

**FIXED-MOBILE INTERCONNECTION
THE CASE OF MEXICO**

This case has been prepared by Arturo Briceño of Strategic Policy Research <abriceno@spri.com>. This study is part of a series of Telecommunication Case Studies produced under the New Initiatives program of the Office of the Secretary General of the ITU. The fixed-mobile interconnection case studies program is under the direction of Dr. Tim Kelly <tim.kelly@itu.int>, Coordinator, Strategies and Policies Unit (SPU), and is managed by Lara Srivastava <lara.srivastava@itu.int>. Other cases, including fixed-mobile interconnections in China and Hong Kong SAR, Finland and India, can be found at <http://www.itu.int/osg/sec/spu/ni/fmi/case_studies/>. The author is grateful to the numerous people who provided input to the report, particularly from COFETEL and industry representatives of Mexico. The opinions expressed in this study are those of the author and do not necessarily reflect the views of the International Telecommunication Union, its member or the Government of Mexico.

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1 Background: Mexico and its Telecommunication Sector

Mexico has the second largest economy in Latin America in terms of nominal gross domestic product (GDP) (US\$ 479 billion in 1999). In 1999, the Mexican economy experienced a real GDP growth of 3.7 per cent, and it is expected to grow at an annual rate of more than 4 per cent in the following 4 years.

During the 1990s, the telecommunication sector grew 5.6 times faster than the overall economy. In 1999, the telecommunication sector amounted to 2.6 per cent of the GDP, versus 1.1 per cent in 1990. During the same period nearly US\$ 22 billion have been invested in network expansion and modernization of the telecommunication industry.

Table 1 compares some indicators for Mexico with other Latin American countries. As the table shows, in 1997, the GDP per capita in Mexico was US\$ 4,216, which placed Mexico at fifth place among the eight economies listed in the table.

In 1997, the penetration rate of fixed telephones in Mexico was 10.4 lines per 100 inhabitants, one of the lowest among the major economies in the Latin American region, such as Argentina, Chile, Brazil, and even compared with Colombia or Uruguay.

The international long-distance telephony is a very important market in Mexico's telecommunications industry, and its size may help to understand many of the fierce interconnection disputes that long-distance carriers in Mexico have had since the liberalization of the long-distance market in 1997. Mexico has the great majority of its international traffic with the United States. For instance, in 1997, 84 per cent of the outgoing traffic and 95 per cent of the incoming traffic in Mexico were with the United States. Table 2 shows the figures of the international long-distance market of switched minutes of Mexico with the United States in 1997 and 1998.

For the years 1997 and 1998, the incoming to outgoing traffic ratio was 3 to 1. Given the collection rates in Mexico, the annual outgoing international collection revenue was around US\$ 800 million, whereas the net settlement revenue was around US\$ 700 million. It is very well accepted that both the settlement and collection rates are well above any reasonable measurement of costs, so there are strong pressures for the international carriers in Mexico to arbitrage prices in this context.

Table 1: Comparative indicators for Mexico and other Latin American countries

	Population (1998)	Density (1998)	GPD Per capita (1997)	Teledensity (1997)
Argentina	36.1	13	8'214	20.3
Brazil	165.9	19	5'029	12.1
Chile	14.8	20	5'182	20.6
Colombia	36.7	32	2'424	17.4
Mexico	95.8	49	4'216	10.4
Peru	24.8	19	2'676	6.7
Uruguay	3.3	18	6'149	25.0
Venezuela	23.2	25	3'849	11.7

Notes: Population is in million of inhabitants. Density is inhabitants per squared kilometre. GDP per capita is in US\$. Teledensity is telephone lines in service per 100 inhabitants.

Source: Adapted from *World Telecommunication Development Report, ITU (1999)*.

Table 2: Mexico's international long-distance market with the U.S.

Traffic	1997	1998	Var %
1. Outgoing traffic (million of minutes)	942	1'086	15%
2. Incoming traffic (million of minutes)	2'767	3'021	9%
3. Net traffic (million of minutes) (2)-(1)	1'825	1'935	6%
Prices			
4. Collection rate (US\$ per minute)	\$0.88	\$0.72	-19%
5. Settlement rate (US\$ per minute)	\$0.35	\$0.37	6%
Revenues			
6. Collection revenues (million US\$) (1)*(4)	\$833	\$782	-6%
7. Net settlement revenues (million US\$) (3)*(5)	\$639	\$716	12%

Source: Adapted from *Direction of traffic, ITU, (1999)*. Settlement rates extracted from FCC, see <<http://www.fcc.gov/ib/td/pf/account.html>>

2 Regulatory Regime

2.1 Laws and regulations

The telecommunication sector in Mexico is subject to the Federal Telecommunications Law (Ley Federal de Telecomunicaciones) (FTL), which was enacted in 1995, the 1990 Telecommunications Regulation (Reglamento de Telecomunicaciones), the 1940 Law of General Means of Telecommunications (Ley de Vías Generales de Comunicación), and the regulations issued thereunder and complemented by certain rules issued by the Ministry of Communications and Transport (Secretaría de Comunicaciones y Transporte) (SCT) and the Federal Telecommunications Commission (Comisión Federal de Telecomunicaciones) (COFETEL), i.e. long-distance rules (June 1996), international long-distance rules (December 1996), local service rules (December 1996), satellite telecommunications rule (August 1997), and pay television and audio rules (February 2000), among others.

2.2 Regulatory authorities

Under the FTL, the Mexican telecommunication industry is regulated for administrative and operational matters by COFETEL, which was created in 1996 as an autonomous entity from the SCT to regulate and promote the efficient development of the telecommunications sector in Mexico. COFETEL is responsible for, among other things: enacting regulations and technical standards; ensuring that holders comply with the terms of their concessions and permits; suspending operators without concessions; resolving interconnection disputes between competitors; and maintaining a registry of applicable rates.

The telecommunications policy-maker is the SCT, who retains the authority to grant all concessions and permits. COFETEL makes recommendations to the SCT on major issues, such as amending existing telecommunications laws and regulations, allocating spectrum, granting, transferring, renewing or revoking concessions and applying penalties for concession violations. The SCT has final decision-making power on these issues. Once a final decision is made, COFETEL implements the related regulations.¹

3 Market Liberalization

The liberalization process of the telecommunication industry in Mexico started in 1990 with the privatization of the state-owned telecommunication incumbent Teléfonos de México S.A. de C.V. (Telmex).

3.1 Privatization

Some shares in Telmex were already held privately when the government sped up its privatisation in 1990. A total of 55.1 per cent was privatised over 1990-1994. In 1990, 4.4 per cent went to the employees for US\$ 325 million (financed through loans) and 20.4 per cent was sold to a consortium including Grupo Carso of Mexico (owned by Carlos Slim), France Telecom and Southwestern Bell Corporation (SBC) of the United States for US\$ 1,757 million. In 1991, 15.7 per cent was offered to the public yielding US\$ 2,170 million. In 1991, SBC bought 5.1 per cent for US\$ 467 million. In 1992, 4.7 per cent was sold for US\$ 1.5 billion through a domestic and international offering. In 1993, 3.3 per cent was sold for US\$ 1 billion. In 1994, the remaining 1.5 per cent was sold for US\$ 550 million.

The privatization of Telmex included a six-year monopoly for basic telecom services. The terms of the sale called for Telmex to expand access by 12 per cent through 1994, reduce the waiting period for repairs, improve the quality of service, and improve services in rural areas (at least one telephone to each town with 500 inhabitants or more by 1994).

¹ A complete analysis of the regulatory reform in Mexico from the OECD's perspective can be found at OECD. (1999). *Regulatory Reform in Mexico. Background Report on the Telecommunications Industry in Mexico*. Preliminary Edition. August.

3.2 Long-distance liberalization

Pursuant to the concession agreement, the Telmex exclusivity period for long-distance and international services officially ended in August 1996, but competition in long-distance and international services did not begin until January 1997. Before the exclusivity period ended, Telmex was required to take measures to ensure that competition would be viable. This included bringing rates toward a cost-basis, by lowering long-distance charges and increasing local rates, and establishing an interconnection plan that provided competitors with equal access to end users.

There were 10 long-distance operators by 1997: (Alestra, Amaritel, Avantel, Iusatel, Midtel, Nextel, Protel, Telinor, Telmex and Telnor). As of December 1999, the key long-distance operators include among others:

- Telmex, Telefonos de Mexico S.A. de C.V. in which Grupo Carso of Mexico, SBC (U.S.) and France Telecom (France) are shareholders;
- Alestra, S. de R.L. de C.V., in which AT&T is a shareholder;
- Avantel, S.A. de C.V., in which MCI WorldCom Inc is a shareholder;
- Telinor, S.A. de C.V., commonly known as “Axtel”, in which Bell Canada International is a shareholder;
- Iusatel, S.A. de C.V., in which Bell Atlantic Corporation is a shareholder;
- Maxcom Telecommunications, S.A. de C.V., in which CT Global Telecommunications Inc. is a shareholder.

The 1994 Interconnection Resolution required Telmex to provide interconnection to new operators at 60 points on the network by 1997, rising to 200 by the start of the year 2000. Equal access was to begin in April 1998. Equal access has two components: (i) carrier pre-selection access, which has been implemented since April 1998, and (ii) call-by-call access, not implemented yet. The call-by-call system has not been implemented due to disagreements among operators on billing and collection arrangements. The carriers that participated for the carrier pre-selection system were: Alestra, Avantel, IUSATEL, Marcatel, Miditel, Protel and Telmex. As of May 2000, there were 19 long-distance concessionaires for long-distance services.

3.3 Local competition

It started slowly in 1999, as the competition rules were not published until October 1997. As of May 2000, concessions have been granted to six companies to provide wired telephone service.

Frequencies were auctioned to provide wireless access services, including personal communications services (PCS), and wireless local loop (WLL). As a result of the auctioning processes, seven companies have received their concession title.

Two fixed and three mobile carriers have already started operating.

4 Mobile Penetration

Since 1996, penetration by mobile services has grown sharply (Figure 1). In 1996, mobile penetration stood at 1.1 lines for every 100 inhabitants. In 1997, this rose to 1.8 lines per 100 inhabitants and in 1998 to 3.4 lines. These figures show that penetration has been practically doubling every year.

However, even more spectacular has been the leap in penetration levels seen in 1999 and the first half of 2000.² In 1999, market penetration reached 7.5 lines per 100 inhabitants, or more than twice the level of the previous year. It is estimated that for June 2000 the level of mobile penetration will have reached nearly 11 lines per 100 inhabitants, meaning that the mobile service will have achieved a level of penetration nearly equal to that of the fixed service. In absolute numbers, it is estimated that there are 11 million mobile lines as of June 2000 (Table 3, Figure 1).

² The estimate for June 2000 assumes a 6.4-percent growth rate in mobile lines, the same rate that was observed at the end of 1999.

Table 3: Expansion of telephone network in Mexico over the past decade

Lines /Year	Numbers of lines in existence (in thousands)				Growth rates (annual averages)		
	1990	1995	1999	2000 (*)	1995/1990	1999/1995	2000/1999
Fixed lines	5 355	8 801	10 878	11 387	10.4%	5.4%	9.6%
Mobile lines	64	689	7 442	10 679	60.9%	81.3%	105.9%

* Estimate as of June 2000.

Source: Adapted from ITU, COFETEL, Telmex..

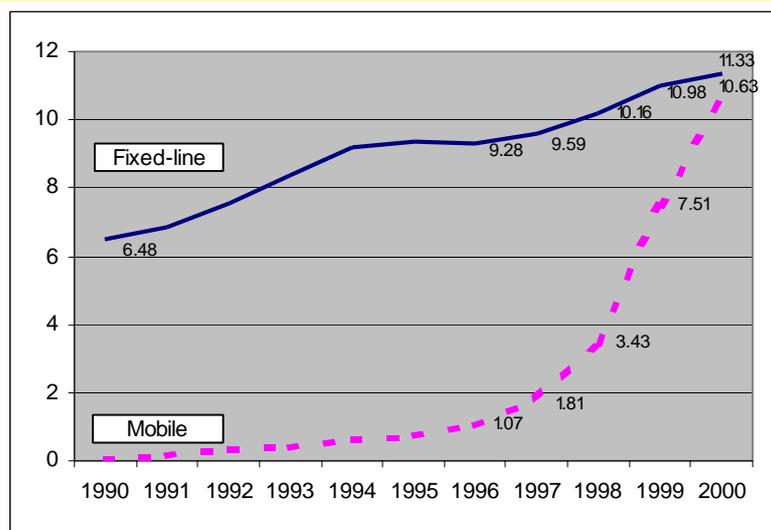
In contrast, the evolution of penetration of the fixed service in Mexico has not been entirely satisfactory. At present, there are 11 fixed telephones for every 100 inhabitants, and many view that as inadequate for a country such as Mexico, in light of the experience of other countries in the region. Moreover, it can be seen that the rate of growth in the number of fixed lines fell by half in the second half of the decade, to 5.4 per cent a year.

There are at least four reasons for the rapid increase in mobile penetration in Mexico in recent years, particularly since 1999.

1. The system of prepaid for mobile services, which was introduced in 1995, has become more widespread. At present, nearly 80 per cent of mobile subscribers are enrolled in prepayment schemes (for example, 76 per cent of IUSACELL subscribers are on prepayment).
2. The “caller pays principle” or “calling party pays” (CPP) was introduced on 1 May 1999.
3. There are more mobile providers entering the market. For instance, new mobile operators such as Pegaso and Unefon have entered the marketplace in the last two years in the wake of the liberalization of the sector and the auctioning of frequencies from 1996 to 1998.
4. The overall economic situation has improved following the crisis of the mid-1990s.

