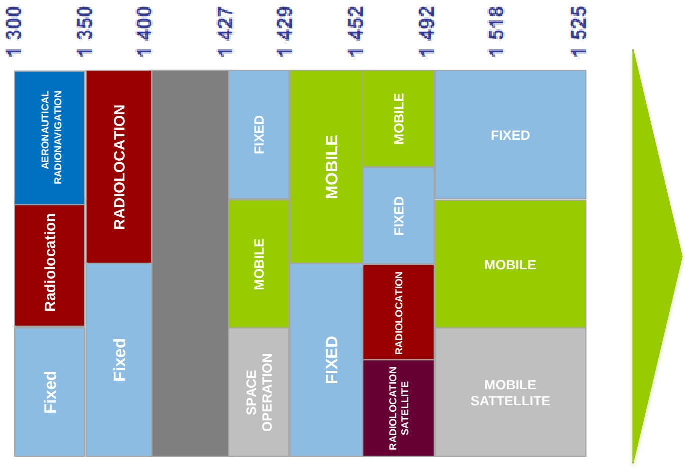
IMT roadmap and new bands under study

The Dominican Republic has not defined yet its final position for the next World Radio communication Conference (WRC) to be held 2015, partly because the INDOTEL is still participating in the cycle of meetings of the Permanent Consultative Committee II (CCP.II) of CITEL, where the topic is being assessed.

Current allocation

For Dominican Republic it was considered the ranges 1300-1400MHz and 1427-1525MHz as scope of this study. The figure below shows the services allocation in the band under analysis.

Figure 55: L-band´s services allocation in the Dominican Republic



- Most of the band, 98MHz, is allocated to fixed and mobile services on a primary basis (shared with other services)
- The range 1300-1400MHz follows the international trend of radiolocation but shared with fixed services (on a secondary basis)

Source: INDOTEL

Most of the band under analysis, 98MHz in the range 1427-1525MHz, is allocated to fixed and mobile services on a primary basis (shared with other services).The band 1350-1400MHz follows the international trend of radiolocation and aeronautical radionavigation, but shared with fixed services (on a secondary basis)

As for economic compensation for the use of spectrum in L-band, the terms and conditions are established in the General Telecommunications Law. The L-band is assigned following the same methodology as for the other services.

Actual use and potential migrations

A significant part of the L-band has been assigned and is being used; there are more than 130 licenses in the 1300-1525MHz range. There are 12 users including public agencies, religious organizations and other stakeholders, accounting for approximately 100 links. The most relevant use of this band is for aeronautic radionavigation and point-to-point links.

Position regarding future use of the L-band

There is no plan to modify the allocation to the L-band nor to migrate the current users out of this band.

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