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BRAZILIAN STRATEGY ON MOBILE SPECTRUM

by

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Abstract

The strategic decision of Brazil concerning IMT-2000 spectrum and its implications are analyzed. The specific situation of the Latin America countries concerning 3G spectrum is summarized. An overview of the Brazilian telecommunications sector is also presented.

1. Introduction

The Brazilian strategy on spectrum management, particularly to the introduction of the IMT-2000 system, has been highly impacted by two conflicts related to spectrum use. The first and most important conflict is the overlapping between the PCS 1900 system and the uplink of the original IMT-2000 spectrum. The second conflict is the overlapping between the MMDS return channel and part of the downlink of the original IMT-2000 spectrum.

These conflicts had to be faced by the Brazilian Administration even before deciding to implement the IMT-2000 system. The reason was the need to find spectrum for the introduction of new mobile operators after the end of the duopoly situation on 31 December 1999. The two alternatives to allocate spectrum for the new mobile licenses were to use either the 1.8 GHz band or the 1.9 GHz. That strategic Brazilian decision that favoured the 1.8 GHz band was taken on 21 June 2000. The background and major reasons of that decision are explained in this paper.

It is also presented the spectrum allocations for mobile services and the Brazilian strategy for evolution of the existing mobile platforms in order to provide third-generation (3G) wireless services, or IMT-2000.
The CITEL Member States have been working hard to find the best solution concerning spectrum arrangements for the introduction of IMT-2000 in ITU Region 2. Several alternatives have been examined in order to find a solution compatible with the spectrum available in each country and, at the same time, harmonized with global systems in order to have the advantage of economies of scale. It is presented an overview of the spectrum allocation status for IMT-2000 in the Latin America countries.

In addition to the main subject of this paper, i.e. Mobile Spectrum, it is given an overview of the Brazilian Telecommunications Sector.

2. An Overview of the Brazilian Telecommunications Sector

Brazil is the fifth largest country in the world in terms of area, after Russia, China, Canada and the United States. With an estimated population of 170 million (2001) Brazil is ranked as the sixth most populous nation in the world. Brazil, the only Portuguese-speaking nation in the Western Hemisphere, has by far the largest economy in Latin America with an estimated 2001 GDP of USD 731 billion.

Brazil’s telecommunications sector legislation and regulation is widely regarded as pro-competitive and progressive. The telecommunications sector is considered to be among the most progressive in Brazil due to the large-scale privatization, which was concluded at the end of 1999, and the introduction of open market competition.

2.1 Sector Reform

BEFORE 1995

Brazil has been through various distinct phases during the past century. In the 1950s the private sector began to invest in Brazilian telecommunications companies and regulation was divided between federal, state and municipal authorities. Spread throughout Brazil were more than 1,000 telephone companies, many of which were tied to municipalities so the service largely depended on the quality and often the size of the company providing service. Due to the wide range of quality, the Government of Brazil enacted the Brazilian Telecommunications Code (Código Brasileiro de Telecomunicações), which concentrated the regulation and oversight in the federal government. The Código also allowed for the creation of Embratel in 1965, the first parastatal telecommunications entity to provide long distance. As Embratel grew stronger and started to link the entire country by microwave and other means, the state and municipal systems became weaker and did not have the money to invest to update and improve their systems. In 1972, Telebrás was created to consolidate and organize the various companies into one telephone company per state that would provide local and state-wide services, with long distance being provided by Embratel which also became part of the Telebrás system. For 26 years, Telebrás held monopoly control over the provision of local, long-distance and international telecommunications.
REFORM MOTIVATION

In 1995 the Brazilian Administration conducted an analysis of the telecommunications sector. The analysis showed that in 1994, there were 13 million fixed telephones and 800,000 mobile telephones in Brazil -- up from 2 million in 1972. In addition, only around 6% of homes belonging to the poorest social class were provided with telephone service. After reviewing these figures and acknowledging the huge pent-up demand for telecommunications services, the government set a goal of 33 million telephones in Brazil by the end of 2001. Given that Telebrás had installed 0.5 million phones per year during the past 22 years, and the government was looking for a 20 million increase in phones in 7 years, the government realized that it had to make some substantial changes to achieve this goal. Outside investment was necessary and in view of that support for privatization was given.