Figure 1 : Penetration of fixed and mobile services in Mexico

Number of lines per 100 inhabitants in December of each year. The 2000 figure has been estimated as of June.



Source : ITU, COFETEL, Telmex.

5 Market Shares

The principal operator in Mexico, Telmex, is also the owner of the country's principal mobile network, Telcel. The country's second-largest operator is IUSACELL. Table 4 shows the market shares of the principal mobile operators. With seven out of every 10 mobile subscribers, Telcel has the largest market share. The IUSACELL market share stands at about 20 per cent. Viewed in terms of international standards, it can be seen that the structure of Mexico's mobile market is highly concentrated.

Since 1989, there are two mobile operators in each of the nine regions into which Mexico has been divided. The two major providers are Telcel in first place and IUSACELL in second place. However, there are new entrants in the mobile market such as Pegaso and Unefon that may trigger price competition in the Mexican mobile market in the coming months.

TELCEL. (Radiomovil Dipsa, S.A. de C.V.) It is a wholly-owned subsidiary of Telmex. It provides nationwide wireless mobile services. Telmex is the vertically integrated incumbent providing basic telecommunication services (local and long-distance fixed telephony), value added services, mobile services, etc. In December 1990, the Mexican government sold a controlling portion of Telmex equity to a private consortium led by Grupo Carso, S.A. de C.V., a Mexican conglomerate, as well as to subsidiaries of Southwestern Bell Corporation (U.S.) and France Telecom (France).

IUSACELL. (Grupo IUSACELL, S.A de C.V.) It provides wireless mobile services in Central Mexico (in four of the nine regions in Mexico, which includes Mexico City). It is majority-owned and controlled by Bell Atlantic Corporation (U.S.). IUSACELL also owns a long-distance carrier (IUSATEL.)

PEGASO. It launched nation-wide PCS services in February 1999 in Tijuana. Later it started commercial operations in Monterrey and Mexico City.

UNEFON. It is a joint venture between TV Azteca, a major broadcasting conglomerate in Mexico, and the Saba family. It is the largest holder of nationwide radio spectrum in Mexico with: 30 MHz at 1.9 GHz (PCS), 50 MHz at 3.4 GHz (fixed-wireless local loop, WLL) and 110 MHz at 7 GHz (nation-wide point-to-point microwave transmission links). Unefon launched fixed-wireless services in Toluca and Acapulco during the first quarter of 2000, and Mexico City during the second quarter of 2000. It started offering mobile services from May 2000 in Leon (100 per cent coverage) and Mexico City (50 per cent coverage by August 2000). The mobile services have been launched with an introductory average price of MXP 1.00 per minute, equivalent to US\$ 0.105 per minute at the exchange rate of MXP 9.5081 = US\$ 1.00 in May 2000. Unefon plans to offer fixed and mobile services in all cities from its roll-out. Other planned services to be launched are: broadband Internet, corporate telephone and wireless web applications.

The Unefon business plan for wireless services targets middle-income customers. It plans to fully use economies of scope from the marketing and retail outlets infrastructure for retail distribution of Elektra, a major retail distributor of appliances in Mexico owned by the Saba family. Elektra has 850 stores throughout the country and targets middle and low-income families.

Table 4: Mobile operators' market shares (as of March each year)

Mobile operator	1996	1999
Telcel	58%	71%
IUSACELL	23%	18%
Pegaso	0%	2%
Other	19%	9%
Total	100%	100%
<i>Note:</i>		
Number of mobile subscribers (thousands)	1'022	7'442

Source: Mobile operators, Telmex, COFETEL, ITU.

6 Overview of the Mexico Interconnection Policy

The regulatory framework requires that public telecommunication operators adopt an architecture that will permit interconnection and interoperability of their networks with those of other concession-holders. The regulations provide that the parties concerned must first attempt to negotiate interconnection terms on the basis of the provisions of the Federal Telecommunications Law (FTL), concession contracts and the Rules for Local Services.

The regulatory framework privileges private negotiation between parties for the interconnection agreements. All terms of interconnection, such as points of interconnection, are negotiated between telecommunications carriers under COFETEL supervision.

The concessionaries have a period of 60 calendar days from the date one party requests interconnection to the other party to reach an interconnection agreement. COFETEL is entitled to intervene if the parties do not reach an agreement after the 60 days or if both parties request it. In the case of COFETEL intervention, the regulatory body has 60 calendar days to take a decision regarding those issues on which the parties have failed to reach agreement.

Interconnection agreements do not have to be approved by COFETEL in order to be valid. In principle the concessionaries are not subject to any restriction regarding the execution of interconnection agreements. However, telecommunications carriers are prohibited from adopting discriminatory practices in the application of rates or any other terms of interconnection. Article 64 of the FTL requires operators to register interconnection agreements with COFETEL, which is responsible for setting up an Interconnection Registry. The same Article also establishes that the information contained in the Registry is public and can be consulted by the public, with exemption of the information that legally is considered as confidential.³

7 Stages in Fixed-Mobile Interconnection

In technical terms, each mobile operator is interconnected directly with the Telmex fixed network. The physical interconnections are situated at the key exchanges: namely, the transit exchanges (tandem offices). Interconnections between the mobile networks are indirect, through Telmex, using the transit service.

The fixed-mobile interconnection situation in Mexico has not been uniform throughout time, but it has been subject to important changes generated from the regulation, the own telecommunication industry, as well as the impact of exogenous factors. The following points can be distinguished.

Non-reciprocity and macroeconomic crisis (July 1990 to November 1998)

The key features of fixed-mobile interconnection during this period were as follows:

- Non-reciprocity in interconnection charges. Mobile operators had to pay a charge to terminate their traffic on the fixed networks. However, the fixed networks paid nothing to terminate their traffic on the mobile networks.
- A period of macroeconomic crisis in the country affected the evolution of rates for telecommunication services as well as interconnection charges, both in constant Mexican pesos and in United States dollars. At the same time, the authorities' efforts to regulate prices of final telecommunication services and interconnection charges were unsuccessful in overcoming the wide fluctuations of the exchange rate and the overall level of prices.
- Since 1995 at least, the possibility of introducing the “calling party pays” (CPP) system in Mexico had been informally discussed between mobile, fixed operators and the Mexican government in various fora, in light of the experience of other countries that had introduced this system (Israel, Peru, etc.). Moreover,

³ It is important to mention that two of the interconnection principles that Mexico has subscribed under the World Trade Organization (WTO) are transparency of the interconnection agreements and non-discrimination of interconnection conditions among operators. The mandatory creation of a public Registry is a positive step towards the achievement of these principles. However, no information is available as to exactly how the Registry actually works in practice. Thus, (i) it is not clear who can have access to the information contained in the Registry, (ii) it not clear which information of the interconnection contracts is disclosed and which is considered confidential, (iii) it may be the case that “public nature” may refer to a situation in which, given that interconnection agreements are to be registered with COFETEL, that body may be responsible for enforcing transparency and non-discrimination.

the discussions were not restricted to the application of CPP to mobile but also paging services.⁴ The main opposition to the system came from Telmex and its mobile subsidiary, Telcel. From the standpoint of the mobile operators, not only did the CPP system have its own advantages *per se*, but introducing this system would make it possible to remedy the situation of non-reciprocal treatment in respect of interconnection charges which had been working against them since July 1990.

- Once the long-distance market was opened up to competition in 1997, the evolution of interconnection arrangements between the long-distance operators and Telmex had a direct influence on the new interconnection regime of December 1998, which currently governs interconnection between fixed and mobile networks.

7.1 Start of the period

After an unsuccessful round of lengthy negotiations between Telmex and the mobile operators with respect to interconnection terms, the Secretariat of the Ministry of Communications and Transport (SCT) established charges for interconnection between fixed and mobile operators in July 1990 as follows:

- For calls from a mobile network to the fixed network, a charge of US\$ 0.055 per minute was set for terminating calls on the fixed network. The mobile operator would charge its mobile subscriber the air-time rate per minute, and out of that would pay the fixed operator US\$ 0.055 for each minute terminated on the fixed network.
- For calls from the fixed network to a mobile network, a charge of US\$ 0.036 per minute was set for calls originating on the fixed network. Initially, it was the mobile operator that was to pay this charge in order to alleviate the burden to the fixed subscriber when he/she made a fixed-to-mobile call. However, in October 1991, responsibility for paying it was transferred to the fixed subscriber making the call. The mobile operators did not receive any interconnection charge for terminating calls originating on the fixed network. The fixed subscriber had to pay the local service tariff (which is a rate per call, not per minute), plus the origination charge of US\$ 0.036 per minute. Telmex ended up collecting from the fixed subscriber the local service tariff per call plus the origination charge per minute.
- The main characteristic of the scheme of interconnection charges was non-reciprocity.

Table 5: Payment scheme for local calls between mobile and fixed subscribers, 1993 (in US\$)

Direction of call	Mobile subscriber	Mobile network	Fixed network	Fixed subscriber	Remarks
<i>Mobile to fixed</i>	Air-time rate per minute X ¢ per minute ("Mobile pays" system)	Pays charge for terminating call on the fixed network 5.5 ¢ per minute	Receives charge for terminating call on the fixed network 5.5 ¢ per minute	Pays nothing 0 ¢	
<i>Fixed to mobile</i>	Air-time rate per minute X ¢ per minute ("Mobile pays" system)	Receives air-time rate from mobile subscriber	Receives fees paid by fixed subscriber	Measured local service rate: 13.80 ¢ per call (1993 average) + Origination charge: 3.6 ¢ per minute (See Note 1)	Effective fixed-to-mobile rate paid by fixed user is: 11.48 ¢ per minute (See Note 2)

Note 1: From July 1990 to September 1991, the origination charge was paid by the mobile operator. As from October 1991, however, responsibility for paying this charge was transferred to the fixed subscriber originating the call.

Note 2: The effective rate assumes an average call duration of two minutes. Value-added tax of 15 per cent is not included (for a certain period of the 1990's the VAT was 10 per cent). The calculation method is described later in this paper and in Annex 1.

Source: COFETEL, mobile operators. Own elaboration.

⁴ For instance, as early as 1995, the Ministry of Communications and Transport (SCT) prepared a report inviting comments from the industry on whether the CPP principle should be introduced for paging services. See "Invitación a Comentarios sobre la Conveniencia de Introducir el Sistema 'El que llama paga' para el Servicio de Radiolocalización Móvil de Personas" ["Request for comments on the possibility of introducing the 'Calling Party Pays' system for the Personal Mobile Radio-paging Service"], 30 November 1995.

In summary, the mobile networks were required to pay the fixed network a charge for terminating calls on the fixed network. That charge was US\$ 0.055 per minute. However, traffic generated on the fixed network and terminated on the mobile networks did not give rise to any termination charge paid to the mobile networks. Moreover, the fixed network was authorized to receive (rather than to pay) a call origination charge of US\$ 0.036 per minute for traffic originating on its network and terminated on the mobile networks. Furthermore, the fixed network charged its subscribers a measured local service rate equivalent to US\$ 0.138 per call in 1993. As Table 5 demonstrates, the effective fixed-to-mobile rate per minute paid by a fixed subscriber was US\$ 0.115 per minute.

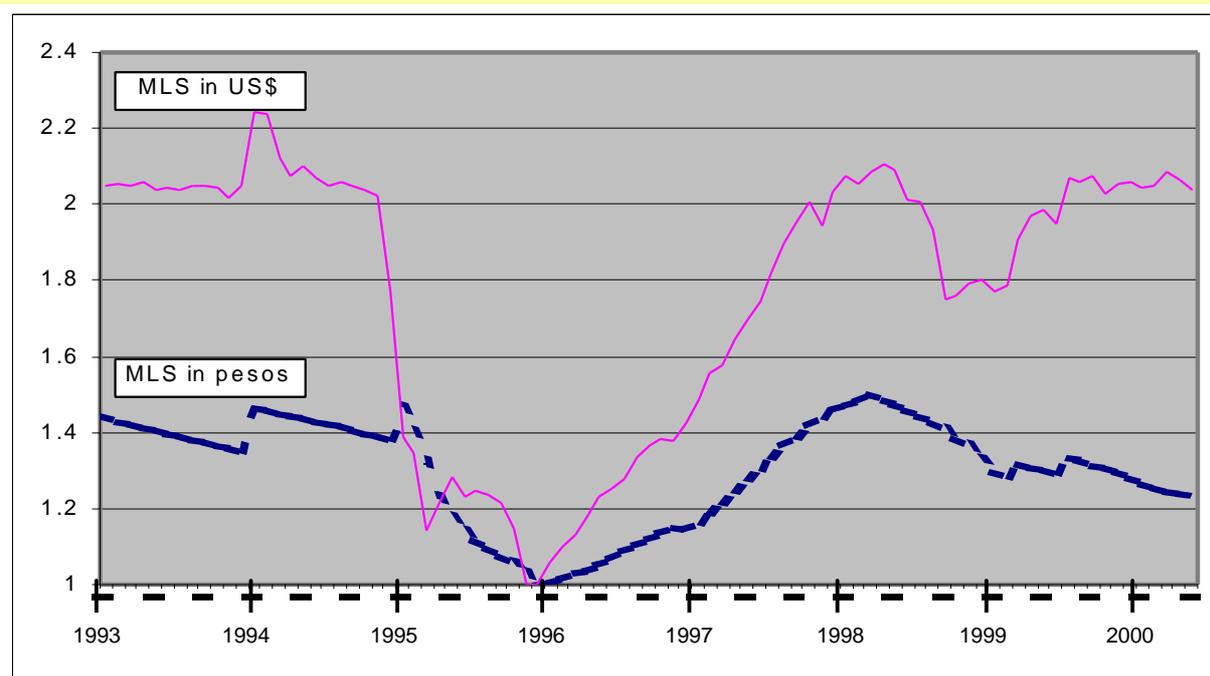
The decision by the SCT to set the interconnection rate at US\$ 0.036 per minute was based on the following: (i) the provisions contained in the Telmex concession, which established that the interconnection charge had to be at least US\$ 0.05 per minute at that time;⁵ and (ii) the SCT estimate of the effective rate for measured service. According to COFETEL, the charge of US\$ 0.036 "was determined by the difference between the rate of US\$ 0.055 per minute and the approximate rate for measured service of US\$ 0.019 per minute".⁶

7.2 Onset of the macroeconomic crisis

Starting in December 1994, when the country's macroeconomic crisis began, the origination charge collected by the fixed network ceased to be indexed to inflation. This meant that, from that moment, the real value of the origination charge began to erode thanks to inflation and devaluation of the peso vis-à-vis the United States dollar. This was a period of major adjustments in relative macroeconomic prices (exchange rate, wages and salaries, etc.), as well as in the prices for other goods and services. For example, Figure 2 below shows the evolution of the level for the measured local service tariff from January 1993 to May 2000.

