## ANNEX G – Operator experience in transitioning to IMT-2000 systems

This annex provides operator experiences in transitioning to IMT-2000 systems. Table G.1 cross-references these operator experiences with the transition scenarios listed in section 3.2.

**TABLE G.1**

**Transition scenario of operator experiences**

| Scenario | Operator Experiences | **Pre-IMT-2000 Network** (Frequency) | **IMT-2000 Network** (Frequency) |
|---|---|---|---|
| **Scenario 1** | **Russian Federation** | NMT 450 (450 MHz) | CDMA2000 1x (450 MHz) |
| **Scenario 2** | **Chile** (Telefónica Móvil de Chile) | AMPS/TDMA (850 MHz) | GS+M/GPRS/EDGE (1900 MHz) |
| **Scenario 2** | **Japan** (NTT DoCoMo) | PDC (800 MHz) | WCDMA (2000 MHz) |
| **Scenario 3** | **Hong Kong** (Hong Kong CSL Ltd.) | GSM/GPRS (900/1800 MHz) | GSM/GPRS/ EDGE (900/1800 MHz) |
| **Scenario 3** | **Japan** (KDDI : au) | cdmaOne (800 MHz) | CDMA2000 1x (800 MHz) |
| **Scenario 3** | **Thailand** (Advanced Info Service Public Co. Ltd.) | GSM/GPRS (900 MHz) | GSM/GPRS/EDGE (900 MHz) |
| **Scenario 3** | **Venezuela** | TDMA (800 MHz) | CDMA2000 1x (800 MHz) |
| **Scenario 4** | **Hungary** (Pannon GSM Telecommunications Ltd.) | GSM (900 MHz) | GSM/GPRS/ EDGE (1800 MHz) |

## CHILE - Implementation of IMT-2000 technology (EDGE) and TDMA Migration in Chile

***Source:*** *Telefónica Móvil de Chile*

### 1. Background

Telefónica Móvil de Chile has been providing wireless telecommunication solutions in Chile since 1989. Telefónica Móvil de Chile is part of the Telefónica group of companies present in 14 countries and covering a potential 514 million subscribers. Telefónica group companies in Latin America make up over half of the 50 million Telefónica subscribers worldwide.

Telefónica Móvil de Chile draws on the experience in design and implementation of networks provided by its parent and partners to ensure they provide a high quality of both voice and data services to its customers nationwide.
In the first quarter of 2003 Telefónica launched GSM/GPRS in the 1900MHz band and this launch was followed in October by the launch of EDGE.

### 2. Infrastructure Implementation

Telefónica's new GSM network was granted as part of Chile's last 30 MHz spectrum auction in the 1900 MHz band. This process included a technical proposal where coverage and implementation times were evaluated. In order to obtain the necessary spectrum, Telefónica Móvil de Chile had to outline a fast nation wide roll out project.

Currently in the process of migrating from AMPS/TDMA mobile technology at the 850 MHz band, Telefónica Móvil de Chile selected the GSM/GPRS/EDGE family of technologies. The move was a decision that was based on global penetration, cost, services, and handsets considerations.

Telefonica's GSM network was set up in approximately four month's. All base stations were purchased new and a significant proportion were fitted with EDGE transceivers. Nationwide roll out was not affected by the later implementation of EDGE because as a radio feature EDGE can be activated per transceiver.

## 3. Spectrum Efficiency

EDGE provides a cost effective way to offer advanced services without increasing existing spectrum. All EDGE devices will support GSM/GPRS and work on multiple spectrum bands including variations of 800/900/1800/1900 MHz. EDGE is compatible with GPRS (Telefónica Móvil de Chile have nationwide GPRS coverage) so when customers move out of an EDGE enabled area GPRS packet data services will remain available. Telefónica Móvil de Chile has initially concentrated EDGE deployment in high demand data areas only.

Telefónica Móvil de Chile currently have commercially available class 2 multi-slot terminals (up to 2 TSL in downlink an 1 TSL in uplink), and have seen average rates of around 40 to 80 kbps for static applications with peaks of up to 100 kbps. Given the low cost and effort required to deploy EDGE these are pleasing results. Spectrum efficiency has also improved showing an increment of around 2.5 times compared with that of GPRS.

## 4. GSM Migration

With the addition in 2003 of GSM/GPRS/EDGE Telefónica Móvil de Chile now have a very robust network platform to compete in the Chilean mobile market. Providing to its customers a complete profile of advanced voice services, a wide range of terminals and enhanced mobile data services.

The service portfolio includes games download (MOVIL GAMES), ring-tones download (MOVIL MUSIC) and Multimedia Messaging (MOVIL IMAGES). In terms of Mobile Data Telefónica Móvil de Chile provide MOVIL INTERNET and have recently launched the VPN MOVIL that is very much enterprise oriented. These services allow customer's added mobility and a complete set of applications will become available in their own mobile office.

In general, Telefónica Móvil de Chile have found that the key is to concentrate the marketing of EDGE on giving mobility to data users and not to sell data mobility to voice users. Telefónica Móvil de Chile believe that EDGE will assist them to improve the users experience with mobile data and that this will in turn expand the market, and as a result increase revenues.

# HONG KONG - Implementation of IMT-2000 technology (EDGE) in Hong Kong

***Source: Hong Kong CSL Limited***

## 1. Background

CSL launched its mobile services in 1983, and today operates a world-class GSM/Dual Band network through its mobile brands: 1O1O and One2Free. The Company also provides comprehensive pre-paid mobile services and international roaming services. It offers leading-edge mobile technology including WAP (Wireless Applications Protocol), HSCSD (High Speed Circuit Switched Service Data) and GPRS (General Packet Radio Service).

## 2. EDGE Services

In August 2003 CSL launched Hong Kong's first commercial EDGE network. Customers in Hong Kong can now enjoy data applications at a faster data transfer rate when using an EDGE capable device. Mr. Hubert Ng, CSL's Chief Executive Officer says, "The adoption of EDGE is a natural evolution of the existing GPRS network. The EDGE deployment is also aimed at accelerating the adoption of mobile data services, and prepares the market when the next generation of mobile data gets widely accepted."

EDGE services offered include the GPRS suite of Multimedia Messaging Service, Java games, email and WAP browsing plus a new range of video downloads. Video downloads will work on video equipped GPRS terminals however the EDGE addition is geared towards the social premium segment of the market.