THE REFORM OBJECTIVES

The Telecommunications sector reform in Brazil was designed to achieve five major objectives:

I. strengthen the regulatory role of the State and eliminate its role as an entrepreneur;

II. increase the offer and improve the quality of telecommunication services;

III. in a competitive environment, create opportunities that draw in investments and foster technological and industrial development;

IV. provide conditions so that the sector development be consistent with the country's goals for social development; and

V. maximize the sale value of state-owned telecommunication companies without prejudicing the foregoing objectives.

To achieve targets II, III and IV, the model relies on two basic principles: *Competition and Universal Service*.

THE REGULATORY BODY – ANATEL

The creation of the regulatory body on 5 November 1997, just before Telebrás privatization, was essential to implement the new model for the Brazilian telecommunications sector. Anatel (Agência Nacional de Telecomunicações) was created by the General Telecommunications Law of 1997. Title I, “Creation of the Regulatory Body,” reads “The National Telecommunications Agency is hereby established, an entity integrating the indirect Federal Public Administration, subject to special government agency rules and connected to the Ministry of Communications, acting as the telecommunications regulatory organ, with headquarters in the Federal District (Brasília), and with powers to set up regional units.”
Anatel operates separately from the Ministry. Structurally, Anatel enjoys administrative independence and financial autonomy, fixed mandates and job stability for the five Members of the Board of Directors, and no hierarchical subordination.

Anatel has been empowered to oversee most telecommunications regulatory functions including licensing, tariff approval, establishing technical standards and interconnection rates, type approval, frequency allocation, establishing licensing fees and ensuring service quality. There are some areas of shared responsibilities such as dispute settlement, which is conducted both by the regulator and the courts. Anatel’s decisions are binding and can only be altered by the courts.

Anatel has introduced a number of innovative regulatory mechanisms, some unprecedented for any telecommunications regulator and some unprecedented for any regulatory agency within Brazil, that set it above its counterparts. It has obtained the prestigious ISO 9001 certification for its regulatory practices.

### 2.2 Competition

The opening of the telecommunications sector in Brazil, with the 1997 Telecommunications Law and the auction of Telebrás in 1998, brought a significant influx of new investment from foreign and domestic telecommunications players into the sector. Table 1 illustrates the significant increase in the presence of foreign telecom operators in Brazil from 1990 to 2000. As a result, Brazil was the leader in foreign investment in Latin America, as shown in Figure 1.

**TABLE 1**

<table>
<thead>
<tr>
<th>Economic Group</th>
<th>1990</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argentina</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venezuela</td>
<td></td>
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<tr>
<td>Colombia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Presence in the country]
Figure 1
Telecommunications Investment in Brazil

FIXED-LINE OPERATORS

Brazil is divided into four Regions (Regions I, II, III and IV) for the fixed-line services. The Regions and the fixed-line operators are shown in Figure 2. These operators in Regions I, II and III have licenses to provide local service and also national long-distance service but restricted to calls originated and terminated in the region. Region IV comprises the national territory. The two operators in Region IV have licenses to provide national and international long-distance services. Such duopoly scheme ended on 31st December 2001.

The incumbents resulting from Telebrás privatization and the new competitors in the telecommunications market, the so-called “mirror companies” are presented hereafter referred to the situation on 31st December 2001. In view of the end of the duopoly, the expectation is to have several other fixed-line operators in the near future.

Region I

? Incumbent: TELEMAR  (Andrade Gutierrez, Inepar and other domestic companies)
? Mirror Company: VESPER  (Qualcomm, BCI and others)

Region II

? Incumbent: BRASIL TELECOM  (Telecom Italia and others)
? Mirror Company: GLOBAL VILLAGE TELECOM  (GVT and others)
**Region III**

? Incumbent: TELESP (Telefónica and others)

? Mirror Company: VESPER (Qualcomm, BCI and others)

**Region IV**

? Incumbent: EMBRATEL (MCI and others)

? Mirror Company: INTELIG (National Grid, Sprint and France Telecom)

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**Figure 2**

**Fixed-line Operators**

MARKET SHARE: FIXED-LINE

The present level of competition in the fixed-line national and international long-distance services is considered very good in view of the short time of competition in Brazil (three years). Embratel, the former state owned long-distance monopoly has now only 43.1% (in minutes) of the market share.

On the other hand, in despite of several asymmetric regulations in favor of the newcomers, competition in the local service is still incipient. The market share of the incumbents is around 99% (in minutes). However, it is worth to mention that the newcomers in that market (the “mirror” companies) have already installed around 13% of the total number of local accesses in Brazil. Therefore, the “mirror” companies have infrastructure sufficient to expand their market share to much more than 1%.
MOBILE OPERATORS

For purpose of mobile service, the country was divided into ten service provision areas, as shown in Figure 3.