Figure 2: Monthly evolution of the measured local service rate in constant US\$ and MXP

Jan. 1993-May 2000 (index Dec.95 = 1)



Note: The solid line shows the measured local service rate per call in United States dollars as an index based on the December 1995 rate (which is set at 1.00). The dotted line shows the measured local service rate per call as an index in constant December 1995 pesos, using the national consumer price index (INPC) as a deflator. In December 1995, the nominal measured local service rate was MXP 0.517 per call, equivalent to US\$ 0.0675 (the exchange rate in December 1995 was MXP 7.66=US\$ 1.00). See Annex 2.

Source: Adapted from Cofetel, Banco de Mexico.

⁵ Pursuant to clause 6.8 of the Telmex licence, as amended in October 1990, interconnection charges during the period 1991 to 1996 could only be changed at six-month intervals, and could not be less than five cents per minute (i.e., US\$ 0.05), in 1990 United States dollars, converted to Mexican pesos at the current rate of exchange.

⁶ COFETEL. "Tarifas de interconexión para servicios inalámbricos en México" ["Interconnection rates for wireless services in Mexico"]. Presentation to the Second Interconnection Workshop, ALACEL. Cancún, Mexico, 29 April 1999.

Examination of Figure 2 reveals the following points:

- The real measured local service rate, whether expressed in United States dollars or in constant Mexican pesos, varied widely. This was a reflection both of how the government administered fluctuations in the maximum nominal rates for local telephone service and of the evolution of two key macroeconomic variables: the exchange rate and the overall price level. From the end of 1994 to 1996, Mexico faced one of the most severe macroeconomic crises in its history, the result primarily of a gaping balance-of-payments shortfall. It is during this period of crisis that the greatest relative price variability is observed.
- Over all, during the period 1993 to 2000 the evolution of the measured local service rate appears quite different depending on whether it is measured in United States dollars or in constant Mexican pesos. Clearly, the variability of the rate as expressed in United States dollars was substantial owing to the sharp decline in the value of the Mexican peso against the United States dollar and the freezing of nominal measured local service rates for the duration of the macroeconomic crisis that struck at the end of 1994. In less than one year, the measured local service rate as expressed in United States dollars fell by one-half.
- December 1995 represented one of the lowest points for the macroeconomic crisis. From that month onward, the measured local service rate expressed in United States dollars began to make its way back to pre-crisis levels. This happened towards the end of 1997 and at the start of 1998.
- The variability in the measured local service rate as measured in constant Mexican pesos is less than the variability in the rate as measured in United States dollars. Broadly speaking, both exhibit similar trends except for the period from 1999 onwards. From then on, the measured local service rate falls as measured in constant Mexican pesos, while the rate as expressed in United States dollars rises towards pre-crisis levels. This is attributable to continuing inflation and the nominal appreciation of the Mexican peso vis-à-vis the United States dollar, the latter having been an especially strong factor in recent months.

7.3 Interconnection and long-distance networks

Since the privatization of Telmex in 1990, the government announced that the competition in long-distance would start in 1997. Condition 5-4 of the Telmex concession contract established specifically that “Starting January 1, 1997, the SCT might oblige Telmex to allow to interconnect other long-distance public networks in such a way that the fixed subscriber may choose his long-distance carrier.”

In 1996, when the government announced again that long-distance services would be opened to competition the following year, negotiations began for interconnections between long-distance operators and the incumbent Telmex. In Mexico, as in most countries, the legal framework for interconnection provides that the parties concerned must begin their negotiations on their own, and that if the negotiations are not successful both parties may ask the government to step in and resolve any disagreements. The government established a three-month period for negotiations between the parties, from January to March of 1996. If the parties failed to reach an agreement, the SCT would settle the matter by setting the interconnection charges itself. As was only to be expected given the gulf between the two parties' negotiating positions, no agreement was reached and the government had to step in and settle the matter.

Phase I: Transitional Regime

In April 1996, the SCT resolved the dispute between the long-distance operators and Telmex over interconnection charges. On a transitional basis, a two-part interconnection charge was established as follows:

- A charge was established for originating or terminating calls on Telmex's fixed network for traffic from both domestic and international long-distance operators. This access charge was set at MXP 0.19 per minute, equivalent to US\$ 0.0254 (using the average rate of exchange for April 1996 of MXP 7.4713 = US\$ 1.00).
- For incoming international long-distance traffic, a surcharge was established of 58 per cent to be applied to the international accounting rate for incoming international long-distance calls. At that time, on the

basis of the accounting rate then in force, the surcharge amounted to approximately US\$ 0.23 per minute, and its impact on the average interconnection charge was around US\$ 0.0282 per minute.⁷

- Therefore, the weighted average interconnection charge for 1997 was estimated at US\$ 0.0536 per minute (i.e., US\$ 0.0254 + 0.0282).
- The SCT Resolution also established that in 1999 the interconnection charge could not be higher than the equivalent to US\$ 0.031 per minute.

Only those long-distance licensees authorized by the SCT to have an international teleport may be interconnected directly to their international counterparts. The regulations established the “proportional return” system and “uniform settlement rates”. Under the proportional return system, calls entering Mexico are divided amongst the long-distance licensees in proportion to the volume of outgoing traffic originating with each of them.

At that point of time, for a variety of reasons, the country entered a phase marked by disputes between some long-distance operators and Telmex. The long-distance operators and Telmex then decided that their disagreements needed to be resolved by the courts. The following were some of the most bitter areas of dispute between Telmex and the long-distance operators:

- The long-distance operators opposed the two components of the interconnection charge. They argued that the charge for terminating long-distance traffic was too high, and included an unwarranted subsidy of US\$ 0.016 per minute to Telmex. They maintained that the regulatory authorities themselves had publicly stated that the long-run incremental cost per minute of terminating or originating traffic on the fixed network was no more than US\$ 0.010 per minute.
- The long-distance carriers opposed the 58 per cent surcharge, considering that it had no justification other than to favour Telmex over new entrants.
- The cost of the so-called “special interconnection projects” was disputed. These “special projects” would correspond to the modifications and investments made in Telmex telephone network to enable it to accommodate the interconnection of new long-distance operators. Although the Telmex estimate for the special projects was much higher, Telmex agreed to accept the figures calculated by Bellcore, which reckoned the amount to be recovered for the special projects at US\$ 423 million. The Telmex view was that this amount had to be paid only by the new long-distance operators entering the market. However, a SCT Resolution was issued recognizing the existence the special projects at US\$ 423 million, but it mandated that the cost had to be shared by all long-distance carriers including, of course, Telmex.

One of the key issues underlying the discussions in Mexico at that time was whether the rebalancing of the basic telephone tariffs had been fully accomplished. For instance, Telmex argued that the current local rates did not contribute to recover local network costs. It seems that there was a general belief among the key actors (i.e. Telmex, Government, new entrants) that the rebalancing program had not been fully completed, but the point of disagreement was the extent of the misalignment of the tariffs and whether the best way to offset it was to impose an interconnection charge well above long run incremental costs. The SCT Resolution recognized that local rates were not fully rebalanced, but it seems that the main obstacle to rebalance the local rates, i.e. set up them just above their long run incremental costs, was the political opposition to do so.

Disputes between the long-distance operators and Telmex continued to escalate since the SCT Resolution of April 1996. In the interim, in August 1996, COFETEL was established. An additional consequence of the interconnection surcharge (58 per cent of the settlement rate) for the incoming international traffic has been the increase of by-pass activities for transporting international traffic. Since the surcharge made incoming telephony traffic costly for competing carriers to supply, they partially circumvented the high interconnection rates through a more intensive use of private lines. Thus, private lines circuits with the U.S were 5 per cent in 1995, 32 per cent in 1996, 39 per cent in 1997 and 42 per cent in 1998.

⁷ See COFETEL slide presentation, “Telecommunications in Mexico: Regulatory Issues and the Teledensity Challenge.” Presented at the Interconnection Latin America 99 Conference, Miami, Florida, 27 April 1999.

Phase II: New interconnection regime (from December 1998)

From 1996 until 1998, Telmex was able to advance with its rebalancing process: local rates increased and long-distance rates came down in real terms.⁸ On 27 November 1998, COFETEL established a new set of charges and conditions for interconnection between fixed and long-distance,⁹ fixed to mobile,¹⁰ and fixed to fixed networks, to be applied from 1 January 1999 to 31 December 2000.

7.4 Interconnection between local and long-distance networks

The key features of the new interconnection regime between local and long-distance traffic were as follows:¹¹

- A flat interconnection charge per minute was established for all types of calls originated or terminated in the fixed networks: MXP 0.261 per minute (equivalent to US\$ 0.026 per minute). The 58 per cent surcharge on the incoming international calls was eliminated. The new charge would cover for the following interconnection costs: switching, transmission, administration and monitoring systems and all the required functions to originate or terminate a call on the Telmex local network.
- Telmex might apply a surcharge of 5.7 per cent on the Alestra total billed interconnect minutes for unsuccessful calls.
- A transit interconnection charge of MXP 0.0507 per minute (equivalent to US\$ 0.005) that Telmex might charge for transiting calls of other networks was established.
- The interconnection charge did not include the costs of the “special projects” or interconnection links, ports and co-location.
- The Telmex charges for links, ports and co-location must be registered with COFETEL. These charges, as well as the interconnection charge per minute will vary according to an indexation formula. The interconnection charge for the month t (w_t) would be equal to

$$w_t = w_o \frac{p_{t-2}}{p_0}$$

where w_o is the interconnection charge in October 1998, p_{t-2} is the national consumer price index (INPC) of month $t-2$, and p_0 is the INPC for October 1998.

7.5 Interconnection between local and mobile networks

In November 1998, COFETEL also established the guidelines of what were to become the new conditions for interconnection between fixed and mobile networks to help pave the way for the imminent introduction of the “calling party pays” system.¹² The following are some of the provisions that COFETEL has established with respect to charges:

- The CPP system has been applied only for local calls originated from a fixed or mobile telephone to a mobile telephone within the same local area. It does not apply for long-distance incoming calls to a mobile telephone.
- The charge for terminating traffic on mobile networks was set at MXP 1.80 for each minute or fraction thereof.
- The charge for originating or terminating calls in the fixed networks has been established at MXP 0.2573 per minute if the point of interconnection fixed-mobile is at tandem switches, and MXP 0.2440 per minute if the interconnection is at terminating switches.

⁸ See for instance the evolution of the measured local rate in Figure 2, both in constant pesos as well as in US\$.

⁹ Resolution No P/271198/0281 of 27 November 1998 established the charges and other interconnection conditions between the fixed network of Telmex with Alestra.

¹⁰ Resolution No P/271198/0282, 27 November 1998.

¹¹ COFETEL Resolution No P/271198/0281, 27 November 1998.

¹² COFETEL Resolution No P/271198/0282, 27 November 1998.

- There is no charge for call attempts.
- The numbers for mobile subscribers opting for the CPP system are given a prefix of “044” so that fixed subscribers making calls to mobile subscribers on the CPP system can be identified.
- Telmex has been given the freedom to set the fixed-to-mobile rate freely, and that rate could include a tariff for billing and collection.
- A transit interconnection charge was established at MXP 0.0507 per minute.
- An indexing mechanism based on the national consumer price index (INPC) was established. The interconnection charge for the month t (w_t) would be equal to

$$w_t = w_o \frac{P_{t-2}}{P_0}$$

where w_o is the interconnection charge in October 1998, p_{t-2} is the INPC of the month $t-2$, and p_0 is the INPC for October 1998.

7.6 Interconnection between local networks

In November 1998, COFETEL determined that the fixed-to-fixed interconnection would be done on basis of reciprocal interconnection charges.