## 3. Evolution from 2GSM

Upgrading the existing HKCSL GPRS network was a relatively straightforward process, since in effect EDGE is an upgrade of GPRS. The upgrade became attractive due to the rapidly increasing demand for data transmission driven by the growing number of MMS and GPRS terminals attached to the network. Customers with these camera equipped colour screen handsets initially want to personalize them with their choice of polyphonic ringtone and colourful wallpaper. The more adventurous extend this use of data into uploads or downloads of MMS pictures and video clips of their favourite obsessions or download java games for offline time killing. The combination of the S curve growth in MMS terminals plus the larger file sizes for downloads of these features has driven a need for more capacity and quicker processing by the network.

The process of upgrade was relatively straightforward, much like a version upgrade of the network software, however it was accompanied by a revised radio plan in order to optimize the network performance for data. Remote sites were upgraded initially until the software and network performance was stable and then the major data traffic areas were progressively cut over to the EDGE. Since this was fully integrated with the current GPRS network, any slip-ups in the cut over of a particular base station were likely to affect the entire customer base, so the stakes were high. In practice the event ran smoothly without significant incidents.

## 4. Network Performance

Part of what makes EDGE so attractive is that the network has performed very closely to theoretical data rates, which are roughly three times that of GPRS, which gives plenty of headroom for expansion in both scope and scale of applications. This has enabled a range of video 'channels" to be created for downloads, which then allows customers a richer experience in their use of mobiles.

## 5. EDGE Roaming

CSL then quickly implemented EDGE roaming with AIS, who was also in the process of upgrading to EDGE. The speed, with which this was completed utilizing the normal GPRS roaming process, was a graphic illustration of the ease of global rollout of new higher speed data services. Thailand is an important business and recreational roaming destination to CSL customers, who can now use all of their favorite data applications whilst abroad.

## 6. EDGE, Market Reality

Since the launch of EDGE in August subscriber growth to date has exceeded CSL's expectations. The Nokia 6220, the first EDGE terminal is currently the best selling handset in Hong Kong, in part because it offers the novelty of video on an affordable cool handset.

Data usage by the subscribers has been double that of normal MMS handset buyers, where package subscription is currently 50% for EDGE data transport package subscription has been near 100%. In effect this means that those currently buying this handset plan to use it on an ongoing basis for data services. This indicates that we have turned the corner in data service adoption for segment, although it is still an early adopter/fast follower phenomenon.

EDGE network topology has provided CSL a cost effective way of offering 3G like services and thus satisfying immediate customer demand. EDGE is paving the way to a full and harmonized 3G rollout and will allow CSL to deliver optimum performance, flexibility and coverage at the lowest possible cost.

# HUNGARY - Implementation of IMT-2000 technology (EDGE) in Hungary

***Source: Pannon GSM***

## 1. Background

Pannon GSM Telecommunications Ltd launched its 900 MHz frequency in March 1994 and in 1999 they won the tender for the 1800 MHz frequency in Hungary. In November of 2000 Pannon GSM rolled out its 1800 MHz frequency in Budapest, this network was built at record speed. Pannon GSM then began to operate its 1800 MHz band nationwide in 2001. In May 2003 Pannon made the first EDGE (IMT-2000) test call in Europe and since October 2003 the service is being tested in several parts of Budapest. With over 2.785 million subscribers on its GSM900/1800 network Pannon GSM holds a 36% share of the Hungarian mobile market.

Since first launching its mobile services in March 26, 1994, Pannon GSM have followed a continuous development process. Development has been aimed at ensuring coverage of the motorways, county seats and the Balaton area, followed by single-digit national highways. As a result of the ongoing, detailed network expansion efforts, as well as the expansion of the capacity of the existing network, 75% of the population had access to the digital services provided by Pannon GSM by the end of 1995. By the end of 1996, this number had reached 99%. Building on its existing voice and data capabilities Pannon GSM introduced WAP services in 2000 and in 2001 were the first to launch GPRS technology in Hungary. Pannon GSM also provides WLAN services in Ferihegy Airport, making a high-speed connection to a local computer network and thus to the Internet, WLAN provides extremely fast access to data stored on the network and the worldwide web.

While awaiting government decision on 3G licenses in Hungary Pannon GSM are continuing their evolutionary path to 3G by testing EDGE technology at several Budapest spots.

## 2. EDGE Services

EDGE is a significant enhancement to GPRS, offering traditional GPRS services at a higher data speed and ensuring better quality of service. EDGE is capable of data transfer faster than that of fixed lines and paves the way for a huge increase in the popularity of non-voice applications. Mobile based broadband applications such as mobile Internet access, MMS, television and video streaming, interactive games and the ability to remotely access workplace networks will become available. Hungarian users now require such services as increased data speeds for non-voice services and eventually total telecommunication mobility. EDGE implementation will allow Pannon GSM to bring users closer to these requirements.

## 3. Evolution Costs

EDGE technology utilizes existing GSM/GPRS infrastructure, enabling Pannon GSM to implement EDGE at only incremental cost. EDGE enabled terminals will continue to work on both GSM and GPRS enabled networks and will also work on WCDMA networks. The compatibility of the GSM family of technologies that includes GSM/GPRS/EDGE/WCDMA ensures that Pannon GSM can avail of economies of scale when implementing EDGE.

## 4. EDGE Implementation

Pannon GSM is currently performing EDGE trials before rolling out commercially. Trials began on the 20th October 2003 and a pre-selected group of users in Budapest are currently testing the new technology. To date tests have proven positive. Current tests that have taken place in Budapest's largest shopping mall have shown a significant increase in data rates to end users and improved mobile services usability. By upgrading existing GSM network elements to include EDGE capability, Pannon GSM will greatly enhance user experiences with mobile services, while leveraging the most from its current network investment. EDGE will allow Pannon GSM to provide its Hungarian operators 3G like services both immediately and cost efficiently.

# JAPAN - Implementation of IMT-2000 technology (FOMA) in Japan

***Source:*** ***NTT DoCoMo***

## 1. Introduction

Japan's mobile telecommunications company, NTT DoCoMo, provides wireless voice and data telecommunications to more than 47 million customers. The company provides a wide variety of leading-edge mobile multimedia services. These include i-mode®, a very popular mobile Internet service, which provides e-mail and Internet access to over 40 million subscribers, and FOMA®, launched in 2001 as the world's first 3G mobile service based on WCDMA. At the heart of our operations is a commitment to providing customers with cutting-edge, cost-effective service and a belief that ongoing, focused research and development can help us to continually reinvent the concept of mobile telecommunications. In addition to wholly owned subsidiaries in Europe and North and South America, the company is expanding its global reach through strategic alliances with mobile and multimedia service providers in Asia-Pacific, Europe and North and South America.