Mobiles Operators in Brazil are known according to the licenses of the frequency bands: A, B, D and E. Licenses in band A are held by operators resultant from the privatization of the Telebrás system, the former state-owned holding company.

The licenses in band B are held by new operators, who compete with the incumbent operators in band A. The first license in band B was given in April 1998. The latest band B license, for Area 8 (the Amazon Area), was granted in October 1998. Bands A and B holding companies or operators and their main shareholders are shown in Table 2.

Presently in Brazil, bands A and B operators are the only mobile service providers in operation. Bands D and E operators will start providing service around July 2002. Bands D and E holding companies or operators and their main shareholders are shown in Table 3.

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Figure 3

Mobile Service Provision Areas
**Table 2**

<table>
<thead>
<tr>
<th>AREA</th>
<th>BAND</th>
<th>HOLDING or OPERATOR</th>
<th>MAIN SHAREHOLDERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>Telesp Celular S.A.</td>
<td>Portugal Telecom (Portugal)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>BCP S.A.</td>
<td>Bell South (USA) and Safra</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>Telesp Celular S.A.</td>
<td>Portugal Telecom (Portugal)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>CTBC Celular S.A.</td>
<td>Algar (Brazil)</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>Tele Sudeste Celular Participações S.A.</td>
<td>Telefónica (Spain)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>ATL - Algar Telecom Leste S.A.</td>
<td>Algar (Brazil) and SBC (USA)</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>Telemig Celular S.A.</td>
<td>TIW (Canada) and CVC (Brazil)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>CTBC Celular S.A.</td>
<td>Algar (Brazil)</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
<td>Tele Celular Sul Participações S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Global Telecom S.A.</td>
<td>DDI (Japan) and Motorola (USA)</td>
</tr>
<tr>
<td>6</td>
<td>A</td>
<td>Tele Celular Sul Participações S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Celular CRT S.A.</td>
<td>Telefonica (Spain)</td>
</tr>
<tr>
<td>7</td>
<td>A</td>
<td>Tele Centro Oeste Celular Participações S.A.</td>
<td>Splice (Brazil)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>CTBC Celular S.A.</td>
<td>Algar (Brazil)</td>
</tr>
<tr>
<td>8</td>
<td>A</td>
<td>Tele Norte Celular Participações S.A.</td>
<td>TIW (Canada) and CVC (Brazil)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Norte Brasil Telecom S.A.</td>
<td>Splice (Brazil)</td>
</tr>
<tr>
<td>9</td>
<td>A</td>
<td>Tele Leste Celular Participações S.A.</td>
<td>Telefonica (Spain)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Maxitel S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
<tr>
<td>10</td>
<td>A</td>
<td>Tele Nordeste Celular Participações S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>BSE S.A.</td>
<td>Bell South (USA) and Safra</td>
</tr>
</tbody>
</table>

**Table 3**

<table>
<thead>
<tr>
<th>AREA</th>
<th>BAND</th>
<th>HOLDING or OPERATOR</th>
<th>MAIN SHAREHOLDERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4, 8, 9 and 10</td>
<td>D</td>
<td>TNL PCS S.A.</td>
<td>Telemar (Brazil)</td>
</tr>
<tr>
<td>3 and 8</td>
<td>E</td>
<td>Unicel S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
<tr>
<td>6 and 7</td>
<td>D</td>
<td>Blucel S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
<tr>
<td>1 and 2</td>
<td>D</td>
<td>Starcel S.A.</td>
<td>Telecom Italia (Italy)</td>
</tr>
</tbody>
</table>
MARKET SHARE: MOBILE

The present level of competition in the mobile cellular service is considered very good. Before the fourth year of competition, the band B operators succeeded in getting 32.9% of the market (31st December 2001). Certainly, the level of competition will improve even further in 2002 with the entrance in operation of the new operators in bands D and E.

2.3 Universal Service

Universal service policies are traditionally used to ensure the offer of basic telecommunication services far beyond the limits that would be set by the dynamics of a free market. More recently, the increasing technological convergence and the ever increasing lack of barriers among the different markets have changed the telecom business structure to such an extent that the definition of basic telecommunication services have been thought over by the Governments, mainly in what concerns issues related to digital divide.