However, during the first quarter of 1999 COFETEL introduced some changes for interconnection between fixed local networks. For interconnection purposes between fixed networks, COFETEL classified on an ad-hoc basis two types of carriers: those such as Telmex, who serve both residential and commercial customers and have universal service obligations built in their concession contracts, and those “specialized” operators, who basically target corporate and business users in highly populated areas and have limited coverage in the local area, like fibre rings and microwave access. The key criteria for the classification of a non-specialized operator is that the carrier must have “a significant percentage of residential users” but COFETEL has not yet explicitly quantified it.

- The interconnection agreements of Telmex with “specialized” networks were amended to incorporate asymmetrical interconnection charges. The “specialized” networks would get a lower interconnection charge than Telmex: US\$ 0.01 per minute, which COFETEL considers is enough to cover the “specialized” networks’ costs for terminating calls. Since these “specialized” networks attend basically corporate and business users and their tariff structure for that market would be above costs, there would be no need for a contribution to the residential access deficit.
- The interconnection agreements between Telmex with other local networks with “a significant percentage of residential users” were amended to incorporate a “bill and keep” scheme for interconnection payments. Under a “bill and keep” agreement, if the imbalance between calls originated by Telmex and terminated in the competitor fixed network and the calls originated by the competitor fixed network and terminated by Telmex during a month does not exceed a predetermined percentage, then no interconnection fee amounts are payable by the net user of interconnection services. If the imbalance is greater than the predetermined percentage, then the net user must pay interconnection fees in excess of the predetermined percentage.¹³

In summary, the current interconnection regime in Mexico was primarily formulated with the COFETEL Resolutions at the end of 1998. Table 6 summarizes the interconnection charges applicable in Mexico from December 1998 for the various kinds of interconnection.

¹³ For instance, in the case of the interconnection agreement between Telmex (the incumbent) and Maxcom Telecommunications, S.A. de C.V., a new telecommunications operator, the predetermined percentage established in their interconnection agreement is decreasing over time from February 1999 until September 2002: 40 per cent, 25 per cent and 15 per cent. In addition, if the imbalance of traffic between Telmex and Maxcom exceeds 70 per cent in any given month, the “bill and keep” scheme would no longer apply for that month. See, Maxcom. (2000). “Offering Memorandum.” 10 March.

7.7 Calling-Party-Pays

On 16 April 1999, COFETEL made a public announcement that “COFETEL had reached [the day before] agreements with the telephone industry to implement the “Calling-Party-Pays” system starting 1 May 1999.”¹⁴

Table 6: Interconnection charges in Mexico

IN US\$ and MXP for December 1998

	Amount		Type of interconnection		
	MXP	US\$	Fixed-to-mobile	Fixed-to-long-distance	Fixed-to-fixed
Charge for termination on the fixed network, per minute (tandem exchanges)	0.262	0.0264	Yes	Yes	No
Charge for termination on the fixed network, per minute (terminating exchanges)	0.247	0.0249	Yes	Yes	No
Charged for termination on specialized fixed networks, per minute (see Note 1)	0.100	0.0101	No	No	Yes
Charge for termination on similar fixed networks (see Note 1)	Bill and keep		No	No	Yes
Charge for termination on the mobile network, per minute	1.90	0.1917	Yes	No	No
Billing and collection “tariff”, per minute (see Note 2)	0.60	0.0605	Yes	No	No
Transit charge (see Note 3)	0.0507	0.0050	Yes	Yes	Yes
Interconnection port, per port					
One-time payments	7 353	742	Yes	Yes	Yes
Monthly payments	1 481	149	Yes	Yes	Yes
Co-location, squared meter					
One-time payments	108 000	10 896	Yes	Yes	Yes
Monthly payments	18 000	1 816	Yes	Yes	Yes
Interconnection links, per E1					
One-time payments	70 784	7 141	Yes	Yes	Yes
Monthly payments	5 175	522	Yes	Yes	Yes
Exchange rate, December 1998: MXP 9.9117 = US\$ 1.00					

Note 1: COFETEL has divided local operators into two types: those called “specialized” operators which have no commitments in regard to universal service and whose markets consist mainly of commercial customers; and other operators which do have commitments in regard to universal service and whose customer base is not limited to businesses.

Note 2: Legally, the billing and collection has a tariff even when in the practice it may be considered as an interconnection charge.

Note 3: This is the charge levied by one network that serves as an indirect interconnection between two other networks.

Source: Adapted from COFETEL.

¹⁴ See COFETEL Bulletin 17/99, 16 April 1999.

In the same announcement, COFETEL said that the interconnection charge that the Telmex fixed network would pay to mobile networks for termination of calls would be MXP 1.90 per minute (*not* MXP 1.80 per minute as it was established under the COFETEL Resolution P/271198/0282).¹⁵ On the other hand, the fixed to mobile call tariff that Telmex would charge to its fixed subscribers would be MXP 2.50 per minute. This fixed-mobile tariff would suffice to cover the interconnection costs and the expenses incurred by the fixed network for billing and collection of the fixed to mobile calls.

It is important to point out the following: (i) COFETEL has certain discretionary power to set up interconnection charges. It exercised this power by setting the terminating charge in mobile networks as demonstrated by Resolution P/271198/0282; (ii) FTL and the Telmex concession contract provide that the concessionaire has the freedom to set up its own tariffs, so the fixed-mobile tariff could be set up by Telmex at MXP 2.50 per minute; (iii) as a result of (i) and (ii), it was implicitly acknowledged that the “tariff” for billing and collection was MXP 0.60 per minute, equal to the difference between the fixed-mobile tariff (MXP 2.50 per minute) and the mobile terminating charge (MXP 1.90 per minute.) But in this way, COFETEL was giving up its discretionary power to consider billing and collection service under CPP as an essential facility of interconnection, and hence to regulate its level.¹⁶ Alternatively, even when Telmex has the freedom to set up its own tariffs, this right has to be exercised within the limits of public interest, as COFETEL itself stated in its Resolution No P271198/0282.¹⁷

Another important change introduced by the April 1999 announcement was that the fixed-mobile tariff would not change during the first six months of functioning of the CPP system. Therefore, the indexation rule for mobile interconnection charge based on past inflation was no longer in place. In fact, the levels of the fixed-mobile tariff and the terminating charge in the mobile network have remained fixed in nominal pesos since their insertion in May 1999 when the CPP started.

Finally the “calling party pays” system for mobile networks was introduced on 1 May 1999. Table 7 shows the scheme of payments for fixed-to-mobile and mobile-to-fixed calls as of May 2000.

There are some features of Table 7 that deserve some comments:

- For terminating calls on the fixed network, the interconnection charge at tandem level in May 2000 would have been MXP 0.3098 per minute or US\$ 0.032578. The estimation of the charge as of May 2000 assumes that the indexation rule mandated in Resolution P/271198/0281 has been applied.¹⁸ Thus, since the nominal charge in October/November 1998 was MXP 0.2573 per minute, and the ratio of price indexes March 2000/October 1998 was 1.203855,¹⁹ the nominal charge in May 2000 would have been MXP 0.30975 per minute, equivalent to US\$ 0.032578 at the exchange rate of May 2000 MXP 9.5081 = US\$ 1.00.
- For interconnection billing purposes, each mobile to fixed call is registered in seconds of duration. At the end of the billing period (i.e. one month), all the calls are added together to get an aggregated number of terminated seconds in the fixed network, and only then is the figure in seconds rounded up to total minutes. This billing for interconnection purposes means that, in practice, each mobile to fixed call is billed by the second.

¹⁵ During October 1998 and March 1999, the inflation rate was 9.3 per cent as measured by the INPC (see Annex 2). According to the indexation rule established by Resolution No. P/271198/0282, the interconnection charge for April 1999 would have been MXP 1.97 per minute (i.e. MXP 1.80 * (1+0.93)).

¹⁶ Under a CPP system, the billing and collection service to be provided by the fixed incumbent operator can be considered as an essential facility as: (i) it is used by the owner of the facility to provide its own mobile services; (ii) it cannot be duplicated by the mobile competitor and the denial of access to the service would harm substantially the competition in the mobile market; (iii) there is absence of valid reason for not providing access to the service. For further discussion on the essential facility doctrine, see Vogelsang, I. And Mitchell, B. (1997). *Telecommunications Competition: The Last Ten Miles*. Cambridge, MA: MIT Press/AEI Press.

¹⁷ The next section explains in more detail the background discussions that took place before the establishment of the billing and collection “tariff” (charge) of MXP 0.60 per minute.

¹⁸ Note that the indexation rule for interconnection charges applies only for the fixed network’s interconnection charges, but it does not apply for the mobile network’s interconnection charges.

¹⁹ It is interesting to note that the inflation rate, as measured by the change in the INPC between March 2000/October 1998, has been 20.4 per cent, whereas the exchange rate, as measured Mexican pesos by US\$ 1.00, has appreciate in nominal terms 8.4 per cent during the same period.

- Since their insertion in May 1999, both the fixed-mobile tariff (MXP 2.50 per minute) and both of its components, the mobile terminating charge (MXP 1.90 per minute) and the billing and collection rate (MXP 0.60 per minute), have remained the same in nominal pesos.²⁰
- In May 2000, for each fixed-to-mobile call a fixed subscriber had to pay the following: (i) a measured local service tariff (US\$ 0.1375 per call or MXP 1.307); (ii) a fixed-mobile tariff (US\$ 0.2631 per minute or MXP 2.50 per minute) which comprises the terminating interconnection charge per minute in the mobile network (US\$ 0.20 or MXP 1.90) and the billing and collection tariff per minute (US\$ 0.0631 or MXP 0.60).

However, in contrast to the mobile-to-fixed calls, the mobile operator rounds each fixed-to-mobile call to the nearest minute, which makes the effective price per minute higher than the nominal price. This means that fractions of a minute are rounded upwards, so that a call lasting 10 seconds or 59 seconds is billed as though it had lasted one minute, a call that takes 1.5 minutes is billed as though it had lasted two minutes and so on. The next section describes the effects of the rounding up of call durations on the effective fixed-to-mobile calls.

Table 7: Payment scheme for local calls between mobile and fixed subscribers, May 2000 (US\$)

Direction of call	Mobile subscriber	Mobile network	Fixed network	Fixed subscriber	Remarks
<i>Mobile to fixed</i>	Air-time rate per minute X ¢ per minute (“Calling party pays” system)	Pays charge for terminating call on the fixed network: 3.26 ¢ per minute (See Note 1)	Receives charge for terminating call on the fixed network 3.26 ¢ per minute (See Note 1)	Pays nothing 0 ¢	Interconnection fixed-mobile is at tandem level.
<i>Fixed to mobile</i>	Pays nothing (“Calling party pays” system)	Receives charge for terminating the call on the mobile network: 20¢ per minute	Receives tariff paid by fixed subscriber Pays charge for terminating the call on the mobile network: 20 ¢ per minute	Measured local service rate: 13.75 ¢ per call + Charge for terminating the call on the mobile network: 20 ¢ per minute + Billing and collection charge: 6.31 ¢ (See Note 2)	Effective fixed-to-mobile rate paid by fixed user is: 40.29 ¢ per minute (See Note 3)

Note 1. In Mexican pesos the termination charge at trunk exchanges was MXP 0.2573 in October 1998. Average exchange rate in May 2000: MXP 9.5081 = US\$ 1.00. Domestic inflation March 2000/October 1998: 20.4 per cent. See text.

Note 2. In Mexican pesos the prices are: (1) measured local service rate, MXP 1.307; (2) termination charge on the mobile network, MXP 1.90; (3) billing and collection charge, MXP 0.60. Average rate of exchange in May 2000: MXP 9.5081 = US\$ 1.00.

Note 3. The effective rate assumes an average call duration of two minutes. Value-added tax of 15 per cent is not included. The calculation method is described later in this paper and in Annex 1.

Source: COFETEL, Banco de Mexico. Own elaboration.

²⁰ In addition to its April 1999s announcement, COFETEL has issued two additional announcements regarding the fixed-mobile tariff and the mobile interconnection charge: the first in October 1999 (Bulletin 43/99, 28 October 1999) and the second in April 2000 (Bulletin 16/2000, 28 April 2000). The former kept, in effect, both prices until 30 April 2000, and the latter extended it for additional six months until 31 October 2000.

8 Effective Tariffs

8.1 Fixed-to-mobile tariff

How much, on average, does a fixed subscriber effectively pay for each minute that he makes a call from his fixed telephone to a mobile subscriber? This depends not only on the nominal rate per minute established for the fixed-to-mobile rate, i.e., MXP 2.50 per minute, but also on the average duration of a call and any other rates that may come into play, such as whether or not the fixed subscriber has exceeded his minimum allocation of 100 calls. As will be seen, the effective rate per minute is much higher than it might seem at first glance.

The following factors are taken into consideration to obtain an estimate of the effective rate.

- It is assumed that the average duration of fixed-to-mobile calls is 2.0 minutes per call.²¹
- The fixed-to-mobile rate is assumed at MXP 2.50 per minute or US\$ 0.263 at the exchange rate of MXP 9.5081=US\$ 1.00 of May 2000. That tariff consists of MXP 1.90 for the charge for termination on the mobile network, plus MXP 0.60 for billing and collection.
- The measured local service connection rate is assumed at MXP 1.307 per call or US\$ 0.137 at the exchange rate of MXP 9.5081=US\$ 1.00 of May 2000. That rate is independent of the call duration and is applied to those fixed subscribers who make more than 100 calls per month.
- Billing of fixed-to-mobile calls is based on measuring the duration of each call in one-minute intervals or pulses. Fractions of a minute are rounded upwards, i.e. a call that takes 10 seconds is billed as if it lasted one minute, etc. The moment a fixed-mobile call is completed, i.e. the mobile party answers the call, two initial pulses are transmitted to the register of the fixed subscriber. As long as the conversation continues, the register periodically accumulates pulses every 60 seconds.
- It was assumed that the distribution of calls follows a negative exponential distribution function depending of the average call duration.