## 2. FOMA Launch

In October 2001, NTT DoCoMo launched the world's first fully commercialized third-generation mobile telecommunications service under the brand name of "FOMA", which stands for "Freedom of Mobile multimedia Access". Using the WCDMA technology, one of the IMT-2000 global 3G standards, FOMA enables high-capacity, high-speed data transmissions and offers an exciting new range of services including videophone and video mail. Ever since the launch of FOMA, NTT DoCoMo has continued expand its network coverage at a rapid pace and released a number of new handsets equipped with advanced functionality. As a consequence, the total number of subscribers to the 3G FOMA service nationwide exceeded 1.6 million in November 2003, approximately two years after the commencement of the service.

## 3. FOMA Services

FOMA has made mobile video and high-speed data transmissions a reality. Since its fully commercialized service launch in October 2001, new handsets offering advanced features have been released one after another to satisfy the needs of ever-expanding number of subscribers. With the evolution of FOMA far from over, NTT DoCoMo is committed to move further ahead in its efforts to create a richer mobile telecommunications environment, in which users can access virtually any information they require, free from the constraints of time or location.

### 3.1 i-mode

Following the functional enhancements enabled by "i-appli", i-mode service has become even more advanced with the use of FOMA 3G technologies. FOMA's high-speed packet transmission speeds of up to 384Kbps makes i-mode service significantly faster and able to handle greater volumes of data such as e-mail messages of up to 10,000 characters, and to attach files of melodies and still images. The latest handset models also feature an enhanced data capacity, increasing the size of each "i-appli" content to as large as 200KB. The i-mode service has always offered enhanced convenience to its users, whereas FOMA's new capabilities realize entirely new potentials.

### 3.2 Visual Communications/Videophone

Mobile telecommunications became infinitely more expressive with the introduction of videophone capability on FOMA. The service, which allows subscribers to speak to each other face-to-face, is extremely useful for personal communications as well as in business situations, as it enables business users to provide an initial view of products to their clients and customers, and maintain closer contacts between office and field operations, or personal users to place a video call to a friend over a mobile phone.

### 3.3 High-speed data telecommunications

- High-speed packet transmission at rates of up to 384Kbps* allowing users to access to e-mail and web sites at faster speeds.
- 64K circuit-switched data transmission, an ideal solution for sending a large volume of data, such as video images, in real time.

* The uplink transmission of data is carried out at rates of up to 64Kbps. This is, however, provided on a best-effort basis, and the actual transmit speed varies depending on the propagation conditions and network traffic.

### 3.4 Multi-access

FOMA's multi-access capability allows subscribers to simultaneously engage in multiple modes of telecommunications. For instance, in a business setting, this capability allows salespersons to talk to customers while accessing their corporate database, and for personal use, the service is convenient for chatting with friends while searching restaurants on i-mode. The latest handset models even enable subscribers to take still pictures and send them as e-mail attachments while talking on a phone.

### 3.5 i-motion

i-motion service allows subscribers to download exciting content combining audio and video data. The service is offered in three formats — video with sound, still picture frames with sound, and sound-only files. The number of compatible content sites has been increasing, providing subscribers with a greater variety of information services, such as movie previews, promotional music videos, and news and sport highlights, among others. The "i-motion mail" video message service enables subscribers to send video, recorded by the mobile phone's built-in camera or downloaded from a web site, by attaching it to an email. The maximum file size has been dramatically extended from previously only 100KB to 300KB, and users are now able to play back videos of up to 30 seconds containing more expressive content and higher-definition images.

## 4. A Vision for Growth

Futuristic 3G telecommunications capabilities have long been anticipated worldwide, but they could not be realized until the advent of WCDMA technology. NTT DoCoMo launched its WCDMA-based 3G FOMA service ahead of the rest of the world and continues to progress by streamlining its operations to achieve greater business efficiency, enhancing the functionality of its state-of-the-art mobile handsets, supplementing its product line-up with advanced new offerings, and aggressively expanding the FOMA service area. With many high value-added functions superior to the second-generation PDC service, FOMA has proven itself capable of reliably meeting the most demanding business needs and is well on the way to becoming one of our mainstream mobile telecommunications service offerings.

In addition to introducing sophisticated new functions and further expanding the service area of FOMA, NTT DoCoMo's future plans include the reduction of handset weight to less than 100g and the extension of handset battery life to more than 300 hours. To accelerate the uptake of FOMA service in Japan, NTT DoCoMo aims to extend its nationwide population coverage to 99% by the end of March 2004. Meanwhile, indoor coverage will also be expanded in parallel to enable customers to use FOMA in buildings and underground shopping malls, etc.

## 5. 3G Global

Through technical exchange and joint studies with leading operators abroad, NTT DoCoMo is stepping up its efforts to facilitate an early implementation of 3G mobile telecommunications services worldwide. Leveraging its extensive technical R&D capabilities, its expertise pertaining to the WCDMA technology, one of the global 3G standards for which the company played a primary role in the standardization activities, and its experience and know-how as a world pioneer in commercial 3G services, NTT DoCoMo aims to further proliferate 3G mobile telecommunications services on a global scale.

# JAPAN - CDMA2000 1X Deployment and Associated Multimedia Services Launched in Japan[1]

***Source:*** ***KDDI (JAPAN)***

## 1. Wireless Market Outlook in Japan

The total number of wireless subscribers in Japan at the end July 2003 was 77,795,800. The total number of mobile Internet subscribers in Japan jumped up from 12,720,000 (as of end June 2000) to 65,174,100 (as of end July 2003) – an increase of 512% just in 37 months. KDDI attributes much of this dramatic growth to the launch of its commercial CDMA2000 1x service, known as "au".

## 2. CDMA2000 1x Launch by au

In July of 1998, au launched its second-generation cdmaOne system throughout Japan, offering new high-quality voice services to its existing TACS and PDC customers, while continuing to run those other networks. In April of 1999, au began offering its "Ezweb" service, which enabled the provision of Web-based applications to mobile devices. In April of 2000, au began offering international roaming with other cdmaOne operators, while in July of 2000, au launched IS-95B, the packet service upgrade to cdmaOne, which provides data rates of 64 kbps.

By November of 2001, only three years after deploying its cdmaOne network, au had reached a total of 10 million subscribers. In the same timeframe, au terminated its TACS operations and decided that to shut down its PDC operations by the end of March 2003.

In April of 2002, au upgraded its cdmaOne system to CDMA2000 1x, covering 54% of the Japanese population initially and expanding to cover 90% by December of 2002. Less than sixteen months after its initial commercial launch, there were 9 million CDMA2000 1x subscribers on the au network.