The Brazilian universal service policies include firstly the expansion of the basic fixed-line telephone service. Other services, like Internet access, are also planned to be expanded. The universal service policies are translated into Universal Service Plans. Except the first Universal Service Plan, the other plans will be implemented using the resources of the Universal Service Fund.

According to the Law that created the Universal Service Fund, its main purpose is “to provide resources intended to cover the cost related to the fulfillment of obligations that cannot be repaid by the efficient exploration of the service”.

The Fund main revenues sources are:

a) 1% of telecommunication services gross operational revenue, taxes excluded;

b) 50% of revenues destined to inspection of telecommunication services, up to the limit of R$ 700 million (around USD 350 million);

c) fees of telecommunication licenses.

The first Universal Service Plan establishes contractual obligations to the incumbent companies, derived from the Telebrás system. It contains a quite extensive set of targets for the basic fixed-line telephone service. The plan sets obligations for the expansion of two types of accesses: individual telephone and public payphones. In addition to the expansion targets, the plan establishes priorities and obligations with respect to schools, hospitals, handicapped persons and public emergency entities. The main plan targets are summarized Table 4.

The second Universal Service Plan (using the Fund resources) is a pioneering project in the educational area. A communication network that shall offer Internet connection and related specialized
services (as those of teleconference). The first year target is the installation of 290,000 terminals in 13,500 secondary level public schools with more than 600 students.

Another Universal Service Plan is being elaborated for improvement of the telecommunication network of the public health system.

### TABLE 4

**FIRST UNIVERSAL SERVICE PLAN**

<table>
<thead>
<tr>
<th>TARGETS</th>
<th>UNIT</th>
<th>1999</th>
<th>2001</th>
<th>2003</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INDIVIDUAL FIXED ACCESSES</strong></td>
<td>MILLION</td>
<td>25.1</td>
<td>33.0</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td><strong>LOCALITIES WITH INDIVIDUAL FIXED ACCESS</strong></td>
<td>PEOPLE</td>
<td>-----</td>
<td>1000</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td><strong>PAYPHONE ACCESSES</strong></td>
<td>THOUSAND</td>
<td>713.2</td>
<td>981.3</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>PER 1000 INHABITANTS</td>
<td>-----</td>
<td>-----</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>LOCALITIES WITH PAYPHONE</strong></td>
<td>PEOPLE</td>
<td>1000</td>
<td>600</td>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td><strong>PAYPHONE DISTRIBUTION</strong></td>
<td>METER</td>
<td>800</td>
<td>500</td>
<td>300</td>
<td>-----</td>
</tr>
</tbody>
</table>

**FIXED-LINE ACCESSES**

As mentioned in item 2.1, a very ambitious target was established to be achieved by the telecommunication sector reform: 33 million fixed-line accesses in 2001. That target was by far exceeded (47.8 million) as it is shown in Figure 4. In addition, around 50% of homes belonging to the poorest social class were provided with telephone service. The main reason of such impressive evolution is the impediment for incumbents fixed-line operators to obtain new telecommunication licenses unless anticipating the 2003 universal service targets. The majority of these operators have already anticipated their targets.

**MOBILE ACCESSES**

The cellular telephone operators, in both bands A and B, have expanded their networks very fast. From 1998 (privatization) until 2001 the total number of accesses increased around four times, as shown in Figure 5.

According to Anatel estimation, the fixed and mobile number of accesses in Brazil will be the same in 2005. This number is estimated to be around 58 millions for each service.
Figure 4
Fixed-line Access Evolution

Figure 5
Mobile Access Evolution
3. **2G/2.5G Mobile Spectrum**

There are no regulatory impediments in Brazil for provision of mobile service using any kind of technology. However, to describe the way spectrum is allocated, it will be classified into two groups: a) 2G/2.5G Mobile Spectrum; and b) IMT-2000 Spectrum.

In Brazil, the frequency bands to provide the so-called 2G (second generation) and 2.5G include the frequency bands allocated for mobile in both ITU Regions 1 and 2. A small portion of these bands are also allocated for provision of fixed-line and trunking type services.

The present allocation of the frequency bands belonging to the 2G/2.5G Mobile Spectrum is given below. It is worth to emphasize that in Brazil there are no restrictions to provide service of 3G (third generation) or higher generation in these bands.

**CELLULAR SPECTRUM**

The frequency bands allocated to the cellular mobile service in Brazil are in the 800 MHz, 900 MHz and 1,800 MHz frequency bands as follows:

- **Bands A and B** (25 MHz each):
  - uplink: 824 - 849 MHz
  - downlink: 869 - 894 MHz

- Additional bandwidth may be authorized to bands A and B in the 1,800 MHz frequency band.