The calculation is as follows: if the mean duration of a call is two minutes, then the effective tariff paid by a fixed subscriber making a call to a mobile subscriber is *MXP 3.83 per minute or US\$ 0.4028 per minute* at the exchange rate of MXP 9.5081=US\$ 1.00 (May 2000). By decomposing this effective tariff into its components, it can be estimated that 83 per cent of it comes from the rounding up of the tariff of MXP 2.50 per minute, and 17 per cent is attributable to the effect of the MXP 1.307 tariff per call.

In general, the shorter the duration of a call, the higher the effective tariff due to the rounding up of calls. The impact of the tariff by call or event on the effective tariff per minute, will be also inversely related to the duration of the call, since the fixed value of this component could be distributed among more minutes in a long call than in a short call. For instance, if the assumption of average duration of a call was one minute instead of two minutes, the effective tariff would be US\$ 0.553 per minute and the proportion attributable to the tariff per call would be 25 per cent instead of 17 per cent.

8.2 Mobile-to-fixed tariff

It is interesting to compare the foregoing results with the effective mobile-to-fixed rates. For the two main mobile competitors, the nominal rates in pesos did not change following the introduction of the CPP system, remaining the same from March 1999 to May 2000. Table 8 shows Telcel main rate plans in effect in May 2000 expressed in United States dollars.²²

²¹ This is a COFETEL unofficial estimate. Some mobile operators indicate that the average call duration is lower than this number, but other operators suggest a higher value. In Annex 1, we develop in great detail the methodology used to estimate effective tariffs and present different scenarios for effective tariffs depending on the assumed average duration of a call.

²² Only Telcel plans are shown here because IUSACELL rate plans are very similar.

Table 8: Telcel mobile consumer rate plans, May 2000 (US\$*)

Type	Plan name**	Monthly rental	Peak air-time (per minute)	Off-peak air-time (per minute)	Average rate*** (per minute)
Analogue	<i>Básico</i>	30	0.26	0.16	0.24
	<i>Master</i>	97	0.21	0.13	0.19
	<i>Práctico</i>	38	0.25	0.15	0.23
Digital	<i>Clásico</i>	25	0.27	0.27	0.27
	<i>Global</i>	100	0.18	0.18	0.18
Prepaid			0.46	0.46	0.46

* May 2000 exchange rate: MXP 9,5081 = US\$ 1.00

** Free minutes on each plan: *Básico*, 30 minutes; *Master*, 300 minutes; *Práctico*, 100 minutes, *Clásico*, 50 minutes; *Global*, 380 minutes; Prepaid, 0 minutes.

*** Assumption: Peak traffic, 80 per cent; off-peak traffic, 20 per cent.

Source: Telcel

The last column in Table 8 shows the weighted average rate for the various plans. It was not possible to estimate a weighted average tariff for the mobile user since there was no available information of the traffics per plan. However, it is interesting to note the following: the simple average tariff for the analogue plans was US\$ 0.22 per minute, and the simple average for the digital plans was also US\$ 0.22 per minute. Assuming that 20 per cent of the consumers are under traditional plans and 80 per cent are under prepaid, the average rate for mobile consumers would be US\$ 0.411 per minute without considering the effect of the rounding up. Table 9 shows the same information on rates per minute and estimates the effective rate charged per minute for purposes of comparison with the fixed-to-mobile per minute rate.

Effective average rates for the analogue and digital plans would be US\$ 0.28 and US\$ 0.29 per minute, respectively, which are considerably lower than the effective fixed-to-mobile rate of US\$ 0.40. On the other hand, the effective rate for the prepaid plan is significantly higher: US\$ 0.58 per minute. On average, the effective mobile-to-fixed tariff would be 30 per cent higher than the effective fixed-to-mobile rate.

With the entry of new competitors in the mobile market, such as Pegaso and Unefon, more competition in mobile prices is expected. For instance, since May 2000, Unefon has launched its mobile services with an introductory average price of MXP 1.00 per minute, equivalent to US\$ 0.105 per minute at the exchange rate of MXP 9.5081 = US\$ 1.00 in May 2000. The nominal US\$ 0.105 per minute tariff would be the lowest rate in the market as can be seen in the second column of the table.

As of May 2000, Pegaso was the only mobile provider offering its customer billing by the second, with a minimum ten-second billing for each call. This may exert competitive pressure on competitors to adopt billing systems closer to billing by the second. For instance, for prepaid minutes, the nominal per minute tariff was at US\$ 0.46 in May 2000, but the effective tariff paid by customer was US\$ 0.58, i.e. a 26 per cent increase just due to the rounding up to the minute.

Table 9: Per-minute rates for Telcel plans (US\$)

	Average rate - Nominal (*)	Average rate - Effective (**)
Analogue <i>Básico</i>	0.24	0.31
<i>Master</i>	0.19	0.24
<i>Práctico</i>	0.23	0.29
Digital <i>Clásico</i>	0.27	0.34
<i>Global</i>	0.18	0.23
Prepaid	0.46	0.58

(*) From Table 8.

(**) Assumes an average call duration of two minutes.

Source: Adapted from Table 8 and methodology described in Annex 1.

9 Fixed-Mobile Interconnection as of June 2000

9.1 Billing and collection charge

The charge that Telmex levies on mobile operators for billing and collection, at MXP 0.60 per minute, is considered excessive by the mobile operators. Telmex, and its subsidiary Telcel, regard the current level of the charge as appropriate.

COFETEL has asked Telmex to justify the charge in writing and will decide on the matter in October 2000. However, there is a further problem in regard to the revision of this charge by COFETEL. Resolution P/271198/0282 specifically sets the amount of the charge that the mobile networks can collect for terminating calls on their networks, as MXP 1.80 for each minute or fraction thereof (Article 2 of the resolution) or US\$ 0.18 at the average rate of exchange in effect in October 1998.²³

However, the same resolution gives Telmex and Telnor the freedom to set the rates to be charged to their users for traffic to mobile telephones under the CPP system. Moreover, Article 3 of the Resolution P/271198/0282 provides that the rates must first be approved by COFETEL, which may set the rates in those cases where objectives in the public interest are not fulfilled.²⁴

The rate per minute from fixed to mobile subscribers was set by Telmex – i.e., by the operator of the fixed network. Given the freedom to set rates, Telmex set the rate which included a billing and collection tariff. It is this tariff that is the subject of dispute between the mobile operators (with the exception of Telcel, a subsidiary of Telmex) and Telmex.

In the negotiations that took place prior to setting the fixed-to-mobile rate between Telmex and the mobile operators, Telmex argued that a high charge was necessary for billing and collection functions because it would have to absorb charges that its customers refused to pay when its fixed subscribers decided not to pay higher rates for fixed-to-mobile calls than for fixed-to-fixed calls, and because the new CPP system would require Telmex to devote additional resources to handling customer enquiries, calls to the operator, complaints and so forth. In September 1998, Telmex officially presented its position on the matter. Its position was that both it and Telnor would withhold 70 per cent of the rate per call to mobile telephones, without assuming the collection risk, quite apart from the applicable local telephone charges. Given that the nominal fixed-mobile rate mandated by Resolution P/271198/0282 was MXP 1.80 per minute, the 70 per cent charge for billing and collection meant a charge of MXP 1.260 or US\$ 0.135 per minute (at the exchange rate of MXP 9.34 per US\$ 1.00 of September 1998).

For their part, the mobile operators sought a billing and collection charge well below the figure eventually levied by Telmex, citing cost reasons and international comparisons as their arguments. In July 1998, the mobile operators proposed that Telmex and Telnor withhold 11 per cent of the rate per call to mobile telephones for billing and collection, and assume the effective risk. This proposal by the mobile operators worked out to a billing and collection charge of approximately MXP 0.198 per minute, or US\$ 0.022 per minute (at the exchange rate of MXP 8.904 per US\$ 1.00 of July 1998).

It should be borne in mind that Telmex opposed the introduction of the CPP system, so it was in its interests to see the discussions on fixed-to-mobile rates drag on for as long as possible. Mediation by the regulatory body COFETEL brought the parties together on an intermediate position on which there was relative consensus. The mobile operators did not want to delay the introduction of the new system any longer. As well, there was some fear on the part of the mobile operators that if Telmex was not entirely in agreement with the billing and collection charge that it would be levying, Telmex could stop paying them the charges for terminating calls on the mobile networks. Indeed, this was part of the strategy being used by the long-distance operators in confronting Telmex: they sought redress from the courts and stopped paying the charges.

As an interim measure, COFETEL authorized the billing and collection rate to be set at MXP 0.60 per minute, while cautioning Telmex that the justification it had given for the level at which it had tried to set the charge was not entirely satisfactory. As a compromise, it was decided that the charge would be reviewed within a few months.

²³ The average rate of exchange in effect in October 1998 was MXP 10.15 = US\$ 1.00.

²⁴ It is not clear exactly what is understood by the notion of failing to fulfill objectives in the public interest.

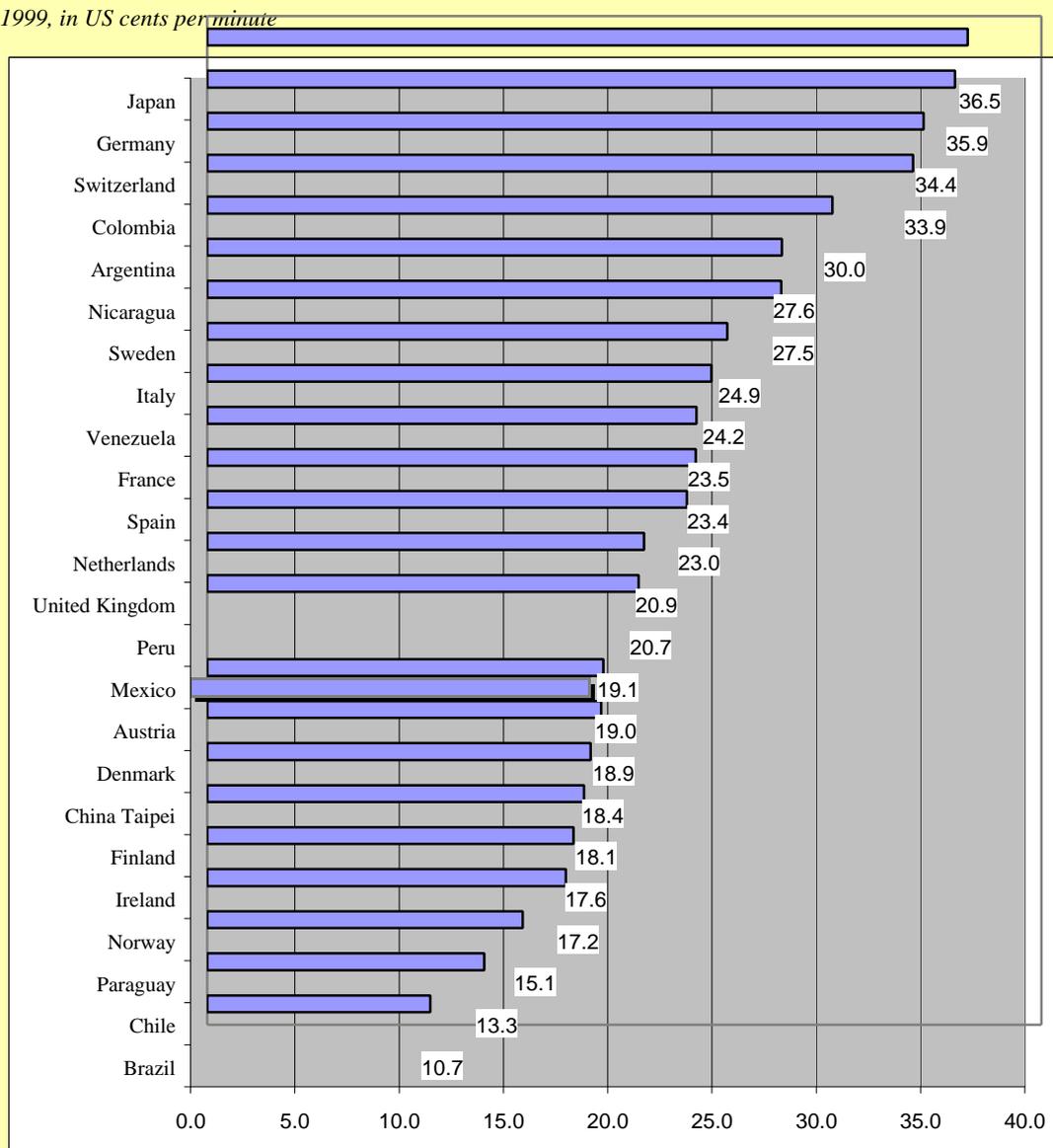
Table 10. Billing and collection rate for fixed-to-mobile traffic under the “calling party pays” system*In Mexican peso and US\$ per minute*

	Official proposal by mobile operators (July 1998)	Official Telmex proposal (September 1998)	Rate set by Telmex (May 1999)*
In Mexican peso	0.198	1.260	0.600
In United States dollar	0.022	0.135	0.064

* May 1999 was when the “calling party pays” system was introduced.