## 3. Secret of au's Success in CDMA2000 1x Launch

Due to CDMA2000 1x's inherent backward compatibility with cdmaOne, which enables cdmaOne terminals to operate on CDMA2000 systems and vice versa, service coverage for the CDMA2000 1x system was practically equivalent to the existing cdmaOne service coverage from day one. In addition, the straightforward upgrade path from cdmaOne enabled a rapid and low cost CDMA2000 1x roll-out. Moreover, the technology maturity inherited from cdmaOne, led to the development of CDMA2000IMT-2000 CDMA Multi Carrier handsets that were the same size or smaller than cdmaOne handsets, had the same battery life and operational stability, with a minimal increase in cost.

In deciding how to rollout its CDMA2000 1x network, au considered two different options: 1) an upgrade approach; or 2) an overlay approach.

In an upgrade approach, a cdmaOne operator upgrades all of its existing infrastructure equipment and software to CDMA2000 1x in one step. This approach has the advantage of requiring less capital expenditure for the upgrade to CDMA2000, but results in some disruption of services while the cdmaOne software was modified.

In the overlay approach, a cdmaOne operator deploys a CDMA2000 network alongside its existing cdmaOne network, migrates customers over to the new network, and then upgrades the cdmaOne network equipment. This approach has the advantage of not requiring an initial modification to the cdmaOne network, enabling ongoing, uninterrupted services. However, this approach requires more capital expenditures.

After weighing these options, KDDI adopted the "upgrade" approach in its rollout of CDMA2000 1x.

## 4. Mobile Multi-media Services by au

With its fully commercial CDMA2000 1x system in place, au has been offering a variety of multimedia services to its customers, including:

- Ezweb - WAP2.0-based Internet Access and Browsing Platform
- EZweb@mail - IMAP4-based e-mail platform

[1] More detailed information is available at the ITU-D IMT-2000 website (www.itu.int/ITU-D/imt-2000/documents/Case%20studies%20ITU-D%20Meetings/KDDI_Japan_Annex.pdf)

- Ezplus – Java™ application services, with support of mobile agent function using HTTP, and automatic application update from servers
- Eznavigation - Accurate position location-based services powered by gpsOne
- Ezmovie - Video distribution available nationwide, using industry standards, i.e. MPEG-4 for video coding and MP4 for video file format
- Photo-mail (including eznavigation associated with Photo-mail, which stores location information along with pictures to provide vivid memories for travellers, the ability to provide easy recommendations on locations, and a number of business applications)

## 5. Objectives and Goals for 3G Migration : au's Next Step

As au continues to expand its successful CDMA2000 1x services, it is looking down the road to determine what is driving customer demand. Based on its experience with IMT-2000 services, au has discovered, to no one's surprise, that customers want large-volume content with low prices. An obstacle to providing advanced applications with rich content is the cost per bit of data. Therefore, a low-cost infrastructure for data transactions is required. Reducing cost per bit is essential for the provision of content-rich services and applications.

In order to further reduce the cost per bit and offer its customers more content-rich applications, au plans to add CDMA2000 1x EV-DO later in 2003. CDMA2000 1x EV-DO is specifically tailored for asymmetric high data rate packet telecommunication with mobility. It uses the same carrier width that cdmaOne and CDMA2000 1x occupy (1.25 MHz), and has similar RF characteristics and link budgets, allowing collocation of CDMA2000 1xEV-DO carriers and base stations with those of CDMA2000 1x network. The forward link (base station to mobile) sector throughput of CDMA2000 1x EV-DO is 600kbps or higher on average, with 2.4Mbps as the peak, which performs very much higher (bps/Hz) than CDMA2000 1x or WCDMA.

# RUSSIAN FEDERATION - Evolution and Migration of 1st Generation NMT450 Analogue Mobile Networks to IMT-2000

***Source: Russian Federation***

## 1. Background on NMT450 Evolution and Migration

NMT (Nordic Mobile Telephone)[2] is a first-generation analogue mobile cellular network standard that was first deployed in 1981 in Scandinavia in 450 and then in 900 MHz band, and later in 12 other Eastern European and CIS countries including Russian Federation in 450 MHz frequency band[3]. NMT450 was a first federal cellular standard deployed in Russia in 1991. Number of users of NMT450 in Russia once reached 1mln is now declining.

In 1998 a need for digital technology for future migration of NMT networks was identified at the NMT MoU Plenary. After studying three different technology options for digitization of the NMT systems, two technologies were selected in 1999 for future evolution of the NMT450 networks: GSM400 and CDMA450. After deployment of two trial GSM400 networks, this evolution path was abandoned by manufacturers who supported it. Between October of 2000 and December of 2002, trials of CDMA450 (also known as IMT-MC-450, or Band Class 5 of IMT-2000 CDMA Multi-Carrier[4]) were conducted by different NMT operators in Russia, Hungary, Romania, Sweden, Georgia and Belarus. Trials have led to successful commercial launches in Romania, Belarus and then in Russia.

## 2. IMT-MC-450 studies and trial networks

Russian Administration in support of requests from leading NMT450 operators has initiated a study on effective use of 450 MHz frequency band by digital technologies for s smooth migration of NMT450 networks. The studies included studies of NMT network evolution options and implications, EMC and sharing studies of CDMA technology. Studies were carried out by leading Russian scientific research institutes. Studies have shown that IMT-MC-450 is an effective solution for evolution of NMT450 networks in Russia.

In order to practically support the results of theoretical studies trial networks were deployed first in Moscow by Moscow Cellular Communications (December 2001) and then in St. Petersburg by DeltaTelecom. The trials were aimed at testing system coverage and capacity, high-speed packet data capabilities, electro-magnetic compatibility (EMC)/sharing with NMT450 network and other users of the band and adjacent bands, and roaming capability.

The following trial results were reported by operators:

- Single cell radio coverage of up to 50 km;
- Capacity claims proved;
- Approximately 100 kbps average packet data transfer rate (download and upload) achieved in urban environment, in movement;
- Excellent voice quality experienced;
- Roaming successfully tested;
- EMC: two networks, analogue and digital, may coexist in the band, if the guardbands are used at both sides of CDMA carrier.

Based on the studies results and trial network tests IMT-MC-450 was chosen by the Ministry of Telecommunications and Informatics of the Russian Federation as the technology evolution path for existing NMT450 networks in Russia. The IMT-MC-450 standard was adopted as a federal standard in the Russian Federation.