- **Bands D and E** (30 MHz each):
  - uplink: 1710 – 1725 MHz and 1740 – 1755 MHz
  - downlink: 1805 - 1820 MHz and 1835 – 1850 MHz

- Additional bandwidth may be authorized to bands D and E in the 900 MHz frequency band.

**TRUNKING SPECTRUM**

The trunking service in Brazil is provided to corporations and operates in the 800 MHz frequency band as follows:

- uplink: 806 - 821 MHz
- downlink: 851 - 866 MHz

**FWA SPECTRUM**

The fixed-line operators are authorized to use Fixed Wireless Access (FWA) in the 1,900 MHz frequency band as follows:
FDD technology:
uplink:  1895 – 1910 MHz
downlink:  1975 - 1990  MHz

TDD technology:
1880 – 1885 MHz and 1910 – 1920 MHz

4. **IMT-2000 Mobile Spectrum**

In Figure 6 are illustrated the difficulties faced by several Latin American and other ITU Region 2 Administrations related to IMT-2000 spectrum. There are two conflicting areas. First and most serious, the overlapping between the original IMT-2000 band (uplink: 1920 to 1980 MHz) and the PCS 1900 (downlink: 1930 to 1990 MHz). Second, the overlapping between the original IMT-2000 band (downlink: 2110 to 2170 MHz) and the MMDS return channel (2150 to 2162 MHz).

The MMDS conflict exist only in a few Latin America Administrations that have already decided to allocate a return channel to this service. Most of the Administrations are still analyzing the implications of such allocation on the 3G systems. It is also worth to emphasize that the equipment commonly used for the MMDS return channel can be tuned on bands above 2170 MHz. The Brazilian Administration has already allocated the band 2170 to 2182 MHz to this service, hence avoiding any impact in the future implementation of 3G systems.
The conclusion is that the MMDS conflict impacts only a few countries where the return channel is in operation. In addition to that, it can be avoided by allocating the return channel in the spectrum above 2170 MHz. As mentioned above, in general, the equipment available in the market can be re-tuned to frequencies above 2170 MHz.

4.1 Latin America Spectrum Allocation

Concerning the PCS 1900 conflict, the Latin America Administrations may be classified into two groups with respect to the seriousness of the problem:

Group I: Countries where none or only a few of the PCS 1900 blocks are in use, so that the reminding spectrum in the frequency range 1920 to 1980 MHz is still sufficient for the IMT-2000 implementation by all existing operators in the country.

Group II: Countries where the majority of the PCS 1900 blocks are in use, so that the reminding spectrum in the frequency range 1920 to 1980 MHz is insufficient for the IMT-2000 implementation by all existing operators in the country.

For Group I countries, evidently the best solution is to use the original IMT-2000 band to implement 3G services. However, in case of Group II this solution is not possible due to the unavailability of the IMT-2000 uplink band.

The Inter-American Telecommunication Commission (CITEL) Member States have been working hard to find the best solution concerning spectrum arrangements for 3G in Region 2. The CITEL Document PCC.III/doc.1842 rev.1 cor.1, 8 March 2001, analyzes proposed frequency arrangements in the 1710 to 2170 MHz band.

It was identified that, in addition to the original IMT-2000 uplink (1920 to 1980 MHz), an alternative frequency arrangement is to use up to 60 MHz in the frequency range of 1710 to 1850 MHz for IMT-2000 uplink paired with the original IMT-2000 downlink band (2110 to 2170 MHz).

These two pairing arrangement are illustrated in Figure 7.

The most difficult point with this CITEL proposal for Group II countries is the choice of the precise band edge in the band 1710-1850 MHz. Some Administrations have expressed support to the mobile transmit band starting at 1755 MHz and others at 1710 MHz.

The present situation of the Latin America countries, on July 2001, concerning the possibilities of using the above frequency arrangements is presented in Table 5. The countries were classified into Group I or Group II according to the number of PCS 1900 licenses.
Brazil and Colombia are the only countries using PCS 1900 system only for access to the fixed-line telephone service (FWA/WLL).

The conclusion, in view of Table 5, is that the majority of the Latin American Countries may easily adopt the original IMT-2000 spectrum for 3G applications.