Source: Adapted from COFETEL Resolution P/271198/0282, 27 November 1998.

According to estimates of COFETEL, the fixed-to-mobile traffic per subscriber was 94 minutes per month in December 1999.²⁵ At US\$ 0.064 per minute for billing and collection, it means that Telmex is charging for that service a total of US\$ 6.0 per mobile subscriber per month, which seem to be high in terms of underlying costs and the international practice in other similar countries.

Figure 3. Interconnection rates for fixed-to-mobile calls in Mexico*November 1999, in US cents per minute*Source: Based on Briceno, A., *Economic Revision of the Interconnection Policy in Peru*, OSIPTEL Working Paper, December 1999.²⁵ See below a further discussion in section on structure of mobile traffic.

9.2 Interconnection charges incurred by mobile networks

The interconnection charge of MXP 1.90 per minute is a competitive charge when comparing it among a set of countries. As of November 1999, it can be observed that the Mexican interconnection rate of MXP 1.90 or US\$ 0.199 was among the lowest ten rates of a sample of 23 countries (Figure 3).²⁶ The simple average interconnection charge of the 23 countries of the sample was US\$ 0.233 per minute, i.e. 22 per cent above the Mexican level. The lowest interconnection charge was Brazil, US\$ 0.107 per minute, due to the devaluation of the Brazilian real during 1999.

9.3 Interconnection links

The Mexican legal framework establishes that each operator must reach the exchange of another interconnecting operator with its own interconnection links. Specifically, Article 9 of COFETEL Resolution P/271198/0282 provides that each operator must install the necessary links to terminate traffic in the destination network, that the links may be its own or leased, and that the costs thereof are to be borne by the operator that needs to terminate its traffic. The Resolution also establishes that interconnected operators may install bidirectional links and share the costs equally.

The practice followed by Telmex for the installation of interconnection links, however, has eschewed bidirectional links. Telmex asks the operators interconnecting with its fixed network to install unidirectional E1 links, for example, from the mobile network to the Telmex exchange.²⁷ These links carry the traffic originating on the cellular network and terminating on the Telmex network. For its part, Telmex undertakes to install unidirectional interconnection links from its exchange to the mobile network exchange.

There should be no serious problems regarding the agreements reached concerning the installation of interconnection links. However, weaknesses with this system have emerged in practice.

- Telmex has no incentive to install an adequate number of interconnection links from its exchanges to the mobile operators' exchanges. Moreover, the lack of links from the Telmex network to the networks of its mobile competitors works to its advantage because this has a direct impact on the proportion of calls completed from fixed telephones to its competitors' mobile telephones.²⁸ Some mobile operators report that three out of every 10 calls from fixed telephones to mobile telephones are not completed, and in some extent this may be attributable to the lack of adequate interconnection links between Telmex and the mobile networks.²⁹
- The mobile networks control the links that go out from their exchanges to the Telmex network, but they do not control the links that come into their networks from Telmex. This situation is aggravated by the leisurely pace at which Telmex installs the links. Telmex can take up to six months to install them. This is truly inadequate given that, in the past 12 months, the interconnecting mobile networks have been growing at an annual rate of over 100 per cent.³⁰
- A mobile operator has two options for installing unidirectional links from its network to Telmex's network. (i) It can hire Telmex to provide the interconnection links. The payments for an E1 link consist of: (a) a one-time charge, and (b) recurring monthly charges. If the mobile network chooses this option, it does not have to pay Telmex for the co-location service or for ports.³¹ (ii) The second alternative is for the mobile network to install its own links. In this case, it must pay Telmex for two interconnection services: (a) co-location; and (b) interconnection ports for each E1 link.³²

²⁶ See Annex 3 for an analysis of interconnection charges among 23 countries.

²⁷ As noted above, there is no legal obstacle that prevents interconnecting operators from linking their exchanges using bidirectional links and splitting the cost between them.

²⁸ A lower quality for completing calls from the Telmex fixed network to a Telmex competitor mobile network would put the latter in a disadvantageous situation compared to the Telmex mobile network, Telcel.

²⁹ On the other hand, the quality problems affecting mobile services in recent months may be attributable to some degree to the mobile operators' infrastructure lacking the capacity necessary to handle the burgeoning demand. It is well known that investments in expanding the capacity of telecommunication networks are "lumpy" in that they are neither marginal nor instantaneous.

³⁰ Telmex has argued that the real problem is the explosive growth in the demand of dedicated circuits for interconnection.

³¹ Another interesting feature worth noting is that Article 9 of COFETEL Resolution 0282 does not prohibit the interconnecting companies from leasing links from a third party. In practice, however, all links have been installed either by Telmex or by the interconnecting company because Telmex has refused to allow sharing of collocation sites.

³² Table 6 shows the charges for these interconnection services.

- Telmex argues that the requirement for having different link and ports for each type of traffic (i.e. local, mobile, long-distance, etc) is because of billing purposes. This argument would make sense when there are different interconnection charges for different services (as in the case of Mexico) and the Telmex billing system for interconnection is based on trunks. However, if there were just a single interconnection charge for all classes of services, there would be no need for requiring different interconnection links. The requirement of having different trunks or links depending on the type of traffic has some drawbacks: (i) the interconnecting operator cannot make full use of economies of scope of having just, say a single trunk or link by which all its types of traffic can be transported to the Telmex network; (ii) the interconnecting entrant using different links for different services has less flexibility of using more effectively its links when there are unexpected changes in the demand of its downstream services. The entrant may end up under using some links and/or over-using others links.

9.4 Asymmetry in the indexing of charges

Asymmetry exists in the treatment of interconnection charges and rates between the fixed and mobile networks. Interconnection charges on fixed networks are indexed according to the INPC with the purpose of cancelling the effects of inflation on the real value of the charges.

Although COFETEL Resolution P/271198/0282 authorized monthly indexation of interconnection charges on mobile networks (Article 11), the fixed-to-mobile tariff of MXP 2.50 per minute has remained the same in nominal pesos since its insertion, in spite of the current inflation and the fluctuation of the US\$ exchange rate.

9.5 Quality of mobile services

As noted above, the mobile market has seen explosive growth in recent months. The spectacular growth in the number of mobile subscribers and the resulting level of traffic has resulted in quality problems affecting mobile services (congestion, increase in the number of mobile calls not completed, etc.) to the point that COFETEL decided to intervene to resolve the issue.

It is very likely that even the mobile operators themselves underestimated the increase in demand in their business plans before introducing the CPP system. The only way to handle the unexpected excess demand is by expanding the mobile infrastructure to accommodate the new level of demand; in other words, additional investment is needed to increase the capacity of the mobile networks. In June of this year, Telcel announced publicly its commitment to invest US\$ 1.8 billion in infrastructure and equipment this year alone. Telcel has stated, "Owing to this [rapid] growth and the enormous demand for the service, our expectations and projections have been far outstripped in terms of both the number of subscribers and the volume of traffic per subscriber. Telcel [... will] install new infrastructure to expand and improve the network, [...] on occasions may have a momentary effect on the service [...]. Telcel is investing [in 2000] more than US\$ 1 800 million in infrastructure and equipment, more than it has invested in the last five years [US\$ 1 603 million from 1995 to 1999]."

An additional factor that may have increased the degree of congestion of the mobile traffic is that under the CPP system the majority of the mobile users do not disconnect their telephones as used to be the case when called party paid was the ruling system. A mobile telephone that is switched on occupies a portion of a communication channel, so it helps to increase traffic congestion.

On 20 October 1999, COFETEL and the mobile companies of Region 9 (Mexico City and the States of Mexico, Hidalgo and Morelos) signed the Quality Norms System that establishes the maximum quality allowable levels: 7 per cent dropped calls, 7 per cent blocked calls and call establishment time of 20 seconds. From 1 September 2000 until 31 March 2001, the maximum levels are set up to: 6 per cent of dropped calls, 5 per cent blocked calls and call establishment time of 12 seconds. Mobile operators unable to meet the standards are required to give bonus minutes to clients as compensation.

On 17 January 2000, COFETEL began to investigate the quality standards for the two major mobile providers (Telcel and IUSACELL.) Once the investigation was concluded both operators recognized they had achieved standards levels below the target levels, so both operators accepted to compensate their clients with airtime compensation during April and May of 2000.³³ The compensation scheme was as follows:

³³ See COFETEL. (2000). *Telecommunications in Mexico: Regulatory Changes and New Opportunities*. Slide presentation. May.

- For traditional plans: companies compensated users each month with additional airtime equivalent to 20 per cent of the existing time in their plans.
- For prepaid plans: companies compensated users each month with an additional 5 free minutes, which was an equivalent to 20 per cent of the monthly consumption for prepaid users.

9.6 Long-distance calls under the CPP system

One of the unique characteristics of the CPP system in Mexico is that it does not apply to domestic long-distance calls or to outgoing international long-distance calls.

9.7 Calls from mobiles

For long-distance calls from mobile telephones, the mobile network chooses the long-distance carrier to transport the call and sets up freely the long-distance tariffs to the mobile subscribers.

For off-net national long-distance calls, i.e. when a mobile call needs to be terminated in a local area where the mobile network does not have an interconnection point with the fixed network and the chosen long-distance carrier is, for instance, Telmex, the long-distance tariff that Telmex is required to offer to the mobile operator is a wholesale rate 38 per cent lower than the retail rate for national long-distance calls delivered through the fixed network.³⁴ According to COFETEL data, during the fourth quarter of 1999, the national long-distance tariff was MXP 1.35 per minute (equivalent to US\$ 0.1425 at the exchange rate of MXP 9.4586 = US\$ 1.00), so the tariff for off-net calls would have been MXP 0.8356 per minute (equivalent to US\$ 0.0883 per minute).

9.8 Calls to mobiles

For long-distance calls (national or international incoming calls) terminated by a mobile subscriber, it is the mobile subscriber who must pay to his/her mobile operator the equivalent of his airtime per minute rate as established in his/her rate plan. The mobile network does not receive any interconnection charge for terminating calls in its network.

However, some mobile operators claim they should be paid an interconnection charge at least for the international incoming calls terminating in mobile networks. They argue that the level of the charge should be at least the same as applied for terminating calls in a fixed network.

Mobile-to-mobile interconnection. Interconnections between mobile networks are indirect and employ transit services from Telmex. The rationale of mobile operators to use indirect interconnection (i.e. using Telmex's transit service) instead of direct interconnection is that because the traffic between mobile operators is low, it is economically more efficient to use transiting services. If the traffic increases between mobile networks there would be a certain point at which it would be economically convenient to establish a direct interconnection. The payments to which such interconnections give rise between mobile operators and with the Telmex fixed network are as follows:

- As of May 2000, the transit charge is estimated at MXP 0.061 per minute, equivalent to US\$ 0.0064 per minute.³⁵
- Each mobile operator receives from the other the standard charge for terminating a call on its network – i.e., MXP 1.90 for each minute terminated on a mobile network. Traffic charges are billed and settled directly between mobile operators without Telmex involvement. One of the advantages of this arrangement is that, if there are any problems on the destination network, the network on which the call originates is better able to pursue those problems with the mobile network terminating the call.
- However, one disadvantage of the aforementioned practice is the large number of billing and collection agreements that operators interconnected through transit services need to conclude: the number of agreements required grows exponentially as the number of interconnected operators increases. As an

³⁴ Off-net calls may represent an important fraction of the total outgoing national long-distance calls. In some cases, the proportion may reach 30 percent.

³⁵ Note that this interconnection charge is indexed according to inflation. The ratio of price indexes of the INPC was 1.203855 between March 2000 and November 1998; and the exchange rate for May 2000 was MXP 9.5081= US\$ 1.00.

alternative, Telmex may act as a clearing-house, i.e. Telmex would handle all the payments between the interconnecting networks using its transit service.

9.9 Structure of mobile traffic before and after CPP

One of the Telmex arguments against the introduction of CPP was that the fixed-to-mobile traffic was going to decrease as a consequence of the increase of the fixed-mobile tariff. Telmex was right when it expected an increase in the fixed-mobile tariff, but as it will be seen below, a satisfactory explanation of the ex-post behaviour of mobile traffic patterns deserves more investigation.

What does the data show in terms of traffic patterns? The public monthly aggregate traffic data as published by COFETEL is total number of mobile subscribers, total mobile traffic and ratios of outgoing and incoming mobile traffic. Using these data, the total minutes of use per subscriber was estimated at two points in time, March 1999 and December 1999. The results are shown in Table 11.

It was estimated that just before the introduction of CPP in March 1999, a mobile subscriber used to make an average 89 outgoing minutes and receive 73 minutes, which amounted to a total of 162 minutes per month. Eight months after the introduction of the CPP system, the average subscriber would have:³⁶

- Reduced his outgoing minutes of use from 89 to 83 minutes per month, i.e. a decrease of 7 per cent.
- Increased his incoming minutes of use from 73 to 94 minutes per month, i.e. an appreciable increase of 29 per cent.
- Increased the overall minutes of use from 162 to 177 minutes per month, i.e. an increase of 9 per cent.