## 3. IMT-MC-450 Commercial Network Deployments

Following the trials and decision of Administration mentioned above, DeltaTelecom deployed a full scale commercial IMT-MC-450 network in Saint Petersburg, Leningradskaya Oblast (Region), and several other regions in north-west of Russia under trademark "SkyLink". Moscow Cellular Communications (MCC) is currently deploying an IMT-MC-450 network in Moscow and Moscow Region to provide services under SkyLink name starting this autumn. There are other NMT450 operators in Russia currently deploying IMT-MC-450 networks in other parts of the country.

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[2] See Report ITU-R M.742-4, Annex 3 for general description of the NMT standard; See NMTA website http://www.nmtworld.org for more information on NMT450 operators.

[3] Almost all of NMT450 networks operate in the 450-470 MHz frequency band.

[4] See Recommendation ITU-R M.1457-3.

## A) Stages of IMT-MC-450 Network Deployment

Studies have shown that smooth migration to digital technology in the 450 MHz band may be performed in several stages, as illustrated in Figure 1. In most cases, the NMT450 operators have limited bandwidth available (2x4.5 MHz on average), which allows usage of three IMT-MC-450 carriers (1,25 MHz each). The need to move from one stage to another may appear at different times in different parts of the network. Traffic demands may greatly vary across the covered territory. Thorough analysis and careful planning should be used to achieve high efficiency and quality.

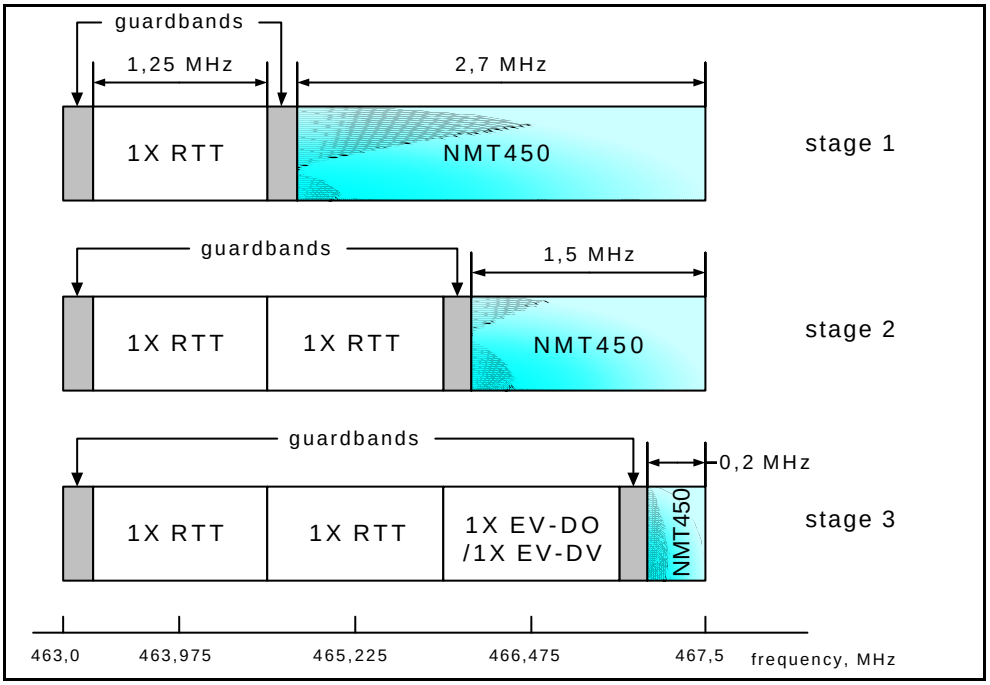



FIGURE 1

**Spectrum usage (BS Tx band) in 3 stages of network evolution.**

*1) First stage: initial deployment.*

First, a single IMT-MC 1X RTT carrier is introduced. This requires the NMT450 operator to clear 2x1,79 MHz of spectrum used by the analogue NMT system (2x1,25 MHz for the 1x RTT carrier, and 2x2x0,27 MHz for a guardbands between the IMT-MC and analogue narrowband carriers). At this time, the NMT analogue network is still operational and providing service to the customers in parallel with the new IMT-MC system.

*2) Second stage: network growth.*

With growth of voice and data traffic in parts of the network, a second IMT-MC 1X RTT carrier can be introduced. This requires the operator to clear an additional 2x1,25 MHz of spectrum used by the analogue NMT system. No guardbands between the IMT-MC carriers is needed. Depending on traffic demand, one IMT-MC carrier can be used mainly for voice, while the second carrier can be used for voice and data. During this stage, NMT analogue subscribers are still being served by the network, but with limited quality due to restricted bandwidth of 1,5 MHz.

*3) Third stage: high demand for data services.*

When the data traffic in the network increases substantially and higher bitrates are desirable by end users, a data-optimized carrier – (1xEV-DO) and furthermore 1xEV-DV can be introduced.[5]

[5] Assuming 2x 4,5 MHz, continued analogue NMT operation is not possible in areas where all three IMT-MC 450 carriers are in use.

## B) Commercial IMT-MC-450 Services

When SkyLink began its IMT-MC-450 commercial operations, the cellular mobile radio telecommunications market in St. Petersburg was well developed with nearly 37% penetration and with three competing operators, Megafon and MTS (GSM), and Fora (analogue).

SkyLink's objectives for its IMT-MC-450 deployment were to 1) replicate coverage of its analogue NMT network and continue provision of high quality voice services, and 2) provide a variety of new data services to compete with the GPRS services offered by its competitors.

*1) Coverage*

SkyLink began offering commercial IMT-2000 services over its IMT-MC-450 network in December of 2002. Initially, the network deployment was limited to Saint Petersburg and its nearest suburbs. In order to cover the same geographic area as its analogue NMT system, SkyLink deployed IMT-MC-450 base stations (BTSs) on top of 60 of the 67 existing analogue NMT cell-sites. It was shown that the coverage quality of IMT-MC-450 network is significantly better than that of the analogue NMT system.

*2) Services*

In addition to providing high-quality voice services, SkyLink is offering the following advanced data services over its IMT-MC-450 network:

- High-speed access to Internet (with data rates up to 153 Kbps) using computers, notebooks and PDAs;
- Access to specialized Web-portals using mobile terminals or PDAs[6]
- E-mail reception and transmission with SMTP/POP3 protocols using mobile terminals or computers;
- Mobile games and specialized applications, such as "Search of objects" with option to receive a city map with the found objects on PDA screen.

When it began providing these services, SkyLink decided to offer three different pricing plans, see Table 1.