4.2 Brazilian Spectrum Allocation

DECISION FOR IMT-2000 CORE BAND

Anatel announced on 21 June 2000 the decision of establishing new 2G/2.5G cellular operators in the band of 1.8 GHz, preserving the band of 1.9/2.1 GHz for implementation of IMT-2000, as recommended by the International Telecommunication Union (ITU).

That decision of Anatel was preceded by a 30 days Public Consultation, issued in December 1999, to which Anatel had received contributions from operators, manufacturers and organizations from Brazil and abroad. The amount of contributions reached almost 600 pages, demonstrating the huge interest in that matter.
The consultation sought contributions on the following aspects: market of mobile services, roaming, economies of scale and industrial aspects, standardization, availability of terminals and infrastructure, technological evolution of the networks and implementation of IMT-2000.

### TABLE 5

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Subscribers (thousand)</th>
<th>Subscribers in PCS 1900 (thousand)</th>
<th>PCS 1900 Licenses</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP I - original IMT-2000 pairing: 1920-1980 MHz with 2110-2170 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRAZIL</td>
<td>26 000</td>
<td></td>
<td></td>
<td>FWA</td>
</tr>
<tr>
<td>COLOMBIA</td>
<td>2 730</td>
<td></td>
<td></td>
<td>FWA</td>
</tr>
<tr>
<td>COSTA RICA</td>
<td>247</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECUADOR</td>
<td>580</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HONDURAS</td>
<td>199</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>NICARAGUA</td>
<td>156</td>
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<td></td>
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<tr>
<td>PANAMA</td>
<td>425</td>
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<td></td>
<td></td>
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<tr>
<td>PERU</td>
<td>1 482</td>
<td>93</td>
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<tr>
<td>URUGUAY</td>
<td>545</td>
<td>16</td>
<td>1</td>
<td></td>
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<tr>
<td>VENEZUELA</td>
<td>6 215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GROUP II - pairing: (up to 60 MHz) 1710-1850 MHz with 2110-2170 MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARGENTINA</td>
<td>7 720</td>
<td>&gt; 600</td>
<td>2 (2x20), 2 (2x10)</td>
<td>4 per region</td>
</tr>
<tr>
<td>BOLIVIA</td>
<td>680</td>
<td>50</td>
<td>2 (x15)</td>
<td>FWA and GSM 1900</td>
</tr>
<tr>
<td>CHILE</td>
<td>4 130</td>
<td>1 980</td>
<td>3 (2x15)</td>
<td></td>
</tr>
<tr>
<td>EL SALVADOR</td>
<td>1 033</td>
<td>290</td>
<td>2 (2x15)</td>
<td></td>
</tr>
<tr>
<td>GUATEMALA</td>
<td>1 027</td>
<td>590</td>
<td>3 (2x15)</td>
<td></td>
</tr>
<tr>
<td>MEXICO</td>
<td>17 850</td>
<td>1 390</td>
<td>2 (2x15), 2 (2x5)</td>
<td></td>
</tr>
<tr>
<td>PARAGUAY</td>
<td>1 096</td>
<td>267</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Sources:

a) EMC World Cellular Database 2001
b) ITU-T Seminar on IMT-2000, Rio de Janeiro, 6 September 2001 (ASETA Presentation)

The decision of ANATEL took into due consideration the contributions received and also the results of the last ITU World Radiocommunication Conference (WRC-2000), held in Istanbul.

The choice of 1.8 GHz was driven by the following advantages: the possibility of immediate introduction of new operators in that band and, at the same time, allowing the implementation of IMT-
2000 in the near future (2002/2003). Another major point considered was the advantage for consumers in view of the quality and large scale of GSM equipment.

It was a strategic decision of the Brazilian Regulator. Conscious that Brazil is a technology follower and not a technology generator, the Anatel Board decision was biased by the principle that large scale systems are beneficial for consumers. Although the impact of that decision will be noticed by the consumers only in the medium and long term. Certainly several Latin American countries will follow in the same direction.

The argument and reasoning of the Brazilian decision are described hereafter. The objectives pursued by Anatel, short and medium term, are formulated. The frequency bands candidates are examined and the key reasons that supported the choice of the 1.8 GHz frequency band are presented.

Short-term objective: To facilitate the introduction of new mobile telecommunication service providers, in order to foster competition in the provision of 2G and 2.5G mobile services, taking into account the end on 31 December 1999 of the duopoly situation and the existence of a considerable demand for predominantly voice services in Brazil.