The first result is not surprising given the steady decline in the average minutes of use per subscriber observed for outgoing mobile traffic since 1995. Thus according to COFETEL data, since 1995 the evolution of outgoing mobile traffic per subscriber has been:

- December 1995: 157 minutes per month
- December 1996: 110 minutes per month
- December 1997: 89 minutes per month
- December 1998: 93 minutes per month

The persistent decline in the average minutes of use per subscriber can be explained by the incorporation of new subscribers with very low usage patterns,³⁷ such that the average usage per subscriber declines each year. In turn, at least part of this may be a consequence of the massive introduction of prepaid system, by which low income subscribers are added to the mobile subscriber stock. With regard to mobile tariffs, as already analysed, they have not been changed before or since the introduction of CPP.

Table 11: Minutes of use per month by a mobile subscriber

	Before CPP March 1999	After CPP December 1999	Var.%
1. Outgoing mobile traffic	89	83	-7%
2. Incoming mobile traffic	73	94	29%
3. Total mobile traffic (1)+(2)	162	177	9%

Notes: Data used: Outgoing mobile traffic: 55% (March), 47% (December); Incoming mobile traffic: 45% (March), 53% (December)
Total minutes of use in million of minutes per month: 355 (March), 644 (December)
Mobile subscriber in thousands: 3985 (March), 7732 (December).

Source: COFETEL. Own elaboration.

³⁶ There was no official estimation provided to us as for the traffic mobile-to-mobile, but it seems that it has been a low proportion of the total mobile subscriber traffic, between 5 to 10 percent. This may introduce some bias to our estimates of average minutes of use per subscriber, since the calculations assumed that the traffic is just between mobile and fixed networks.

³⁷ For instance, prepaid subscribers consume much more less minutes than regular subscriber attached to traditional plans.

What it is difficult to explain is the appreciable increase of 29 per cent of incoming mobile traffic i.e. the traffic originated by the fixed subscribers, in spite of the increase of the effective fixed-to mobile tariff. Thus, as has been shown, the effective fixed-to-mobile tariff went up from US\$ 0.115 per minute to US\$ 0.403 per minute, i.e. 250 per cent, before and after the introduction of the CPP system, respectively. If an absolute price elasticity is assumed for this traffic, one should expect a decrease instead of an increase in demand. So there should have been other factors that have helped to more than compensate for the price effect on the traffic from fixed-to-mobile.³⁸

10 Concluding remarks

The current fixed-to-mobile interconnection regime in Mexico has experienced a remarkable improvement in the last two years. Currently there is a more level playing field for mobile operators than before 1999. It can be argued that there are some problems with the practice of fixed-to-mobile interconnection and that there are some price and non-price issues that need to be reviewed but, overall, the current interconnection regime fixed local-mobile shows better characteristics than the local-long-distance interconnection or local-local interconnection regimes.

However, the fixed-mobile interconnection situation in Mexico has not been uniform throughout time, but has been subject to important changes generated from the regulation of its own telecommunication industry such as the developments in the local-long-distance interconnection regime, as well as the impact of exogenous factors such as the Mexican economic crisis of the mid 90s.

Two phases can be distinguished. The first phase, from 1990 until the end of 1998, is characterized by the non-reciprocity in interconnection charges: mobile operators had to pay a charge to terminate their traffic on the fixed networks, but the fixed networks had to pay nothing to terminate their traffic on the mobile networks. The country had one of the most severe macroeconomic crisis of its history that started in the mid 90s, which also impacted negatively in many areas of telecommunications, such as the development of relative prices of telecommunication services.

The second phase began at the end of 1998 and is characterized by the reciprocity of charges between mobile and fixed networks, the introduction of the CPP system, the widespread use of prepaid system, and the consolidation of the macroeconomic stabilization program. It is during this second period that there has been an outstanding increase of mobile penetration: it is estimated that as of May 2000, the mobile penetration is at the same level as fixed telephone penetration, 11 telephones per 100 inhabitants. Also during this phase, the Mexican government allowed the entry of more competitors to the telecommunications market by deepening the liberalization program in the telecommunications industry through better policies in interconnection, licensing, tariff, etc. For instance, there are new players in the mobile market who are willing to compete on prices and better quality with the two incumbent mobile operators, Telcel/Telmex and IUSACELL.

There are some important lessons that can be learned from the Mexican fixed-to-mobile interconnection experience. Here are some of them.

Market liberalization. It is a precondition to achieve a stronger telecommunications sector. Mexico is one example. It started the liberalization process in 1990 with the privatization of the incumbent, Telmex. Then, in 1997, competition in the long-distance market was introduced and thereon liberalization in other markets, including the mobile. However, the implementation of the liberalization and hence the development of competition is not instantaneous, but a process in which there are feedbacks between industry developments and policy-making.

Level of the interconnection charge in mobile networks. It may be convenient for a country to establish cost-based interconnection charges to terminate traffic in mobile networks, mainly when a CPP is introduced. In the case of Mexico, even when the charge of MXP 1.90 per minute, equivalent to US\$ 0.20 in May 2000 can be considered adequate according to the international practice, there is a certain degree of consensus that that

³⁸ A possible explanation is the following. Before CPP, a mobile subscriber used to keep off his mobile set at certain times to avoid receiving unwanted calls that had to be paid by him for receiving the call. Thus, fixed subscribers were not able to complete all their calls to mobile subscribers because mobile users used to keep off their telephones. So there was a degree of "repressed" traffic from fixed-to-mobile subscribers. With the introduction of CPP, the fixed subscriber is willing to pay a higher price for a call than before, but now the call can be successfully completed with the mobile subscriber since there is no need for keeping off mobile telephones anymore. I thank Carlos Hirsch for advancing me this possible explanation.

level is still above long run incremental costs. A charge above long run incremental cost may turn out to be a barrier to price competition in the mobile market as the competing operators cannot reduce their prices up to long-run incremental costs, and hence there is an inadequate floor constraint for price competition.

Fixed-to-mobile tariff. The experience of Mexico shows the convenience of regulating not only the interconnection charge in mobile networks but also the service of billing and collection. By letting the incumbent Telmex set the fixed-to-mobile tariff at MXP 2.50 per minute, the billing and collection tariff was set at MXP 0.60 per minute, equivalent to US\$ 0.063 per minute (May 2000). By any standard, either international benchmarking or cost analysis, the current billing and collection tariff in Mexico can be considered high. There is a conceptual and practical case to consider the billing and collection service under the CPP system as an essential facility: it is difficult to imagine the mobile operators sending bills to fixed subscribers for those calls made from fixed-to-mobile telephones. By classifying billing and collection as an essential facility to be provided by the fixed operators there is a chance to regulate its price.

Effective prices. The case study has used a methodology to estimate effective tariffs that result of rounding up calls to the minute. For instance, the effective fixed-to-mobile tariff increased 250 per cent in May 1999 when the CPP system was introduced, from US\$ 0.11 to US\$ 0.40 per minute. However, it seems that the traffic fixed-to-mobile per subscriber increased rather than decreased, by around 29 per cent. This is a puzzle that deserves a satisfactory answer in further study. The only comment that can be made at this stage is that other variables (supply constraint, etc) would have had such an effect that it reversed the reducing effect of a price increase.

Unexpected increase of mobile demand. Mexico, as well as other countries, has experienced an extraordinary growth in the mobile demand in a very short time period. The reasons behind this increase have been already mentioned. The lesson to be learned from these developments is that regulators should be prepared to deal with users' complaints about quality of services caused by, among other things, an unexpected explosion of mobile traffic. It is difficult to keep quality levels in situations in which the demand is increasing at a pace of 100 per cent a year. Investments to increase capacity lag behind the pace of increase in demand due, among other things, to the lumpy feature of telecommunications investments. Regulators should place in advance detailed regulations to keep quality standards of mobile services, similar to the ones usually imposed on fixed networks.

Non-price interconnection issues. The design and implementation of a sound interconnection policy has to take into account also non-price aspects of the interconnection regime, such as the power of the incumbent in negotiation processes on interconnection conditions, the conditions for provisioning the interconnection links and the symmetry of treatment to index on equal basis all the interconnection charges. Policy-makers have to acknowledge that incumbents, such as Telmex, very often surpass in negotiating power to new entrants, so the role of the regulator has to serve as a counterbalance of the incumbent's power to level the playing field in almost all the key aspects of interconnection. One case in point is the practical implementation of the interconnection links as dictated by Telmex: just unidirectional links, excluding other schemes even contemplated by the regulation such as bi-directional links and costs sharing. Another case is the universal application of rules for all the types of interconnection. In this sense it is difficult to understand how the indexation rule for interconnection charges is applied only for those charges in the fixed networks, say Telmex, but is not applied for the interconnection charge in mobile networks.

Effective fixed-to-mobile rate

Billing of fixed-to-mobile calls is based on measuring the duration of each call in one-minute intervals or pulses. Fractions of a minute are rounded upwards, so a call that takes 10 seconds is billed as if it lasted one minute, a call that takes 1½ minutes is billed as if it lasted two minutes, and so on.

In order to estimate the effective fixed-mobile per minute rate, a statistical model of distribution of call duration was developed. It was assumed that distribution of calls follows a negative exponential distribution curve as a function of average call duration.

At the moment that a fixed-mobile call is completed, i.e. the mobile party answers the call, two initial pulses are transmitted to the register of the fixed subscriber. As long as the conversation continues, the register periodically accumulates pulses every x seconds. Under the assumption that the distribution of call duration follows a negative exponential distribution, the total number of pulses N_p accumulated in N_c conversations can be estimated as follows:³⁹

- Let m be the average duration of all calls. In the case of Mexico, all fixed-mobile calls receive two initial pulses: the first pulse is transmitted to the register when the call is completed, and the second pulse corresponds to the set-up pulse per call.
- The calls receiving the first periodic pulse are those calls that last at least x seconds, or $N_c * \exp(-x/m)$. In other words, x is the time unit used for billing calls (i.e. every second or every minute or every three minutes, etc.)
- The calls receiving the second periodic pulse are those that last at least $2x$ seconds, or $N_c * \exp(-2x/m)$. Thus, the total number of pulses is the sum of the series

$$N_p = 2N_c + N_c e^{-\frac{x}{m}} + N_c e^{-\frac{2x}{m}} + N_c e^{-\frac{3x}{m}} + \dots$$

Or

$$N_p = N_c + N_c \left(1 + e^{-\frac{x}{m}} + e^{-\frac{2x}{m}} + e^{-\frac{3x}{m}} + \dots \right)$$

$$r(x, m) \equiv \frac{N_p}{N_c} = 1 + \frac{1}{1 - e^{-\frac{x}{m}}}$$

where $r(x, m)$ is the average number of revenue units (pulses) per call.

If the value of a pulse is the same for all the pulses, including the initial set-up pulse, one could estimate the revenue unit per call using the previous equation. However, if the value of the set-up pulse is different to the

³⁹ The technical part of this section is based on Mitchell B. (1979). "Telephone Call Pricing in Europe: Localizing the Pulse." Mimeo. *The Rand Corporation*.

value of the periodic pulse, one has to modify the previous equation. In Mexico's case, a fixed-to-mobile call charge can be divided into two components:

- An initial set-up charge per call independent of the duration of the call.
- A rate per minute. The value of the rate per minute is different to the set-up charge of a call.

One way to accommodate this feature is to assume that the set-up pulse is a proportion of the periodic pulse, i.e. the set-up pulse is $q N_c$. Plugging this in the above derivation results in the following equation.

$$r(x, m) = q + \frac{1}{1 - e^{-\frac{x}{m}}} \quad (1)$$

The parameter q can be assumed to be the relationship between the rate per call and the rate per minute. If the two rates are the same, then $q = 1$. From the Mexican data, it is known that the rate per call is MXP 1.307 and the average fixed-to-mobile rate per minute is MXP 2.50. Consequently, $q = 0.528$.

Using formula (1) and the value $q = 0.528$, and assuming different average durations for fixed-to-mobile calls, the effective rates for fixed-to-mobile calls are obtained as shown in Table A1.1 below.

Example: Suppose that in May 2000 the rate per call is MXP 1.307 (equivalent to US\$ 0.1375 at the exchange rate of MXP 9.51 = US\$ 1.00 of May 2000), the average rate is MXP 2.50 per minute (equivalent to US\$ 0.2629), and the time unit of billing is one minute (i.e., $x=1$). According to COFETEL's estimate, the average duration of fixed-mobile calls is two minutes (i.e., $m = 2$). Plugging these values into equation (1) gives:

- $r(1,2) = 3.0643$ billable minutes
- Total billing for the call is $3.0643 \times \text{MXP } 2.50 = \text{MXP } 7.66075$
- The effective rate per minute is $\text{MXP } 7.66075 \div 2 \text{ minutes} = \text{MXP } 3.834$ per minute
- Converting to United States dollars, the effective rate is $\text{MXP } 3.834 \div \text{MXP } 9.5081 \text{ per US dollar} = \text{US\$ } 0.4028$ per minute.

Table A1.1. Effective rate per minute for a fixed-to-mobile call

Average call duration (minutes)	Effective rate per minute (Mexican pesos)	Effective rate per minute (United States dollars *)
1.0	5.262	0.5534
1.5	4.297	0.4519
2.0	3.834	0.4028
2.5	3.556	0.3740

(*) May 2000 exchange rate: MXP 9.51 = US\$ 1.00

Source: COFETEL, Banco de Mexico. Own elaboration.