TABLE 1

| Pricing Plans (Tariffs) | Subscriber's number | Voice minutes included | MBytes of data included | Monthly fee |
|---|---|---|---|---|
| 1 | 7-digit (local StP numbering area) | Unlimited | 75 | 72 $ |
| 2 | 7-digit (local StP numbering area) | Unlimited | 30 | 60 $ |
| 3 | 10-digit: (8-901+7-dig.) | Unlimited | 30 | 50 $ |

The duration of voice conversations was not limited, and the cost for data transmissions over the limit is 0,3$ per MByte.

*3) Network and service offering expansion*

Once it completed its initial network deployment in the St. Petersburg region, SkyLink began to expand its IMT-MC-450 network and services to Leningrad Region. Wireless service penetration in the St Petersburg and Leningrad Region had increased to 45%, with four GSM operators (Megafon, MTS, BeeLine and Tele2), which were offering a variety of services using GPRS, including MMS.

Under these conditions, SkyLink decided to focus its IMT-MC-450 network deployment and service offering in Leningrad Region area where the majority of the population (more than 50%) lives, and to offer a wider variety of higher quality voice and data services.

The new pricing plans included: the Manager Tariff (30$ monthly fee, includes 300 minutes to public telephone network (PTN) numbers and an unlimited number of minutes to mobile phone numbers); and the Special Tariff (exclusively for analogue NMT subscribers that migrate to the IMT-MC-450 network).

[6] The SkyLink network is developed and constantly modified the Web-portal SkyMobile on which is collected the most important, operatively updated information on user's account, dealers, cash departments, news, exchange rates, weather, help phones etc.

The expanded list of data services included: protected access to Intranet (based on VPN); a significantly extended list of services through the Web portal; and preparation for introduction of special platforms of online access to wireless applications using BREW (Binary Runtime for Wireless).

## C) Lessons Learned from Commercial IMT-MC-450 Operations

Based on its experience with a commercial IMT-MC-450, SkyLink has made the following observations:

1. Actual capacity and network throughput of the IMT-MC-450 network met declarations made by equipment manufacturers.
2. Electromagnetic compatibility between the analogue NMT and IMT-MC-450 systems was achieved when guardbands were implemented between the analogue and digital carriers.
3. No serious electromagnetic compatibility problems occurred between the IMT-MC-450 system and other wireless systems operating in adjacent frequency bands.
4. The adopted market entry strategy, including tariff plans, was justified: Despite a high entrance fee (> 400 $) there is a steady demand for offered services;
   - More than half of subscribers use data services;
   - Average monthly data traffic volume is approximately 10 Mbytes per subscriber;
   - More than 5% of subscribers have monthly data traffic volumes significantly exceeding the amount included in the pricing plan (30 MBytes per month for pricing plan 1 and 2, see Table 1);
   - Average Revenue Per Subscriber (ARPU) of IMT-MC-450 network is eight times more than the ARPU of analogue NMT450 network;
   - Stable growth of subscriber base of IMT-MC-450 network;
5. The further reduction of analogue NMT subscriber base in 2004 will enable to enter the deployment of a second IMT-MC-450 carrier, that will double the network capacity.

## 4. Conclusion

The evolution path for the 1st generation NMT450 analogue mobile networks to IMT-2000 has been explored in Russia by studies and trial networks, and has proved successful by commercial launches in Russia and elsewhere in Eastern Europe.

The use of IMT-MC in the 450 MHz frequency band may serve as an efficient solution not only for NMT450 operators seeking to evolve their networks, but also for new operators interested in providing IMT-2000 services across vast territory with less investment. At the same time experience of rolling out of IMT-MC-450 network in St. Petersburg has shown that the system also allows operators to build IMT-2000 systems in the 450 MHz range in territories with high density of traffic.

The experiences of the NMT operators in the Russian Federation demonstrates that there is a demand for wireless data services and Internet access, particularly as subscribers get used to paying not for session duration, but for information volume. In addition, in the absence of advanced wireline infrastructure, IMT-MC-450 networks provide a unique opportunity to deliver high-speed data services (especially access to the Internet) to subscribers in both urban and rural areas.

In conclusion, the Russian Federation anticipates that the experience of its NMT450 operators in evolving their 1st generation analogue systems to IMT-2000 using IMT-MC-450 will be useful to other countries and operators as they investigate their options for IMT-2000 deployment.

# THAILAND - Implementation of IMT-2000 technology (EDGE) in Thailand

***Source: Advanced Info Service Public Company Limited***

## 1. Introduction

Advanced Info Service Public Company Limited (AIS) started out in the information technology field as a computer service provider and today we have firmly established ourselves in the wireless telecommunications sector as an analog mobile phone service provider of cellular 900 and digital GSM systems. With over 13 million subscribers AIS is not content with being Thailand's leading mobile phone service provider, AIS continues to integrate the latest in advanced technology and deliver more than just voice telecommunication into the hands of its subscribers. In return for their confidence and support, AIS is committed to exceeding customer expectations in all aspects of mobile phone technology provision and service.

## 2. EDGE

In October 2003 AIS began to roll out EDGE technology in Bangkok's financial district and Chonburi, other major cities will be upgraded by December or January 2004. The decision was made by AIS to deploy EDGE to satisfy customer demand. Current customer demand expects wireless data to provide the same data rates as wireline data does. WLAN technology is currently used in hotspots to ensure that these data rates were satisfied however it has been found that these rates were demanded in a wider area.

AIS see EDGE as the technology that is essential to cater for user demand and improve quality of service (e.g. faster FTP/MMS/e-mail). EDGE will provide AIS customers with mobile data and multimedia services such as video streaming, Internet browsing, email and corporate data access. The enhancements will enable customers in Thailand to access mobile multimedia services at higher speeds, and improve the quality of service such as Video Message, Multimedia Messaging Service, Java games, email and WAP browsing.

## 3. Marketing

The marketing of EDGE today is not different from that of marketing GPRS. AIS have been focusing on the marketing of services and applications rather than technologies behind the services. Customers are educated about how they can receive better QoS using bandwidth consuming services and applications if they switch to using an EDGE capable phone. The special marketing promotion will be advertising the bundle of EDGE/GPRS and WLAN package. This promotion is set up to give more benefit to heavy data users and convince them to switch to using EDGE capable phones.

## 4. Spectrum Efficiency

EDGE stimulates the growth of mobile data traffic, increasing throughput by up to three times that of GPRS. The increase in quality and speed means that user experience with data services will improve for both private user and business customers. High-speed access will become available to MMS, video and audio streaming, intranet/internet access and corporate email.