Medium-term objective: To facilitate implementation in Brazil of the IMT-2000 system whose specifications and frequency band were established by the ITU, within a two to three-year period.

The criterion for choosing the frequency band was constrained to the attainment of the above-mentioned short and medium-term objectives.

Initially, in light of telecommunication regulation and equipment availability, the frequency bands available in Brazil were identified. Figure 8 shows the three systems available or being developed: two second-generation systems, the PCS-1800 (GSM European system) and the PCS-1900 (U.S.A. system), as well as the IMT-2000 (ITU system).

The GSM-1800 is on bands 1710 to 1785 MHz and 1805 to 1880 MHz (“1.8 GHz band”); the PCS is on the bands 1850 to 1910 MHz and 1930 to 1990 MHz (“1.9 GHz band”); and the original IMT-2000 spectrum is on the bands 1920 to 1980 MHz and 2110 to 2170 MHz (“1.9/2.1 GHz band”).

In the 1.8 and 1.9 GHz bands the existing second-generation systems enable the short-term objective to be easily attained. As shown in Figure 8 there are allocations for the Fixed Wireless Access (FWA/WLL) use on the 1.9 GHz band. However, there is still enough spectrum for at least three service providers operating on the 1.8 GHz band, with 2 x 15 MHz each, and two service providers on the 1.9 GHz band, with 2 x 15 MHz each.
The conclusion was that the 1.8 and 1.9 GHz bands were perfectly adequate for the entry of more second-generation competitors, since both bands comply with the requirements of the short-term objective.

Then it was analyzed the relevance of both options, 1.8 and 1.9 GHz, regarding the medium-term objective: introduction in Brazil of the IMT-2000 system within a two to three-year period.

As mention before, the core of the matter lies in the conflict between the PCS and the original IMT-2000 bands. Figure 8 shows that there is an overlap between the PCS band and the one referring to the uplink of the original IMT-2000 spectrum. The conflict result in very serious technical consequences, since the overlapped parts are the PCS downlink and the IMT-2000 uplink.

Given this conflict, the conclusion is that the use of one system prevents the other from being used. A summary should be made here of the relevant events leading up to this conflict.

During the WARC-92 (World Administrative Radiocommunication Conference - 1992), the ITU allocated the 1.9/2.1 GHz band for the implementation of the terrestrial component of the IMT-2000, in accordance with footnote S5.388 of the ITU Radio Regulations.

A few years after the WARC-92, in 1994, the U.S.A. allocated the 1.9 GHz band to the PCS, giving rise to the conflict mentioned above between the PCS and the IMT-2000.
Subsequently, the CITEL, through recommendation Rec. PCC-III/12/95, identified the 1.9 GHz band for the use of PCS in the continent of America. However, in the same recommendation, CITEL acknowledged the conflict with the IMT-2000, created by the PCS, and recommended that each State Member adopt strategies aimed at evolving towards the IMT-2000.

It was also analyzed the decisions adopted during the WRC-2000 (World Radiocommunication Conference - 2000), held in Istanbul from 8 May to 2 June 2000.

The WRC-2000, in item 1.6 of its agenda, attempted to allocate additional frequencies, for global use, for the IMT-2000. Unfortunately, the Conference was not successful enough in the search for a sole global band to complement the needs of the IMT-2000, which only had the 1.9/2.1 GHz band, considered insufficient to meet the needs beyond 2010.

Instead of a sole band, the WRC-2000 identified three additional bands: 806-960 MHz (already intensively used by second-generation systems); 1710-1880 MHz (“1.8 GHz band”, still not used in the continent of America, although it is widely used in the rest of the world); and 2500-2690 MHz (“2.5 GHz band”). Therefore, being defined the three possibilities, the task was to analyze which one was more suitable to attend the medium-term objective of Anatel: implementation of IMT-2000 within a two to three-year period.

Concerning the 1.9/2.1 band, it was considered at that time, June 2000, highly probable that the IMT-2000 equipment on this band would be available in two or three years (2002/2003). It was even expected that in Europe and Asia the UMTS system, a commercial implementation of the IMT-2000 system on this band, since it was adopted by the European Union countries and Japan, would become a great success similar to today’s GSM. In effect, some countries announced commercial operation of this service in 2001. Other indicators of the potential success of the UMTS were the great number of license envisaged and the price paid for them, showing the immense interest for this system.