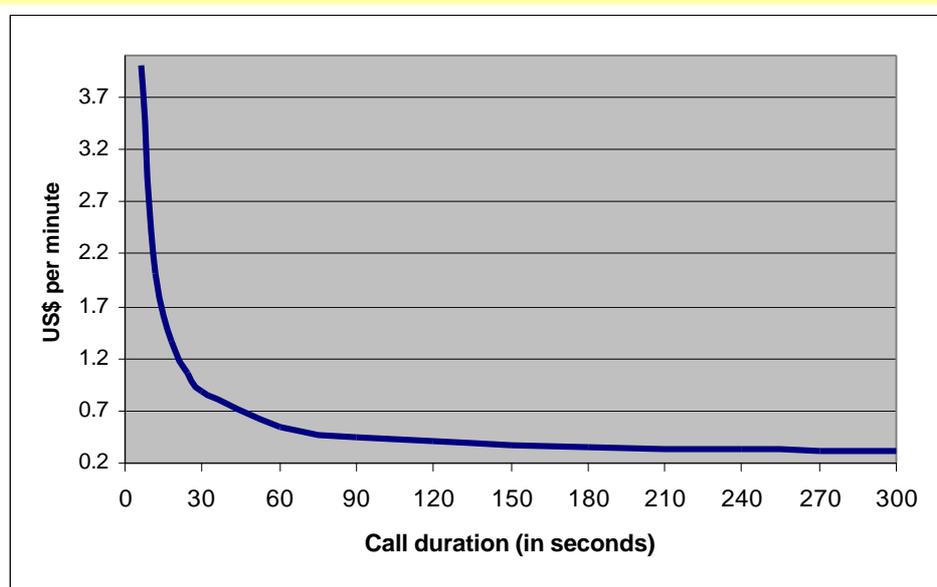
Figure A1.1 presents the same information as Table A1.1 above, but with more alternatives for the average call duration. The average rate effectively charged in United States dollars is shown as a function of the fixed-to-mobile call duration, expressed in seconds. The curve shown in the figure has been determined on the basis of the assumptions made regarding the exponential distribution of call duration and the nominal rates charged for fixed-to-mobile calls.

Clearly, the shorter the call duration, the higher the effective rate per minute. For example, it is known that a significant proportion of fixed-to-mobile calls have a duration of half a minute – i.e., 30 seconds. For calls of

that length, the effective average rate per minute is US\$ 0.89. As the call duration increases, the effective rate falls, but it falls more and more slowly. For example, a call of five minutes' duration has an effective rate of US\$ 0.32 per minute, while if the call goes on for 15 minutes the effective rate falls only to US\$ 0.28 per minute.

Figure A1.1: Effective fixed-mobile tariff

In United States dollars



Source: Case Study

Annex 2

Monthly series of exchange rate, INPC and local measured service call tariff

Month/Year	Exchange Rate (MXP per US\$)	INPC (94=1.00)	SLM (MXP per call)
01/1993	3.110	0.9042	0.430
02/1993	3.099	0.9116	0.430
03/1993	3.108	0.9169	0.430
04/1993	3.096	0.9222	0.430
05/1993	3.123	0.9275	0.430
06/1993	3.121	0.9327	0.430
07/1993	3.124	0.9372	0.430
08/1993	3.113	0.9422	0.430
09/1993	3.113	0.9492	0.430
10/1993	3.114	0.9530	0.430
11/1993	3.155	0.9573	0.430
12/1993	3.108	0.9646	0.430
01/1994	3.108	0.9720	0.470
02/1994	3.112	0.9770	0.470
03/1994	3.284	0.9821	0.470
04/1994	3.354	0.9869	0.470
05/1994	3.312	0.9916	0.470
06/1994	3.361	0.9966	0.470
07/1994	3.401	1.0010	0.470
08/1994	3.382	1.0057	0.470
09/1994	3.400	1.0128	0.470
10/1994	3.416	1.0181	0.470
11/1994	3.443	1.0236	0.470
12/1994	3.931	1.0326	0.470
01/1995	5.513	1.0714	0.517
02/1995	5.685	1.1168	0.517
03/1995	6.702	1.1827	0.517
04/1995	6.300	1.2769	0.517
05/1995	5.963	1.3303	0.517
06/1995	6.223	1.3725	0.517
07/1995	6.139	1.4005	0.517
08/1995	6.191	1.4237	0.517
09/1995	6.303	1.4532	0.517
10/1995	6.691	1.4831	0.517
11/1995	7.658	1.5196	0.517
12/1995	7.660	1.5692	0.517
01/1996	7.505	1.6256	0.537
02/1996	7.504	1.6635	0.557
03/1996	7.574	1.7001	0.577
04/1996	7.471	1.7485	0.597
05/1996	7.435	1.7803	0.617
06/1996	7.543	1.8093	0.637
07/1996	7.623	1.8350	0.657
08/1996	7.514	1.8594	0.677
09/1996	7.545	1.8892	0.697
10/1996	7.685	1.9127	0.717
11/1996	7.919	1.9417	0.737
12/1996	7.877	2.0039	0.757
01/1997	7.830	2.0554	0.787
02/1997	7.793	2.0900	0.817

03/1997	7.963	2.1160	0.847
04/1997	7.904	2.1388	0.877
05/1997	7.906	2.1583	0.907
06/1997	7.947	2.1775	0.937
07/1997	7.886	2.1965	0.967
08/1997	7.784	2.2160	0.997
09/1997	7.779	2.2436	1.027
10/1997	7.811	2.2615	1.057
11/1997	8.284	2.2868	1.087
12/1997	8.136	2.3189	1.117
01/1998	8.180	2.3693	1.147
02/1998	8.493	2.4108	1.177
03/1998	8.569	2.4390	1.207
04/1998	8.500	2.4619	1.207
05/1998	8.561	2.4815	1.207
06/1998	8.895	2.5108	1.207
07/1998	8.904	2.5350	1.207
08/1998	9.260	2.5594	1.207
09/1998	10.215	2.6009	1.207
10/1998	10.152	2.6382	1.207
11/1998	9.987	2.6849	1.207
12/1998	9.912	2.7504	1.207
01/1999	10.110	2.8198	1.207
02/1999	10.015	2.8577	1.207
03/1999	9.769	2.8843	1.256
04/1999	9.446	2.9108	1.256
05/1999	9.362	2.9283	1.256
06/1999	9.542	2.9475	1.256
07/1999	9.367	2.9670	1.307
08/1999	9.398	2.9837	1.307
09/1999	9.340	3.0125	1.307
10/1999	9.540	3.0316	1.307
11/1999	9.421	3.0586	1.307
12/1999	9.415	3.0892	1.307
01/2000	9.479	3.1307	1.307
02/2000	9.446	3.1584	1.307
03/2000	9.296	3.1760	1.307
04/2000	9.375	3.1940	1.307
05/2000	9.508	3.2060	1.307

Note: Exchange rate: MXP per US\$

INPC: National Consumer Price Index, base 1994=1.00

SLM: Local Measured Call Tariff, in MXP

Source: COFETEL, Banco de Mexico

International benchmark of interconnection charges for Terminating Traffic in Mobile Networks

This Annex presents an international comparison of terminating charges in mobile networks as of November 1999.⁴⁰

Table A3.1 Interconnection charges in mobile networks to terminate traffic from local fixed networks: November 1999
(Cents of US\$ per minute)

Group A: Total of countries

Country	Peak	No peak	Average
1. Germany	37.81	18.24	35.85
2. Argentina	33.00	18.00	29.98
3. Austria	19.00	19.00	19.00
4. Brazil			10.70
5. Chile	14.45	10.11	13.28
6. China Taipei	18.38	18.38	18.38
7. Colombia	35.84	24.29	33.85
8. Denmark	21.31	11.36	18.89
9. Spain	25.77	13.20	23.43
10. Finland	21.42	13.43	18.06
11. France	25.28	17.38	23.46
12. Netherlands	25.59	17.74	23.00
13. Ireland	19.33	14.00	17.57
14. Italy	45.72	3.30	24.94
15. Japan	37.85	29.18	36.46
16. Peru	22.07	12.13	20.68
17. Nicaragua	27.55	27.55	27.55
18. Norway	17.19	17.19	17.19
19. Paraguay			15.12
20. United Kingdom	23.89	14.93	20.94
21. Sweden	31.94	18.58	27.53
22. Switzerland	37.33	24.89	34.35
23. Venezuela	25.24	16.57	24.18
<i>Mean</i>	26.95	17.12	23.23
<i>Median</i>	25.28	17.38	23.00

⁴⁰ This Annex is based on Briceño, A. (1999). *Economic Revision of the Interconnection Policy in Peru* [Revisión Económica de la Política de Interconexión]. Working Paper, OSIPTEL. 29 December.

Group B: The best practice: the three lowest rates

Country	Peak	No peak	Average
Brazil			10.70
Chile	14.45	10.11	13.28
Paraguay			15.12
<i>Average</i>	14.45	10.11	13.03

Group C: Latin American Countries

Country	Peak	No peak	Average
Argentina	33.00	18.00	29.98
Brazil			10.70
Chile	14.45	10.11	13.28
Colombia	35.84	24.29	33.85
Peru	22.07	12.13	20.68
Nicaragua	27.55	27.55	27.55
Paraguay			15.12
Venezuela	25.24	16.57	24.18
<i>Average</i>	26.36	19.09	21.92

Mexico (*)	19.11	19.11	19.11
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Mexico versus Group (A):	-29%	12%	-18%
Mexico versus Group (B):	32%	89%	47%
Mexico versus Group (C):	-27%	6%	-13%

(*) In December 1999, the terminating charge in mobile network was MXP 1.80 per minute, equivalent to US\$ 0.1911 per minute (exchange rate MXP 9.421=US\$=1.00)

In addition to Mexico, Latin America and European countries are included in the sample of 23 countries. The countries are grouped in three Groups: the total of the countries (Group A), the countries with the three lowest charges, called "best practice" (Group B), and Latin American countries (Group C). For each Group, the average and/or median interconnection charge has been estimated for the countries within each Group. Then, the interconnection charge in Mexico is compared against each of the three Groups of countries.

The results show the following:

- The interconnection charge in Mexico as of November 1999, which amounted to US\$ 0.1911 per minute is 18 per cent below the average rate of the 23 countries of the sample.
- If the comparison is against the average charge of the Latin American countries, the interconnection in Mexico is 13 per cent below the average.
- When comparing with the average of the three lowest charges existing in the sample of countries (Brazil, Chile and Paraguay), it results that the rate in Mexico is 47 per cent above.
- Therefore, we could conclude that the Mexican interconnection rate for terminating calls in mobile networks is below most of the countries with the exception of the three most competitive countries.

Useful Web links

1 Government of Mexico	
Comisión Federal de Telecomunicaciones [Federal Telecommunication Commission] (COFETEL)	www.cft.gob.mx
Secretaría de Comunicaciones y Transporte [Ministry of Communications and Transport] (SCT)	www.sct.gob.mx
Comisión Federal de Competencia [Federal Competition Bureau] (CFC)	www.cfc.gob.mx
Banco de México [Bank of Mexico] (BANXICO)	www.banxico.org.mx
2 Fixed operators	
Teléfonos de México (Telmex)	www.telmex.net
Teléfonos del Noroeste S.A. (Telnor)	www.telnor.com
Axtel	www.axtel.com.mx
Maxcom	www.maxcom.com.mx
2.1.1 Mobile operators	
Radio Móvil Dipsa (Telcel)	www.telcel.com
Grupo IUSACELL, S.A. de C.V.	www.iusacell.com.mx
Unefon	www.unefon.com.mx
CEDECEL, NORTEL, Baja Celular Mexicana (BAJACEL), MOVITEL	www.bajacelular.com.mx
Movitel del Noreste S.A.	www.movitel.com.mx
Pegaso PCS, S.A. de C.V.	www.pegasopcs.com.mx
2.2 Long-distance operators	
2.3 Alestra	www.alestra.com.mx
2.4 Avantel	www.avantel.com.mx
2.5 International agencies	
ITU case studies	www.itu.int/osg/sec/spu/ni/fmi/case_studies/index.htm .
OECD	www.oecd.org/dsti/sti/it/cm/

Interviews conducted in Mexico

(5 to 7 June 2000)

1 Government	
Comisión Federal de Telecomunicaciones [Federal Telecommunication Commission] (COFETEL)	Jorge Arreola Economic Affairs Commissioner Salma Jalife General Coordinator, International Affairs Francisco Javier Valdez Director, Rates and Cost Analysis Luis Fernando Peláez Assistant Director, Regulatory Studies
2 Fixed operators	
Teléfonos de México (Telmex)	Juan Iglesias Vigueras Assistant Director, Regulatory Affairs and Rates Alejandro León Salmeón Manager, Local Interconnection Directorate of New Technologies and Regulatory Affairs
Axtel	Carlos Escalante Director, Regulatory Affairs and Negotiations
Maxcom	Alejandro Martínez Finance Director
2.2.1 Mobile operators	
Radio Móvil Dipsa (Telcel)	Gabriel Rivera Martínez Assistant Director, Financial Operations
Grupo IUSACELL, S.A. de C.V.	José Antonio Ducoing Arvizu Regulatory Affairs Directorate Jorge Jalvas Begovich Vice President, Regulatory Affairs Carlos Hirsch Ganievich Director of Planning
Unefon	Jesús Celorio Sánchez Director, Regulatory Affairs Gerardo Ibarra Fil Director, Corporate Finance
Pegaso PCS, S.A. de C.V.	Anastacio Ramos Rivera Director, Planning and Interconnection