EDGE was first rolled out in the main centers of Thailand because of the high data traffic in that area. AIS expected that heavily consuming data users mostly would adopt new bandwidth consuming applications. Speed provided by GPRS may not be able to satisfy their QoS demand on those applications.

In that area, AIS dedicated 4 TS for EDGE/GPRS traffic channels. Assuming that a user with GPRS phone would like to download 120 kbyte video mail. With GPRS phone (1 Tx + 4 Rx), it takes around (120*8)/(4*10) = 24 seconds: but with EDGE phone (1 Tx + 2 Rx) it only takes around (120*8)/(2*30) = 16 seconds. In addition there are 2 TS left available for other EDGE/GPRS users to use also. So, QoS on data usage is better. The QoS on voice usage will be achieved only when all data users switch to use EDGE phone and remain downloading same data volume; then, some EDGE/GPRS TS can be freed up for voice calls.

## 5. 3G Evolution/Compatibility

3G licenses have not yet been awarded to operators in Thailand so by implementing EDGE, AIS are able to provide 3G like services at a relatively low cost. Given that EDGE shares the same packet core network with WCDMA and that is it also backward compatible with GPRS, EDGE will enable AIS to provide a seamless and standardized migration to 3G in the future.

# UGANDA - GSM networks bring health care to rural Uganda

***Reprinted with permission, Cellular News – 23 September 2003***

The launch of a nationwide, wireless network to improve Uganda's ability to treat patients and combat the spread of disease was announced yesterday. The network is built around the country's well- established cell phone network, inexpensive handheld computers, and innovative wireless servers called "Jacks." The technology allows health care workers to access and share critical information in remote facilities without fixed telephone lines or regular access to electricity.

The announcement was made by Canada's International Development Research Center (IDRC), WideRay, a wireless technology company based in San Francisco, and SATELLIFE, a non-profit organization focused on improving health in developing countries.

The Jack servers, which are about the size of a thick textbook and use long lasting industrial-grade batteries - a single charge lasts up to a year - are being installed in health care facilities across Uganda. Health workers can link to the device using the infrared port on their handheld computers to retrieve or submit information, and to access email.

"This is going to be a giant leap forward for Ugandan health care. It could save thousands of lives and have significant benefits in health outcomes for Uganda's citizens," said Holly Ladd, Executive Director of SATELLIFE.

This project will provide health practitioners in the field with tools that were previously unavailable or outdated. For example, users can now access the latest treatment guidelines for tuberculosis and malaria and learn of the most cost-effective approaches to fight HIV/AIDS, which infects one in 10 adults in Uganda. They can also read the latest medical journals and textbooks from around the world, in a digital form.

The technology should also improve health care administration by reducing the time taken to submit, analyze and respond to reports and requests for supplies.

Recognizing the potential of this technology for Uganda, Connectivity Africa, a Canadian government initiative managed by IDRC and funded from Canada's Fund for Africa, contributed US$565,000 to the development of this information network.

"The convergence of new technologies low-cost handhelds, broad and reliable wireless coverage and WideRay's innovative use of it have made applications that once seemed impossible in Africa a reality," said Richard Fuchs, Director of IDRC's Information and Communication Technologies for Development (ICT4D) program area. "This project will be a powerful example to the rest of the world of what is possible with wireless technology."

# VENEZUELA - Venezuelan Experience on the Implementation of CDMA 1xrtt Network by one Existing TDMA Operator in the 800 MHz Band (824-849 MHz/869-894 MHz)

***Source: Venezuela***

## 1. Background

By 2001, one Venezuelan mobile operator, completed studies on the feasibility and revision of the business case for deployment of a new technology in the 800 MHz band, with two options: GSM and CDMA, and several requirements, such as: substantial increase in network capacity, greater compatibility with existing infrastructure, better positioning to provide 3G services, and substantial reduction of future CAPEX and OPEX requirements.

In studies of the two options, six main aspects were taken into account by the operator:

- Availability of technologies in the 800 MHz band
- Efficiency of frequency use (traffic handling capacity)
- Compatibility with existing infrastructure
- Positioning to offer 3G services
- International experiences
- Availability of terminals

## 2. Study of Options

### 2.1 Availability of technologies in the 800 MHz band

By 2001, only one digital technology could provide solutions that met the requirements considered by the operator: CDMA 1xRTT. Some manufacturers had announced their intent to provide a GSM solution for the 800 MHz band, but thus far, this had not materialized.

The operator had then to choose either the CDMA 1xRTT option, with successful experiences in other countries of the Americas, or GSM, without knowing whether that solution would be developed, and without previous experiences to draw upon. In addition to the infrastructure problem, there was major concern in connection with the GSM option regarding the availability of user terminals as, thus far, no manufacturer was offering GSM terminals in the 800 MHz band.

### 2.2 Efficiency of frequency use (traffic handling capacity)

To date, on this item, CDMA has shown itself to be the technology making the most efficient use of the spectrum and, therefore, providing greatest traffic handling capacity. Nonetheless, we must note another important problem that had to be resolved: radio frequency engineering.

Having to implement the new network in the very congested 800 MHz band, it was necessary to revise frequencies plan to provide for the coexistence of a new technology. This involved considerable effort to make room for the new technology in part of that band without affecting the quality of the existing TDMA system.

### 2.3 Compatibility with existing infrastructure

As GSM is a form of TDMA technology, some people had the impression that there was greater compatibility between these two technologies (GSM and TDMA) than between TDMA and CDMA. However, the fact that IS-136 and GSM are two forms of TDMA does not mean that they are at all compatible from either the user terminal or the operator network standpoint, while TDMA and CDMA networks share the same telecommunications protocol in the core network (ANSI-41).

Such a feature of compatibility enabled the operator to share the same TDMA applications and systems on a new CDMA 1x network. In concrete terms, it meant sharing such important platforms as HLRs, voice mail, SMS, WIN, prepaid, etc., enabling customers to migrate from the TDMA to the CDMA platform while retaining their telephone numbers and user profiles.

## 2.4 Positioning to provide 3G services

Careful study of a TDMA operator's options in migrating toward 3G shows that the GSM route requires additional spectrum (UMTS spectrum), as well as two additional platforms: the GSM network and the UMTS network. However, the CDMA2000 route does not require additional spectrum, as it can be implemented in the 800 MHz band on only one platform: the CDMA2000 network.

## 2.5 International experiences

By 2001, the European operators that had invested heavily to obtain licenses for use of the spectrum required to implement UMTS were in a critical situation since financial point of view. Many could not make payments while others were asking governments to relieve them of their payment obligations. Problems were aggravated by delays in the development of UMTS technology and none of the implementation commitments had been fulfilled. In fact, new delays were announced regularly.