Evidently, to use the additional IMT-2000 bands it would be required several definitions on various points. It was considered that, due to the recent adoption of these frequencies, such lack of definitions would persist for some years, mainly those concerning the technology that should be employed, the market scale to produce equipment and the resulting price.

The 1.8 GHz band could eventually be used by Brazil and the CITEL countries that supported it at the WRC-2000. However, it must be pointed out that the U.S.A. Administration did not support in the WRC-2000 the use of that band for IMT-2000 systems. The reason was the existence of serious problems related to military use of the upper part of the 1.8 GHz band. European and most of the Asian countries do not have an immediate interest in implementing the IMT-2000 on the 1.8 GHz band, since they already use it for second-generation cellular phones. The availability of IMT-2000 equipment reliable and at competitive prices within the two to three-year period would be a decision.
extremely likely to lead to failure. Certainly, the risk could be considerably reduced if this band were a priority for the U.S.A. or for Europe or Asia.

The 2.5 GHz band in Brazil is allocated to MMDS. It is very difficult to change its destination to permit implementation of IMT-2000 systems owing to the large number of MMDS licenses already on this band.

The 806-960 MHz band is already intensively used by the second-generation cellular systems, which makes their use for the IMT-2000 extremely difficult in the short or medium-term. On the American continent, systems operate on 800 MHz, and on 900 MHz in the rest of the world.

In addition to the foregoing argument, it was pointed out the fact that the WRC-2000 did not indicate which parts of the additional bands would be for world use. It would be highly likely that the use of the IMT-2000 on these bands would be regional in nature.

From the foregoing analysis, it was concluded that it is highly likely that the only possibility of implementing IMT-2000 systems in Brazil within a two to three-year period, would be in the 1.9/2.1 GHz band. Therefore, the 1.8 GHz alternative is the one that should be chosen for introducing new second-generation operators.

The above conclusion was complemented by detailed studies (WWW.ANATEL.GOV.BR) regarding inter alia the following aspects:

1. Mobile service market.
2. Possibility of national and international roaming.
3. Economies of scale and industrial aspects.
4. Standardization aspects.
5. Availability of infrastructure and terminals.
6. Difficulties to remove the existing users in the bands.
7. Technological development of other networks in Brazil, the Americas and the world.

The results of the studies regarding the above aspects point out that the advantages of selecting the 1.8 GHz band for new mobile operators were far greater than the disadvantages, and that the latter were of no impediment nature.

Therefore, the 1.8 GHz band was considered the only candidate capable of permitting the simultaneous introduction of new mobile competitors without harming, in the near future, the implementation of IMT-2000 in Brazil within the next two to three-year period.
EVOLUTION TO 3G

Given the above decision that favoured the original IMT-2000 band for implementation of 3G services in Brazil, some reallocations need to be undertaken. Such reallocations affect only the fixed-line operators using the Fixed Wireless Access in the 1.9 GHz band. The decision is to do the necessary reallocations but keeping the FWA users in the same 1.9 GHz band.

Since the number of FWA subscribers in Brazil is still low, it is quite possible to rearrange the spectrum to let free most of the original IMT-2000 uplink band. The user terminal and the base-station can be easily programmed to work in any of the PCS 1900 blocks. Figure 9 shows the new allocations in the 2 GHz band in Brazil for FWA, PCS and IMT-2000. The new allocations changes are:

ền To reduce the bandwidth allocated to FWA from 60 to 45 MHz.
ền To move part of the FWA (WLL FDD) allocation to the PCS 1900 “C” block, taking advantage of the fact that two third of this block is outside the original IMT-2000 spectrum.
ền To allocate to PCS a bandwidth of 90 MHz for new 2G/2.5G operators.
ền To allocate in the original IMT-2000 spectrum a bandwidth of 110 MHz (2 x 55 MHz), which is sufficient to the evolution to 3G of all the existing 2G/2.5G operators in Brazil.
The mentioned reallocation will also result in availability of a bandwidth of 60 MHz on the 1.8 GHz band to be used eventually by both mobile (PCS) and fixed-line (FWA) operators.

It is up to mobile operators the decision on the strategy to offer 3G type services. However, Anatel understands that it is its responsibility to provide the spectrum roadmap to such evolution. Therefore, Anatel will make available to mobile operators additional spectrum in both 1.8 GHz and 1.9/2.1 GHz (IMT-2000 “core band”).

Figures 10 and 11 illustrate examples of possible evolution strategy to 3G for TDMA and CDMA platforms, respectively. GSM platforms have already a very clear evolution path to 3G.