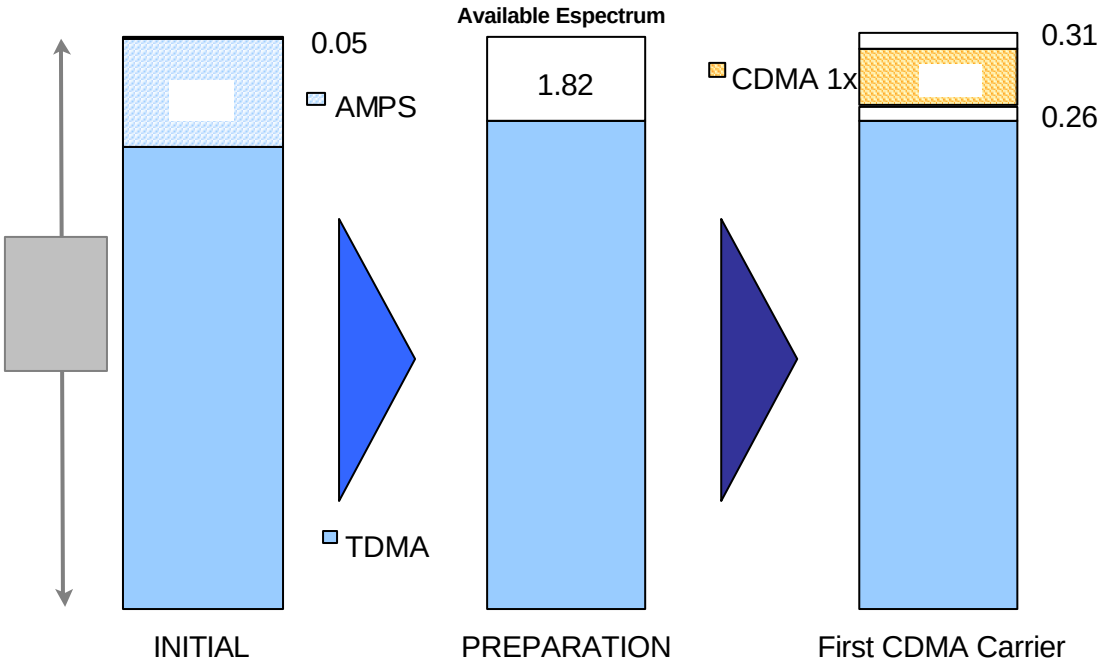
On the other hand, Korean and Japanese experiences with the CDMA 1x platform had been very successful. The number of users was growing rapidly and new applications and terminals were appearing every day.

## 2.6 Availability of terminals

For purposes of the decision, the terminal issue was one of the more studied aspects. The operator had already learned from experience how advantageous it was to have a wide variety of terminals tailored to the different customer segments, as well as manufacturers willing to provide in the terminals the latest technological innovations in the technology used by the operator. Thus, the decision had to take into account the existence of a wide range of manufacturers, committed to delivering terminals tailored to the applications to be implemented and to market requirements, taking into account the Korean and Japanese experience, as well as the decision taken by one large North American operators, and one large Brazilian operator to implement the technology CDMA 1x, generated confidence that terminals would be available.

# 3. Network Construction and Commissioning

The project to install and bring into operation of the CDMA 1xRTT platform consisted, as mentioned above, of building a network parallel to the TDMA network (over 400 cells), retuning the entire existing network (AMPS and TDMA) to free the necessary spectrum to raise the CDMA 1xRTT carrier, adaptation of sites for installation of the new radio base stations and the MTX, interconnection, connecting platforms and common nodes to the AMPS, TDMA, and CDMA 1x, and adjustment of operating systems, billing, and administrative procedures.




**Plan for Spectrum Migration to CDMA 1xRTT**

One of the project's main challenges was to integrate the TDMA and CDMA 1x networks into the core network, operations support systems (OSS), and business support systems (BSS). The objective was to ensure number portability between networks, transparency of services, and compatibility of the two networks by reutilizing platforms providing basic and value added services, such as SMS (*Moviltexto*), voice mail (*Movilmensaje*), HLRs, the other voice services, SCP, and Wireless Intelligent Network (WIN), both for the prepaid service collection platform and for calling records to bill for the new network's services. Processes and systems to support the new wireless data services also had to be designed.

At the time the project began, no platform existed enabling subscribers' profiles and locations to be stored (HLR) that was capable, for both networks simultaneously, of handling and managing subscribers to ensure the transparency of the process.

At the same time, an exhaustive study had to be made of the services associated with the WIN network and their current support procedures so as to be able to integrate them with the new network.

The possibility of coverage of 1x subscribers under the analogue network had to be evaluated, as several services required fundamental changes in treatment. Even basic services such as voice messaging required adjustments to call routing procedures owing to existing differences among providers.

Prepaid service had been operating over TDMA with manufacturers' proprietary protocols which, with introduction of the new network and a new provider, became an obstacle to integration with 1x. For this service, solutions were more sophisticated. Negotiations were conducted with providers and competitors to ensure deployment of a system based on the standard IS-826 telecommunications protocol for prepaid mobile telephony systems. This involved designing a new network architecture, in order to meet the objectives by the deadlines without affecting existing systems.

Within nine months – from January to October 2002 - all these efforts had met with success, with participation by all company units, while simultaneously satisfying the installation and operating requirements of the existing AMPS, TDMA, and CDPD networks.

## 4. Tests of Operation

The commercial certification process consisted of validating the network's commercial operation through the use of general testing protocols for calls, services, and systems supporting commercial operation and customer services. The certification process was conducted on the call and service different systems, that is, postpaid and prepaid on-line systems, agents' extranet, voice activation, on-line The operator, operational intranet (Switch-MTX and short message service, postpaid and prepaid calls and services, tests in outdoor locations; indoor tests in each region's most important structures; handoff: maintenance tests for calls when the receiving radio base station changes, for both digital and analogue radio base stations; IVR: card activation, data transmission.

Tests were divided into postpaid and prepaid categories, and a multidisciplinary certification team was formed. Its structure was: the fault repair group, responsible for monitoring and correcting problems on systems operated on The operator; the testing group, organized into regions by the regional managers; and a group of regional manager's office employees, responsible for call and service tests. The test protocol explained the objective, scope, and execution of each test, as well as the anticipated result. This tool was highly important in team coordination, for which a small group was required, which acted as liaison between the regions of each commercial area.